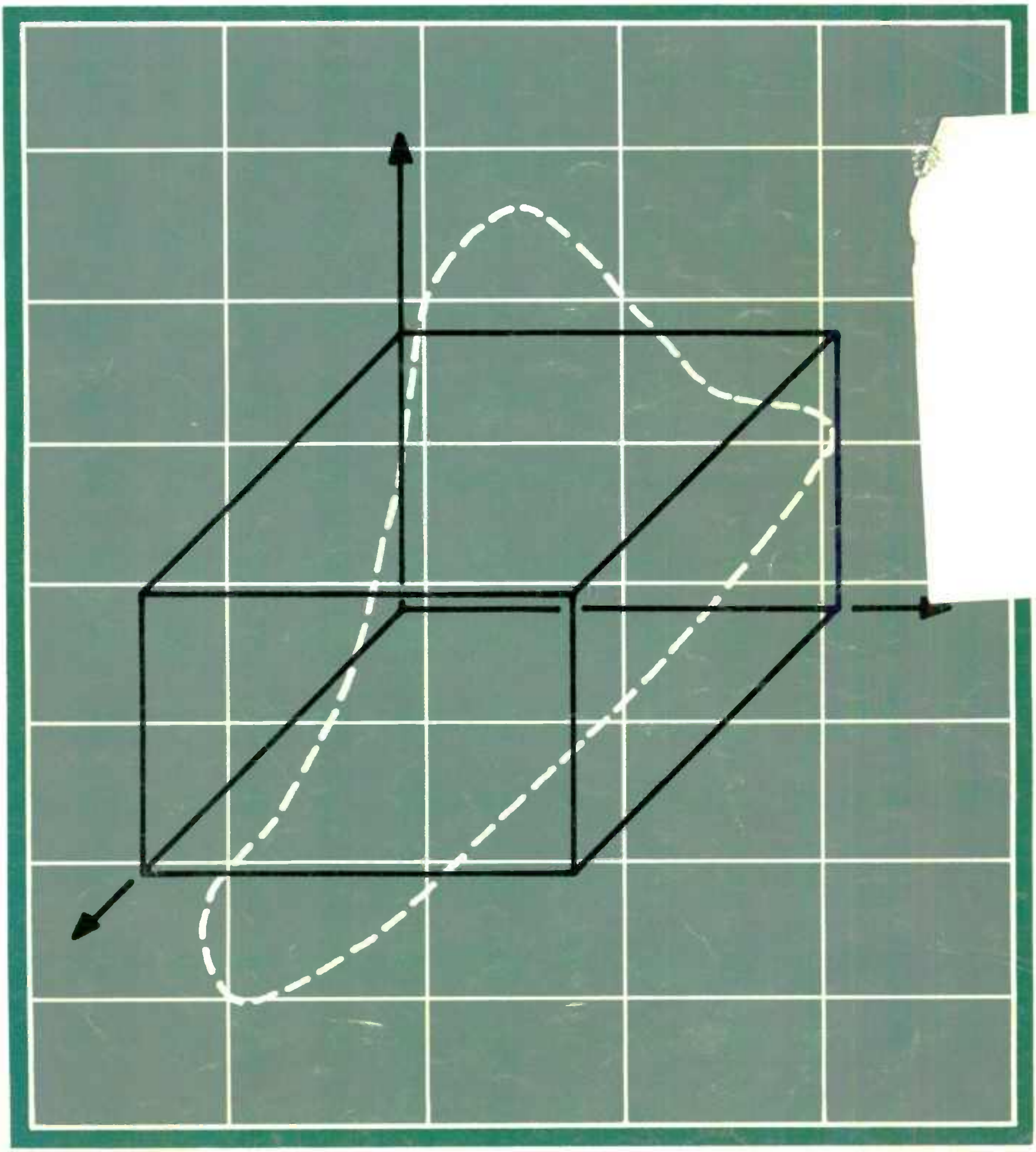
World Radio History

SIX/92

U.S. $7.00
CANADA $8.00

Speaker Builder

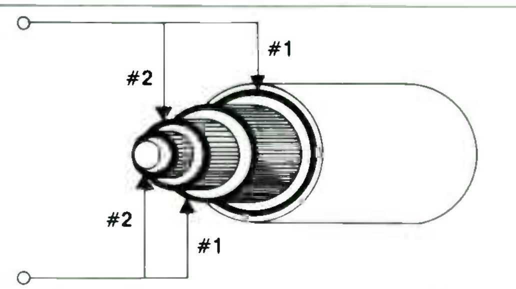
THE LOUDSPEAKER JOURNAL



What do ...WILSON AUDIO, VTL, AUDIO RESEARCH, HALES, SONIC FRONTIERS, NHT, CARY, ARTEMIS, NESTOROVIC, PARADOX, MAS, WHATMOUGH, JACKSON BROWNE STUDIOS, ATHENA PRODUCTIONS, WATER LILY ACOUSTICS... **have in common?**

The MIT MultiCap

Why? FIRST – because it improves the sonic performance of their products. Audio manufacturers around the world are increasingly aware that when they need the best performance, MIT's unique, patented self-bypassed MultiCap delivers what other capacitor manufacturers claim but cannot offer: the highest level of *sonic* performance.



This cross-sectional drawing shows the coaxial construction of a MultiCap. For simplicity's sake, only two of the ten sections are included.

SECOND – MIT offers more: We can help you get the best results from our capacitors in your designs. MIT has over a half-million dollars in advanced test equipment. We know what it means when a capacitor has "phase deviations," "high ESR," and "high series inductance." We know how important it is – to the final sound of your products – to reduce these and other parasitics.

Whether you use all MultiCaps in your all-out efforts or a few in only the most critical places for cost-effective products, you will find the MultiCap advances performance.

So get the real story:

We don't want you to invest thousands of dollars in the best drivers and equipment only to have your sonics bottle-neck through a $2 capacitor. MIT's conservative designs are trusted throughout the industry – our 200 volt dielectric is equivalent to another "audiophile-grade" capacitor's 600 volt rating!

Call us for our literature – which major capacitor companies outside of audio have used in in-house training for its informative and accurate presentations. And don't hesitate to call us for application advice.

Papers Available

Considerations for a High Performance Capacitor
The MIT MultiCap: Phase Response vs. ESR
MIT Introduces the New Metallized MultiCap
The MIT MultiCap in Power Supplies & Filter Circuits
The MIT Film & Foil MultiCap: Installation & Applications
Questions & Answers About Capacitors

MIT MultiCap
"The most advanced capacitor design in the world."

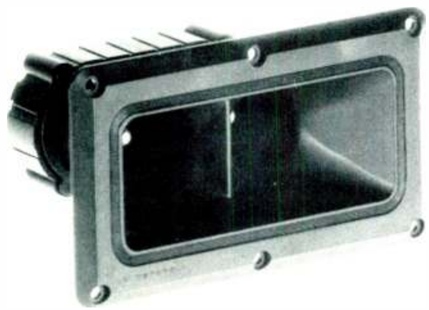
For U.S. Inquiries: CVTL Inc.,
Component Division of Music Interface Technologies
3037 Grass Valley Hwy.
Auburn, CA 95603
(916) 823-1186 FAX (916) 823-0810

For International Inquiries:
MIT Components
760 Pacific Road. Unit 19
Oakville, ONT Canada L6L 6M5
(416) 847-3277 FAX (416) 847-5471

Fast Reply #KG703

World Radio History

Good News



MOTOROLA CERAMICS PRODUCTS has added the Twin Drive (TD) Bullet tweeter to its high tier line. Designed for MI, Pro Sound and Sound Reinforcement, the TD Bullet has an average sensitivity of 99dB at 1M/2.83V, and is rated at 100W.

Further information may be obtained from Motorola Ceramics Products, 4800 Alameda Blvd., N.E., Albuquerque, NM 87113, (505) 822-8801, FAX (505) 822-8812.

Fast Reply #KG1481

WOMEN'S TECHNET (WT), an organization dedicated to improving opportunities for women in pro audio, video, broadcast, recording and related industries, is now online. The organization's quest is to promote a higher profile for women in these technical industries, increase their educational and career opportunities, provide support, and to network subscribers.

Technet established two private conferences on a non-profit telecommunications network, the Institute for Global Communications. These include a calendar of events, lists of professional organizations and publications, technical support, a Job Board, and Technet organizing and fund raising. Women's Technet is actively soliciting the participation of people with expertise, knowledge, information, and a desire to contribute to the advancement of women in technical careers.

An IGC subscription is $15 to sign up and $10 per month. Membership includes one hour of off-peak connect time each month. For more information, send a SASE with postage for 2 oz. to Women's Technet, PO Box 966, Ukiah, CA 95482.

SNELL ACOUSTICS and **AUDIO ALCHEMY** have formed an alliance to found a new company called MusicSoft who will develop an open-architecture digital signal-processing (DSP) audio computer and a DSP music operating system called MOS.

According to the participants, these products will make it possible to control and manipulate sound in new ways with conventional audio signal processors. Plans for the new system include the ability to digitally nullify unwanted loudspeaker characteristics and eliminate the unwanted acoustic characteristics of the listening room.

The audio computers will be sold under the Snell Digital brand name and manufactured in the US by Audio Alchemy.

Snell Digital is located at 143 Essex St., Haverhill, MA 01832, (508) 373-6114, FAX (508) 373-6172.

Fast Reply #KG1437

Because the average listening room is far from perfect, **AUDIOSOURCE** offers the EQ Twelve Graphic Equalizer/Spectrum Analyzer ($299.95) to compensate for room anomalies or aid lackluster recordings. The EQ Twelve is designed for those who require not only a full ten bands of equalization, but also a professional method for analyzing each frequency.

The unit comes with an ultra-sensitive laboratory grade, calibrated electret condenser microphone with a built-in pink-noise generator. The unit's multi-function spectrum analyzer provides a visual display of the relative signal levels for each of ten frequency bands—30Hz, 60Hz, 120Hz, 240Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz, and 16kHz. It also provides several inputs for tape equalization, impedance matching of audio/video systems and tape-to-tape dubbing. With dual tape loops, input/output loops are possible using the EQ Twelve.

For additional information, contact AudioSource, 1327 N. Carolan Ave., Burlingame, CA 94010, (415) 348-8114, FAX (415) 348-8083.

Fast Reply #KG23

Norsonic Type 1230 ½″ pressure microphones are now available from **SCANTEK**. The precision, Type 1, stable and linear microphone is meant for random- and grazing-incidence measurements, especially for sound measurements in reverberation rooms. The Type 1230 is complementary to the Norsonic Type 1220 Free-field (normal-incidence) microphones, also available from Scantek, Inc. Both are compatible with most preamplifiers.

The detachable, Type 1201 microphone preamplifiers that drive long cables with a virtually linear frequency response are also available. For example, for a 32m microphone cable and a Type 1201, the frequency response is essentially flat from 2Hz-20kHz.

For pricing and details: Scantek, Inc., 916 Gist Ave., Silver Spring, MD 20910, (301) 495-7738, FAX (301) 495-7739.

Fast Reply #KG1413

World Radio History

NETWELL NOISE CONTROL's A-Z Silence acoustic wall coverings have been designed to reduce reflective noise by 65%, according to the manufacturer. The 100% polyester coverings, which are less than ¼-inch thick and Class A fire-rated, come in 24 colors.

NetWell has also added moisture resistant noise control panels to its product line. The 1-inch thick A-Z Vet Panels, created for use in harsh environmental conditions, are available in 24′ × 48′ panels, and absorb 85% of reflective noise.

To learn more, contact NetWell Noise Control, 6125 Blue Circle Dr., Minnetonka, MN 55343, (612) 939-9845 or (800) 638-9355, FAX (612) 939-9386.

Fast Reply #KG644

ESS POLLUTION CONTROL PRODUCTS' NDM is a noise damping material that you can paint on any structure to increase damping. You can apply it to speaker cabinets, loudspeaker chassis, and automotive trunks and door panels by means of airless spray, brush, trowel, or roller. On 20-gauge steel (or speaker chassis) the damping decay rate is increased from less than 1dB/S–58dB/S. As a result, the resonant frequencies are reduced and well damped. NDM also seals and protects wood cabinets from deterioration caused by humidity and pollutants.

Contact ESS Pollution Control Products, Inc., Sound and Vibration Div., 9145 N. Dixie Dr., Dayton, OH 45414, (513) 454-5540, FAX (513) 454-5542.

Fast Reply #KG1475

RUSSOUND cut the ribbons on a new line of high fidelity loudspeakers with drivers and crossovers tailored for in-wall applications. Design highlights include full LC crossover networks, automatic, self-resetting tweeter protection, and polypropylene woofer cones.

The SP-502 ($99.95) features a 5¼″ woofer and 2¼″ tweeter, the SP-602 ($124.95) comes with a 6½″ woofer and a 2¼″ tweeter, the SP-610 ($179) has a 6½″ woofer and a 1″ tweeter, and the SP-692 features a 6″ × 9″ driver with an 80 oz. magnet structure ($229.95). The SP-691's built-in 90Hz crossover matches other Russound in-wall systems. The top-of-the-line SP-692 ($295) features a dual voice coil subwoofer based on the same driver used in the SP-691 although with the SP-692, one subwoofer handles the bass for both left and right channels.

For additional information, contact Russound, 5 Forbes Rd., Newmarket, NH 03857, (603) 659-5170.

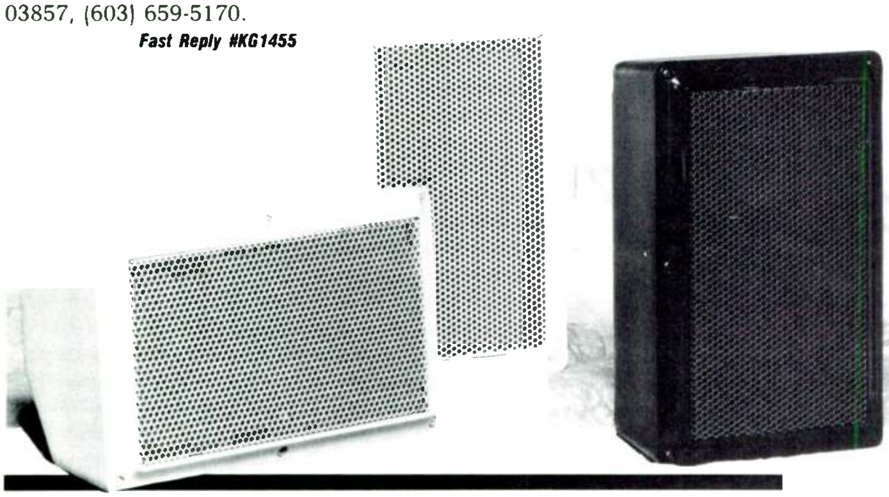
Fast Reply #KG1455

The first in a series of high resolution studio monitors, **RIGHT COAST RECORDING**'s LRM-2 is a two-way mid-field design utilizing a pentagonal graduated-density, low-resonance enclosure that reduces internal standing waves and cabinet edge diffraction. The LRM-2 features a vertically symmetrical driver layout for controlled dispersion and point-source radiation pattern. Proprietary bi-wired passive crossover networks employing audio-grade oxygen-free high-conductivity copper inductors and polypropylene film capacitors eliminate driver interaction. For more on this system, contact Right Coast Recording, 151 Delp Rd., Lancaster, PA 17601, (717) 560-1530.

Fast Reply #KG1460

Well-known technical and marketing executive C. Victor Campos joined **NAD ELECTRONICS, LTD.**, recently as director of product development. In addition to his worldwide role in product development, he will be responsible for manufacturing and quality control operations for the entire NAD product line.

Campos held the same title at ADCOM for six years. Prior to his stint at ADCOM, his private consulting business served such clients as Boston's WGBH, New York City's WNYC, and the CBS Technology Center. He was also in charge of the Audio Division of the consumer electronics Group of the Electronic Industries Association, as well as a variety of marketing and technical management positions at Acoustic Research and KLH Research and Development Corp.



GALAXY AUDIO has introduced the Hot Spot PM compact loudspeaker, a 16Ω model capable of handling 120W of power. Also offered are 70V and 100V transformer versions; black, white or primer-gray finish as well as custom colors; and a swivel bracket that allows the PM to be mounted on the wall or ceiling. Cabinets are constructed of black ABS and contain two 5″ speakers.

Contact Galaxy Audio at 625 East Pawnee Ave., Wichita, KS 67211, (616) 695-5948, FAX (616) 695-7623.

Fast Reply #KG1485

Celebrating its tenth anniversary is the **SOUND RECORDING TECHNOLOGY PROGRAM** at the University of Massachusetts/Lowell. In keeping with the program's objective to further the discipline of sound recording technology, faculty and staff invite contact with professionals and firms in all realms of the audio industry.

This year the program, which offers Bachelor of Music major and minor degrees in Sound Recording Technology, was nominated for "Outstanding Institutional Achievement" by *MIX* magazine. More information may be obtained by contacting the department at 1 University Ave., Lowell, MA 01854, (508) 934-3850.

Fast Reply #KG1486

World Radio History

CAIG LABORATORIES, INC. has produced a one-step deoxiding solution to clean, preserve, lubricate, and improve conductivity on metal connector and contact surfaces. DeoxIT also prevents dissolved oxides and contaminants from reattaching to metal surfaces, providing longer-lasting protection.

DeoxIT is available in spray, liquid, wipes and pen applicators for use on switches, potentiometers, relays, PC board edge connectors, batteries, faders, interconnecting cables, plugs, jacks and the like.

Inquiries may be directed to Caig Laboratories, Inc., 16744 W. Bernardo Dr., Rancho Bernardo, CA 92127, (619) 451-1799, FAX (619) 451-2799.

Fast Reply #KG167

ANALOG DEVICES offers two internal cards designed for IBM PC and compatible systems. Designed to provide a high-quality audio subsystem for PCs and workstations, the two codecs (coder/decoder) feature a complete system-on-a-chip. Their high level of integration make them economical solutions for use in motherboards and add-in cards. Both ICs—the AD1848 and AD1849—support microphone and line-level output, and include nearly all related components, reducing virtually all digital audio requirements to a single IC.

With a pair of 16-bit A/D converters and another of 16-bit D/A converters, these devices provide multiple channels of stereo input and output for analog signals plus complete interface to a system processor.

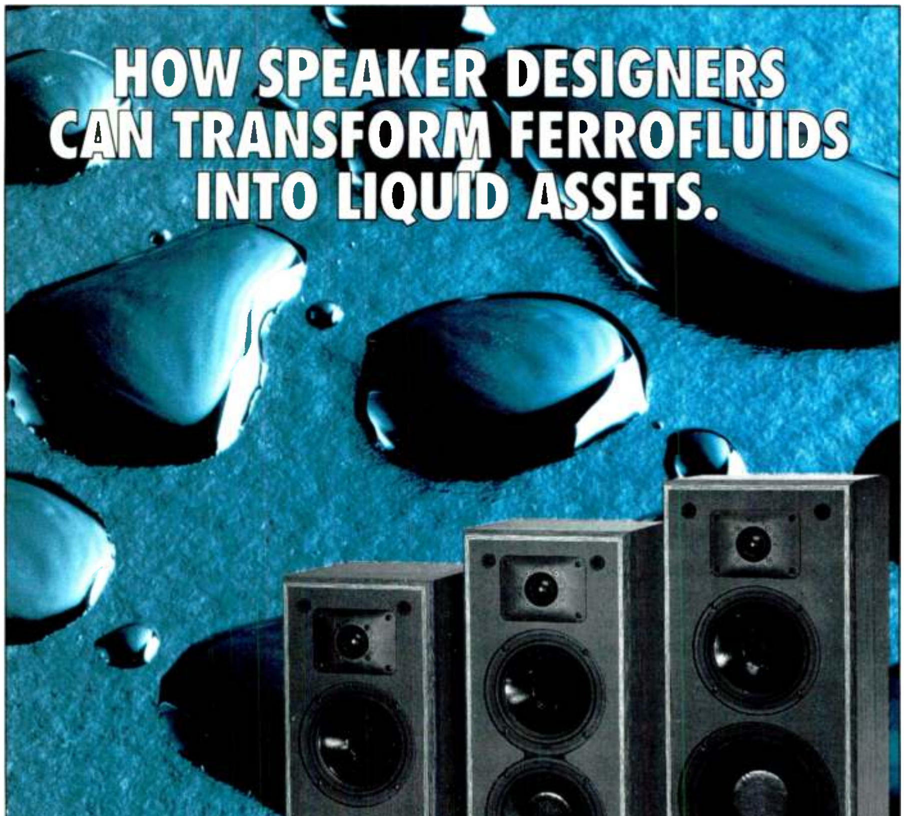
For details, contact Donna Molinari, Analog Devices, 804 Woburn St., Wilmington, MA 01887, (617) 937-1480, FAX (617) 937-1011.

Fast Reply #KG1085

B + K PRECISION has released a 64-page catalog detailing the company's line of electronic test instruments, including oscilloscopes, IC testers, spectrum analyzers, digital multimeters, signal and function generators, power supplies, component testers, video test instruments, probes and accessories.

Copies of Test Instrument Catalog BK-93 are available from B + K Precision, Maxtec International Corp., 6470 W. Cortland St., Chicago, IL 60635, (312) 899-1448, FAX (312) 794-9740.

Fast Reply #KG719



Introducing the FerroSound Technical Assistance and Customer Support Program.

The company that first set the standards in ferrofluid technology over 20 years ago now raises them even higher with the most comprehensive value-added support program in the industry.

FerroSound is Ferrofluidics' commitment to you that starts with access to the latest expertise (and our state-of-the-art audio test lab) dedicated to maximizing loudspeaker design and performance. Then we'll continue to back you by providing ongoing technical support for your current engineering applications.

Finally, by telling consumers of the many advantages of speakers utilizing FerroSound technology, we'll be right by your side at point-of-purchase as well.

For more information about how the FerroSound Program can be a real asset to your company, call 603-883-9800 or fax 603-883-2308.

FerroSound
The Solution Is Loud And Clear®

Ferrofluidics Corporation, 40 Simon Street, Nashua, NH 03061

© 1992. FerroSound is a trademark of Ferrofluidics Corporation

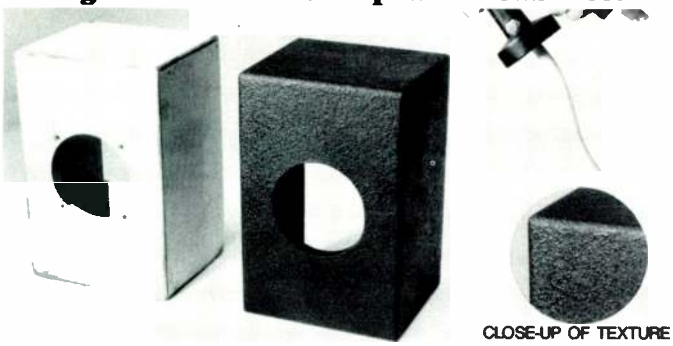
Fast R

World Radio History

A Quality Texture Look

Without Laminating Costs and Labor!

Designed For Use On Speaker Cabinets



RESTORES OLD WORN OUT SURFACES

TEXTURELAC Spray finish produces a three-dimensional look that resembles a pebble, stucco or leather texture. It can be handled within 15 minutes of spraying and eliminates most sanding, spackling or extra paint operations. Dries to a hard mar-resistant and washable finish.

—Can reduce production spray room material and labor costs by 70 percent or more—

TEXTURELAC Is formulated for use on all wood, and composition woods, plastics and metal castings. It is available in most colors.

For a trial order or swatch panel of TEXTURELAC with descriptive literature call or write:

ARD **Abilene Research and Development Corp.**
PO Box 294, Hewlett, NY 11557 • (516) 791-6943 • FAX (516) 791-6948

Fast Reply #KG66

Speaker Builder

The Staff

Edward T. Dell, Jr. Editor and Publisher
Karen Hebert General Manager

Contributing Editors
Joseph D'Appolito, Robert Bullock, John Cockroft, David Davenport, Vance Dickason, Bruce C. Edgar, Gary Galo, G.R. Koonce, David Moran

Mary Wagner Managing Editor
Whitney Henry Assistant Editor
Christine Orellana Graphics Director

Production
Glenn Galloway, Edward Roane

Katharine Gadwah Circulation Director
Doris Hamberg Circulation Assistant
Sharon McHugh Advertising Assistant

Advertising Rates & Schedules

Maureen McHugh Advertising Director
PO Box 576, Peterborough, NH 03458-0576
Advertising Telephone: (603) 358-3756

The peculiar evil of silencing the expression of an opinion is, that it is robbing the human race; posterity as well as the exisiting generation; those who dissent from the opinion, still more than those who hold it."
—JOHN STUART MILL

Speaker Builder is published bi-monthly in the interest of the art and craft of speaker building.

Subscription Inquiries

To subscribe, renew or change address write to Circulation Department. Call (603) 924-9464 or FAX (603) 924-9467 for MC/VISA charge card orders. For gift subscriptions please include gift recipient's name and your own, with remittance. A gift card will be sent.

Send circulation and editorial correspondence to PO Box 494, Peterborough, NH 03458-0494. No responsibility is assumed for unsolicited manuscripts. All MSs must include a self-addressed envelope with return postage. The staff *will not* answer technical queries by telephone.

Printed in the USA. No part of this publication may be reproduced or otherwise reproduced without the written permission of the publisher. Copyright ©1992 by Edward T. Dell, Jr. All rights reserved.

Speaker Builder (US ISSN 0199-7920) is published bi-monthly, at $25 per year, $45 for two years; Canada add $6 per year; overseas rates $40 one year, $70 two years; by Edward T. Dell, Jr. at 305 Union Street, PO Box 494, Peterborough, NH 03458-0494. Second class postage paid at Peterborough, NH and an additional mailing office.

POSTMASTER: Send address change to:
Speaker Builder, PO Box 494
Peterborough, NH 03458-0494

About This Issue

The search for perfect loudspeakers is never-ending, but what about finding the perfect listening environment as well? In the first of a three-part article, "What Makes Your Room Hi-Fi?" (page 10), **Joseph Saluzzi** explains how room dimension and shape affect what you hear, and describes an affordable solution to improving acoustics by designing your own listening room.

In "Toyota X-Cab Pickup Upgrade," on page 16, **Daniel Ferguson** describes a much different listening environment as he takes us through the process of converting his light truck's sound system. If car manufacturers' sound systems don't meet your expectations, his article offers a detailed approach to designing and building better "speakers on wheels."

Would you like to build your own passive crossovers, but can't find just the right inductor? **Richard Mains**'s article, "An Electronic Counter for Coil Winding," beginning on page 26, describes how you can make the job easier by building a coil winder, complete with electronic coil winder counter.

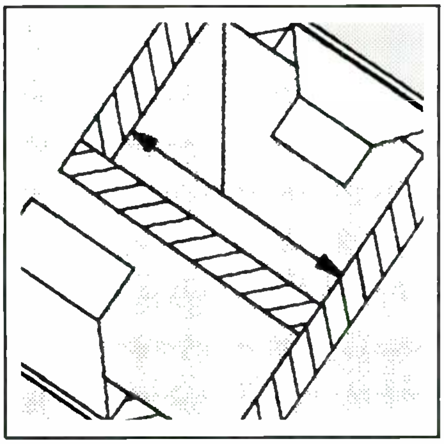
Once you have built the perfect listening room, you'll want to take full advantage of those new acoustics by placing your loudspeakers in the ideal location. **Rick Oakley**'s article on page 30, "The A, B, Cs (and Ds) of Speaker Placement," guides you through the steps of placing bookshelf speakers in just the right spot, and offers "Ten Commandments" for optimum results.

Danish authors **Ole Winberg** and **Knud Thorborg** cap off this issue with "More About Dust Caps," beginning on page 35. They resolve the tight-versus-open controversy, proving with measured results that open is better.

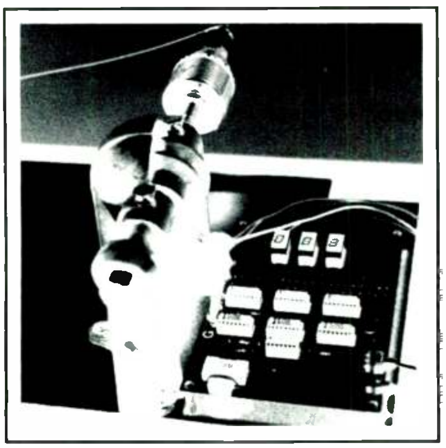
In this issue's "Moran in the Market," **David Moran** takes on the pros. Get the straight story on the so-called professional monitors used in recording studios. If they haven't sounded quite right to you, maybe it's not your hearing after all. But just in case you were wondering, David explains how hearing tests work—beginning on page 66.

Speaker Builder
THE LOUDSPEAKER JOURNAL

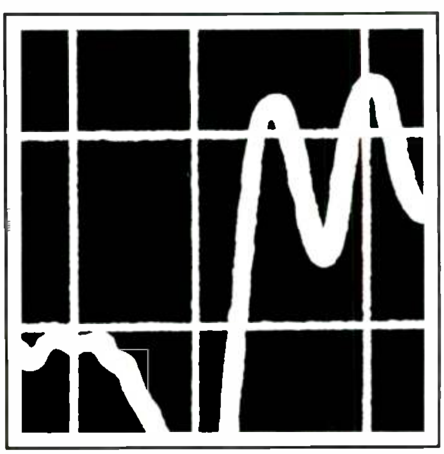
VOLUME 13 NUMBER 6 DECEMBER 1992



16



26

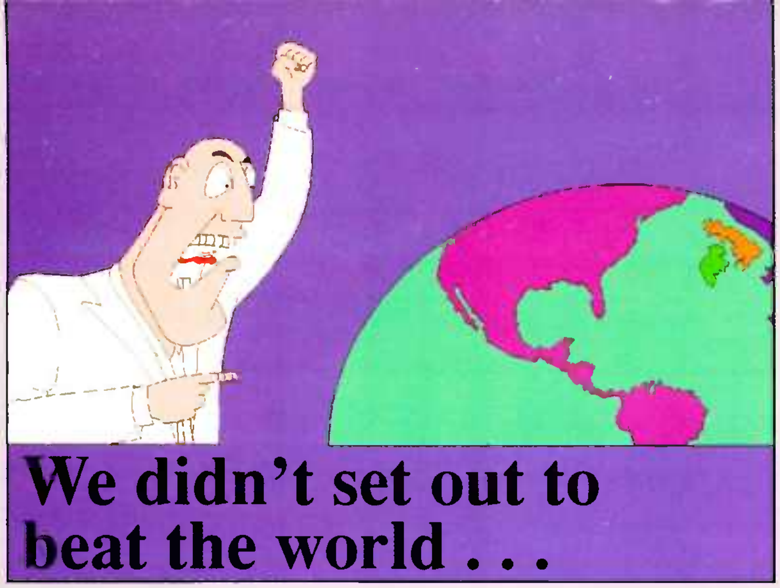


35

FEATURES

DEPARTMENTS

World Radio History



. . . but two new products from ATI have taken the audio world by storm! LMS and LEAP have revolutionized the way loudspeakers are designed and tested.

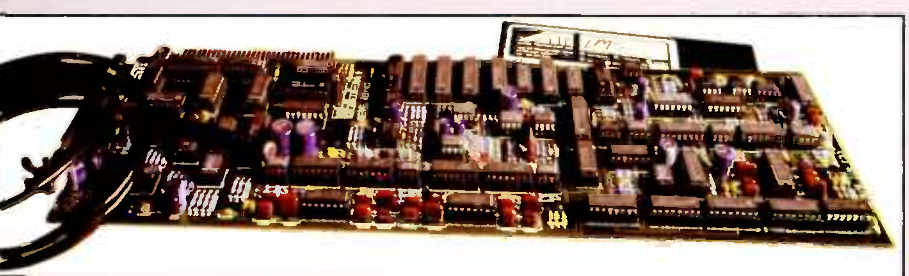
Now you can have audio analysis and electroacoustical measurements using ***real data,*** as well as mathematical simulations.

LMS Loudspeaker Measurement System

At last, there is a complete and affordable analyzer system that provides data suitable for real electro-acoustic engineering purposes. LMS uses its own precision calibrated reference microphone, a PC/AT slot card, and simple menu-driven control software.

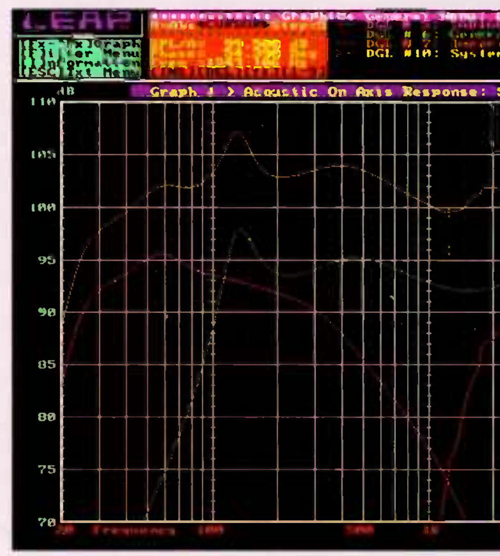
Whether your application is loudspeaker development, automobile audio, room acoustics, industrial environments, or production testing, LMS is the perfect tool for you. LMS can gather data for and perform over 50 different acoustic and electrical tests including SPL Response, Gated SPL Curves, Rub/Buzz Test, Voltage in dBm (gated or non-gated), Auto-Impedance Measurements, Transform Functions in dB, Nyquist Plots, Polar Plots, and Inverse FFT. LMS generates metering graphics and curve displays, and Hilbert Transform calculations for Phase Curve generation, and it can do so much more.

LMS includes a large number of post-processing features and tools to allow you to manipulate data to your needs. Nothing else AT ANY PRICE even comes close! Call us!



LEAP Loudspeaker Enclosure Analysis Program

Now there is one software program that can do it all! LEAP is a powerful full-featured system for electro-acoustic design and analysis.



LEAP 4.1 features include Passive Network/Active Filter Database Libraries, an Optimizer for Passive Networks and Active Filters, Conjugate Network/Crossover Network Designer, Data Import/Export System, and Speaker Parameter Measurement/Motor Coefficient/Impedance Calculator. All this in addition to the basic Transducer/Enclosure System for all TSL, ECL, DGL database functions and box design capabilities.

- Import SPL and Z Data from LMS, MLSSA, AP System 1, and TEF
- Generate 19 pairs of graphs for analysis with complete print support for Dot Matrix, HPGL, PCL, and PostScript
- Compute freq. dependent Revc and Levc
- Derive Phase from Magnitude
- Combine system response on Crossover Design
- Time Offset Correction
- Calculate Voltage/Current/Impedance

Join the distinguished list of LEAP and LMS users: Altec Lansing, JBL, Orion, Yorkville Sound, NEAR, Snell Acoustics, BBC Speakers, Hartkey Systems, Cerwin-Vega, Radian, Lucasfilm, Standford Acoustics, BEST, SCV Audio, Scientific Fidelity, Wavefront Acoustics, Peavey Electronics, Clair Bros., Renkus Heinz, Elipson, TAD/Pioneer, Swans Speakers, Sparkomatic, Rockford/Fosgate, Polk Audio, Joiner-Rose, Sony, Alpine, Bose, Tannoy, Infinity, VIFA, and many more.

LEAP TEC TECHNICAL EXCELLENCE & CREATIVITY 1992 NOMINEE

ATI 7556 SW Bridgeport Road, Portland, OR 97224 TEL: 503-624-0405 FAX: 503-624-0194

World Radio History

Editorial

SOUND VOYAGES FOR 1993

Sound systems in automobiles developed in a kind of tangent to the "high fidelity" movement. Not until the last five years did speaker manufacturers suddenly realize the potential of quality automotive sound. Now three are actively promoting auto systems as proprietary offerings in the luxury car trade.

Two more tangents are now growing. Video sound has become the subject of intense interest by a number of manufacturers—with the peculiar problems it presents. The foremost one is the miserable sound quality of the majority of the films which make up a major portion of what is aired on the networks and cable. The contrast established by the work of Lucasfilm's meticulous care with the sound portion of their productions has made the lackluster movie soundtracks even more glaringly evident.

The other tangent is computer sound. A much more recent development, and still largely embryonic, the computer's power to integrate visual and audio media will undoubtedly flourish. The installed base of personal computers is so large that prices of the sound, tuner, and recording boards will certainly benefit from what I call the "cookie cutter" effect. Translate that "lower and lower, more competitive prices." The speaker and the electronics will begin with a quality ranging from modest to unbearable, with exceptions, of course. Altec-Lansing is already in the catalogs with offerings for video and computer accessory speaker systems.

The computer, however, is also a diagnostic tool. Our first 1993 issue of *Speaker Builder* will include the first in a series of articles on building a computerized analysis system for your loudspeakers, relatively easily and inexpensively. The device is an outboard box which uses a parallel (printer) port to access the computer's capabilities. It will do performance analysis in rooms with very diminished room effects. The chips and the supporting software will bring the average speaker builder much closer to having design tools which heretofore have been unimaginably out of reach.

It should have become abundantly apparent that the computer is rapidly becoming an appliance no audiophile who is serious about experimentation can be without. Fortunately, today's prices make it relatively inexpensive to own a powerful and versatile machine—whether you choose the IBM/clone or the Mac/Apple world. The range of add-on modules and software continues to grow in quantity and richness.

All these are fertile areas of growth and development for us as Americans on our continuing technological adventure. All of it looks to me as I imagine late medieval geography must have looked to Columbus, Magellan and DeSoto. I mention all this to encourage each one of you to learn, acquire and build your way into the new opportunities. And keep in touch with *Speaker Builder* about what you find.

We have had some articles on automotive sound improvements, primarily from our diligent friend Daniel Ferguson, who will be reviewing some new automotive box design software for an upcoming issue in 1993. But automotive sound needs much more attention from amateurs.

Video sound has its own special problems which need exploration as well. The speaker driver and the cathode ray tube are not easy neighbors. The sound quality (or absence of it) requires control facilities which can at least partially manage the deficiencies. If speaker placement in rooms has been a knotty problem, the integration with the video box will be worse, if anything. All these problems are certainly meaty fare for those among us who delight in a really tough challenge. And we cannot leave it to the marketers to make the decisions.

Ever since I observed a modified Apple IIe five years ago monitoring two video recorders in Montreal at a London/Decca recording session, I have known that the computer was destined to become a vital component in audio signal processing (*TAA* 1/87, p. 10). What we are seeing today is racing at breakneck speed toward integrating almost anything to do with sound or sight: recording, playback, editing, transmitting, and receiving. Those 2″ wonders in our computer boxes are not going to handle any of this, or only very anemically.

I learned long ago that you speaker builders are capable of wonderful achievements. Your curiosity, ingenuity and imagination are the motive power behind whatever you are enjoying in this periodical. Simply put, on this page I have been reminding you of the obvious, and how rich our common fare can be when your capabilities are applied to the dazzling array of opportunities appearing on our common technological horizon.

CODA

Just over a year ago I sent word to all active subscribers that we needed help. You responded in a generous, not to say, overwhelming fashion by resubscribing, extending subscriptions and book purchases. That helped us in a major way, for which I am, and the staff is, most grateful.

We took on a new enterprise two years ago in publishing *Elektor Electronics USA*. We are announcing, in the November (and final) issue that we are ceasing publication of the magazine. I remain convinced it is the world's finest general electronics construction magazine. But the recession made it impossible for us to continue.

Our three audio magazines, including this one, are in excellent health, and are in no danger from this change. However, you will realize that such a transition has been difficult for us. If you are of a mind to be helpful, primarily by finding embryonic speaker builders, I would be very grateful indeed. *Speaker Builder* is growing steadily, but more readers would make expansion and exciting improvements possible.—E.T.D.

World Radio History

Part I

WHAT MAKES YOUR ROOM HI-FI?

BY JOSEPH SALUZZI

If you have spent thousands of dollars on a high-quality amplifier, preamplifier, or speaker system or on other high-end components, and still have trouble with room resonances, poor diffusion, early reflections, overly live or dead rooms, or poor decay characteristics, I may have the solution for you. Although several products addressing these problems have recently appeared on the market (for example, Tube Traps and RPG Diffusors to help curb low-frequency resonances and improve diffusion), they are expensive.[1,2] In this article, I present another alternative to solving these problems.

I developed an interest in hi-fi some 20 years ago and typically set up my sound system in either the living room or den of our house. My listening environment had already been defined, and I could do very little to improve it, although I tried. For instance, I experimented with electronic equalization (some of you may remember the Altec Acousta Voicet), noting that changes in the voicing had a dramatic effect on the sound. I eventually discovered, however, that although I changed the character of the sound, I never achieved the right sound using this approach.

Many years ago, I read an article detailing the construction of an add-on listening room.[3] The author had determined the size of the room using the ratio 1:1.6:2.5, which resulted in an 8′ ceiling and a width and length of 12′9″ and 20′, respectively. He then treated the room's surfaces with various acoustic materials to control reflections and experienced "a dramatic improvement in the smoothness of the bass." He also stated that the differences he noted in the new room were "vastly more dramatic than any ever experienced when switching from one super amp to another, or switching to different top-of-the-line speakers or preamps." This article, and in particular those comments, fascinated me.

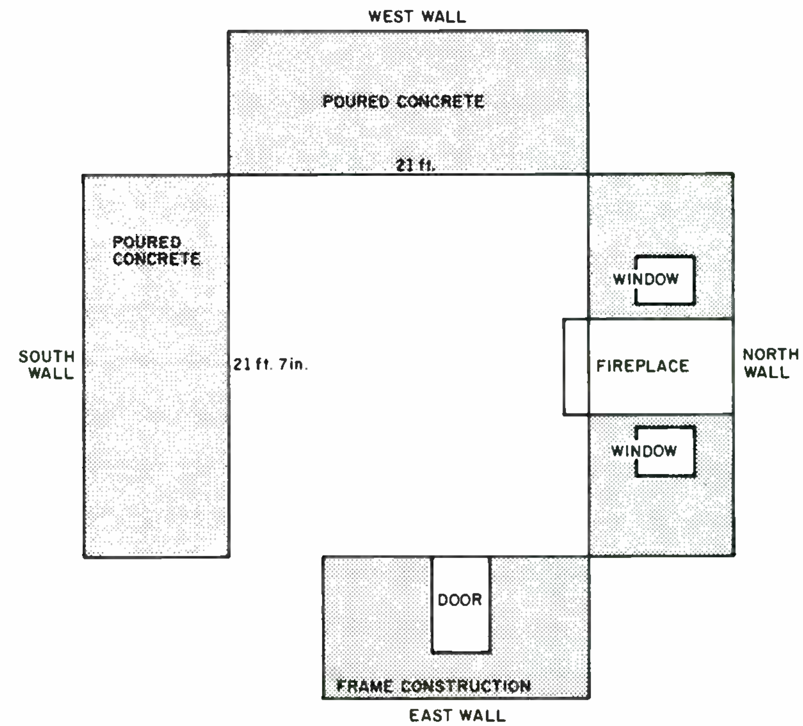


FIGURE 1: My unfinished room, 21′7″ by 8′10″.

In 1985, my family and I moved into a new house with an unfinished basement. The basement included a semi-enclosed section that was isolated from most of the rest of the house and appeared to be an ideal spot for my stereo system. This area (*Fig. 1*) had south and west walls constructed of poured concrete that are, for the most part, below ground level. The north and east walls were unfinished and framed with 2 by 4s. Because of the slope in the property, both are above ground, and both face the backyard. I noted that installation of a storm door and two storm windows would help reduce outside noise levels. The ceiling also was unfinished and was a potential problem, since the duct work and other service lines were exposed and located below the joists. The unfinished room dimensions were as follows: height, 8′10″; length, 21′7″; width, 21′.

At first I was overwhelmed by the prospect of constructing an ideal listening room in this area. Over the next several years, the project involved a considerable amount of research, a crash course in home improvements, and a significant construction effort.

Following is a summary of some of the theory I found useful in designing my listening room. It is by no means a com-

World Radio History

plete treatise on the matter. If you are interested in a more thorough treatment, I highly recommend F. Alton Everest's books on the topic.[4,5] In addition, a publication available from the U.S. government discusses some fundamentals in noise control and provides absorption coefficients for various materials.[6]

TABLE 1

SEPEMEYER'S ACCEPTABLE ROOM RATIOS AND CALCULATED DIMENSIONS FOR VARIOUS CEILING HEIGHTS

Room Ratios	A	B	C
Height	1.00	1.00	1.00
Width	1.14	1.28	1.60
Length	1.39	1.54	2.33
Calculated Dimensions			
Height (ft.)	8.00	8.00	8.00
Width (ft.)	9.12	10.24	12.80
Length (ft.)	11.12	12.32	18.64
Volume (ft.^{3})	811	1,009	1,909
Height	10.00	10.00	10.00
Width	11.40	12.80	16.00
Length	13.90	15.40	23.30
Volume	1,585	1,971	3,728
Height	12.00	12.00	12.00
Width	13.68	15.36	19.20
Length	16.68	18.48	27.96
Volume	2,738	3,406	6,442
Height	14.00	14.00	14.00
Width	15.96	17.92	22.40
Length	19.46	21.56	32.62
Volume	4,348	5,409	10,230

SMALL-ROOM ACOUSTICS. The acoustics of large rooms such as auditoriums, concert halls, and theaters can be complex, and optimization of these listening environments is often more of an art than a science. For example, Avery Fisher Hall in New York was originally designed according to acoustic theory, and it sounded terrible. Eventually, this concert hall was dismantled, redesigned, and fine-tuned by ear. Fortunately for us audiophiles, small room acoustics are more predictable. We can achieve generally satisfactory results if we follow certain fundamental guidelines.

Among these guidelines is the fact that a diffused soundfield is achieved when sound energy is uniformly distributed throughout the listening area. This is an elusive but highly desirable characteristic because it ensures uniform listening conditions. In addition, many of the useful mathematical formulas in the field of acoustics are based on diffuse soundfields. Perhaps the four most important factors that influence diffusion are room dimensions, room shape, surface treatment, and furnishings. I concentrate on the first two factors in this article.

ROOM DIMENSIONS. Depending on its dimensions, a listening room will tend to emphasize certain frequencies. When those frequencies, which are commonly referred to as normal modes or standing waves, are not evenly distributed and they coincide, problems may arise, resulting in room colorations and poor diffusion of sound. The number of modes tends to increase dramatically at frequencies higher than about 300Hz. At even higher frequencies, they become so numerous and closely spaced that the modes tend to homogenize. Ironically, the absorption coefficients of acoustic materials typically decrease at lower frequencies. For this reason, trying to control room resonances can be frustrating, and it is better to avoid the problem in the first place by selecting a listening room with the proper dimensions.

Over the past 50 years, researchers such as Bolt, Sepemeyer and Louden have developed guidelines for optimum room ratios.[7,8,9] Some of their results are presented in *Fig. 2* and *Tables 1* and *2*. Apparently, these studies, which are based on mathematical models and experience, complement each other and are generally in agreement. The 8′ by 12′9″ by 20′ (1:1.6:2.5) room that the author mentioned earlier would be acceptable according to these guidelines. However, my unfinished room, with a ratio of 1:2.5:2.4, did not fall within the acceptable limits. I found these studies very useful in my room selection process.

MODE CALCULATIONS. Consider the room presented in *Fig. 3*. According to the wave theory model, the modal frequency is given by the following relationship:

$$F(p, q, r) = \frac{C}{2} \times \left[\frac{p^2}{L^2} + \frac{q^2}{W^2} + \frac{r^2}{H^2} \right]^{1/2}$$

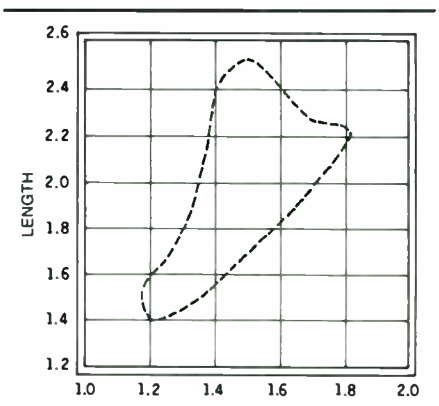


FIGURE 2: Bolt's chart of favorable room dimensional ratios to achieve a uniform distribution of modal frequencies.

TABLE 2

LOUDEN'S ROOM DIMENSION RATIOS IN ORDER OF QUALITY

1:	X:	Y
1	1.9	1.4
2	1.9	1.3
3	1.5	2.1
4	1.5	2.2
5	1.2	1.5
6	1.4	2.1
7	1.1	1.4
8	1.8	1.4
9	1.6	2.1
10	1.2	1.4
11	1.6	1.2
12	1.6	2.3
13	1.6	2.2
14	1.8	1.3
15	1.1	1.5
16	1.6	2.4
17	1.6	1.3
18	1.9	1.5
19	1.1	1.6
20	1.3	1.7

where F(p, q, r) is the modal frequency in Hz; p, q and r are integers with values of 0, 1, 2, 3 . . .; C is the speed of sound and is approximately 1,130′/sec.; L is the length of the room in feet; W is the width of the room in feet; H is the height of the room in feet.

The integers p, q and r become the only variables once the dimensions of the room are defined. In addition, they determine the mode type. For example, when any two are zero, the mode is *axial*. The previous equation simplifies because two of the terms drop out. To help clarify the matter, review the following axial modes:

1. $F(1, 0, 0) = \frac{565}{L}$
2. $F(2, 0, 0) = 2 \times \frac{565}{L}$
3. $F(0, 1, 0) = \frac{565}{W}$
4. $F(0, 3, 0) = 3 \times \frac{565}{W}$
5. $F(0, 0, 4) = 4 \times \frac{565}{H}$

The first two examples are the first and second axial modes due to length. The third and fourth examples are the first and third axial modes, respectively, due to width. The final example is the fourth axial mode due to height. Axial modes apparently involve any two parallel surfaces. The first axial mode for a particular length, width, or height is called the fundamental axial mode for that dimension. Each fundamental mode has a train of multiple modes corresponding to the values of integers greater than one. Ax-

World Radio History

ial modes contribute the most to the acoustic characteristics of the listening environment because they are the most powerful.

When either p, q or r is zero, the mode is *tangential.* This type of mode involves four walls and two dimensions. Following are two examples of tangential modes:

$$F(1, 1, 0) = 565\sqrt{\frac{1}{L^2} + \frac{1}{W^2}}$$

$$F(2, 0, 3) = 565\sqrt{\frac{4}{L^2} + \frac{9}{H^2}}$$

Tangential modes are half as strong as axial modes but may have a significant impact on room colorations.

TABLE 3

AXIAL MODE AND AXIAL MODE SPACING FOR ROOM (10′ × 10′ × 10′)

Standard Deviation = 25.52Hz

AXIAL MODE (Hz)	AXIAL MODE SPACING (Hz)
56.5 (0, 0, 1)	—
56.5 (0, 1, 0)	0.0
56.5 (1, 0, 0)	0.0
113.0 (0, 0, 2)	56.5
113.0 (0, 2, 0)	0.0
113.0 (2, 0, 0)	0.0
169.5 (0, 0, 3)	56.5
169.5 (0, 3, 0)	0.0
169.5 (3, 0, 0)	0.0
226.0 (0, 0, 4)	56.5
226.0 (0, 4, 0)	0.0
226.0 (4, 0, 0)	0.0
282.5 (0, 0, 5)	56.5
282.5 (0, 5, 0)	0.0
282.5 (5, 0, 0)	0.0

When none of the integers is zero, the mode is *oblique.* An oblique mode involves six walls and three dimensions. Following is an example of this type of mode:

$$F(1, 2, 3) = 565\sqrt{\frac{1}{L^2} + \frac{4}{W^2} + \frac{9}{H^2}}$$

Oblique modes have one-quarter the energy of axial modes and have the least influence on room resonances.

MODE CALCULATIONS. Prediction of room behavior is quite complex, and measured room responses often show little apparent correlation with theory. This is because phase relationships among the modes have been ignored. In addition, speaker and listening position, as well as experimental technique, have an impact on the observed room response. When kept in perspective, however, mode calculations can be useful in identifying potential problem areas.

For example, consider a room that is 10′ in all three dimensions. The axial modes are given in *Table 3.* There are 15 axial modes, which include five sets of triplets below 300Hz. The three fundamentals are located at 56.5Hz, and the trains are multiples of these. As you can see, the mode spacing is either zero or 56.5, and the corresponding standard deviation is 25.52Hz. This room would probably emphasize the above frequencies and exhibit poor sound diffusion. Because of its small size and fundamentals of 56.5Hz, it would not support deep bass. Obviously, this would be a poor choice for a listening room.

Apparently, mode theory implies that rooms with duplicate dimensions should be avoided. It follows that rooms with dimensions that are multiples of one another also should be rejected. For example, a room that is 10′ by 20′ by 30′ would be a poor choice.

Let's take a look at my unfinished room. Hypothetically, if we were to enclose it and finish it off, this room would have a total of 408 modes below 300Hz, including 26 axial, 156 tangential, and 226 oblique modes. The axial modes and mode spacing are given in *Table 4.* If this room's dimensions were ideal, all the modes would be evenly distributed, and there would be no coincidences. In reality, however, there are several potential trouble spots. There is a near coincidence at about 27Hz involving the fundamentals F(1, 0, 0) and F(0, 1, 0). Another near coincidence occurs at about 54Hz.

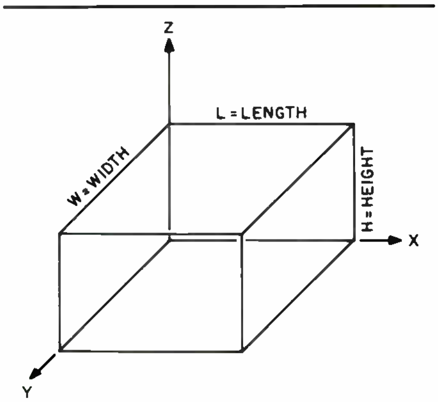


FIGURE 3: Mathematical model for a rectangular room.

The large distance between these near degeneracies might exacerbate this potential problem. At about 130Hz, there is another near coincidence, which may be aggravated by a series of nearby tangential modes—F(1, 0, 2) = 131.8Hz; F(0, 1, 2) = 131.9Hz; F(4, 3, 0) = 132.2Hz; and F(3, 4, 0) = 133.2Hz. The standard deviation for the axial mode spacing is 8.17Hz. Therefore, this room may support low-frequency resonances. Decreasing its length might eliminate these near coincidences and improve the room's sonic character.

TABLE 4

AXIAL MODE AND AXIAL MODE SPACING FOR UNFINISHED ROOM (21.58′ × 21′ × 8.75′)

Standard Deviation = 8.2Hz

AXIAL MODE (Hz)	AXIAL MODE SPACING (Hz)
26.2 (1, 0, 0)	—
26.9 (0, 1, 0)	0.7
52.4 (2, 0, 0)	25.5
53.8 (0, 2, 0)	1.4
64.6 (0, 0, 1)	10.8
78.5 (3, 0, 0)	13.9
80.7 (0, 3, 0)	2.2
104.7 (4, 0, 0)	24.0
107.6 (0, 4, 0)	2.9
129.1 (0, 0, 2)	21.5
130.9 (5, 0, 0)	1.8
134.5 (0, 5, 0)	3.6
157.1 (6, 0, 0)	22.6
161.4 (0, 6, 0)	4.3
183.3 (7, 0, 0)	21.9
188.3 (0, 7, 0)	5.0
193.7 (0, 0, 3)	5.4
209.5 (8, 0, 0)	15.8
215.2 (0, 8, 0)	5.7
235.6 (9, 0, 0)	20.4
242.1 (0, 9, 0)	6.5
258.3 (0, 0, 4)	16.2
261.8 (10, 0, 0)	3.5
269.0 (0, 10, 0)	7.2
288.0 (11, 0, 0)	19.0
296.0 (0, 11, 0)	8.0

ROOM SHAPE. Some researchers have proposed the use of nonparallel surfaces for better diffusion and elimination of room resonances. Others suggest that room resonance effects are associated with volume rather than room shape. The latter group concedes that resonances may be curbed but not eliminated by using nonparallel surfaces and that the modes would be difficult to predict.[10]

MY PROJECT. To make my project more manageable, I broke it down into four phases:

1. Calculate room dimensions and select room.
2. Add walls and ceiling and enclose room.

Continued on page 14

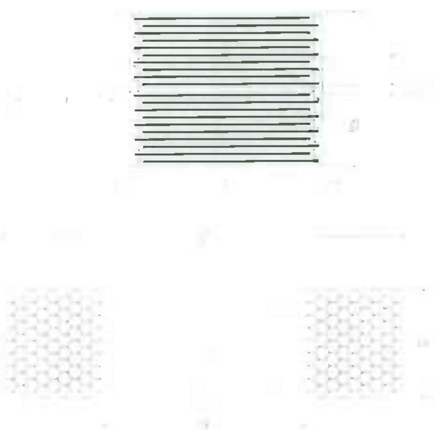
World Radio History

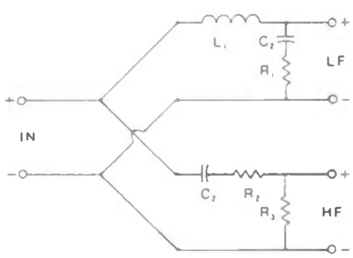
NEW 1993 CATALOG

SOLEN SPEAKER COMPONENTS

DAVIS
scan-speak
vifa
DYNAUDIO
LA PASSION DU HAUT-PARLEUR AUDAX
morel
seas
Peerless
AIRBORNE
CERATECH
ETON
LPG

CROSSOVER, SPEAKER COMPONENTS





FAST CAPACITORS
Metallized Polypropylene (Non-Polarized)
Values from 1.0 mfd to 200 mfd.
Voltage Rating: 250 VDC / 150 VAC

SOLEN INDUCTORS
Perfect Lay Hexagonal Winding Air Cored
Values from .10 mH to 30 mH
Wire sizes from #20 AWG to #10 AWG

HEPTA-LITZ INDUCTORS
Seven Strands Litz-Wire Constructions
Values from .10 mH to 30 mH
Wire sizes from #16 AWG to #12 AWG

SOLEN CROSSOVERS
Custom Computer Design
Passive Crossover for Professional, Hi-Fi and Car Hi-Fi, Power up to 1000 Watt

CROSSOVER, SPEAKER PARTS
Gold Speaker Terminals, Gold Banana Plugs
Gold Binding Posts, Crossover Terminals
Power Resistors, Mylar Capacitors,
Bi-Polar Capacitors, Plastic Grille Fasteners,
Nylon Ties, Car Speaker Grilles, Speaker Books,
Speaker Kit Brochure, Miscellaneous Parts

SOLEN INC.
4470 Thibault Ave.
St-Hubert, QC J3Y 7T9
Canada
Tel.: (514) 656-2759
Fax: (514) 443-4949

COMPUTER AIDED DESIGN FOR ENCLOSURE AND CROSSOVER AVAILABLE TO CUSTOMER

Product specifications and prices available upon request.

NEW 1993 CATALOG

NEW 1993 CATALOG
NEW 1993 CATALOG

Fast Reply #KG1467

World Radio History

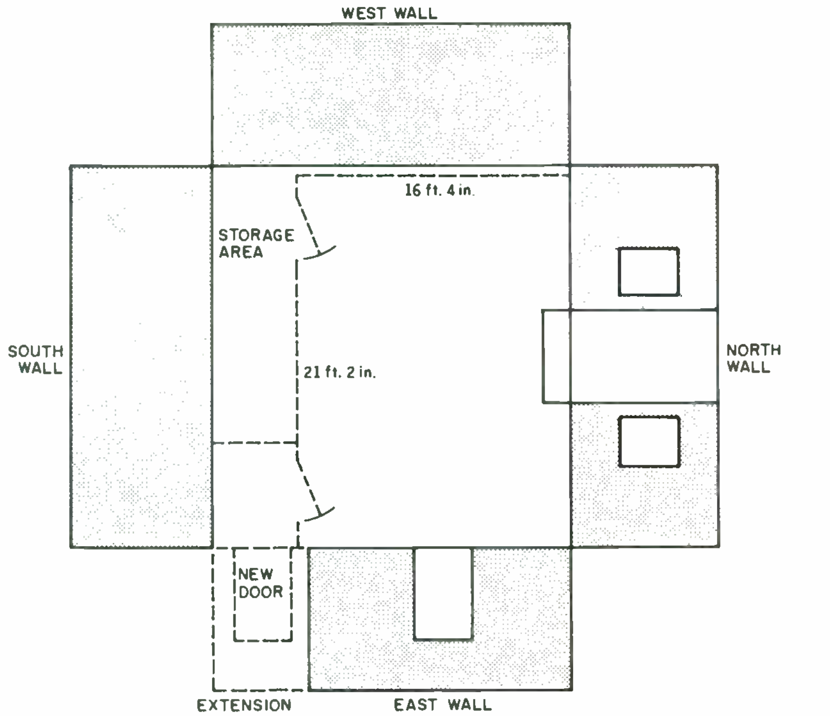


FIGURE 4: Construction plans for my selected room, including a wall in front of the west wall and a storage area in front of the south wall. Finished room, 21′2″ by 16′4″ by 8′9″.

TABLE 5

AXIAL MODE AND AXIAL MODE SPACING FOR SELECTED ROOM (21.17′ × 16.33′ × 8.75′)

Standard Deviation = 7.04Hz Length (ft.) = 21.17
Width (ft.) = 16.33 Height (ft.) = 8.75

AXIAL MODE (Hz)	AXIAL MODE SPACING (Hz)
26.7 (1, 0, 0)	—
34.6 (0, 1, 0)	7.9
53.4 (2, 0, 0)	18.8
64.5 (0, 0, 1)	11.2
69.1 (0, 2, 0)	4.6
80.0 (3, 0, 0)	10.9
103.7 (0, 3, 0)	23.7
106.7 (4, 0, 0)	3.0
129.1 (0, 0, 2)	22.4
133.4 (5, 0, 0)	4.3
138.3 (0, 4, 0)	4.9
160.0 (6, 0, 0)	21.8
172.8 (0, 5, 0)	12.8
186.7 (7, 0, 0)	13.9
193.6 (0, 0, 3)	6.9
207.4 (0, 6, 0)	13.8
213.4 (8, 0, 0)	6.0
240.1 (9, 0, 0)	26.7
242.0 (0, 7, 0)	1.9
258.1 (0, 0, 4)	16.1
266.7 (10, 0, 0)	8.6
276.5 (0, 8, 0)	9.8
293.4 (11, 0, 0)	16.9

Continued from page 12

3. Conduct more library research on absorption coefficients, reverberation time, room surfaces and diffusion, early reflections, and measurement of results and equipment.

4. Treat room surfaces and fine-tune.

As I began to grasp some of the concepts discussed earlier in this article, I developed a better understanding of how to construct my listening room to suit my preferences. I used the following guidelines:

1. Build a traditional rectangular room of sheetrock construction. Size it for maximum diffusion and minimum resonances.

2. Build a wall in front of the west concrete wall. The exact location of this new wall will depend on the length of the listening room and the location of the adjacent window.

3. Construct a walk-in storage room to house my stereo equipment and to protect my turntable from airborne and mechanical acoustic feedback. This room will be built in front of the south concrete wall, and its size will depend on the width of the listening room.

4. Make the listening room as large as possible to maximize the number of modes and to support deep bass response.

5. Avoid true drop-ceiling construction, as drop ceilings may move in soundfields and cause bass loss. Instead, attach sheetrock to the joists, leaving the pipes and duct work exposed. To hide the services, add a false drop ceiling using "eggcrate" panels. These acoustically transparent panels are available from home improvement centers. In this way, the height of the room will be set at 8.75′, and its volume will be maximized.

Figure 4 shows the proposed room according to these guidelines.

REFERENCES

1. Holt, J. Gordon, "Asc Tube Traps," *Stereophile*, April 1986, pp. 66–70.
2. Yates, Keith, "A Matter of Diffusion," *Stereophile*, April 1988, pp. 58–77.
3. Sanders, Roger H., "The Ultimate Component," *Stereophile*, Vol. 4, No. 2, pp. 5–8.
4. Everest, F. Alton, *The Master Handbook of Acoustics*, Tab Books, 1989. Available as BKT13 from Old Colony Sound Lab, PO Box 243, Peterborough, NH 03458, for $19.95 plus $2 shipping (USA).
5. Everest, F. Alton, *Acoustic Techniques for Home & Studio*, 2nd ed., Tab Books, 1984 (out of print).
6. Hedeen, Robert A., *Compendium of Materials for Noise Control*, DHEW (NIOSH) Publication No. 80-116, U.S. Government Printing Office, May 1980.
7. Bolt, R.H., "Note on Formal Frequency Statistics for Rectangular Rooms," *Journal* Acoustic Society of America, July 1946, pp. 130–133.
8. Sepemeyer, L.W., "Computed Frequency and Angular Distribution of Normal Modes of Vibration in Rectangular Rooms," *Journal* Acoustic Society of America, March 1965, pp. 413–423.
9. Louden, M.M., "Dimension-Ratios of Rectangular Rooms with Good Distribution of Eigentones," *Acoustica*, Vol. 24 (1971), pp. 101–104.
10. Everest, *Acoustic Techniques*, pp. 122–126.

About the Author

Joseph Saluzzi is employed as a director of marketing in the chemical industry. He received his M.S. and B.S. in chemistry from Long Island University and his M.B.A. from Fairleigh Dickinson University. He developed an interest in audio in 1968 when he built several Heath and Dyna products. He also has constructed a pair of Bozak Concert Grands. He resides in Atlanta with his wife and their four children.

PREVIEW
Glass Audio

Issue 1, 1993

- Designing 40W Class A Triode
- Overlooked Tube Bargains
- Tubesaurus Rex
- Resurrection for Lazarus

World Radio History

I quickly discovered that working with my TI-59 was time-consuming, each calculation requiring 20-40 minutes to complete, depending on the number of modes generated. It soon became apparent that a computer was in order. I consulted with my nephew, Dominick, who was working for a large university that had a super mainframe computer and a powerful mathematical/statistics package. He wrote a program that would vary the length and width of the room and maintain a constant height of 8.75′. We used the following specifications:

Input

- Maximum length = 21′2″
- Minimum length = 19′10″
- Maximum width = 16′11″
- Minimum width = 14′00″
- Change = 1″ increments
- Reject all rooms with axial mode coincidences below 300Hz.
- Reject all rooms with axial mode spacing less than 1.5Hz below 250Hz.

Output

- Print out all rooms, including rejects. List room dimensions, mean axial spacing, standard deviation for axial mode spacing, sum of the axial modes, range of the axial modes, and number of modes.
- Print out for "good rooms" axial modes only and include dimensions, mode type (values of p, q and r), and mode spacing.
- Print out for "good rooms" all modes and include dimensions, mode type (values of p, q and r) and mode spacing.
- Print out for "good rooms" dimensions, mean, standard deviation, sum, variance, range, minimum value, maximum value, and total number of modes.

Out of a possible 600+ rooms, the program rejected almost 400 because of axial coincidences. Of the remaining "good rooms," about 20 satisfied my criteria. I selected a room with the dimensions 21′2″ by 16′4″ by 8′9″. This room has a volume of 3,025ft.^{3} and a fairly good distribution of modes. There are 23 axial modes and 332 total modes, with no coincidences below 300Hz. The standard deviation for the axial mode spacing is 7.05Hz. *Table 5* lists the axial modes and axial mode spacing for this room.

I wrote a program in Q-Basic called Modes for Your Abodes, which calculates axial, tangential, and oblique modes for any room. It prompts for room dimensions and prints out the modes sorted by either frequency or mode type. To install and run the program, just type "install" and follow the prompts.

When Phase 1 was completed, I began reading about the acoustics of room surfaces, reverberation time, Sabine's equation, and so on. What I really needed to read about was home improvements. I went to the home improvement center and purchased sheetrock, studs, and some nails, and I began to build my listening room.

Part 2 will detail the author's room construction.

MODES FOR YOUR ABODES software (IBM only, 1 by 5¼″, DS/DD) is available from Old Colony Sound Lab, PO Box 243, Dept. B92, Peterborough NH 03458; (603) 924-6371; FAX (603) 924-9467. Order item #SOF-ABO1B5: $25 plus $2 shipping in the USA, $4.50 elsewhere.

LPG

one of the biggest manufacturers of high quality hi-fi loudspeakers in Germany, is now represented in the North American market.

LPG, whose know-how is based on a 65-year experience in designing and manufacturing loudspeakers, offers a totally new loudspeaker design range:

- woofer with polypropylene and coated paper cones (sizes 5″, 6½″, 8″ and 12″) in steel and diecast baskets for hi-fi and car audio applications
- midrange units (sizes 4″ and 5″)
- high quality coaxial-systems (with neodymium dome tweeters) for car audio applications with metal grilles and mounting rings
- 1″ and ¾″ neodymium dome tweeters with enclosures for flush, surface and angle mounting
- Titanium and textile dome tweeters and midrange domes

A & S Speakers
3170 23rd Street
San Francisco, CA 94110
415-641-4573
FAX 415-648-5306

Madisound Speaker Components
8608 University Green, Box 4283
Madison, WI 53711
608-831-3433
FAX 608-831-3771

The Speaker Works
2539 E. Indian School
Phoenix, AZ 85016
602-956-6344

Solen, Inc.
4470 Thibault Ave.
St-Hubert, QC J3Y 7T9
Canada
514-656-2759
FAX 514-443-4949

Importer / representative
Norscan Trading Group, 9858 Vidor Drive, Los Angeles, CA 90035, 310-556-3611, FAX 310-556-0860

Fast Reply #KG1473

World Radio History

TOYOTA X-CAB PICKUP UPGRADE

BY DANIEL L. FERGUSON

My 1980 Toyota pickup was the best transportation bargain I've ever owned, but acoustically it was miserable. The excessive road noise and engine roar above 60 miles per hour, coupled with the cramped passenger compartment, made it pretty difficult to achieve good stereo sound. Still, I derived considerable enjoyment from my old sound system, which added to the loss I experienced when the truck was destroyed in a collision.

As I shopped for a replacement, the shortcomings of my old truck were uppermost in my mind. I was determined to have an extended cab to accommodate a reasonably sized speaker enclosure, and the new(er) truck would have to have decent road noise levels. After looking for a couple of months, I found my 1988 Toyota X-Cab on the local dealer's used car lot.

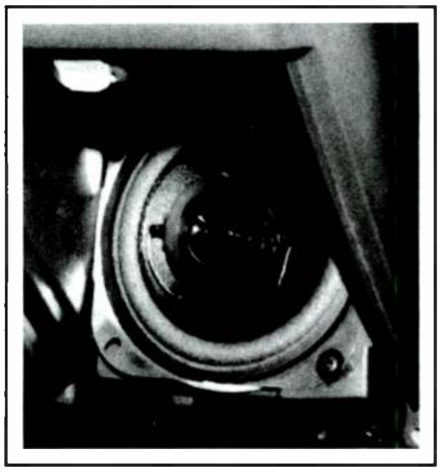


PHOTO 1: Front speaker mounts.

EXISTING EQUIPMENT. The newer truck was equipped with a low-power factory cassette receiver and stock 4" speakers in the dash. The previous owner had installed an inexpensive Audiovox graphic equalizer under the receiver and a pair of Radio Shack truck boxes on the rear shelf. How anyone could have endured the terrible alternator whine this installation put out is a mystery to me. The 8" two-way Radio Shack boxes were very disappointing considering their $180 price. They had no real power-handling capability, and their overall sound quality was poor.

I was beginning to wonder whether I would be able to use any of the existing parts in my new system. The owner's manual for the head unit showed that it was manufactured by Fujitsu, a company I had at least heard of. Listed specifications showed a metal tape playback frequency response of 35–16kHz ±3dB, which is respectable. When auditioning the system, I detected very little flutter on piano passages. The main drawback was the lack of tape noise reduction system. Otherwise, it sounded okay and had acceptable FM reception.

As I said earlier, the Audiovox graphic equalizer had quite a bit of alternator whine. This is usually symptomatic of a ground loop, but I spent quite some time trying to eliminate it and could not. I

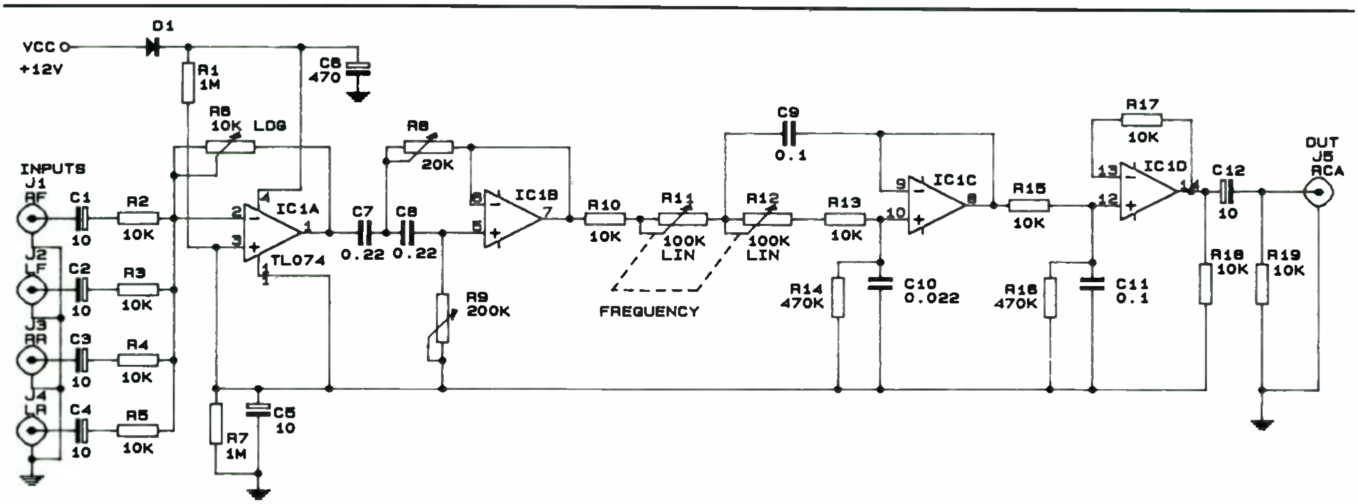


FIGURE 1: The subwoofer filter, dubbed the Ferguson Crossover 2.

World Radio History

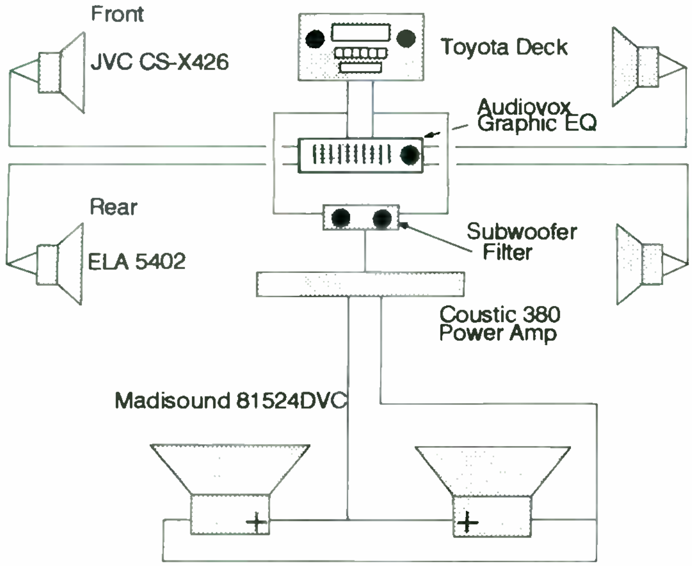


FIGURE 2: Toyota X-Cab system diagram.

later installed a noise filter in the 12V supply, which made the whine almost inaudible.

On a hunch, I decided to retain the tape deck and the equalizer. I reasoned that if the new system sounded good, it would demonstrate that the electronics were not the culprit. (Poor auto sound is usually caused by the apparently intentional use of abysmal speakers.)

NEW SYSTEM OVERVIEW. I knew that I would replace all the speakers and would have to design a subwoofer system for the space behind the bench seat. Starting up front, I removed the grilles in the dash and examined the speaker mounts (*Photo 1*). Toyota had provided space for 4″ drivers, which were aimed slightly upward, toward the driver and passenger. Unfortunately, the mounts were recessed several inches at the top, with varying amounts of recessing on the sides to accommodate the dash contour. I had some worries about how this would affect imaging, but I decided to try some no-compromise coaxes there anyway.

I spent time at several local auto sound shops auditioning 4″ units. Mentally, I had placed little restriction on my budget for these speakers. Eventually, I settled on a pair of JVC CS-X426s. At $70 retail, they were a great buy. While searching for the right speakers, I listened to many harsh-sounding, big-name brands that could not come close to these little wonders.

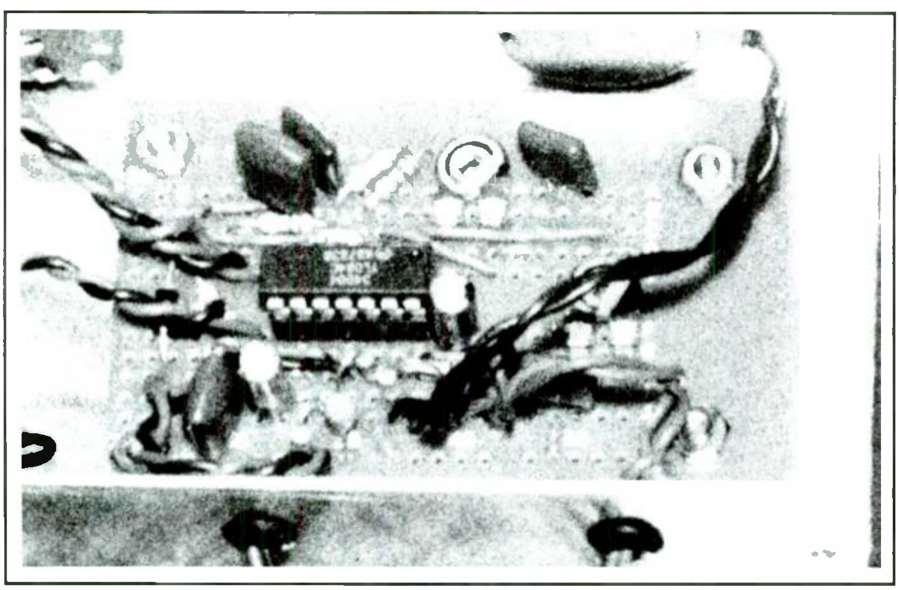


PHOTO 2: Subwoofer filter circuit layout.

For rear fill, I chose ELA-5402 coaxes from Madisound, which I would install in sealed subenclosures in the rear cabinet. By luck, both front and rear coaxes use the same Audax ¾″ dome tweeter, which helps stabilize front-to-rear imaging.

For subwoofers, I selected two Madisound 81524DVCs for the best fit in a 1.5 $ft.^3$ box. I have not found any 8″ subwoofers that have a higher advertised excursion limit and can be properly aligned in the small enclosure volumes required by automobile applications. [For even smaller systems, a single Madisound 8154 can be used in a ported Thiele/Small (T/S) sixth-order alignment with a box volume of only 0.5 $ft.^3$][1] Best of all, these woofers were very reasonably priced.

Not too long ago, I would have settled for a power amplifier with as little as 60W RMS, but today quality high-power amplifiers are inexpensive enough to allow a better choice. I mail-ordered a factory-reconditioned Coustic 380 (250W) from Damark for $129. When purchased new, this amp retails for well over $300. The 380 has quite a kick, which makes the subwoofers perform with authority. Just for fun, I took the cover off this beast to see whether it was as impressive inside as it was outside.

Like many car amps, it has a total FET design, with four pairs of HEXFET switchers firing through a toroidal transformer to power the rails. A TL594 chip controls the pulse width modulation. The rectifier bridge consists of four TO-220 heavy-duty, high-efficiency diodes on a separate heatsink. When running under normal load, these amps are not even warm. They use four output FET devices per channel, and all the preamp circuitry is discrete. It looked impressive to me.

The subwoofer filter I used (*Fig. 1*) is a slightly improved version of the one in my book *Killer Car Stereo on a Budget.*[2] I built it on the Radio Shack prototype board on which I have come to rely. As *Photo 2* shows, the circuit layout is neat and compact.

Figure 2 is the system block diagram. Note that the 12W/channel graphic equalizer powers the four main speakers. To eliminate subwoofer volume sensitivity to the front/rear fader position on the equalizer, the right/left input signals to the subwoofer filter are taken from the tape deck output. If the deck you are using has four outputs, another way to obtain insensitivity to the fader position is to build the filter with four summing inputs, as shown in *Fig. 1*, and to connect all four deck outputs. The filter's input configura-

World Radio History

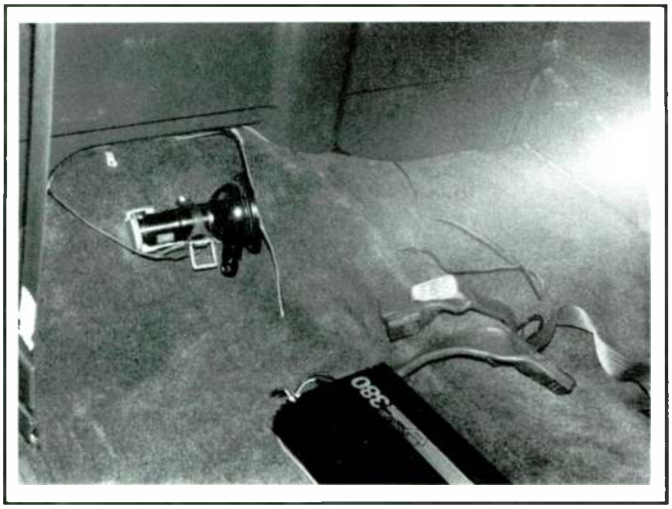


PHOTO 3: Rear cabin wall.

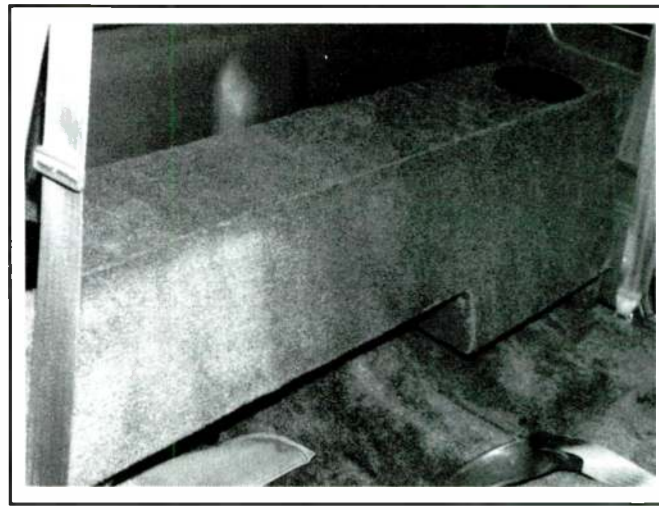


PHOTO 4: Finished rear cabinet installation.

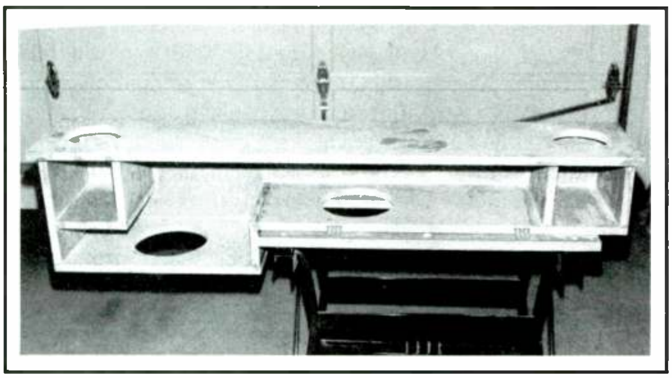


PHOTO 5: Interior view of rear cabinet under construction.

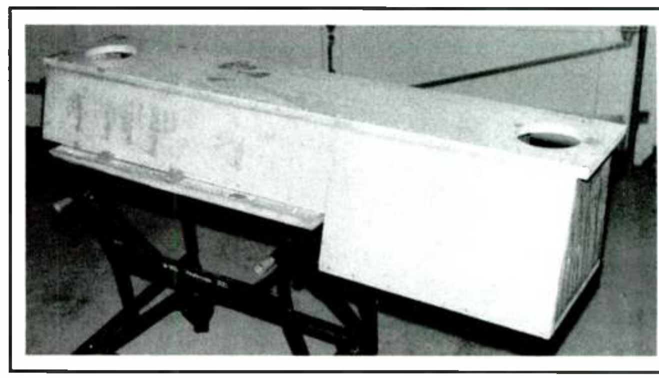


PHOTO 6: Front view of rear cabinet under construction.

tion allows it to be used with decks with either high- or low-level outputs.

REAR CABINET DESIGN. My goals in designing the rear speaker cabinet were to achieve an f_3 of approximately 35Hz with no more than an 8dB boost. I wanted to keep the cabinet small enough so that it would not be intrusive visually or limit seat travel and legroom. I also wanted to allow for at least some passenger seat recline. The top of the cabinet would continue to function as the shelf that it had replaced. With these things in mind, I came up with the cabinet dimensions shown in *Fig. 3*.

Note the large stepped area, which accommodates the correspondingly large hump on the right rear cabin floor and wall and the original jack location, shown in *Photo 3*. I kept the height of the cabinet rather low to avoid close-coupling the rear fill speakers to the occupants. This can wreak havoc with front stage imaging. The completed cabinet, including matching carpeting, is shown in *Photo 4*.

Looking ahead, I designed the coax subenclosures to have a volume of 300 $in.^3$ based on the published T/S parameters from Madisound. As it turned out, this was a good approach. *Photos 5* and *6* show the rear cabinet under construction.

In the past, I never would have considered designing a ported cabinet prior to measuring the T/S parameters with painstaking repetition. Then I would spend hours on end attempting to attain the theoretical alignments given in Robert Bullock's tables.[3-6] Taking the lead from Joseph D'Appolito and James Bock's Swan IV bass cabinet, I realized that it

Continued on page 20

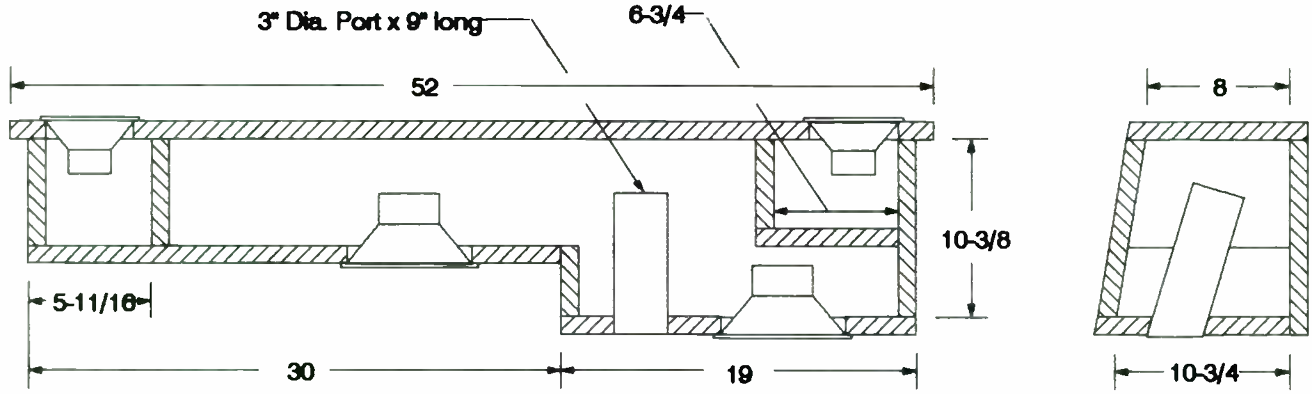


FIGURE 3: Rear speaker cabinet.

World Radio History

DAVIS

Madisound Speaker Components
(8608 University Green)
Box 44283
Madison, WI 53744-4283 U.S.A
Voice: 608-831-3433
Fax: 608-831-3771

Model	Description Size	IMP. Ω	Fs Hz	Qts	Vas Liters	Xmax mm P-P	Power Watts	VC diam. (mm)	SPL n dB/W/m	Box Alignments Sealed/Vented Liters / F_3 Hz	Price Each
TW26T	1" textile dome Tweeter 115 x 98 mm	8	900	0.8	-	-	100@ 3500	26	91	-	$42.00
TW26TDF	1" textile dome Tweeter, dampening fluid 115 x 98 mm	8	900	0.8	-	-	100@ 3500	26	91	-	$44.50
TW26K2F	2" kevlar cone builit Tweeter 110 x 130 mm	8	1300	-	-	-	150@ 5K	25	94	-	$108.00
13 KLV5MA	5" kevlar Midrange w/ phase plug 132 mm	8	62.8	0.35	8.1	6	100@ 500	25	89.1	3S / 124 Hz 4.5V / 80 Hz	$58.00
13 KLV5A	5" Kevlar Bass-Mid 132 mm	8	56.2	0.37	7.98	8	50	25	87.5	3S / 106 Hz 5.5V / 65 Hz	$52.25
16 GKLV6M	6" kevlar midrange w/phase plug, 168 mm	8	63.9	0.40	19.6	5	130@ 500	25	92.6	9.6S / 112 Hz	$116.00
17 KLV6A	6" kevlar Woofer cast frame, 177 mm	8	42.4	0.39	36	7	60	25	90	17S / 75 Hz 29 V/ 45 Hz	$62.00
20 MC8A	8" Carbon Fiber Bass-Mid cast frame, 212 mm	8	39.8	0.46	77.7	8	60	25	91.5	59S / 61 Hz	$69.00
20 SC8A	8" Carbon Fiber Woofer cast frame, 225 mm	8	41.4	0.3	64.6	8	80	25	93	14.5S / 97 Hz 23V / 60 Hz	$119.00
20 KLV8A	8" kevlar Woofer cast frame, 225mm	8	38.5	0.38	81.7	6	80	39	92.1	35S / 71 Hz 60 V / 43 Hz	$108.00
25GCA10W	10" Carbon Fiber Woofer cast frame, foam sur., 262 mm	8	24.6	0.33	237.7	10	100	39	91.4	66S / 53 Hz 100 V / 35 Hz	$129.00

Davis Kits

Model	Description	Efficiency 1W / 1m	Imp. Ω	Power Handling	Dimensions mm	Price per Pair
Kit MV2	13KLV5A woofer, TW26T tweeter, DB-cup input terminal, FM200 crossover, foam insulation	89 dB	8	80 W	500 x 186 x 180	$230.00
Kit MV4	17KLV6A woofer, TW26T tweeter, DB-cup input terminal, FM250 crossover, foam insulation	90 dB	8	80 W	600 x 240 x 250	$250.00
Kit MV6	20MC8A woofer, TW26T tweeter, DB-cup input terminal, FM250 crossover, foam insulation	90 dB	8	100 W	680 x 270 x 260	$265.00
Kit MV7	20MC8A woofer, 13KLV5MA mid, TW26T tweeter, DB-cup, FM300 crossover, foam insul.	91 dB	8	100 W	975 x 270 x 180	$415.00
Kit MV12	25GCA10W woofer, 17KLV6A mid, TW26T tweeter, DB-cup, FM500 crossover, foam insul.	91 dB	8	150 W	1236 x 338 x 300	$540.00

Please call or write for a catalog containing more information on Davis speakers or any of the other European and American speaker brands that we carry.

Fast Reply #KG1071

World Radio History

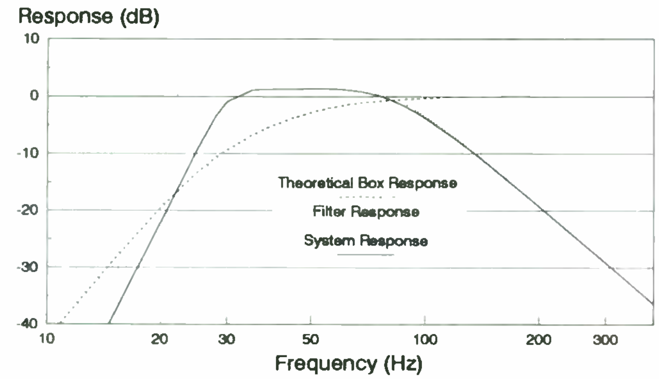


FIGURE 4: Toyota X-Cab theoretical subwoofer response.

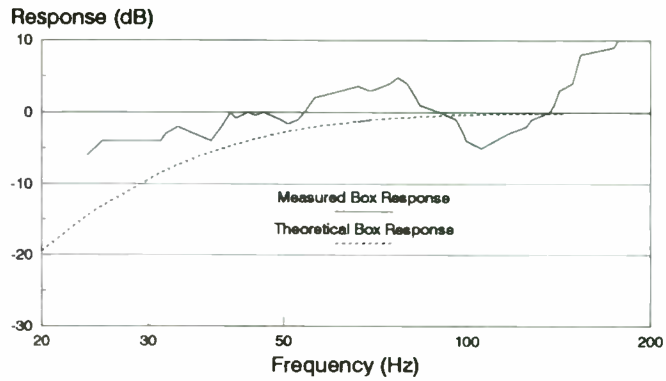


FIGURE 5: Theoretical versus actual box response.

Continued from page 18

is not necessary to design T/S sixth-order aligned cabinets to the full theoretical size.[7] This became even more apparent after I acquired a computer and put G.R. Koonce's equations to work.[8] I can now easily do what-if scenarios that take all the guesswork out of suboptimal alignments. This was fortunate, as the Madisound 81524DVCs were out of spec, which you can see in the following data:

Advertised		Measured	
		Sample 1	Sample 2
f_S	30 ± 2Hz	36.2Hz	36.1Hz
Q_{TS}	0.31	0.367	0.399
V_{AS}	46 liters (2,807 c.i.)	2,054 in.³	2,054 in.³

The V_{AS} shown is one-half the combined V_{AS} of the two drivers.

Because the discrepancy was so much greater than I would have expected, I called Madisound to find out whether there had been a design change. The person I spoke with said no but promptly verified that my numbers were representative of the company's present manufacturing lot. Madisound's observation was that the driver should still work in the published alignments. I wasn't sure I agreed. Further, I was apprehensive about whether these particular drivers would work in my alignment.

My concerns were easily alleviated by some trial-and-error alignments on a

Continued on page 22

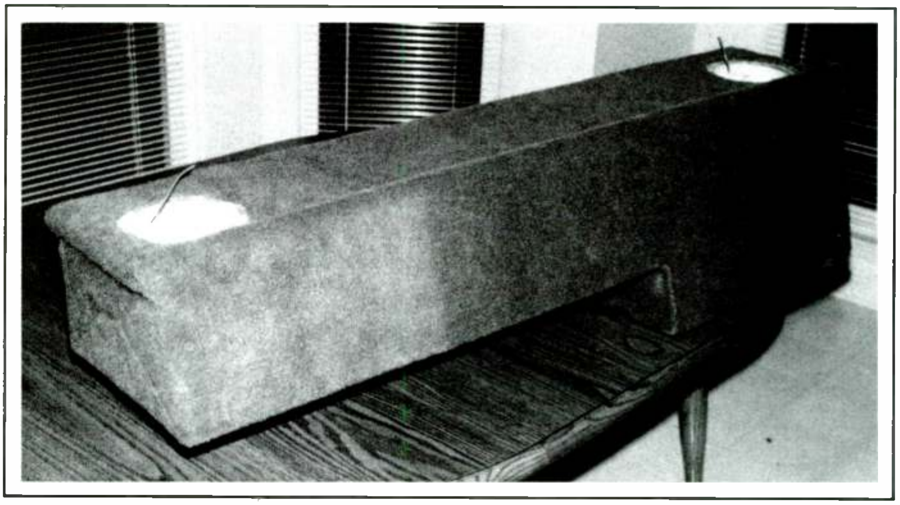


PHOTO 7: Front view of carpeted cabinet ready for speaker stuffing.

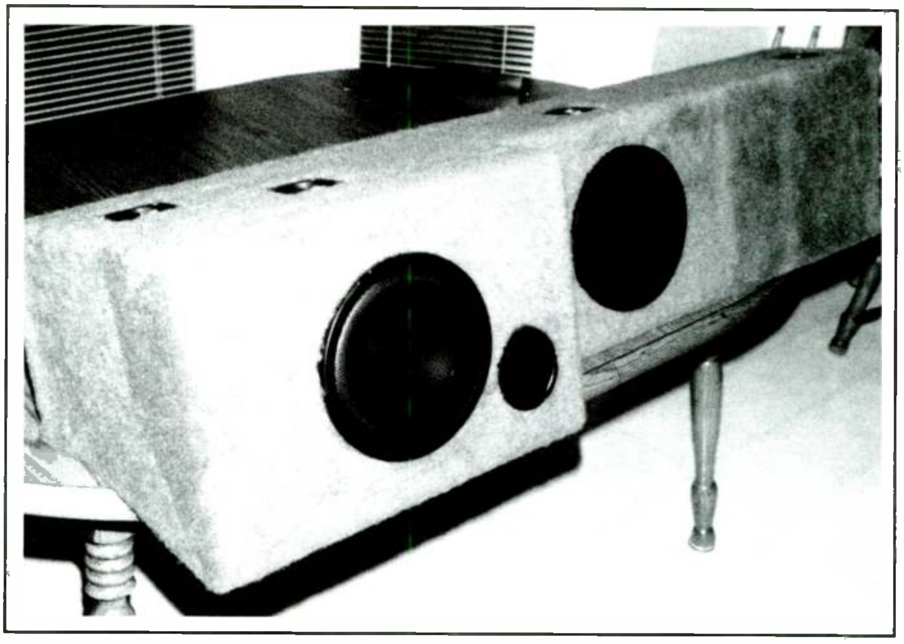


PHOTO 8: Bottom view of completed cabinet minus legs.

REFERENCES

1. Bullock, R.M., "Thiele, Small & Vented Loudspeaker Design, Part V: Sixth-Order Alignments," *SB*, 1/82, pp. 20-24.
2. Ferguson, D.L., *Killer Car Stereo on a Budget*, Audio Amateur Press, 1989.
3. Bullock, R.M., "Thiele, Small, and Vented Loudspeaker Design: Part I," *SB*, 4/80, pp. 7-13.
4. Bullock, R.M., "How You Can Determine Design Parameters for Your Loudspeakers," *SB*, 1/81, pp. 12-18.
5. Bullock, R.M., "Fine Points of Vented Loudspeaker Design," *SB*, 2/81, pp. 18-25.
6. Bullock, R.M., "Alternative Alignments," *SB*, 3/81, pp. 18-27.
7. D'Appolito, Joseph A., and James W. Bock, "The Swan IV Speaker System," *SB*, 4/88, pp. 9-21.
8. Koonce, G.R., "Computing Box Reponses," *SB*, 3/91, pp. 88-89.
9. Bullock, R.M., "Fine Points of Vented Loudspeaker Design," *SB*, 2/81, p. 18.
10. Bullock, R.M., "Alternative Alignments," *SB*, 3/81, p. 18.

World Radio History

HOME TW AUTO

THE SPEAKER WORKS, INC.

2539 East Indian School Road
Phoenix, Arizona 85016
Phone (602) 956-6344

HOME TW AUTO

Peerless

SPECO

SOPHISTICATED LOUDSPEAKER TECHNOLOGY ETON

Calrad

seas

Quam-Nichols

CANARE

csi PROFESSIONAL SERIES

Versa Tronics

LPG

WRITE OR CALL FOR OUR INFORMATION AND VALUE PACKED 175 PAGE CATALOG AND HANDBOOK TODAY. IT IS ASSEMBLED IN A THREE RING BINDER WITH INDEX TABS FOR HANDY REFERENCE. THE COST IS ONLY $10 WHICH INCLUDES UPS SHIPPING COSTS. CHECKS - MASTER CARD - VISA SORRY, NO COD.

World Radio History

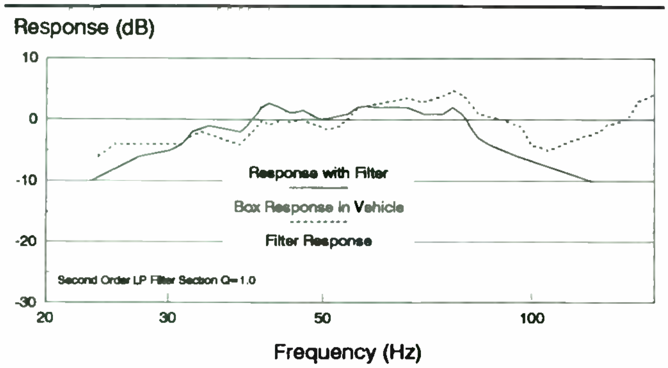


FIGURE 6: Trial alignment frequency response.

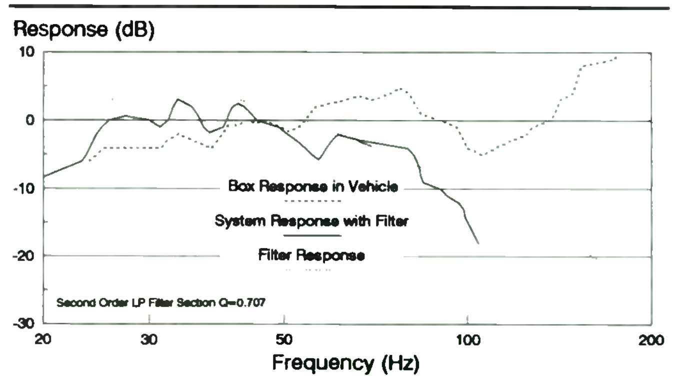


FIGURE 7: Final subwoofer system response.

Continued from page 20

spreadsheet and graphing the results. The final model I selected was based on the actual measured parameters:

f_S	36.1Hz	(meas.)
Q_{TS}	0.38	(meas.)
V_{AS}	4,108 c.i.	(meas.)
Q_L	7	(assumed)
Q_T	6.3	(meas.)
V_B	2,700 in.^{3}	(meas.)
Alpha	1.52	(theo.)
Alpha	1.62	(meas.)
f_B	31Hz	(meas.)
L_V	9″	(actual)
L_V	10.5″	(theo.)

I determined all measured parameters by the constant-current method described by Bullock.[9,10] My test equipment consisted of a homemade signal generator using the XR2206 function generator chip, a Hewlett-Packard 5512A frequency counter, and a Fluke Model 77 digital multimeter. Combining the measured data with the predicted response of the conjugate filter tuned to a Q of 2.5 with a corner frequency of 30Hz yielded the response curve shown in *Fig. 4*.

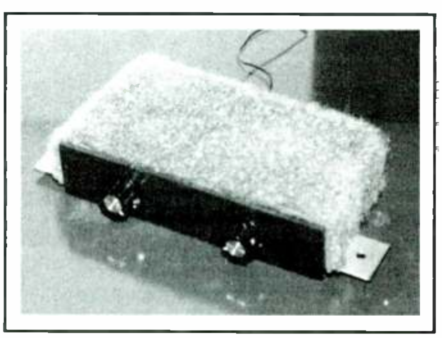


PHOTO 9: Completed filter ready for mounting.

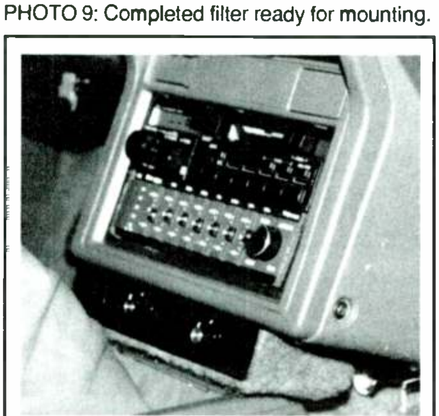


PHOTO 10: Mounted subwoofer filter.

BACK COAX CLOSED-BOX. Next I looked at what to do about the rear coaxes. I measured the two Madisound ELA-5402s, which have the following parameters:

	Advertised	Measured Sample 1	Measured Sample 2
f_S	91Hz	91.3Hz	86.7
V_{AS}	330 in.^{3}	238 in.^{3}	278 in.^{3}
Q_{TS}	0.56	0.58	0.62

The final alignment of the 5402s in the 300 in.^{3} subenclosures stuffed with polyester pillow fiber was as follows:

	Sample 1	Sample 2
f_C	105.9Hz	104.3Hz
Q_{TC}	0.806	0.811

INSTALLATION. I wanted this installation not only to sound good but also to look professional. *Photos 7* and *8* show the final stages of rear cabinet construction prior to installing the legs. I purchased the carpet, designed specifically for this application, at a local auto sound dealer. Many installers use spray-on contact cement to attach the carpet, but silicone caulk is much more forgiving. I used removable staples to hold the carpet in place while the caulk cured.

Photo 9 shows the finished subwoofer filter (inverted) ready for mounting. To make the Radio Shack chassis box proportions more pleasing, I reduced the height by cutting down the sides with a hacksaw. I glued a small piece of the carpet on the bottom and sides, added a piece of ABS black plastic with a grained surface for a faceplate, and bolted on some angle clips for attachment to the center console. I purchased the ABS plastic at a local auto sound dealer. It comes in several sizes and is very easy to work. The final installation is shown in *Photo 10*.

Next I ran all the wiring between the components. At the recommendation of one of the dealers, I installed 8-gauge power wiring. I think 10-gauge wiring would have worked fine, but International Auto Sound Challenge Association (IASCA) rules call for 8-gauge wiring for my amplifier, so I complied. The +12V supply is run through the firewall and directly to the battery terminal.

Two things are important here. First, it is imperative to install an in-line fuse in the positive lead as close to the battery as possible to protect the vehicle from electrical fires in the event of a short circuit. Second, a grommet must be installed in the hole drilled in the firewall to protect the wiring insulation from chafing. These large wires are capable of handling enough current for welding, so safeguards are mandatory.

For some reason, the standard practice is to use the vehicle chassis for the power ground. I'm not sure why, except that this lead can be made very short. Intuitively, I still like the idea of running an identically sized ground wire back to the battery, as opposed to scraping paint off the floor pan and drilling a hole to attach the ground terminal.

The final amplifier installation is shown in *Photo 11*. One oddity occurred at burn-in. The directions supplied with the power amplifier specifically stated not to connect the power amplifier's negative output leads to ground. When I first turned the system on, the subwoofer system had a fairly loud alternator whine. On a hunch, I touched one of the negative

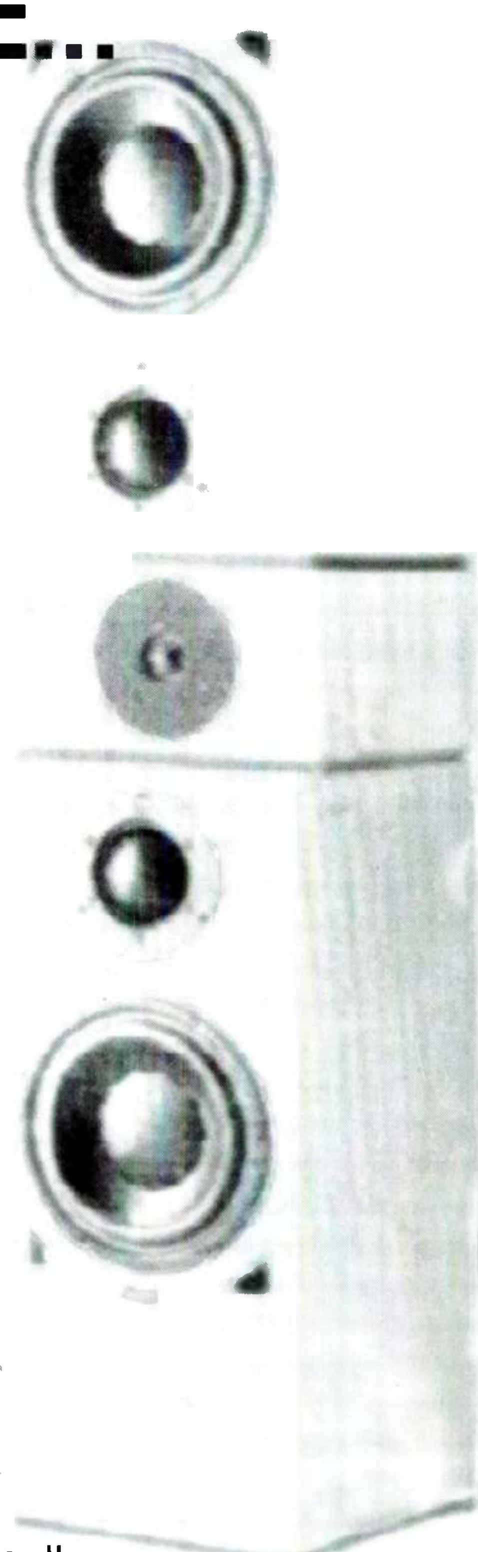
Continued on page 24

World Radio History

WE HAVE GONE FAR TO HAVE them HERE...

90 of EUROPE'S FINEST KITS

The most ingenious designs from European speaker kit builders, now available here. Order our special EUROPEAN KIT BROCHURE, featuring 90 fully detailed drawings and specifications for only $6! (shipping not included)



Exclusively available from:

SOLEN Électronique Inc.

phone (514) 656 - 2759
fax (514) 443 - 4949

4470 Ave.Thibault
St.-Hubert, QC J3Y 7T9
Canada

Fast Reply #KG1468

World Radio History

Continued from page 22
output leads to chassis ground, and the whine stopped. (Since I'm running this system monobridged, these two wires are not used.) I measured the resistance between the wires and found it to be zero. After that, I simply connected one of the leads to the amplifier chassis, and the amplifier has performed without a hitch.

SUBWOOFER ALIGNMENT. With the completed system installed, I made some frequency response measurements of the subwoofer system using my signal generator, frequency counter, and Radio Shack sound level meter. The first measurement was to record the unassisted box response. To do this, I disconnected the filter from the power amplifier input and connected the signal generator. I adjusted the generator's output level for midband 0dB with the meter on the 80dB scale. Starting at the low end, I increased the frequency and watched the meter. Each time the meter indicated a 1dB change, I carefully adjusted the frequency to align the meter needle with a decibel mark on the scale and recorded the digitally indicated frequency. This eliminated the error associated with analog scale interpolation.

The results of the box response measurement are shown in *Fig. 5.* I drew two conclusions from these results. First, and most important, is that it's an imperfect world. Second, don't expect flat responses in a vehicle. Several articles I have read indicate that irregular responses are the rule rather than the exception. Having said all that, the general shape of the actual curve does bear some resemblance to the theoretical curve. This biggest surprise for me was the low extension. The unassisted response was down only 6dB at 25Hz.

The frequency response of my first attempt at subwoofer filter alignment is shown in *Fig. 6*. I adjusted the filter to provide a 3dB boost at 35Hz. On paper, this should have sounded good, but it didn't. The rising response in the mid-bass region was audible and gave the bass a somewhat rough sound. In this test, all the circuit components were as shown in *Fig. 1*. Passband response should have been maximally flat, and it was.

PHOTO 11: Power amplifier mounting under passenger seat.

The response of the final subwoofer alignment is shown in *Fig. 7*. This response is clearly more irregular than the first. The high-pass filter was set for a Q of 2 with a corner frequency of 30Hz—close to the theoretical setting. To counteract the system's rising mid-bass response, I changed C10 from 0.022μF to 0.047μF. This changed the Q of this section from 1.0 to 0.707 and produced a somewhat downward slope in the response. However, with the exception of the 5dB dip at 54Hz, the response varied only ±3dB over the pass-band. This was much improved; I can only describe it as smooth. In spite of the appearance of the response curve, the bass still has extremely good impact and detail.

SYSTEM PERFORMANCE. Probably the most difficult and certainly the most expensive part of being an audiophile is quantifying the performance of the finished product. When a person builds something like this from scratch, personal pride tends to make him or her less than objective. Since my system is cassette-based, I wanted to use a pink noise cassette for the test medium. The local installers had pink noise compact discs but no cassettes. They couldn't even tell me where to order a test cassette. I called IASCA headquarters in California and was told they didn't know either. They suggested that I try the tape manufacturers, and I did—unsuccessfully.

Finally, I called our local high-end audio store, The Stereo Shop in Augusta, Georgia. These folks turned out to be too good to be true. They readily volunteered to make a suitable test tape using their expensive equipment and no-compromise metal tape at no charge except for the cost of the tape.

The moment of truth was at hand. The auto stereo installer near my home, Standard Electronics, has a topnotch real-time analyzer (RTA). Using the pink noise test tape and Standard's RTA, I adjusted the graphic equalizer for the flattest response, and the store manager at Standard recorded the results (*Fig. 8*).

As you can see from the spectrum analysis, the response was quite flat, except for the falling high end above 15kHz, which was as stated in my owner's manual specifications. It's also worth mentioning that the shape of the bass end of the spectrum was exactly as I had measured with my signal generator and sound level meter. The equalizer settings required to obtain the curve are as follows:

Frequency (Hz)	Setting (dB)
60	−4
150	+1
400	0
1k	+5
2.4k	+6.5
6k	+4
15k	+7

The guys at Standard were all very complimentary about the overall sound of the system and were impressed with the front soundstage height and clarity.

CONCLUSIONS. At an IASCA key event I attended in April 1991, the system cleanly recorded a sound pressure level (SPL) of 124dB. This was somewhat surprising, considering that the subwoofers are only 8″ drivers. During the SPL test, the system limit was the 12W/channel graphic equalizer that powered the

Continued on page 61

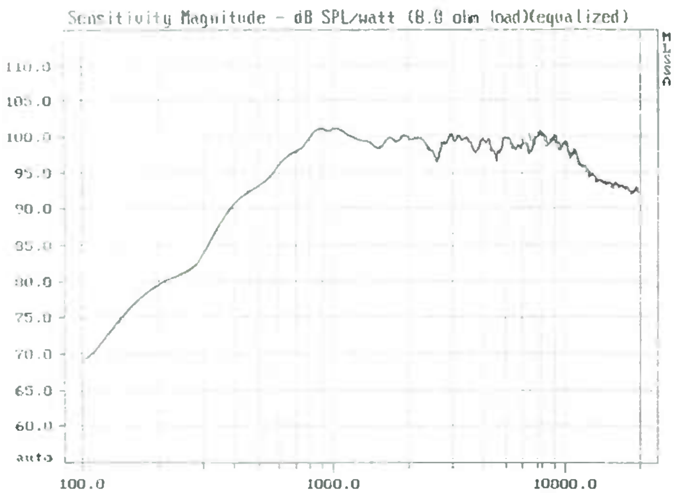
About the Author

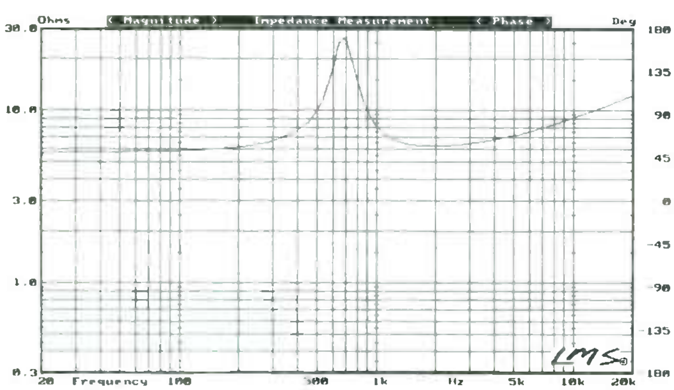
Dan Ferguson has a Master's Degree in mechanical engineering from Clemson University. He is a serious amateur jazz guitar player and speaker builder and has built a number of autosound systems. He also authored the book Killer Car Stereo on a Budget. *He is currently employed as a project manager with a large consumer products company. His most recent audio project is commercial development of an improved subwoofer filter.*

World Radio History

Capture The Mid Frequencies With the New
EQ550-DMR Soft Dome Midrange

The all new 1-1/2" soft dome midrange produces the utmost in uncolored reproduction of the midrange frequencies. It is one of the few soft dome midranges made in the USA. The protective screen is easily removed. The dome/V.C. assembly is replaceable.





Specifications

- Impedance .... 8 Ohms
- DCR .... 5.2 Ohms
- Resonance .... 750 Hz
- Upper Frequency Limit .... 8000 Hz
- V.C. Diameter .... 1.5 Inch
- Former Material .... Aluminum
- Layers 2
- Ht. of Gap .... 0.120 Inch
- Magnet Wt .... 12 Oz.
- Characteristic Efficiency 1W/1M .... 91 dB
- Nominal Power Handling .... *100 Watts

12db Xover @ 1000 Hz

Made in USA

Distributed By

Just Speakers
3170 23rd St.
San Francisco, CA 94110
(415) 641-9228

Speaker City
10615 Vanowen
Burbank, CA 91505
(818) 508-1908

Toutant Electronics
246 E. 131st Street
Cleveland, OH 44108
(216) 451-6325

ITC Electronics
2772 W. Olympic Blvd.
Los Angeles, CA 90006
(213) 388-0624

Speaker Works
2539 E. Indian School Rd.
Phoenix, AZ 85016
(602) 956-6344

Versa Tronics

VERSA-TRONICS INC.

Amherst, N.H. 03031

World Radio History

AN ELECTRONIC COUNTER FOR COIL WINDING

BY RICHARD K. MAINS

When I first began experimenting with passive crossovers, I wound the coils by hand. Hand winding coils is hard work and commercially available coil winding machines are quite expensive. Before long, I came across Bruce Edgar's article describing how to construct a simple coil winding machine ("A Coil Winder Project," *SB* 1/87, p. 25). When I was unable to find a suitable mechanical counter for the machine, I decided to build one myself (*Fig. 1*).

My electronic counter uses an optical sensor to count each revolution of the crank. I should mention a machinist made the crank and plastic bobbin fittings.

TRIGGER FINGER. *Figure 2a* shows the counter layout and, for clarity, *Fig. 2b* shows the same diagram without the component outlines; these are sometimes difficult to distinguish from the traces. Any two traces that cross are electrically connected when a pad is present at the intersection. In my machine, I use a wire-wrap prototype of this counter circuit. The parts list in *Table 1* details the wire-wrap version.

My circuit includes an OR519 optical sensor that detects reflected light from an internal infrared LED. You must mount the sensor within 19mm of where the crank passes in order for it to operate properly. The OR519's photo-transistor senses the crank and uses the output to increment three cascaded 4510 up/down decade counters. Each counter's binary coded decimal (BCD) output connects to one of three 4511 decoder chips driving three seven-segment LED modules. A 150Ω resistor connects each 4511 output thereby limiting the current to the corresponding LED segment.

In this counter, a CKN4007 push-

SOURCES

For general information about coil winding products:
Digi-Key Corp.
701 Brooks Ave. South
Thief River Falls, MN 56701-0677

International Coil Winding Association
PO Box 39395
Minneapolis, MN 55439
(612) 942-7388.

For sources of magnet wire:
Rea Magnet Wire Co.
3600 East Pontiac St.
Fort Wayne, IN 46806
(219) 424-4252

For plastic coil bobbins:
Cosmo Plastics Co.
3239 West 14th St.
Cleveland, OH 44109
(216) 861-5594

Plastron Corp.
429 South Evergreen St.
Bensenville IL, 60106
(708) 595-2212

ACKNOWLEDGMENTS

I thank Tom Munsell for introducing me to coil winding, and Heribert Eisele for suggesting the OR519 photosensor for use in the counter.

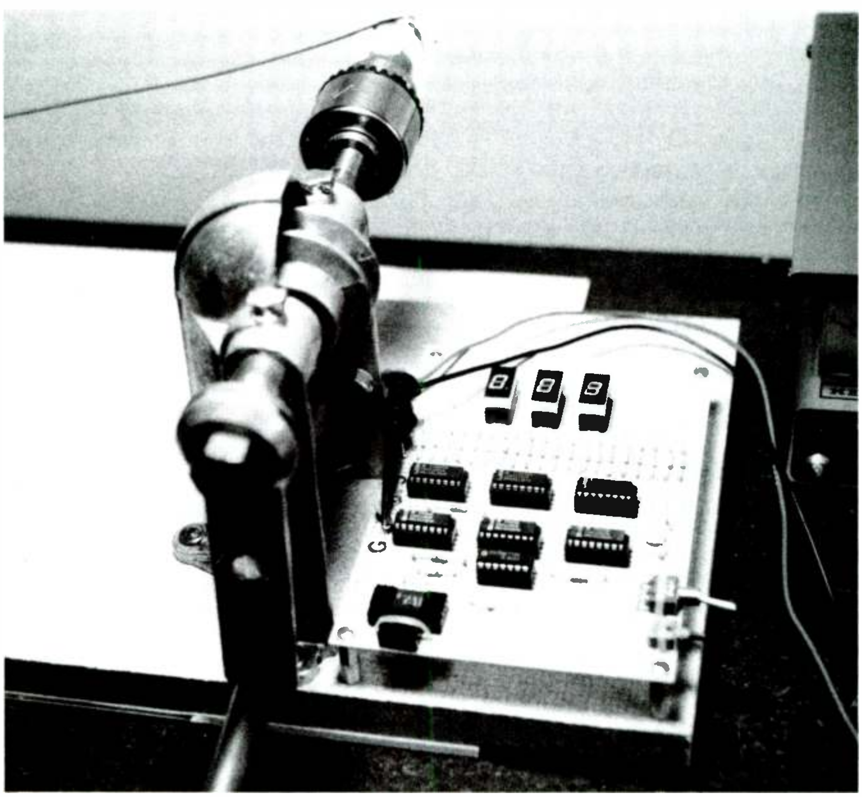


PHOTO 1: The coil winding machine with a wire-wrap version of the electronic counter.

World Radio History

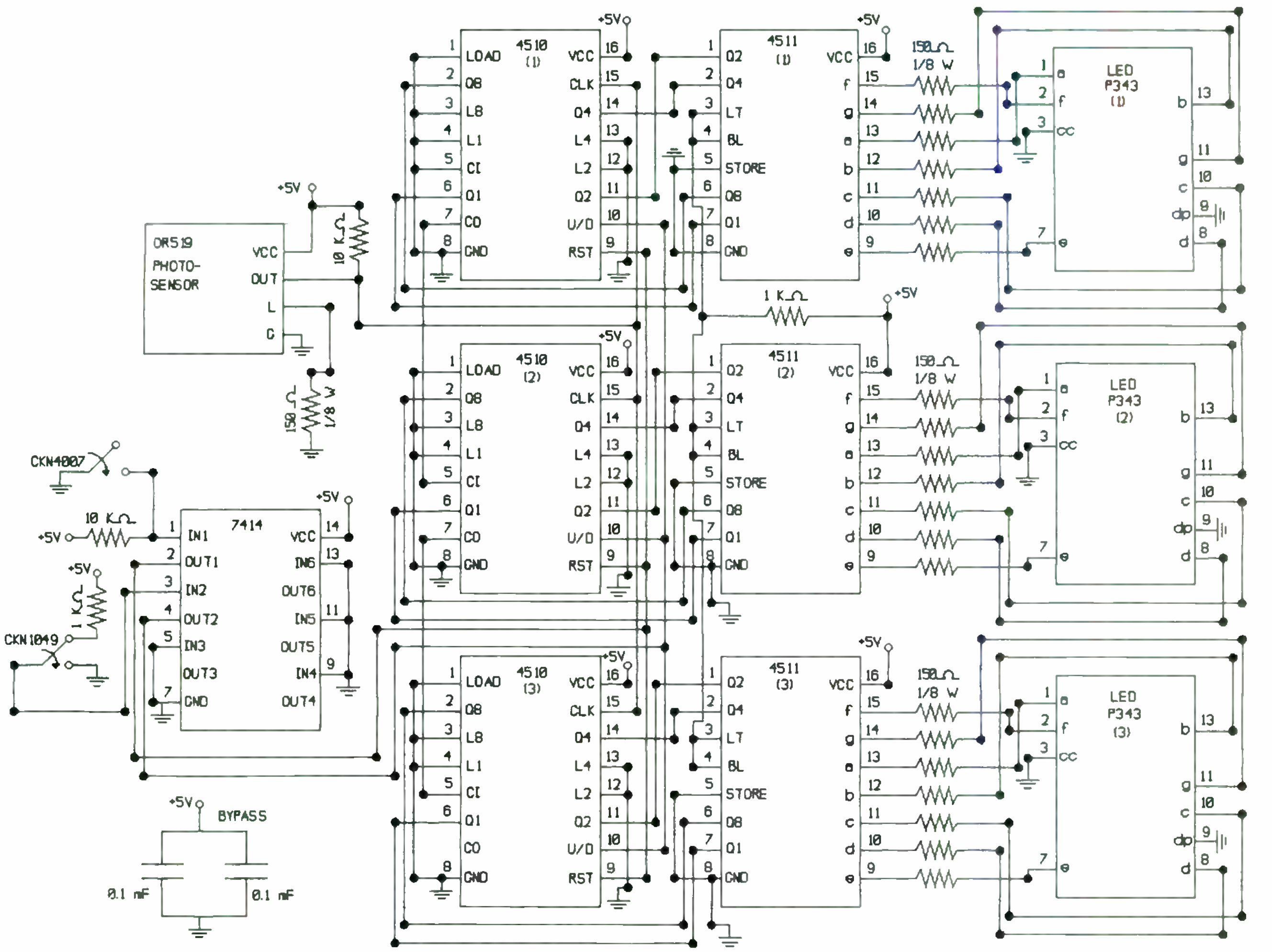
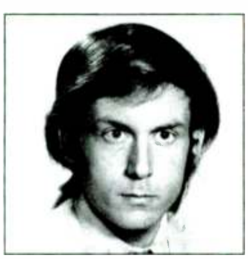


FIGURE 1: Coil winding counter schematic.

button switch resets the counter to 000. The switch first goes through a 7414 Schmitt trigger chip for de-bouncing. When you push the button, the Schmitt trigger output sets the RST pin high on all the 4510 counters. In addition, the counter either counts up or down depending upon the CKN1049 SPDT toggle switch setting. After a second pass through the trigger, this switch determines whether the U/D pin, which controls the calculating direction on the 4510 counters, is high or low. This option is particularly useful when unwinding part of your coil. (You could design a circuit with a second photosensor to reverse direction automatically when the rotation direction changes).

To derive the high signals required for the circuit, I used ¼W 1kΩ and 10kΩ resistors in series with the +5V supply.



About the Author

Since 1979, Richard Mains has been a research scientist at the University of Michigan EECS Department. His area of research is computer modeling of high frequency semiconductor devices. In January 1990, he founded Acoustic Instruments, Inc. to produce microprocessor-based measurement equipment for evaluating audio components. Richard received his Ph.D in electrical engineering from the University of Michigan in 1979.

If there is sufficient reader response, Old Colony Sound Lab may offer a printed circuit board and/or kit of parts for this project.

Use Fast Reply #HG1453 if you would be interested in purchasing the PCB only.

Use Fast Reply #HG1454 if you would like to have the PCB plus the kit.

TABLE 1

WIRE-WRAP VERSION PARTS LIST

QTY.	DESCRIPTION	DIGI-KEY NO.
1	photosensor	OR519
3	BCD up/down counter	CD4510BCN
3	BCD-to-7 segment decoder	CD4511BCN
1	Schmitt trigger	CD74HCT14E
3	1 digit red LED	P343
6	16-pin wire-wrap IC socket	C9116
4	14-pin wire-wrap IC socket	C9114
1	Toggle switch	CKN1049-ND
1	Pushbutton switch	CKN4007-ND
22	150Ω ⅛W resistors	150E
2	1kΩ ⅛W resistors	1.0KE
2	10kΩ ⅛W resistors	10KE
2	0.1μF 25V disc capacitors	P4430
8	0.375″ spacers	J211
4	4-40 × ¼″ screws	H142
4	No. 4 lock washers	H236

You may obtain the following parts from a local electronics distributor.

QTY.	DESCRIPTION	PART NO.
60	Vector wire-wrap terminals	T46-5-9/C
1	Vector board 4.5 × 6.5″, 0.042″ holes	64P44

World Radio History

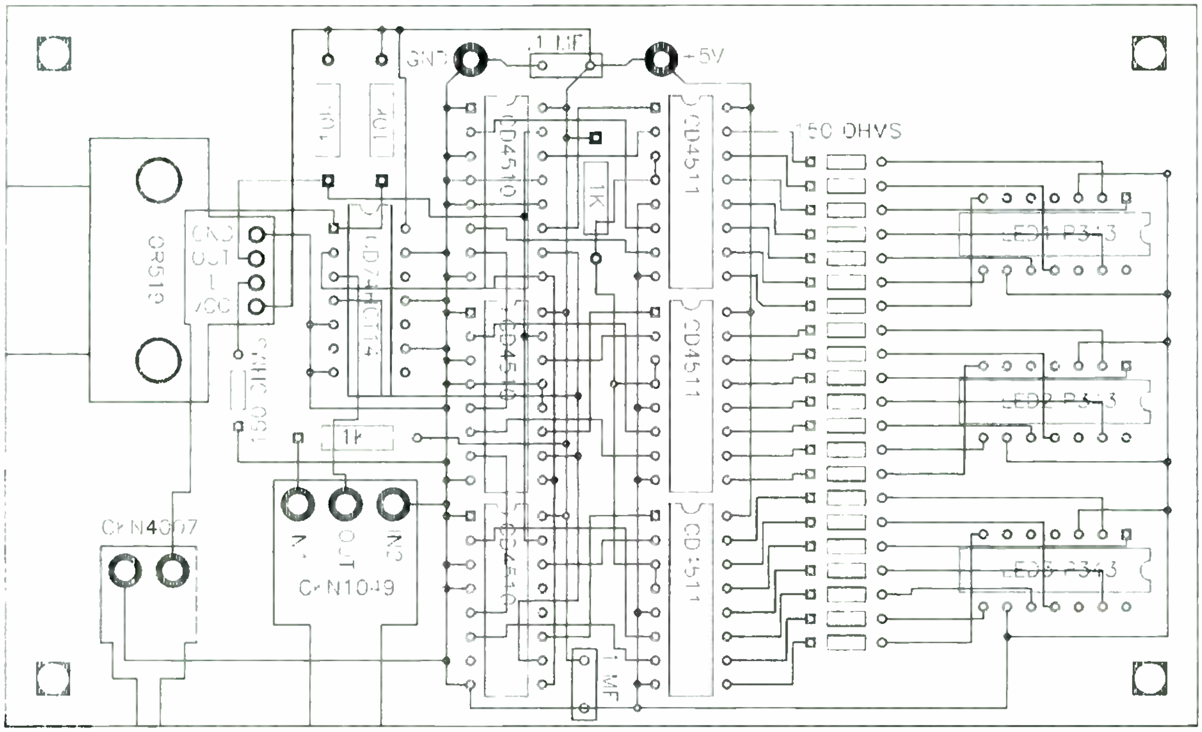


FIGURE 2a: Coil winding counter layout with component outlines.

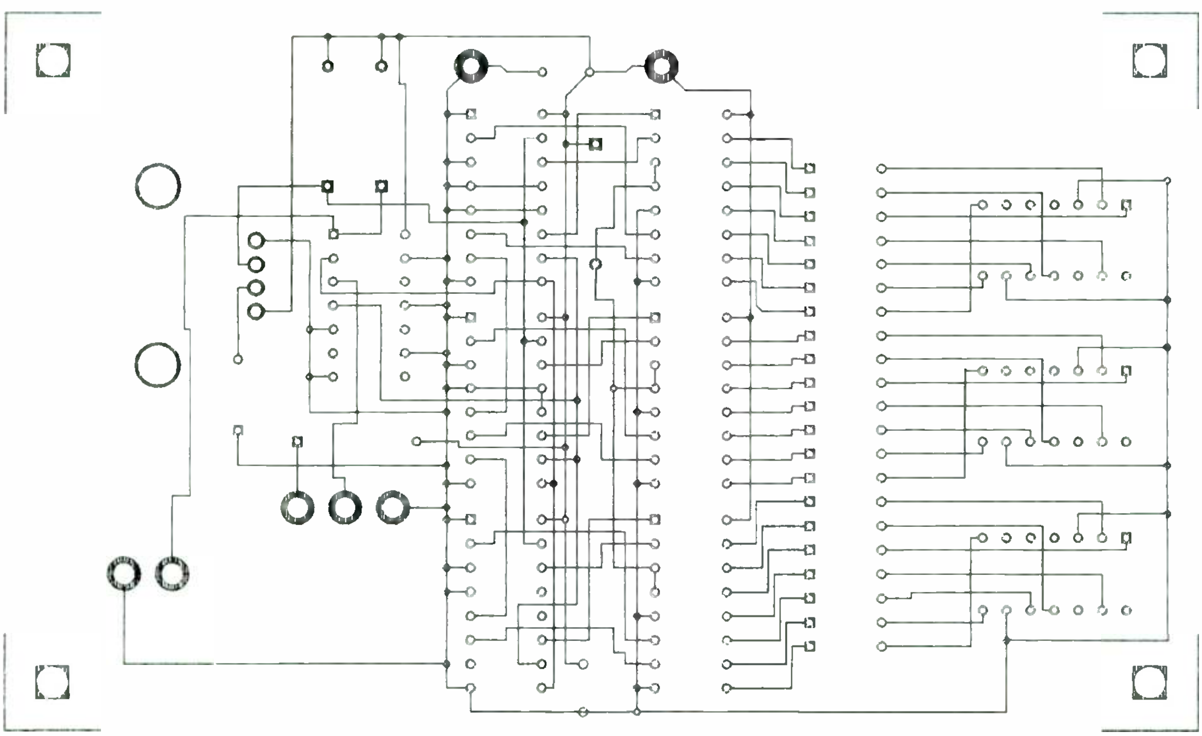


FIGURE 2b: Coil winding counter layout without component outlines.

If you prefer, you can use ⅛W resistors. The 0.1μF disc capacitors filter the +5V power supply. You can place the LED modules in 14-pin wire-wrap IC sockets for convenience.

IT'S A WRAP. This circuit requires an external +5V power source capable of delivering about 300mA (the power consumption depends on the state of the LED segments). I use a Heathkit IP-2718 power supply with my machine.

Photo 1 shows my coil winding machine with the wire-wrap counter. As you can see, I mounted the counter with the OR519 photosensor extremely close to the crank's path. As long as you maintain the proper spacing and the crank part that passes by the photosensor is sufficiently reflective (if not, attach a small mirror or bright paper), your counter should work. Too much ambient light, however, will prevent the photosensor from switching. Sunlight coming through a window and reflecting from a watch faceplate, for example, will also deceive the counter.

Fast Reply #KG128

World Radio History

World Famous

PYLE DRIVER® SPEAKERS...

Your Source for Quality Woofers, Midrange, Tweeters and Crossovers

- Over 200 speaker models and sizes available
- Parameters available for every loudspeaker
- Recommended cabinet sizes available for all woofers

Pyle is the source for all your loudspeaker needs!

PYLE

Pyle Industries, Inc. • 501 Center St. • Huntington, IN 46750 • (219) 356-1200

World Radio History

THE A, B, Cs (AND Ds) OF SPEAKER PLACEMENT

BY RICK OAKLEY

Most speaker manufacturers don't tell you where to place your speakers for best sound, or have not taken the dimensions of your room into account. Speaker placement is fraught with complications—room boundaries, standing waves, speaker dimensions, speaker-power response—all these factors must be taken into account for best results. Here is a mathematical procedure for placing "bookshelf" speakers on stands in conventionally-shaped listening rooms to obtain optimum bass response without compromising midrange and high frequencies. It's a simple solution which works significantly better than trial and error.

FOUR STEPS. First, carefully measure the floor dimensions of the listening room. Designate the larger dimension as the length of the room and the smaller dimension as the width. Now divide the width of the room in half (dimension *A*). The speakers should be placed toward the front of the room, equidistant from this line and perpendicular to it. The listener should be on the line toward the back of the room.

Second, determine how high the centers of the woofers will be if the tweeters are at ear level for the seated listener: dimension *C*. (Placing the tweeters at ear level is important for best stereo illusion, and assures the smoothest and most extended response in the middle and upper frequencies.)

Third, multiply the room's half-width in inches by the woofer height (measured from the center of the woofer to the floor), and find the square root of that product. The answer is dimension *B*, the average path length to the front wall (that is, the wall behind the speakers as viewed from the listening position).

Fourth, multiply the woofer height by itself and divide that product by the average path length. This is the path length from the woofer to the side wall for each speaker (dimension *D*).

Placing the tweeters at ear level is important for best stereo illusion. . . .

HOW IT WORKS. Take a listening room that is 14½′ wide, or 174″. The half-width is 87″ (dimension *A*). The tweeter is at ear height, and the center of the woofer is 32″ off the floor (dimension *C*).

Find the average path length to the front wall:

$$87'' \times 32'' = 2784''^2 = 52.76323$$

Dimension *B* is approximately 53″. Multiply the woofer height by itself, and divide this by the average path length to the front wall:

$$\frac{32'' \times 32'' = 1024''}{52.763623 = 19.40731}$$

The woofer-to-side wall, dimension *D*, is approximately 19.4″.

In order to increase the path length from the woofer to the side wall in very large rooms, you may need to invert the speakers. For this example, the woofers would be 46″ above the floor.

The four numbers we now have—87″, 53″, 32″, and 19.4″—represent a series in which each number is approximately 1.65 times greater than the next smaller number. The series 87″, 53″, 32″ represents the position of a "phantom" speaker, which is located at the intersection of the lines between the speakers and the room-width divider. The series 53″, 32″, 19.4″ is the position of the right and left speakers in relation to the nearest room boundaries. By following this procedure, you have spread out the room boundary effects as much as possible for smoothest bass response. In this example, the effects are staggered by slightly more than two-thirds of an octave.

THE SPEAKER CABINET. Finally, measure the speaker cabinet. Finding how much extra distance the cabinet dimensions put between the woofer and the front and side walls will allow you to position the speakers so they conform to the path lengths already calculated.

For a cabinet measuring 20″ tall by 11″ wide by 9½″ deep:

$$20'' + 11'' + (4 \times 9\tfrac{1}{2}'') =$$

ABOUT THE AUTHOR

Rick Oakley has been the proprietor of ELECTRIC GRAMOPHONE, 367 Boston Post Rd., Sudbury, MA 01776, (508) 443-3703, since May 1978. He was a manufacturers' representative salesman for the Michael Scott Company from 1968 to 1978. Prior to 1968 he was in charge of customer services at Acoustic Research in Cambridge, MA.

World Radio History

$$\frac{69''}{4} = 17.25'' - 53'' = 35.5''$$

This is the distance of the back of the cabinet from the front wall. To find the distance of the side of the cabinet from the side wall, subtract half the cabinet width from dimension *D*:

$$5\frac{1}{2}'' - 19.4'' = 13.9''$$

For optimum listening position, go back and repeat step three. Multiply the room's half-width in inches by the distance from the floor to the seated listener's ear and derive the square root of that product:

$$87'' \times 36'' = 3132^2 = 55.964272$$

The distance from the listener to the wall behind him is 56".

You may want to aim the speakers inward so they focus at the listening position or just forward of it. Rotating them 45° will do this, but you must then recalculate their positions for proper path lengths to the front and side walls. For this example, a correction factor of 19" applies to *both* path lengths. 53" − 19" = 34" (the corner of the speaker from the front wall). 19.4" − 19" = 0.4" (the other corner of the cabinet from the side wall).

TEN COMMANDMENTS. For smooth bass response and best stereo:

1. The listening room shall be as large as practical.
2. The listening room dimensions shall be as unrelated as possible.
3. The listening room resonances shall be well damped.
4. The listening room shall have good lateral symmetry.
5. Speakers shall be elevated so that tweeters are at seated-listener ear height.
6. Tweeters shall be aimed at, or in front of, the listener.
7. The distance between the speakers shall be no greater than the distance from each speaker to the listener.
8. No object shall block the path from speaker to listener, or from speaker to speaker.
9. The woofers shall be at distances from the three room boundaries that are as different as possible.
10. The listener's ears shall be at distances from the nearest three room boundaries that are as different as possible.

(*Note*: Under some circumstances the line dividing a listening room into right and left halves must be considered a room boundary.)

When it comes to speaker stuffing choose a natural

Wool

—unequalled natural sound absorption qualities
—loose batting form makes density control easy
—currently specified in a top-of-the-line speaker

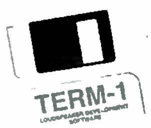
Now you can use nature's most versatile fiber

Send $5.00 for 4 oz. sample or $30.00 for 5 pounds
(all U.S. shipping charges paid)

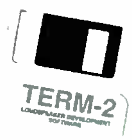
to: **R.H. Lindsay Company**
Dept. S P.O. Box 218
Boston, MA 02124
Tel: (617) 288-1155 Fax: (617) 288-1050

Fast Reply #KG1409

First, let's talk sound design



Cliff utilizes and distributes Term™ sound design software.



then let's talk about our sound line.

Cliff features over 25 models of horns, tweeters and woofers.

Call Cliff today:
(713) 894-2227
Cliff Electronics, Inc., 11552 Cypress N. Houston
Cypress, TX 77429 FAX: 713-894-2119

CLIFF Electronics

World Radio History

NEW FROM OLD COLONY

HIGH POWER AUDIO AMPLIFIER CONSTRUCTION — BKEV18 — $10.95

R.A. Penfold

This book provides background information on high power audio amplifiers, together with some practical designs capable of output powers of up to around 300-400Wrms. Included are types having power MOSFETs in the output stage, which give excellent performance over the full audio range and offer good reliability in what are relatively simple circuits. Printed circuit designs are included for these MOSFET circuits, as are suitable power supply designs. For those who prefer to use bipolar output transistors, inverting and non-inverting circuits are provided. These can be used in single-ended or bridge configurations, and provide output powers comparable to those of the MOSFET designs. United Kingdom, 1991, 76pp., 4⅜ × 7, softbound.

LOUDSPEAKERS FOR MUSICIANS — BKEV19 — $10.95

Vivian Capel

In this unique handbook, the author sets out to narrow the gap between the technician and the musician by relating technical expressions to musical terms. It contains all that a working musician needs to know about loudspeakers: the different types; how they work; and those most suitable for different instruments, for club/cabaret work, and for vocals. In addition, the author gives tips on constructing cabinets, wiring, when and where to use wadding/damping (and when not to), finishing, how to ensure they travel well, how to connect multi-speaker arrays, and much more. Ten practical enclosure designs with plans and comments are given in the last chapter, but by the time you've read that far, you should be ready to design your own. United Kingdom, 1991, 163pp., 4⅜ × 7, softbound.

ACOUSTIC FEEDBACK–HOW TO AVOID IT — BKEV20 — $10.95

Vivian Capel

While feedback usually cannot be completely eliminated, many things can be done to reduce it to a level at which it is no longer a problem. Much of the trouble is often the hall itself, not the equipment, but there is a simple and practical way to greatly improve acoustics. Some microphones are prone to feedback, while others are not. Certain speaker systems are much better than others, and the way the units are positioned can produce or reduce feedback. All these aspects are fully explored in this book, in addition to electronic aids such as equalizers, frequency shifters, and notch filters. The special requirements of live group concerts are also considered, as well as the related instability problems sometimes associated with large setups. Some unsuccessful attempts at curing feedback are even explored, in order to save readers wasted time and effort in duplicating them. The design, layout, and operation of a highly successful twin notch filter is also included in this handy overview. United Kingdom, 1991, 92pp., 4⅜ × 7, softbound.

PREAMPLIFIER AND FILTER CIRCUITS — BKEV21 — $10.95

R.A. Penfold

This book provides circuits and background information for a range of preamplifiers, plus tone controls, filters, mixers, and so forth. The use of modern low-noise operational amplifiers and a high performance audio preamp IC results in circuits that have excellent performance yet are still not too complex. All the designs featured can be built at relatively low cost. Preamp designs featured include: microphone preamps (low impedance, high impedance, and crystal); magnetic cartridge pickup preamps with RIAA equalization; a crystal/ceramic pickup preamp; a guitar pickup preamp; and a tape head preamp (for use with compact cassette systems). Other circuits are: an audio limiter to prevent overloading of power amps; passive tone controls; active tone controls; PA filters (high pass and low pass); scratch and rumble filters; a loudness filter; audio mixers; and volume and balance controls. No construction details are provided for the circuits in this book, and it is not really intended for beginners. On the other hand, the circuits are all pretty simple, and you do not really need much previous experience in electronic construction in order to tackle them. Where appropriate, any setting up procedures and notes on tricky aspects of construction are provided. Mainly intended for use in conjunction with BKEV18, *High Power Audio Amplifier Construction*. United Kingdom, 1991, 91pp., 4⅜ × 7, softbound.

PRACTICAL ELECTRONIC FILTERS — BKEV22 — $12.95

Owen Bishop

Filters play a vital part in almost all electronic circuits, yet many people believe they are difficult to understand. This is probably because so many of the books on this topic are extremely mathematical. By contrast, this book deals with the subject in a nonmathematical way, reviewing the main types of filters and explaining in simple terms how each type works and is used. The book also presents a dozen filter-based practical projects with applications in and around the home or in the constructor's workshop. These include a number of audio projects such as a rhythm sequencer and a multi-voiced electronic organ. Project descriptions include circuit diagrams, explanations of their operation, and detailed instructions for building them. A number of the projects are suited to the beginner, while others will be of interest to the more advanced constructor. Concluding the book is a practical step-by-step guide to designing simple filters for a wide range of purposes, with circuit diagrams and worked examples. United Kingdom, 1991, 188pp., 4⅜ × 7, softbound.

LOUDSPEAKER DESIGN POWERSHEET SOFTWARE

Marc Bacon

Surely at the front of the spreadsheet speaker-design wave of the future, The LOUDSPEAKER DESIGN POWERSHEET was written by professional engineer Bacon with one purpose in mind: to make computer-aided speaker design accessible to everyone. The program covers a wide range of knowledge taken from the most recent publications in the field, yet is extremely simple to use and low in cost. The Professional version covers 19 different kinds of bass loading with extensive graphing capabilities; volume calculation for 5 different enclosure shapes; evaluation of cavity resonances, rectangular panel resonances, and the coincidence effect; 24 different types of crossovers; 10 miscellaneous programs for shaping circuits, zobels, room interaction, and coil design; 8 programs for evaluating driver parameters and losses; electrical laws; conversion factors; room acoustics; and more. A Basic version which includes 41 of the above programs is also available.

An unprotected source code allows the user to customize and build upon individual spreadsheets for his own use. Individual programs are accessed through a user-friendly menu tree, and context-sensitive HELP and an introductory README.1ST file are also included. Requires IBM PC or compatible with 640K of memory, preferably a hard disk, and Lotus 1-2-3, Quattro Pro, Excel, or another spreadsheet which can use Lotus *.WK1 files. PLEASE NOTE THAT SPREADSHEET SOFTWARE IS NOT INCLUDED. From *SB*. Upgrades from the Basic to the Professional version are available for $25 plus proof of purchase.

Purchasing options available:

SOF-PSH1B5	LOUDSPEAKER DESIGN POWERSHEET Basic version for IBM, 2 × 5¼"	$49.95
SOF-PSH1B3	LOUDSPEAKER DESIGN POWERSHEET Basic version for IBM, 1 × 3½"	$49.95
SOF-PSH2B5	LOUDSPEAKER DESIGN POWERSHEET Professional version for IBM, 5 × 5¼"	$69.95
SOF-PSH2B3	LOUDSPEAKER DESIGN POWERSHEET Professional version for IBM, 3 × 3½"	$69.95

World Radio History

MORE NEW PRODUCTS!

ELECTROSTATIC LOUDSPEAKER DESIGN AND CONSTRUCTION — BKT6 — $19.95

Ronald Wagner

This classic, once produced by TAB Books, is now published by Audio Amateur Press for the first time. Both a "how-to" book and an informative text on electrostatic speakers, it provides a step-by-step sequence for building full-range electrostatic speakers as well as acquaints the reader with their basic operating principles. The book also describes the important parameters of an electrostatic speaker and indicates how each affects performance. Intended for the audio amateur, musician, craftsman, or anyone else who is not only interested in this type of speaker, but would also like to obtain the very best in sound reproduction. Chapters include: How It Began; Electromagnetic Speakers; Speaker Measurements; Electrostatic Loudspeakers; Building a Full-Range Electrostatic Speaker; Frames and Ribs; Preliminary Assembly; Preliminary Speaker Testing; Stretching Frame; Final Speaker Assembly; Speaker Mounting Frames; Electronics for Electrostatic Speakers; Speaker Evaluation; and Commercial Electrostatic Speakers. (Because of rights difficulties, not included from original book is the Chapter 15 article by Malme.) Appendix with construction info, Index, Bibliography. 1987, 1992, 244pp., 7½ × 9½, softbound. IN PRODUCTION; PLEASE CHECK AVAILABILITY.

RADIO AND ELECTRONICS ENGINEER'S POCKET BOOK — BKHN2 — $27.95

Keith Brindley

This completely revised and enlarged seventeenth edition of the invaluable standby is a great compendium of facts, figures, and formulae indispensable to the designer, student, service engineer, and all those interested in radio and electronics. The author's main criterion in choosing what to include was to ask himself, "What do *I* look up?" He thus has tried to include anything and everything of relevance to radio and electronics referred to in literature. A considerable amount of new material relating to recent developments in radio and electronics has been added, including new sections on batteries, cables, and connectors. In addition, all the broadcasting information (for the United Kingdom) has been updated. This is a pocket book, in a very handy size. United Kingdom, 1987, 201pp., 3¾× 7¾, hardbound.

DIGITAL AUDIO AND COMPACT DISC TECHNOLOGY — BKHN3 — $49.95

Sony Service Centre (Europe)

Edited by Luc Baert, Luc Theunissen, and Guido Vergult, this is the definitive book on CD players and technology and is essential reading for audio engineers, students, and hi-fi enthusiasts. All modern and proposed sound transmission/storage systems use digital techniques, specifically pulse code modulation (PCM). This is a clear and easy-to-follow introduction which also includes a technical description of DAT (digital audio tape). BKHN3 is produced by Sony, using all of their resources and expertise as one of the forerunners in this field and co-inventor of the compact disc digital audio system. Contents include: Principles of Digital Signal Processing; Sampling; Quantization; A/D Conversion Systems; Codes for Digital Magnetic Recording; Principles of Error Correction; The Compact Disc; Compact Disc Encoding; Opto-Electronics and the Optical Block; The Servo Circuits in CD Players; Signal Processing; Digital Audio Recording Systems; PCM; Video 8; R-DAT; S-DAT; and DASH. United Kingdom, 1988, 253pp., 7¾ × 10, hardbound.

THE TAPELESS DIRECTORY — BKSY1 — $39.95

Yasmin Hashmi, Stella Plumbridge

This valuable reference, now in its second edition, is the only independent source of information on over 70 tapeless audio recording and editing systems. It is divided into two parts: The first gives a comprehensive background to the technology, explaining terminology, operational procedures, and design strategies and including useful pointers for those considering investing in a system. The second part provides detailed information on the systems and is organized according to type. The data provided for the systems is in an easily comparable format and includes target market(s), operational and technical specifications, anticipated developments, and cost and supplier details for the USA and Europe. United Kingdom, 1991, 72pp., 8¼ × 11¾, softbound.

USING TIME CODE IN THE REEL WORLD II — BKSR1 — $19.95

Jim Tanenbaum, C.A.S., with Manfred N. Klemme

Time code, such as 50/60Hz Neopilot or FM sync, provides a way of maintaining the relationship between the sound recorded on audio tape and the image recorded separately on film or videotape. In addition, it provides an initial reference point without clapstick slates; in fact, it provides a continuous reference inherently, without edge coding or other external means. This manual, now in its second edition, will help the reader understand time code and know what standard to use for every possible application. Its level varies from elementary to somewhat advanced, but it develops each subject area in a comprehensible manner, sometimes including a touch of humor. It is assumed that the reader knows non-TC sound recording techniques and understands (somewhat) the operation of the Nagra IV-STC, Denecke TS-1 slate, and so forth. Index, Glossary, Bibliography. 1992, 110pp., 8½ × 11, Velo bound with vinyl covers.

THE NEW STEREO SOUNDBOOK — BKT23 — $18.95

F. Alton Everest, Ron Streicher

This book is a comprehensive, nontechnical guide to stereo sound principles and techniques, explaining all of the underlying facets of stereophonic perception, recording, and reproduction. The authors provide easy-to-follow experiments and all the diagrams, tables, and photographs the reader will require in order to modify and enhance his stereo system. Topics include the development of stereo from its earliest stages to the present; using microphones to achieve special stereo effects; recording binaural signals with the use of a dummy head; making a stereo signal from two or more mono signals; controlling sound reflections for optimal stereo listening; auditory spaciousness; multidimensional and surround sound systems; and much more. 1992, 296pp., 7 × 10, softbound.

DESIGN & BUILD ELECTRONIC POWER SUPPLIES — BKT24 — $17.95

Irving M. Gottlieb

Power supply technology has come a long way in the past few years, largely as a result of new techniques that allow higher switching rates with no significant loss in performance. This practical guide to modern power supply design and new construction techniques will bring the reader up to date on today's most advanced power supply circuits, components, and measurement procedures. The author includes full coverage of the older 20kHz power switch standard, as well as describes how new high frequency devices are reducing production costs and dramatically improving power supply efficiency, reliability, compactness, and volume. New advances covered include electronic and synchronous rectification; resonant-mode switching; sine-wave power supplies; current-mode control; IGBT power switches; MCT thyristors; and more. 1991, 163pp., 7 × 10, softbound.

World Radio History

MORE NEW PRODUCTS!

THE MODERN OSCILLATOR CIRCUIT ENCYCLOPEDIA — **BKT27** — **$12.95**

Rudolf F. Graf

This valuable reference contains an assortment of more than 250 ready-to-use oscillator circuit designs representing the latest engineering practices. Organized by application for easy reference, the circuits are in their original form to prevent transcription errors. Each entry includes a schematic and a brief explanation of how the circuit works. The author also lists the original source for each circuit in a section at the back of the book, making it easy for the reader to obtain additional information. Types covered include audio, burst, sine-wave, Miller, Colpitts, Wien-bridge, bias, multivibrator, crystal, RF, square-wave, Pierce, TTL, code, voltage-controlled, and function generators. 1992, 184pp., 7 × 10, softbound.

DAT: THE COMPLETE GUIDE TO DIGITAL AUDIO TAPE — **BKT25** — **$12.95**

Delton T. Horn

Everything you need to know about the latest development in sound reproduction–digital audio tape–is clearly explained in this easy-to-understand book: what DAT is, how it works, and how it differs from competing analog and compact disc technology. After a brief overview of basic analog and digital recording concepts, the reader will find in-depth coverage of DAT techniques and equipment, manufacturer's information on available (and soon to be available) systems, and what the future holds for DAT technology. 1991, 254pp. 7 × 10, softbound.

TROUBLESHOOTING AND REPAIRING ELECTRONIC MUSIC SYNTHESIZERS — **BKT26** — **$16.95**

Delton T. Horn

This illustrated manual is enjoying a growing audience among musicians who want to save money on repairs, as well as among technicians and hobbyists who want to learn more about the new generation of musical synthesis equipment. The author provides complete, step-by-step instructions for servicing or replacing all synthesizer components and circuitry, from that found in older analog devices to today's most advanced digital systems. Musicians will also find plenty of solid advice on how to refurbish old or unusable equipment and how to modify and expand existing setups. Entire chapters are devoted to MIDI circuitry, cabling, and other aspects of computer-controlled digital synthesis technology. 1992, 206pp., 7 × 10, softbound.

OLD COLONY EASY ORDER FORM

QTY.	ITEM NO.	PRICE EACH	TOTAL

❑ FREE CATALOG

SHIPPING $

TOTAL $

NAME

COMPANY

STREET

CITY ST ZIP

DAYTIME TELEPHONE

PLEASE REMIT IN US DOLLARS ONLY. PAYMENT BY:

❑ CHECK / MONEY ORDER ❑ MASTERCARD ❑ VISA

MC OR VISA EXP.

PLEASE BE SURE TO ADD **SHIPPING** CHARGES:

Shipping Charge According to Destination and Method Desired ($)

	United States		Canada		Other	
Order Value	**Surface**	**Air**	**Surface**	**Air**	**Surface**	**Air**
<$50.00	3.00	7.50	5.00	7.50	10.00	20.00
$50.00–99.99	4.00	15.00	7.50	15.00	20.00	30.00
$100.00–199.99	5.00	20.00	15.00	20.00	30.00	40.00
>$200.00	6.00	30.00	25.00	30.00	40.00	50.00

OLD COLONY SOUND LAB

PO BOX 243, Department B92
Peterborough, NH 03458-0243 USA

24-Hour Lines
Telephone: (603) 924-6371 or (603) 924-6526
FAX: (603) 924-9467

World Radio History

MORE ABOUT DUST CAPS

BY OLE WINBERG and KNUD THORBORG

"Dust capping" poses one of the more delicate questions in speaker manufacturing: whether to make the cap, which covers the apex of the cone and is in front of the voice coil, tight or open. Either way you have problems to solve.

If the mounting is tight, you often must use vents to relieve the pressure under the dust cap (*SB* 1/91, "The Dust Cap Solution," pp. 68–72). In addition, the dust cap will radiate sound and often produce resonances, spoiling what may otherwise be a smooth rolloff. If you do not vent, air pressure around the voice coil will produce a noisy, unclean sound at low frequencies, especially when the loudspeaker is in free air. When the driver is mounted in the box, the noise will come from the backside and will be reduced, depending on the sound insulation of the cone and the dust cap.

A tight dust cap does have some benefits. The voice coil is cooled by the air stream (higher power handling), and harmonic distortion is lowered due to the addition of linear air damping. So it is something of a paradox that the less-clean-sounding speaker has the lowest distortion. Sometimes these benefits more than offset the shortcomings, and the unvented, tight dust cap might be a reasonable choice.

OPEN IS BETTER. In our experience, a very clean sound results from using an open dust cap. For a woofer with a long voice coil in a narrow airgap, the acoustical impedance around the airgap is so high that we get no measurable loss due to air leaks. Of course, we know of drivers where this is a real problem. In such cases another solution must be found.

In the article previously mentioned, a frequency-response measurement is shown of a woofer/midrange with a pronounced dip around 3kHz. The author seals the dust cap to solve the problem, and this is undoubtedly a good solution—except for venting problems and possible resonances.

What is the cause of this dip around 3kHz? It is an out-of-phase reflection from the pole piece and, therefore, will be the same for either an open dust cap

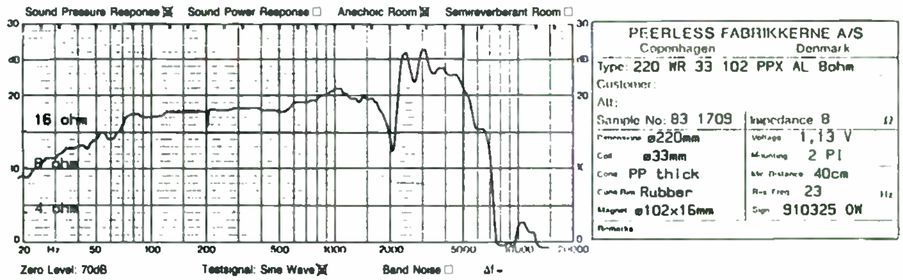


FIGURE 1a: The Peerless 831709 without spacer and dust cap.

Thiele/Small parameters:			Free air	Common	Baffled
Nominal impedance	Znom	(Ω):		8.0	
Minimum impedance/at freq.	Zmin	(Ω/HZ):		5.3/ 200	
Maximum impedance	Zo	(Ω):		28.0	
Dc resistance	Re	(Ω):		4.9	
Voice coil inductance	Le	(mH):		1.0	
Capacitor in series with 8Ω (For impedance compensation)	Cc	(μF):		6	
Resonance frequency	fs	(Hz):	23.1		22.4
Mechanical Q factor	Qms	:	2.14		2.20
Electrical Q factor	Qes	:	0.45		0.46
Total Q factor	Qts	:	0.37		0.38
F (Ratio fs/Qts)	F	(Hz):			59
Mechanical resistance	Rms	(kg/s):		2.13	
Moving mass	Mms	(g):	31.5		33.4
Suspension compliance	Cms	(mm/N):		1.51	
Effective cone diameter	D	(cm):		17.0	
Effective piston area	Sd	(cm²):		227.8	
Equivalent volume	Vas	(ℓ):		108.3	
Force factor	BL	(N/A):		7.0	
Reference Voltage Sensitivity Re. 2.83V 1m at 200HZ (Calculated)		(dB):			88

Znom	(Ω):	8.00						
Re	(Ω):	4.88						
fs	(HZ):	23.09				h	(mm):	17.00
Zo	(Ω):	28.04				nw	:	116.00
vmax	(mm/s):	32.94	V	(ℓ):	18.75	Φ tot.	(mWb):	1.03
f1	(HZ):	18.84	fsb	(HZ):	58.38			
f2	(HZ):	29.64	Zob	(Ω):	29.15			
Zmin	(Ω):	5.26	vmb	(mm/s):	34.20	BL free air	:	7.03
fmin	(HZ):	200.00	f1b	(HZ):	53.94	BL theor.	:	7.03
Z2000	(Ω):	8.65	f2b	(HZ):	63.66	BL box	:	7.10

FIGURE 1b: Measurements and parameters without spacer and dust cap.

World Radio History

or no dust cap. Filling up the cavity over the pole piece with a spacer (phase plug) solves this problem by correcting the phase of the reflection.

TRUE VALUE. Look at the curves shown in *Figs. 1a, 2a* and *3*. *Figure 1a* is a Peerless 831709, 8" CC woofer measured without either a spacer or a dust cap. *Figure 2a* is the same driver, but now fitted with a tight plastic dust cap and having vents in the cone under it. (The arrangement is the same as found in the *SB* article.) *Figure 3* shows the standard speaker with a spacer and an open dust cap. Obviously, the dip in *Fig. 1a* has nothing to do with air compression or air leaks.

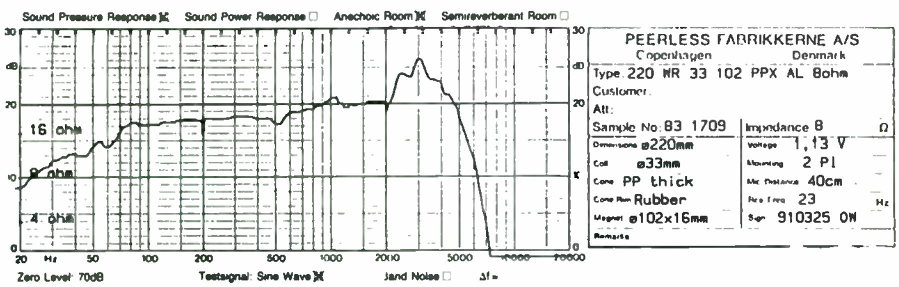


FIGURE 2a: The Peerless 831709 with tight dust cap and vents under dust cap.

Thiele/Small parameters:

			Free air	Common	Baffled
Nominal impedance	Znom	(Ω):		8.0	
Minimum impedance/at freq.	Zmin	(Ω/HZ):		5.3/ 197	
Maximum impedance	Zo	(Ω):		27.9	
Dc resistance	Re	(Ω):		4.9	
Voice coil inductance	Le	(mH):		1.0	
Capacitor in series with 8Ω (For impedance compensation)	Cc	(μF):		6	
Resonance frequency	fs	(Hz):	22.6		22.0
Mechanical Q factor	Qms	:	2.18		2.23
Electrical Q factor	Qes	:	0.46		0.47
Total Q factor	Qts	:	0.38		0.39
F (Ratio fs/Qts)	F	(Hz):			56
Mechanical resistance	Rms	(kg/s):		2.12	
Moving mass	Mms	(g):	32.5		34.2
Suspension compliance	Cms	(mm/N):		1.53	
Effective cone diameter	D	(cm):		17.2	
Effective piston area	Sd	(cm²):		233.7	
Equivalent volume	Vas	(ℓ):		115.5	
Force factor	BL	(N/A):		7.0	
Reference Voltage Sensitivity Re. 2.83V 1m at 197HZ (Calculated)		(dB):			88

Type	: 831709				
Znom	(Ω): 8.00				
Re	(Ω): 4.88				
fs	(HZ): 22.57			h	(mm): 17.00
Zo	(Ω): 27.94			nw	: 116.00
vmax	(mm/s): 33.00	V	(ℓ): 18.75	Φ tot.	(mWb): 1.03
f1	(HZ): 18.51	fsb	(HZ): 58.90		
f2	(HZ): 28.88	Zob	(Ω): 30.50		
Zmin	(Ω): 5.25	vmb	(mm/s): 36.10	BL free air	: 6.99
fmin	(HZ): 197.00	f1b	(HZ): 54.78	BL theor.	: 7.03
Z2000	(Ω): 8.70	f2b	(HZ): 63.66	BL box	: 7.10

FIGURE 2b: Measurements and parameters with tight dust cap and vents under dust cap.

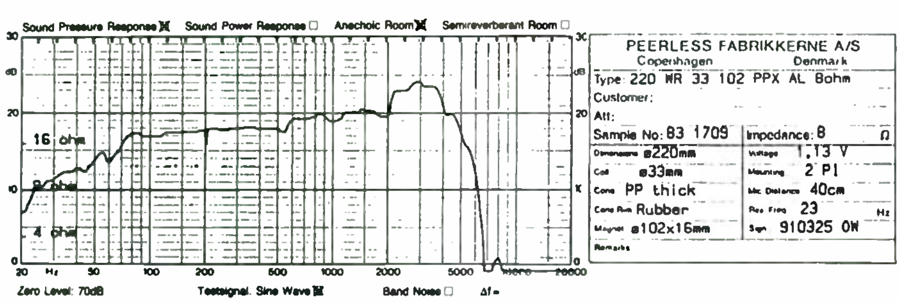


FIGURE 3: The Peerless 831709 standard version with spacer and open dust cap.

We have developed a device which very reliably measures Thiele/Small parameters using Brüel & Kjaer's laser velocity transducer. With this device we can measure loudspeaker parameters and print them out with a computer.

A laser beam is reflected from the cone, which detects and produces a voltage representing cone velocity. No extra weights are needed to find mass. The measurements are first made in free air, and then with the driver mounted in an empty box of known volume. This is all the computer requires to calculate the true value of S_D and V_{AS}. We have found this measurement to be the most reliable to date.

CLEAR RESULTS. Data is calculated from well-known formulas based on familiar electrical analogs. The speaker behaves like a stiff piston with a well defined mass (M_{MS}) and an area (S_D) and, when mounted in the empty test box, the volume of this should behave as a simple compliance (in mobility analogs parallel to speaker compliance C_{MS}).

Inside the box we get higher resonance (f_{SB}); however, resonance impedance should be the same as in free air. The mass should be a little higher due to baffling. If resonance impedance is lower in the test box than in free air, this indicates airleaks in the box, the mounting, or the driver itself.

The measuring method gives a good indication of how well the speaker behavior conforms with theory, which is a precondition for all simulation (but not always met in the case of actual speakers). It is also possible to make control measurements on finished boxes, including the effects of damping material and filters.

We used this method to measure the experimental speaker of *Fig. 1a* (no spacer, no dust cap) first in free air, then in an 18 liter empty box. The resulting data is shown in *Fig. 1b*. Without taking the speaker out of the box (so as not to change mounting tightness) we measured it again with air vents (burnt with a soldertip into the cone so as to avoid introducing extra damping due to an air-stream around the voice coil), and equipped with a tight plastic dust cap. After this we removed the driver and made the measurement in free air. We thus produced the data shown in *Fig. 2b*, corresponding to frequency response *Fig. 2a*.

REFLEX TILT UNVEILED. The only significant differences between the two data sheets are the addition of 1g (due to the mass of the dust cap) and a little rise

World Radio History

in S_D (due to the area of the voice coil now also contributing to radiation, and compression of the air inside the box). From these measurements we can see that both Z_{OB} (the resonance impedance in the box) and f_{SB} itself are very similar in the two cases. Furthermore, it should be noted that Z_{OB} is higher than Z_O (resonance impedance in free air) for both the open and closed dust cap. Even with an open dust cap we have less loss inside the box than outside. This is due to losses in the surround (in the mobility diagram to be placed in series with the inductance C_{MS} representing compliance).

As resonance increases due to ideal air stiffness, the impact of losses in the surround goes down and Z_{OB} rises. For this reason, in most reflex designs the lower impedance peak becomes more damped than predicted, while the upper is less damped.

(*Note:* In our experience, the porosity of some foam surrounds can have much worse effects than dust cap air leaks.)

About the Authors

Knud Thorborg obtained his Masters Degree in Electrical Engineering in 1953 from the Technical University of Denmark. He worked until 1956 at the same institution in the Laboratory for Acoustics, whereafter he joined the staff of Peerless Fabrikkerne. Today he is manager of the Peerless Acoustic Laboratory and has responsibility for development of the well-known Peerless loudspeakers, and in this way ideally combines hobby with work.

Ole Winberg received his Bachelors Degree in Electrotechnical Engineering in 1990 from the Engineering Academy of Denmark. He wrote his master's thesis, "Measurement of Thiele/Small Parameters Using a Laser Velocity Transducer," in cooperation with Peerless Fabrikkerne. After receiving his degree, he was employed at the Acoustic Laboratory of Peerless, where he still works. His current interests are in the areas of audio engineering, PC software and hardware, and transducer and digital systems.

SAVE $1000 ON OUR LEGENDARY 100 WATT AMPLIFIERS!!!

Times are difficult for Americans. We're doing something about it.

We've added Triode Switching to our Compact 100s (50 Watts Class A!)
You're saying to yourself: "SO WHAT?!"
We've Added Wood Sides and a Metal Grille.
You're saying to yourself: "SO WHAT?!"
And best of all:
We've LOWERED the price of our VTL 100 Watt Monoblocks to $2100 per Pair!
Now you're saying: "WOW!!"
AND you still get our industry leading LIFETIME WARRANTY!
(6 months on Tubes when used with a VTL Preamplifier).

We continue to offer value for money. Triode switching is normally a $300.00 option, we've added it free. Protective covers are normally a $150.00 option, we've added them free. We have LOWERED the price of the model by $1000.00! We've given you

$3100.00 in value for $2100.00!

VTL-HANDBUILT IN CALIFORNIA-PROUDLY MADE IN THE USA!

To order, please send Check or Money Order for $2100.00+$40.00 Shipping and Handling, or phone for C.O.D. to: Vacuum Tube Logic of America
4774 Murietta Street, #9
Chino, CA 91710
Tel: (714) 627-5944•(714) 627-8263
Fax: (714) 627-6988

VTL

(CA RESIDENTS PLEASE ADD 7.75% SALES TAX)

Fast Reply #KG494

Audio Control Industrial

Affordable, 1/3 Octave, Real Time Analyzer With Memories & SPL Display Under $1000

- SA3050A with Mic $ 995
- With Battery & Printer Interface $1300
- Rack Mount $ 55
- Soft Case $ 59
- A/C Weighted Filter $ 44

Bradley BROADCAST
In Maryland and DC: 301-948-0650 • FAX: 301-330-7198

Call TOLL FREE: 1-800-732-7665

Fast Reply #KG123

World Radio History

SUCCESSFUL SMALL WOOFERS

These 5" and 6½" Vifa dual-chamber projects were based on a 1973 50%/50% volume apportionment idea, which is unlike Weems' 67%/33% method previously outlined in his book and in these pages (*SB* 4/85, p. 14).[1,2] When I returned to speaker building as a hobby five years ago, I was unable to get the latter method to turn without overstated bass. Therefore, I reverted to my own symmetrical approach and have had 100% success.

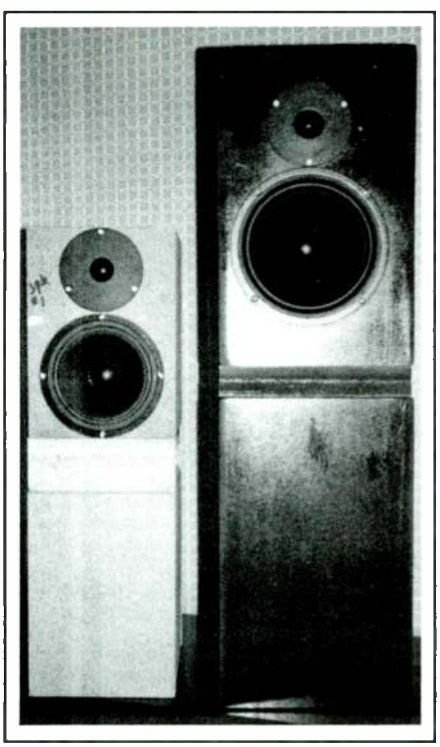


PHOTO 1: The 5" Vifa ¾" Vifa speaker on the left, 6½" Vifa ¾" Scan Speak speaker on the right.

My initial assumptions were:

1. V_B would equal the BB4 QL7 alignment plus 35%/40% over-volume.
2. f_B would be sub-BB4 due to some form of bass reinforcement.
3. f_S would exceed BB4 f_3 and contend with QB3, SC4 f_3.

My assumptions turned out to be correct. In retrospect, it is also possible that f_B is a constant for any specific volume using this type of loading regardless of Q_T or f_S measurements considering an adequate X_{MAX} (*Fig. 1*).

Vifa 5" P13WH factory specs were V_{AS} = 14 liters, Q_T = 0.31, f_S = 50; measured values (excluding V_{AS}) coinciding except f_S = 66. I encountered flat tuning using 0.16 + 0.16 = 0.32 ft.^{3}, f_B = 37, dual PVC vents 15⁄16" × 4". I combined the Vifa ¾" D19TD-05 tweeter with this woofer.

Vifa 6½" P17WJ factory specs were V_{AS}

Continued on page 40

a.) V_B = BB_4 QL_7 35-40%, adding 0.07 to Q_T for s.r.

b.) $V_L = ((1.463 \times 10^7 r^2) / (V_B \times f_B^2)) - 1.463r$.

c.) V_B = gross volume, $f_B = f_S$ (spec, not measured), select *r* yielding a usable length normally of 2-5".

FIGURE 1: Relevant formula.

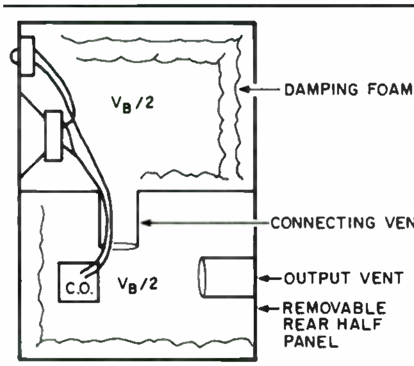


FIGURE 2: A side view of the basic design.

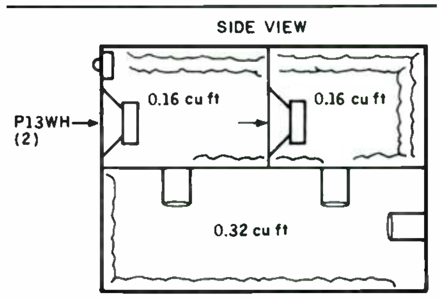


FIGURE 3: Dual 5" design with internal woofer. (Both 50/50% and 33/67% conditions exist for this upcoming project by eliminating the lower partition.)

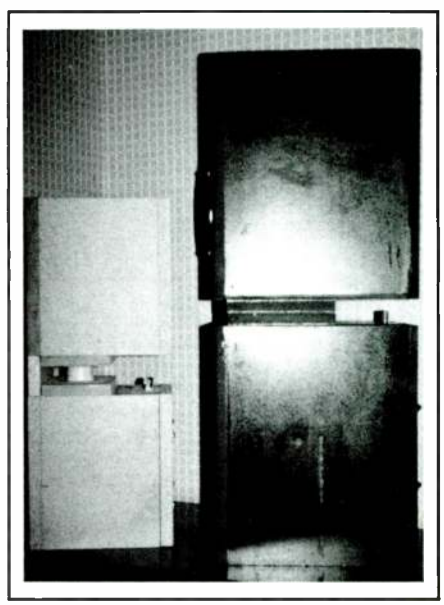


PHOTO 2: Side views show the internal correction port.

Fast Reply #KG1470

World Radio History

ZALYTRON

YOUR ONE STOP SHOPPING CENTER

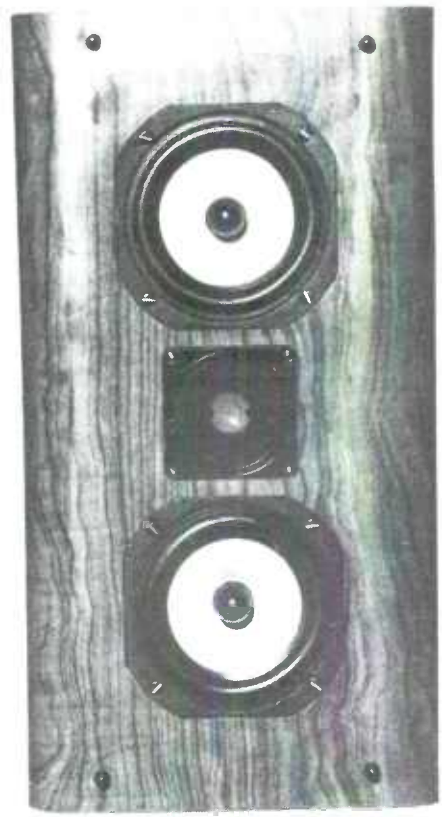
FOCAL VIFA Cabasse LA REFERENCE EN HAUTE FIDELITE SCR

seas morel ZALYTRON CUSTOM WOOFERS PHILIPS

Polydax speaker corporation l'atelier audio FRANCE ACCUTON

In Our Efforts To Bring You The Best Equipment at the Best Price...

We Now Proudly Offer



ARIA 5
With new focal Titanium Tweeter

$399

ARIA 5
With Accuton Tweeter

~~$699~~

Due to an importer authorized Sale, we are reducing the price to:

$599

These prices are without Cabinets
Deluxe Cabinets as shown $300 Pr.

- Order your FREE catalog with over 100 pages of speakers, cabinets and accessories.
- Order your FREE kit catalog coming this fall. Its a must for all you audiophiles.

ZALYTRON INDUSTRIES CORP.
469 JERICHO TURNPIKE, MINEOLA, N.Y. 11501
TEL. (516) 747-3515 FAX (516) 294-1943

Our warehouse is open for pick-up 10AM to 6 PM daily, Monday thru Saturday
UPS orders shipped same day • Minimum order $50.00
FOR ALL YOUR SPEAKER NEEDS OR INQUIRIES - WRITE OR CALL ASK FOR ELLIOT

World Radio History

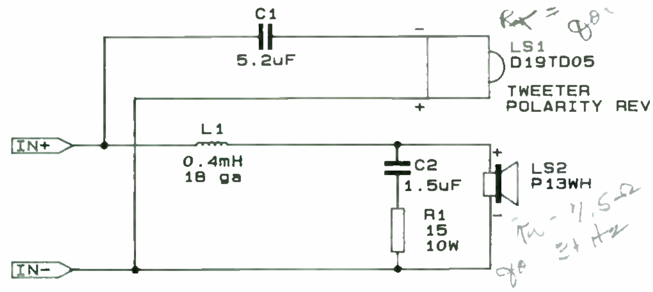


FIGURE 4: Schematic of the 5″ P13WH/¾″ D19TD05.

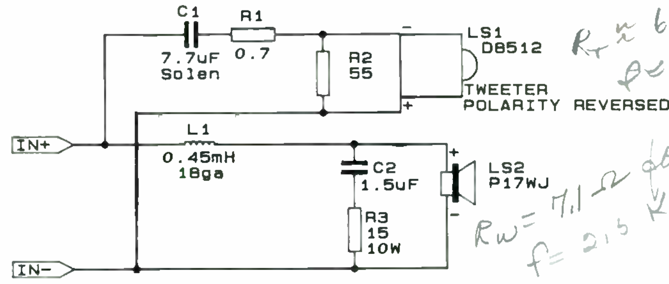


FIGURE 5: Schematic of the 6½″ P17WJ/¾″ D8512.

TABLE 1

P13WH/D19TD05 PARTS LIST

Resistor

R1	15Ω, 10W

Capacitors

C1	5.2μF Solen
C2	1.5μF Mylar

Miscellaneous

L1	0.4mH, 18 ga.

Continued from page 38
= 35 liters, Q_T = 0.35, f_S = 37; measured values coinciding except f_S = 55. I encountered flat tuning using 0.50 = 0.50 + 1.0 ft.³, f_B = 30, dual PVC vents 1⁹⁄₁₆″ × 2⅝″. I combined the Scan Speak ¾″ D8512 tweeter with this woofer.

In both cases, the internal vent seemed to require an ⅛-inch length advantage over the output vents. While I supported the half chambers for true symmetry, both vents can probably protrude into the lower chamber (*Fig. 2*).

Crossovers were symmetric first-order, staggered cutoff, self-designed Zobel, reverse polarity tweeters causing best imaging, tweeter attenuation circuit on D8512. Frequency cut-offs for the 5″ system were 3.0-4.3k, for the 6½″ system, 2.5-3.3k.

Both speakers are better than average performers without discernible flaws and especially nice crossovers despite their lack of time/phase analysis. The 5″ speaker reproduced a creditable 40Hz test record tone but few records contain such information within their grooves and this speaker isn't about to embellish the deficiency. Still, with nice detail, missing ambiences, and satisfying bass on some cuts, I had no complaints during the four

TABLE 2

P17WJ/D8512 PARTS LIST

Resistors

R1	0.7Ω
R2	55Ω
R3	15Ω, 10W

Capacitors

C1	7.7μF Solen
C2	1.5μF Mylar

Miscellaneous

L1	0.45mH, 18 ga.

RELIVE THE GLORY DAYS OF HEATH!

BKTP-1, 1992, 5¼ x 8¼
124pp., softbound

HEATH NOSTALGIA by Terry Perdue

Millions of people worldwide have enjoyed the special experience of assembling a quality Heath product with their own hands, and often learned something useful in the process. And many a youngster went on to pursue a career in the electronics field due to an interest sparked by a Heathkit. As we know, Heath has recently announced that it is going out of the kit business. Still, many people have fond memories of their Heathkit experiences and will enjoy renewing them through this book, as well as learning more about the company's heritage. With 24 pages of photos, *Heath Nostalgia* will be an addition of timeless value to any bookshelf.

CALL OR WRITE FOR YOUR FREE CATALOG!

OLD COLONY SOUND LAB
PO Box 243, Dept. B92
Peterborough, NH 03458
24 Hours: Tel. (603) 924-6371
FAX (603) 924-9467

YES!
Please send me

____ BKTP-1 @ $9.95 $______
Postage ______
TOTAL $______

POSTAGE & HANDLING: In US, please add $2.00 for first book and 75¢ each additional book. In Canada, please add $4.50 for first book, 75¢ each additional. Overseas, please include 20% of total order for shipping.

NAME ______ MAGIC NO. ______
STREET & NO. ______
CITY ______ ST ______ ZIP ______
MC/VISA ______ EXP. ______
☐ MC ☐ VISA ☐ CK/MO ☐

World Radio History

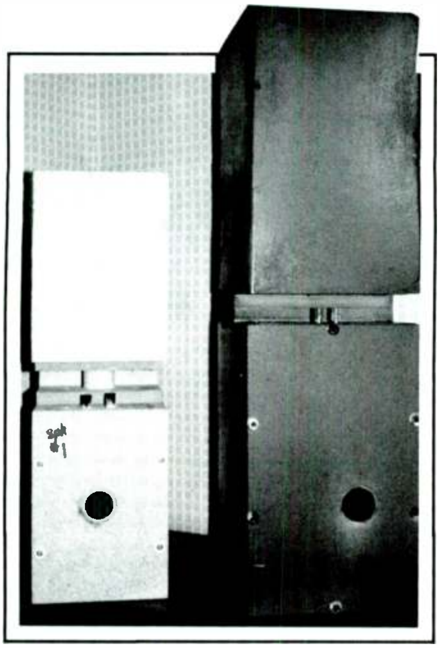


PHOTO 3: Back views show the removable output port-crossover access panel.

months it took to complete the 6½" speaker (*Photos 1–4*). While the 6½" was the clear winner, the differences were surprisingly small. In contrast, the differences between using mid-fi electronics and source and high-end equipment were enormous, even when switching between Ariston RD-80 and RD-11 turntables.

Presently, I am about to begin a dual 5" speaker in 0.64 $ft.^3$ by grafting a similar enclosure onto the rear and hooking up the 8Ω woofers in parallel. I have found that the +6dB efficiency increase is somewhat voided by the internal woofer position. This will also simplify front baffle imaging (*Fig. 3*).

To conclude, whether this loading system is preferable to the QB3 alignment in smaller volume is debatable. No doubt I haven't squeezed as much out of it as could be within the profession. Within their limits, these small woofers perform well (*Figs. 4* and *5*) but are no substitute for 10–15" woofers or subwoofers with a three-way or satellite system.

M. J. Thompson
St. Catherines, Ont., Canada

SOURCE

Meniscus
2442 2 St. SW
Wyoming, MI 49509
(616) 534-9121
FAX (616) 534-7676
drivers, caps, coils, threaded inserts

Sources for test equipment, MDF, foam gasket, silicon, bolts and screws, PVC tubing, and miscellaneous parts can all be found at local hardware stores.

PHOTO 4: Crossover placement on the 6½" speaker prior to final cementing.

REFERENCES

1. Weems, David B., *How to Design, Build, and Test Complete Speaker Systems*, Tab Books, Blue Ridge Summit, PA (out of print).
2. Mr. Weems' article of 4/85 was recently updated in "Another Look at the Double-Chamber Reflex" (*SB* 1/92, p. 18).

MENISCUS
Proudly supplies:

CAPACITORS -
- Polypropylene
- Mylar
- NP Elec.

INDUCTORS -
- Air Core
- Ferrite Bobbin
- 20 - 14ga. OFC

RESISTORS -
- Wire wound
- Non - Inductive 5 W - 25 W

ACCESSORIES -
- Terminal cups
- Gold posts
- Speaker cabinets
- Wire & connectors
- Grill cloth & fasteners
- Black screws
- Port tubes & trim
- Spikes & cones
- Damping materials
- Design books
- Much more!

MENISCUS - 2575 28th St. SW #2 - Wyoming, MI 49509
(616) 534-9121 FAX (616) 534-7676

SPEAKERS -
AUDIO CONCEPTS
CERA-TECH
DYNAUDIO
ECLIPSE
ENTREE'
ETON
EMINENCE
FOCAL
MB
MADISOUND
MAGNAT
MOREL
POLYDAX
PEERLESS
SCAN SPEAK
SWAN
VERSA/TRONICS
VIFA

Fast Reply #KG568

World Radio History

Craftsman's Corner

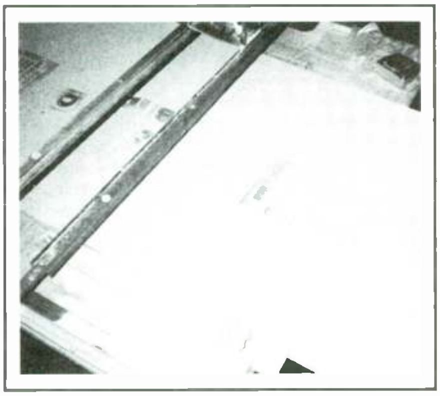


PHOTO 1: Crosscut guide for a portable saw, which will crosscut 36". Adjustable fence to 45° will cut long angles.

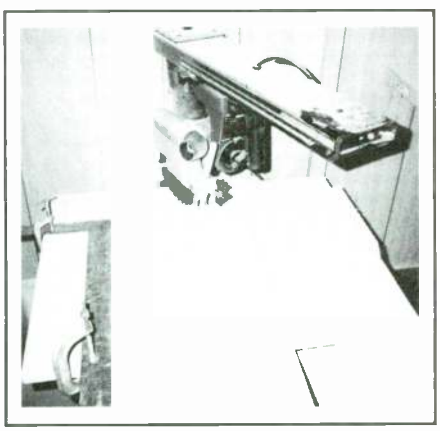


PHOTO 2: I used a square on the saw to cut angles.

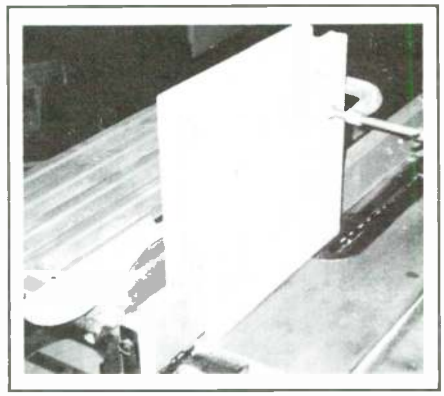


PHOTO 3: Jig on a table saw for cutting edge angles. The middle board is 1/16" thicker than rip fence. Clamp the board to the jig.

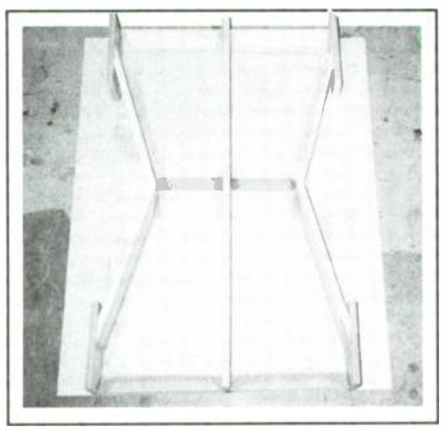


PHOTO 4: Layout of the front with reflectors. The sound path goes in both directions.

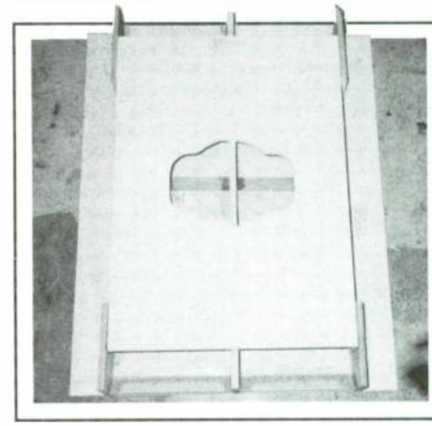


PHOTO 5: I used an odd-shaped cutout for differently shaped throats (8½" × 2½" = 21¼ in.^{2} mouth 530).

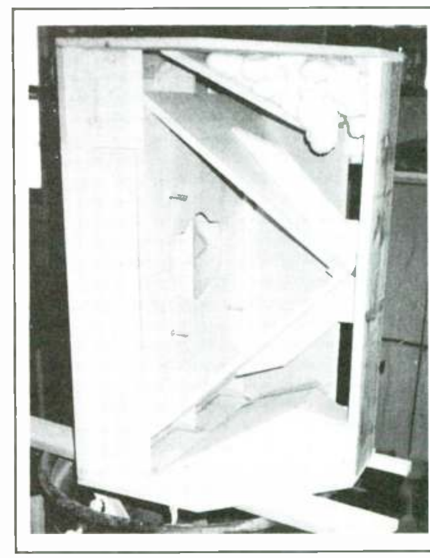


PHOTO 7: The top and bottom have been added, and flare reflectors are in place. I foamed all cavities not used in the sound path. Leave one side off, or the foam will break at give joints. After allowing to dry overnight, cut with a hack saw blade.

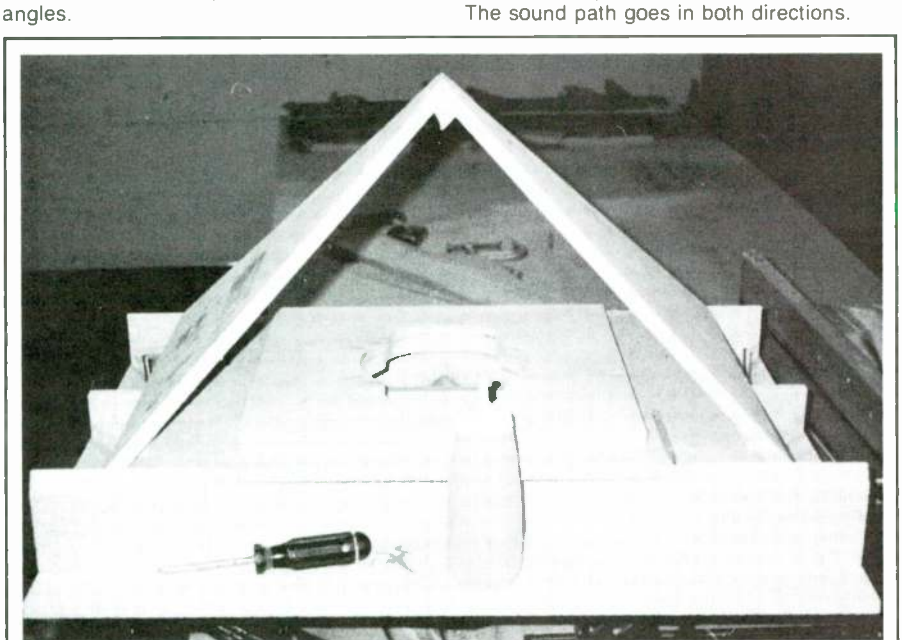


PHOTO 6: The tee-pee which forms back volume for woofer and horn flare.

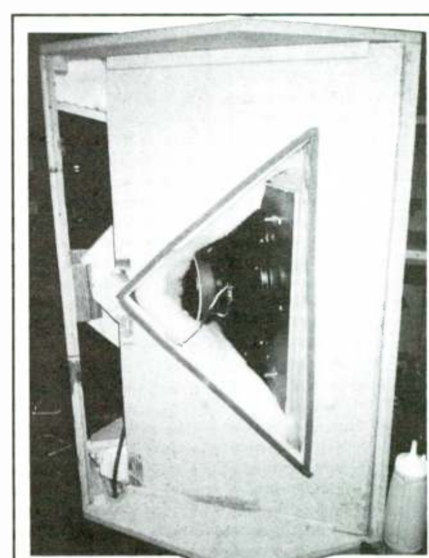


PHOTO 8: Final throat and driver are in place. Side is over foamed cavities; the speaker has been wired, and holes filled. The damping is 2" of Polyfoam tape around the excess hole.

Continued on page 44

World Radio History

CERATEC

MADE BY CERATEC-THIEL

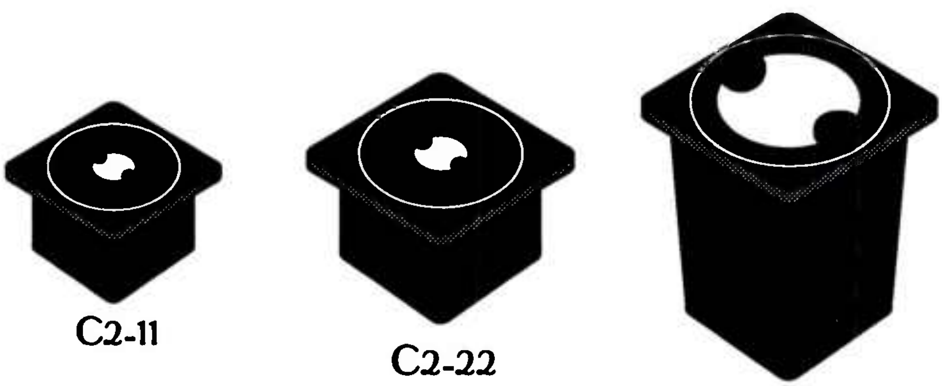
C² CONCAVE CERAMIC LOUDSPEAKERS GERMANY

Ceratec-Thiel, GmbH introduces its new tweeter, the C2-22

The C2-22 is a larger version of the very popular C2-11. The new features are a lower operating range (1500 Hz) and higher power handling capabilities. This tweeter is ideally suited for use in two way applications and is the best speaker we've heard in the 2k-18kHz regain (Flawless!).

Thiel is also introducing its new name, Ceratec, to the U.S. market . Ceratec will be replacing the original U.S. name, Accuton, in our catalog.

Model No.	Description	Price(Each)
C2-11	24 mm Inverted ceramic dome tweeter 88db; 3-25kHz; 8 ohm; 120 watts	$140.00
C2-22	28mm Inverted ceramic dome tweeter 88db; 1.5kHz; 8 ohm; 130 watts	$173.50
C2-77	90mm Inverted ceramic dome midrange 89db; 400-6kHz; 8 ohm; 180 watts	$209.00



C2-11 C2-22 C2-77

A&S speakers 3170 23rd Street; San Francisco, CA 94110
Telephone: (415) 641-4573 Fax : (415) 648-5306

Fast Reply #KG572

World Radio History

Hats Off to Horns

Continued from page 42

It seems as though horns have been neglected in recent years. To help keep the tradition alive, I built my own, and will describe the process pictorially here.

My horns use Pioneer 10-inch instrument drivers #A25 GC40-51F-Q, FS30 V_{AS} 5.8 ft.^{3}, Q_{TS} = 0.15, Q_{TT} = 0.16. The midrange consists of Polydax TX11.25 JSN in an Edgar midhorn, with ½″ spacers; the tweeter is a Speakerlab WA, or E.V. T35A; the crossover is second-order at 450Hz and 5.2kHz.

I wanted the bass to be compact: H = 30″, W = 23″, D = 17″. The total, with midhorn on top, is 40″.

Jim Eldridge
Frankfort, IL 60423

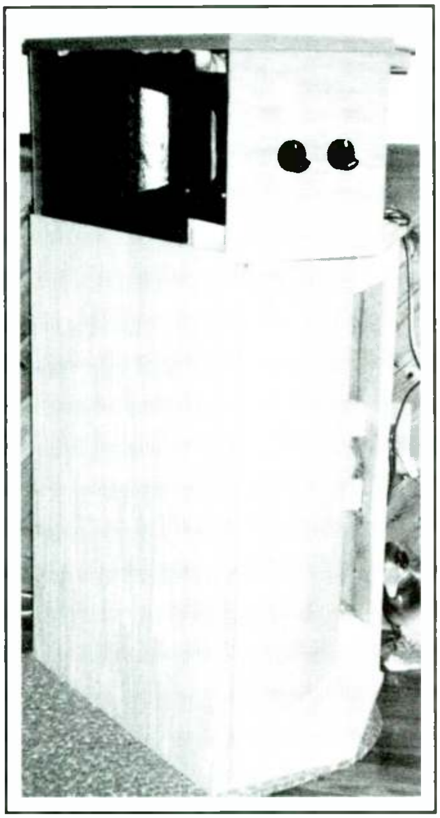


PHOTO 9: Midhorn and tweeter atop bass horn. The crossover sits on the top with L-pad on the side.

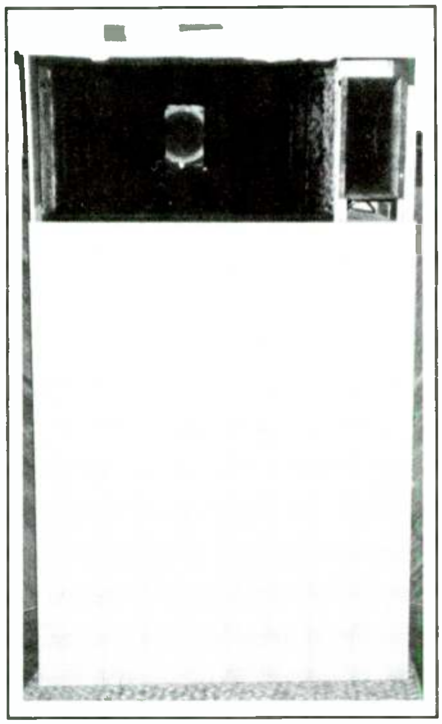


PHOTO 10: The finished product.

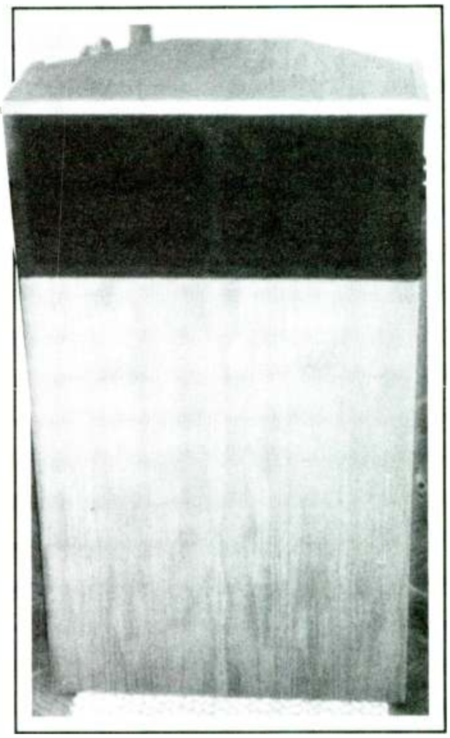


PHOTO 11: Finished horns with grilles in place. My horns are veneered in oak, with an oil finish.

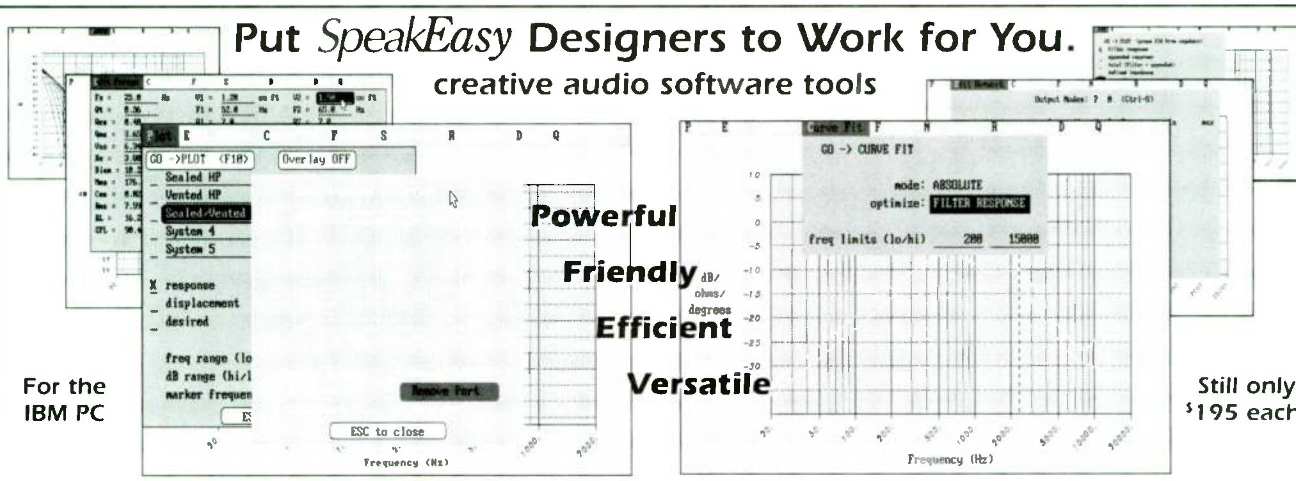
PREVIEW
Audio Amateur

Issue 4, 1992

- Pass Class A Power Amplifier, Part 1
- Antishock Turntable Cradle
- High Quality AM

Put *SpeakEasy* Designers to Work for You.

creative audio software tools



For the IBM PC

Still only $195 each.

LOW FREQUENCY DESIGNER 3.0
State of the art loudspeaker modeling.

FILTER DESIGNER 1.5
Flexible passive and active filter design.

CALL TODAY FOR A FREE DEMO DISK TEL: 617-969-1460 FAX: 617-969-5833
SpeakEasy 46 Cook St., Newton MA 01258 USA

Fast Reply #KG45

World Radio History

Audio Projects BBS

608/836-9473

US Robotics HST answering at

9600/2400/1200/300 Baud (MNP Class 5 also)

8 bit,no parity, 1 stop bit

Madisound Speaker Components
Box 44283 (8608 University Green)
Madison, WI 53744-4283
Voice: 608-831-3433
Fax: 608-831-3771

The Audio Projects BBS, a computer bulletin board run under the auspices of Madisound Speaker Components, is approaching its fourth year of existence. We are very proud of the growth it has shown and would like to share this with you. Since it is the only board supporting audio enthusiasts, we thought that you might enjoy a partial listing of our files which are available for downloading. We welcome new users and the service is free.

Audio Projects BBS Partial System Catalog from the Audio Directory

#1REC90C.ZIP	12k	10/16/90	Top #1 records from 1938 to present
2WAYSYS.ZIP	53k	7/21/88	speaker system cad
2WAYXOVR.ZIP	3k	10/02/89	2 way passive x-over design pgm.
3WAYXOVR.ZIP	3k	10/02/89	3 way passive x-over design program
555TIMER.ZIP	4k	6/05/90	BASIC FILE TO DESIGN A 555 TIMER AS AN OSCILLATOR
70VOLT	10k	8/31/85	info on running 70 volt systems
A10PATCH.EXE	56k	3/22/92	Patch for Sierra A10 ver 1.5
ACOUSTIC.ZIP	15k	4/25/88	Lotus acoustical worksheet-GOOD
ACT2DEMO.ZIP	39k	7/05/88	2way active xover program by gary galo-demo ver
ACTCROSS.BAS	4k	6/27/88	msdos,basic program-3rdord Butterworth filter
ADISPICE.ZIP	341k	9/16/91	Pspice models for Analog Devices (including PMI)
AFILTER.EXE	37k	7/12/89	self extracting active filter design
ALPHA.ZIP	56k	1/20/87	Crossover Design Program Suite Alpha Electronics
ANTENNA.ZIP	37k	6/11/87	Antenna Design & Analysis MS DOS
APCGA.ZIP	165k	2/12/87	Audio Precision's Demo CGA version
APDOC.ZIP	20k	2/19/87	documentation for AUDIO PRECISION DEMO
AUDIO.ZIP	58k	1/01/80	Data Base system for your records collection
AUDIOD.LZH	39k	4/16/92	stereo digitizer design
AUDIOF10.ZIP	194k	4/03/90	Catalogs your C.D.'s & Tapes etc...
AUDIOLAB.ZIP	24k	6/20/86	another system calculation program
AV10.ZIP	42k	3/17/92	Automatic Volume for box volume inc sphere&cyl
BEAM.ZIP	26k	6/03/91	calculate lengths for beam antenna
BODE10.ZIP	86k	10/06/87	do BODE plots on Herc,CGA,EGA
BOUNDARY.ZIP	26k	10/15/91	Roy Allison's Speaker Placement Program (lotus wk1
BOUNDRY.ZIP	41k	3/04/90	Speaker placement program
BOXDZINE.BAS	11k	12/11/85	[No Description Available]
BOXES	2k	2/06/86	[No Description Available]
BOXLOSS.BAS	3k	9/08/87	BASIC program to calc. ported box losses
BOXPLT14.ZIP	57k	9/13/91	Loudspeaker Enclosure design, Sealed, Vented
CABINETS.ZIP	92k	12/08/86	put together your own speaker cabinets
CBS_CD.ZIP	79k	10/25/87	CBS CD catalog
CCALC.EXE	53k	10/05/87	AUDIO- RPN calculator for msdos
CC_LINE.ZIP	2k	4/15/90	Measurements of 831709 220 mm woofer (Peerless)
CE-AMP.ZIP	28k	3/07/87	DESIGN COMMON EMITR XSTR AMPS - No Docs ! sorry
CE-AMP2.ZIP	43k	5/08/87	Improved Xsistr Amp Design Prog with docs, -bugs
CEILING3.ZIP	56k	10/24/89	Distributed Spkr Layout with graphics
CIRCUIT.ZIP	507k	12/07/91	ELECTRONIC WORKBENCH/CKT.DESIGN+ANALYZE
CLASS-A.TXT	3k	2/16/88	text on class A and class B amps
CLOCK.BAS	1k	1/09/86	[No Description Available]
COIL.ZIP	2k	10/04/88	Radio-Electronics Nov.88 inductor program
CONTENTS	2k	6/05/86	a discription of the files inside JBL.ARC
CRBULEAP.ZIP	2k	10/06/91	speaker parameters, Carbonneau spkrs for LEAP V3.x
DACUPGRD.TXT	6k	6/07/89	Availability note on better 16bit DAC + filtr
DC2DRAW.ZIP	17k	7/31/89	Designcad (Prodesign II) speaker drawings
DIFF.ZIP	62k	5/04/89	PR/QR design aid for IBM w/ or w/o 8087 DIFFUSION
ECD.ZIP	27k	9/02/88	ELECTRONIC CIRCUIT DESIGNER SHAREWARE (BASIC)
ELECT2.ZIP	46k	9/11/87	electrical calculations toolbox
ELECTRC5.ZIP	65k	9/21/89	Electrical wiring calculations
EVFR.ZIP	8k	6/30/87	Electro-Voice FR System Data Files for CADP
EVHP2.ZIP	33k	4/28/87	Electro-Voice HP Horn Data Files for CADP
EVHR.ZIP	21k	12/10/84	Electro-Voice HR Horn Data Files for CADP
EVLEAP.ZIP	2k	10/06/91	Speaker parameters for E-V spkrs for LEAP V3.x
EVTL.ZIP	15k	7/08/87	Electro-Voice TL Bass Box Data Files for CADP
FFT26.ZIP	81k	9/18/90	FFT source code in C (Discrete Fourier Transform)
FILTBOX.ZIP	4k	9/21/89	Simple vented box and xover design tools
FILTCAD.ZIP	146k	6/21/91	filtercad, design your own....
FILTER.EXE	226k	9/16/89	active filter v2.01 major update
FILTER.LZH	224k	6/16/90	Build electronic Hi/Low-pass filters
FILTER.ZIP	26k	12/30/86	MS/DOS Active filter design w/shematics
FLTD10.ZIP	135k	8/08/91	Filter Designer Demo from Speakeasy
GAUSLEAP.ZIP	2k	10/06/91	speaker parameters, Gauss spkrs for LEAP V3.x
HELM201.ZIP	22k	7/23/86	calculate helmholtz resonator dimensions
HELMHZ.ZIP	9k	9/22/89	spreadsheet helmholtz reasonator calculator w/doc
HIFIBUZZ.BAS	3k	8/05/85	AUDIO- generates random hi fi buzzword combination
HORN.ZIP	11k	4/25/90	Horn enclosure design
ICBOOK.ZIP	38k	9/01/88	ELECTRONIC SYMBOLS
J&TLEAP.ZIP	3k	10/06/91	speaker parameters, JBL & TAD spkrs for LEAP V3.x
JBL.ZIP	102k	6/06/86	compressed file containing all files in CONTENTS
JBLSTUFF.ZIP	118k	5/21/92	jbl specs and spkr tips brief hist.
JBLSYSTM.BAS	2k	2/06/86	[No Description Available]
KNEWBOX.LBR	51k	12/28/86	NEWBOX re-written for KAYPRO with epson printer
L-PAD.LZH	2k	11/11/91	AMIGA l-pad calculator
LEAPDEM2.ZIP	168k	4/03/88	NEW VER L'SPK DESIGN PRGM. MATH COPROC. NOT RE'QD.
LEDV0_5.ZIP	41k	4/12/92	Loudspeaker Enclosure Designer, v0.5
LEDV0_5A.ZIP	69k	5/10/92	Loudspeaker Enclosure Designer v0.5 update/fix
LEDV0_5B.ZIP	70k	5/21/92	Loudspeaker Enclosure Designer v0.5B. Minor update
LFD201.ZIP	134k	8/08/91	Low Frequency Designer from SpeakEasy
LFDEMO.DOC	6k	12/14/90	Demo Documentation for LFDEMO program
LISTBOX.BAS	4k	8/19/85	[No Description Available]
LISTROOM.ZIP	66k	4/12/92	Opitmal listening room arragement calculator
LNAP.ZIP	161k	9/22/90	Linear Circuit Analysis Program Menu Driven
LOGSIM.ZIP	38k	2/01/87	digital ttl circuit simulation MS DOS
LOTUSBOX.wks	16k	8/13/86	Boxresponse in Lotus with graphing functions.
LOUD30.ZIP	76k	11/29/91	Speaker design software w/ PowerBASIC source code
LOUDSP21.ZIP	52k	11/26/88	Ver 2.10 of loudsp enclosure program- lots new!
LOUDSPKR.ZIP	32k	10/24/88	design aid for ported or closed box system
LPAD.ZIP	16k	6/01/87	X-over attenuator design - color
LSDP.ZIP	8k	11/21/87	LOUDSPEAKER DESIGN SOURCE CODE IN C. UNIVERSAL
LTC_PS10.ZIP	350k	12/15/89	LTC's PSPICE uploaded by Walt Jung
LTC_READ.COM	4k	12/21/89	Info on LTC_PS10.zip
MASS&BOX.ZIP	413k	4/28/92	Compiled KLH box response program
MF10.ZIP	27k	3/23/87	[No Description Available]
MLSSA.AD	1k	1/24/88	advert for nice audio test program and card
MLSSA.ZIP	247k	12/07/89	Working demo of MLSSA audio analysis package
MOTDSCV2.EXE	289k	4/20/90	Database for Motorola Discretes Ver.2
MOT_ICV1.EXE	192k	4/20/90	Database for Motorola I.C.'s Ver. 1
MPAPERS.ZIP	81k	9/10/86	Mike Piede's mods to Peter Schuck xover opt.
NCLOSURE	6k	2/06/86	[No Description Available]
NETWORK2.ZIP	87k	12/11/91	Small SPICE type network analyzer
NEWBOX.BAS	20k	2/06/86	graphic program from JBL people for box response
NEWLTSBX.ZIP	7k	10/12/89	CORRECTIUON TO LOTUSBOX
NEWSPEAK.ZIP	46k	11/02/89	UPDATED SPEAKER.ZIP FROM AUTHOR - MS/DOS.
NEWXOVER.ZIP	65k	5/29/89	Flexible shareware passive xover program
NOTCH1.ZIP	2k	10/02/89	Simple notch filter design program
NUTMEGAT.ZIP	120k	12/08/87	updated Graphic postprocessor for SPICE AT w/87,CG
NUT_XT.ZIP	122k	1/03/88	updated XT version of NUTMEG graphic postprocessor
OHMS.ZIP	27k	12/29/86	MS DOS - OHMS LAW CALCS & OTHEELECT FORMULAE
PADS	3k	11/07/85	[No Description Available]
PAPERS.BAS	21k	8/13/86	Peter Shuck's network opt. prgm. needs input rtn.
PAPERS.ZIP	30k	4/30/86	Peter Schuck's network optimizer w/8087 exe
PAPERS1A.ZIP	30k	9/09/86	corrections made to Schuck's net.opt. program
PARSE.ZIP	37k	11/27/87	MS DOS SPICE3a7 rawfile post-processor
PARSE11.ZIP	40k	11/30/87	MS-DOS update of PARSE.ARC
PCAPS	2k	10/08/85	[No Description Available]
PCB.ZIP	93k	4/10/89	Printed Circuit Board design prgm
PCROUTE2.ZIP	103k	4/17/90	Circuit board layout program
PERF450.ZIP	215k	12/26/89	Updated 12/89 version of PerfectBox Warren Merkel
PERFGRAF.ZIP	1k	1/02/88	EGA prtsc Util, Warren Merkel
PLL.ZIP	139k	10/24/89	Phase Locked Loop circuit design program
PLOTFUNC.BAS	2k	10/05/87	[No Description Available]
PMISPECS.ZIP	98k	4/22/89	Precision Monolithics databook for your PC
POLK-MM.ZIP	3k	10/12/91	Polk Mobile Monitor parameters for LEAP v3.xx
POLYBOX.ZIP	40k	3/11/86	Polydax| Audax basic program to choose drivers
PORTNOTE	3k	12/02/85	[No Description Available]
PORTS	4k	10/24/85	[No Description Available]
PRO-RESP.ZIP	36k	2/05/88	Speaker response program with source code
PSPICE2.ZIP	148k	12/30/86	part 2 of circuit program DEMO VERSION
PSPICE3.ZIP	62k	9/04/86	part 3 of 3 circuit program DEMO VERSION
PSPICE4.ZIP	300k	7/18/88	Update to school version of SPICE
PSPICTUT.ZIP	6k	8/18/87	Simple Turorial for passive networks w/ PSPICE
PVLEAP.ZIP	2k	10/06/91	speaker parameters, Peavy spkrs for LEAP V3.x
PYLELEAP.ZIP	3k	7/27/91	Pyle speaker parameters for LEAP V 3.x
PYLESPEC.TXT	8k	12/24/86	param. for specific pyle speakers
R-LDSPKR.ZIP	101k	2/13/91	loudspeaker design & room placement programs
RA71491.ZIP	36k	7/15/91	rec.audio to jul 14 91- lots of dsp/sampln BS
RCFILTER.BAS	2k	8/05/85	[No Description Available]
REDROSE.ZIP	38k	1/29/88	strange digitized music/vocal
SCHEM.ZIP	23k	12/23/87	Schematic Master util
SCHEMA2A.ZIP	148k	5/13/90	89' Update of Schematic CAD Demo EGA/VGA
SD-LMP.ZIP	221k	11/13/91	Design:Box, X-over, Bandpass (pkunzip -d to unarc)
SONGBS20.ZIP	49k	4/29/90	SongBase database for music collectors
SOUNDLAB.LZH	53k	11/08/91	Spectrogram and Audioscope for AMIGA
SOUNDZ22.ZIP	261k	4/12/92	Catalog your LP's, CD's and Cassettes.
SOUNSYS.ZIP	53k	8/07/85	Basic Sound System (PA) aids (ala Davis SSE text)
SPEAKER.ZIP	45k	4/16/89	AN EGA DEMO CREATED WITH A NEW ANIMATION TOOL.
SPEAKER1.ZIP	53k	1/17/91	Graphic Demo/ad for a speaker system
SPEAKERC.ZIP	42k	11/20/89	IBM CLONE ALIGNMENT PROGRAM CGA
SPEAKERH.ZIP	42k	11/20/89	IBM CLONE ALIGNMENT PROGRAM herc.
SPEAKERS.LZH	27k	4/16/92	Dissidents Speaker design demo for Amiga
SPEAKR10.ZIP	69k	10/06/91	Steve Platt's Thiel-Small alignments (port tune)
SPECSECS.ZIP	179k	11/10/87	motorola power transistor database
SPICEAT.ZIP	158k	12/08/87	updated SPICE full version for AT w/nn87
SPICEDOC.ZIP	29k	3/01/87	Berkeley SPICE3A.7 User's Guide
SPICEXT.ZIP	86k	1/03/88	updated XT version of SPICE
SPKAMI1B.LZH	57k	7/15/91	AMIGA speaker box design software
SPKRDESN.WKS	9k	5/08/91	works/lotus spkr design spreadsht - for novice.
SPKTOOL.ZOO	58k	6/13/91	AMIGA!! speaker design! At Last!!
SPREV.ZIP	23k	8/21/90	stereophile review index
SSPICE10.ZIP	90k	5/01/91	Symbolic Spice circuit analysis
STNDRDS	15k	10/08/85	[No Description Available]
SUBWOOFE.ZIP	2k	10/27/89	Subwoofer design based on Aug. 1978, Audio.
SYMSPKR.ZIP	2k	11/01/89	Lotus Symmetrical load S=.7 spreadsheet
T-S_WK1.ZIP	18k	3/06/92	Theil/Small Lotus Worksheet from KLH
TAPEMKR.ZIP	54k	6/11/90	Cassette labels and database
TCXOVER.ZIP	33k	6/02/90	Terry Cejka's xover program
TDCA.ZIP	47k	9/13/91	digital circuit analyzer
TLINE.ZIP	156k	11/19/86	MSDOS Transmission Line Driver program
TRANS.ZIP	33k	7/02/87	class a transistor amplifier modeling MS DOS
TRANSMAN.ZIP	179k	10/31/87	MOTOROLA TRANSISTOR XFER MANUAL
TRANSMOD.ZIP	36k	12/30/88	Transistor program
TVSAT.ZIP	13k	3/15/87	TVRO pointer
VARI.BAS	5k	7/21/88	calculate Variovents
VARIO.BAS	4k	10/12/88	compute variovent boxes
VBOXRES.BAS	4k	8/19/85	[No Description Available]
VTH.BAS	2k	7/12/87	Op amp parameter calc. (audio) ms-dos
XOVER	7k	4/08/86	[No Description Available]
XOVRTOLS.ZIP	6k	10/02/89	Various Pgms. to design passive x-overs
XYFIT.ZIP	124k	5/28/90	Program to fit curves to data

Fast Reply #KG1059

World Radio History

SB Mailbox

ONE MORE TIME

(In SB 2/91, the wrong letter from Matthew Honnert was published with Vaughn Estrick's reply. This is the correct exchange.—Ed.)

While implementing the changes to my Swan electronic crossover per Mr. Estrick's article ("Second-Order L-R Crossover for the Swan IV," *SB* 1/91, p. 34), I found what is likely to be a problem for many experimenters. My primary satellite amplifier (GAS Son) has a full complementary differential input that is also decoupled at both ends. No resistors are used that might reveal its input resistance. My backup amp, a Pass A-40, uses a "bootstrapped" configuration, but again, no input resistors.

My crossover was already a classic equal-value L-R design, so I found it easiest to simply delete one RC pole to convert it to the slopesas described in the article. This yields a buffered input to my amplifier with a known input resistance of my choice. Purists may not like another active device in the signal path, yet modern op amps are very good and essentially transparent at unity gain.

A simplified version of my circuit is shown in *Fig. 1*. You may add level controls to the outputs, but remember to invert the polarity of the satellite relative to the woofer.

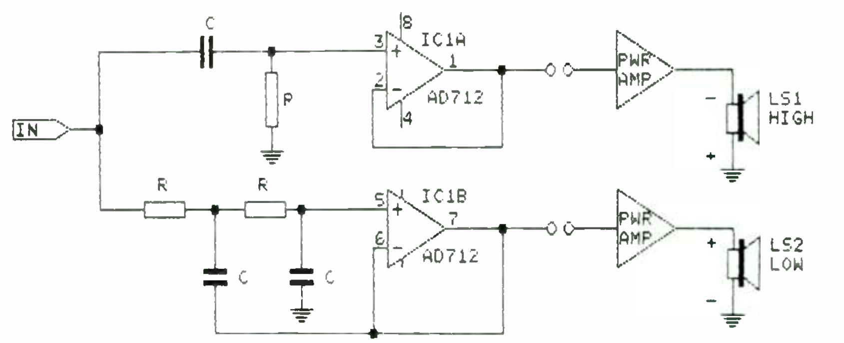


FIGURE 1: Simplified version of the Swan crossover circuit.

Matthew Honnert
Carol Stream, IL 60188

Vaughn Estrick replies:

I am not familiar with the GAS Son amplifier, but I'm certain its input impedance can be determined either analytically or experimentally. The same holds true for the Pass A-40 (*TAA* 4/78, p. 4) even though it uses a form of negative feedback to increase the input impedance. *Figure 2* is a simplified schematic of the Pass A-40 amplifier. For the region near the 200Hz crossover frequency, you can assume C2 is a short circuit and so can assume the input impedance is purely resistive and is given approximately by the following equation:

$$Z_{IN} = R_1 + R_2 (1 + R_3/R_4)$$

For the values shown, this gives an input resistance of 45k and the required value of the series capacitor C_{XO} is 0.0177μF to obtain a −3dB response at 200Hz.

You can also determine the input impedance using the test setup in *Fig. 3*. A series resistor is inserted between a 200Hz signal source and the amplifier input as shown. Measure the AC voltage to ground at V1 and V2. The input impedance can be calculated using the following formula:

$$Z_{IN} = V_2 \times R_S / (V_1 - V_2)$$

As long as Z_{IN} is resistive, this procedure should give a good estimate. The measurement can be repeated at 100 and 400Hz to verify that the input impedance remains constant over the frequencies near those of the crossover.

If you think this is too much trouble, you can use the buffer amplifier suggested by Mr. Honnert.

By the way, the formula on page 35 of my article in *SB* 1/91 should read:

$$C = (2\pi \times 200 \times R_{IN})$$

Vaughn H. Estrick
Fullerton, CA 92635

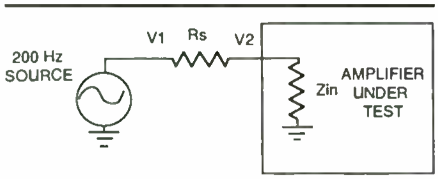


FIGURE 2: Simplified schematic of the Pass A-40. R_{IN} is approximately 45k.

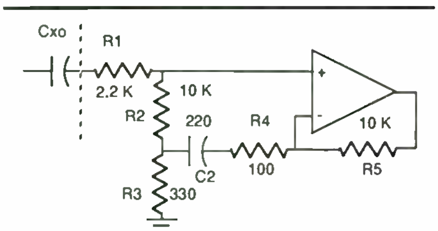


FIGURE 3: Setup to determine Z_{IN} experimentally.

Glad you asked that! Good Idea!

You really have some great ideas, so why not share them with your fellow readers? We love to receive typed letters (or even better, a word processor file or output) including clearly written comments and questions. Not everyone's penmanship is easily discernible—please don't make us guess.

If you are responding to a previously published letter or article, please identify it by author; it helps us research and get the answers or comments you seek. In addition, please include your full name and address on your letter in case we need to contact you (and your envelope goes south).

Direct your comments, questions, and concerns to *Speaker Builder*, PO Box 494, Peterborough, NH 03458-0494.

One more thing . . . a SASE always puts your letter on the top of the pile.

DAMPING FACTOR DIALOG

I read with interest Gary Galo's article "Bi-Amping the Sapphire II Sub-1 System" (*SB* 3/92, p. 24). I agree with him on the desirability of using bi-amplification, but there is a part of the article called "Damping Factor Reviewed" which is misleading: ". . . If the loudspeaker is con-

Continued on page 48

World Radio History

ACI Sound that Satisfies...™

The Sapphire IIs and Sub 1s are the top of the ACI line of fine loudspeakers sold factory direct in kit form or assembled and backed by a money back guarantee. Here are a few comments from owners and reviewers.

"It fills a genuine need by providing deep, clean bass in small and medium-sized rooms at a ridiculously low price in a very compact package." Editor Peter Aczel writing about the Sub 1s in the Winter 1991-92 issue of The Audio Critic.

David Rich, reporting in the 1991 Spring-Summer edition of The Audio Critic said, *"In summary, this is an excellent speaker when used in conjunction with a good subwoofer... After eight years, I decided to sell the Spicas and purchase the Sapphire IIs."*

"The Sapphire II/Sub I system has become my new reference loudspeaker, and I plan to purchase the review samples. They have given me months of musical satisfaction, and I'm looking forward to many more." Contributing editor Gary Galo Speaker Builder, Issue Three, 1991.

"I have owned Magneplaners, Dahlquist and DCM. The Sapphire IIs were the best yet!... and then they broke in! Mark G., Portage, MI

"Performance is the best I have ever heard from a direct radiator speaker system. Very realistic sound quality." Ronald J., Hampton,VA

"Quality, Accuracy of sound fantastic imaging, sound similar to best electrostatics I've heard. Getting me to give these speakers up would be impossible. My brother has B&W 800s driven by Krell 300 watt amps. I am in no way dissatisfied listening to my system nor am I broke." Ray P., Highlands, NJ

"I can listen for a long time and not get tired of listening or feel moved to turn the volume down. Voices are very natural...The soundstage is very spacious - wide, deep and stable; localization of voices and instruments is excellent. I didn't think I'd be satisfied after listening to the Magnepans (which are very spacious) for several years but I am." Ken C., Morristown, NJ

"Deep, wide soundstage with height; accurate tonal balance; excellent treble, mid, bass balance, coherence. The music, not the speakers, draw the listener in." Chris H., Madison, WI

"Superb soundstage, precise palpable images, neutral tonal balance, amazing dynamics, very revealing (great detail) without being overly analytical, beautiful finish, easy to assemble! Love the placement flexibility of the satellite/subwoofer arrangement-best of all possible worlds. These are the finest speakers I've owned and I've owned some very sophisticated/expensive competitors: (Snell A's, Celestion SL600's, Accoustat 2+2s etc.) Don't change a thing!" Neil W., Elgin, IL.

"Reality: At low listening levels I was at the original recording session. Speaker Builder *magazine reviewer Gary Galo's description of these speakers is right on the mark-This is one system the adjectives used are not advertising hype. Thanks for providing more than I've ever heard in* any *speaker system, reality!"* Rich P., Las Vegas, NV

"Incredible depth and imaging-solid bass foundation, very musical." Robert F., Davis, CA

"Transparent, detailed sound; easy to listen to. Gives a sense of always hearing timbres right and in a natural space. What goes in is what comes out!" Jon A., Silver Springs, MD

"Excellent bass, soundstage very musical and transparent. Excellent product, superior to other speakers three times the price." William R., Oshawa, Ont. Canada

"Rarely do you find all *the things said about a speaker (or anything) to be true but there's no hype here. They're exactly as stated. The strongest things are probably the resolution of detail and the incredible extension and ease of the highs. In a "speaker showdown" the Sapphire II's won by consensus. They made the music sound alive. Not bad considering they were the least expensive."* Larry N., Scotts Valley, CA

"Depth, separation clarity, uncolored . I sold a pair of Martin Logan CLS = $2500 for them...Imaging, soundstage, definition palpable presence, lively, smooth!" William B., Staten Island, NY

"The performance vs. the cost is outstanding. Not only are the Sub Is worth double their cost, they have greatly improved my Spica TC50's performance." Tony W., Tucson, AZ

"Finally, after searching for 12 years I found a good sounding reasonably priced speaker." Dieter Z., Milledgeville, GA

For catalog, call toll-free
1-800-346-9183
Questions? call (608) 784-4570
Fax (608) 784-6367

ACI
901 S. 4th St.
La Crosse, WI 54601

All Rights Reserved
Audio Concepts, Inc. 1992

World Radio History

Continued from page 46
nected to a high source impedance, the cone will make a great deal of extraneous motion. If the source impedance is low, the loudspeaker motion will more closely mirror the signal from the amplifier, with minimal extraneous movement."

This is true, but the implications are wrong. Consider the loudspeaker voice coil resistance in series with the source impedance. This resistance is over several ohms; it makes no significant improvement to lower the source impedance below an ohm or so. From an engineering viewpoint, there is only a minute (inaudible) difference between the extraneous motion of a loudspeaker connected to an amplifier with a damping factor of 200.

I also disagree with him on fuses. Actually, speaker fuses are much worse than he describes them because they add series resistance which can vary appreciably depending on the current in the fuse; this leads to distortion. I have measured 2% total harmonic distortion (THD) due to the fuse shortly before it blew; it is so much easier and cheaper to replace a fuse compared to a speaker. The answer is to place the speaker fuse inside the amplifier's negative feedback loop, thus reducing the effects of the fuse series resistance and distortion. Some manufacturers have done so.

Dick Crawford
Los Altos, CA 94024

Contributing Editor Gary Galo comments:

Mr. Crawford raises an interesting question: whether the loudspeaker impedance is in series with the amplifier source Z or in parallel with it. This, in turn, raises the question of whether or not the voice coil's DC resistance must be added to the source impedance when computing damping factor. A search through various reference books raises some contradictions, adding to the confusion.

The second edition of Howard Tremaine's *The Audio Cyclopedia* (Howard W. Sams, 1969, p. 1,120), is in agreement with Mr. Crawford. He gives the following formula for calculating damping factor:

$$DF = \frac{Z_{LS}}{Z_{OUT} + R_{VC}}$$

where Z_{LS} is the loudspeaker impedance, Z_{OUT} is the amplifier's output impedance, and R_{VC} is the voice coil resistance. Using this formula, Tremaine shows that even an amplifier with a 0Ω source impedance would have a true damping factor of 1.33Ω, given an 8Ω loudspeaker with a DC resistance of 6Ω.

However, Howard W. Sams' more recent *Handbook for Sound Engineers—The New Audio Cyclopedia*, first edition (Sams, 1987), offers an explanation like my own. On page 1,043, in the chapter "Sound System Design," author Chris Forman states: "The *damping factor* of a power amplifier is a number found by dividing its load impedance (the loudspeakers') by the actual output impedance of the amplifier, which will be very low for a modern solid-state power amplifier. An amplifier with a high damping factor can exert a greater control over the motions of a loudspeaker cone than an amplifier with a low damping factor. Thus, a high damping factor may improve the sound quality of a system (this subject is one of continuous debate, however)."

Mr. Forman is certainly correct on his last point. The rest of his statement, however, isn't consistent with Tremaine's explanation.

In the second edition of *The Audio Dictionary* (University of Washington Press, 1991, p. 85), Glenn D. White also offers an explanation similar to mine: "There is a common misconception that the impedance of the voice coil of the speaker also must be added to the amplifier output impedance when calculating the effect of the damping factor, but this is not true."

White also contradicts Tremaine. Also note that White mentions adding the voice coil's *impedance* to the amplifier source Z, rather than the voice coil's DC *resistance*. If Mr. Tremaine's explanations are valid, this distinction is important, since it is possible for a loudspeaker in an enclosure to have an impedance lower than the voice coil's DC resistance.

On page 6.81 of his *Audio Engineering Handbook* (McGraw Hill, 1988), K. Blair Benson offers a similar explanation: "The output impedance is sometimes expressed as the *damping factor* of the amplifier, defined as the ratio of the nominal load re-

Continued on page 50

Peerless

12" CC-LINE WOOFER

831857

The Peerless 831857 is the latest development in the CC line. It is a 12" woofer with an extra heavy magnet with very good linearity combined with a very long voice coil.

The most important features of the 831857 are:
- New 45 oz. magnet.
- 26 mm long 4 layer voice coil.
- Distortion killing short circuiting ring.
- New and improved rubber surround.

The short circuiting ring in the magnet system reduces distortion while the new rubber surround improves the restoring force linearity over a longer stroke. This results in a (sub)woofer capable of moving a large amount of air.

The 831857 has a rather high Q maintained over a long stroke which makes it very suitable for both closed boxes and reflex systems of 60-100 liters. If extra deep bass is required it can also be used in larger reflex boxes. Furthermore the 831857 is recommended for applications in car audio systems.

Peerless of America, Inc.
800 W. Central Road, Mt. Prospect, IL 60056
Phone: 708-394-9678 FAX: 708-394-5952

Fast Reply #KG666

World Radio History

NEW AIRBORNE SPEAKER DRIVER UNITS

AIRBORNE SPEAKER DRIVER WILL CARRY YOU ON THE

WINGS OF MUSIC

Airborne isn't merely a new car speaker driver unit, it's exclusivity, it's a star borne of many years of evolving design philosophy.

Over the years, we have gained some prestige and a reputation for technical innovation and leadership via our manufacturing of high-end inductors, capacitors and distribution of exotic european speaker driver units.

The Airborne car speaker driver units represent a complete departure from other conventional car speaker. The goal that we set for ourself for the creation of the Airborne car speaker driver units included a high level of research and development, advanced technology to enhance the performance and a high level of craftsmanship to increase product value.

With the expensive european speaker driver units as a model, maximum bass become a major goal in our pursuit of higher levels of performance. The path to maximum bass led to driver units designed with Thiele-Small parameters optimized for bass reflex alignments.

The high quality features are achieved by using aluminium voice coil former, high temperature voice coil wire, vented magnet system, polypropylene cone, poly dust cap and coated foam surround. The delicate balance of all of those features really lend credence to the term «speaker».

Until now, you had no choice but to pay the price or do without the top-ranking car speaker driver units. Not anymore. Airborne offerts you for the first time all those outstanding features and high levels of performance at down to earth affordable price while being made in Canada using american and canadian parts.

Airborne is destined to position Solen as a credible producer of exotic driver units. Out of the box, it can't hope to have a status, image or prestige of well-entrenched manufacturers such as Redline, Blue Thunder, Punch and Kicker. That takes time. But judged purely on its merits, it can hold its own and then some with any of these legendary marques.

Airborne will carry you on the wings of music.

AIRBORNE

SOLEN INC.
4470 Ave Thibault
St-Hubert, QC J3Y 7T9
Canada

Tél.: (514) 656-2759
Fax: (514) 443-4949

AIRBORNE Loudspeaker Driver Unit — **PRELIMINARY DATA**

20WP38/4 — **20 cm WOOFER MIDRANGE**

Features

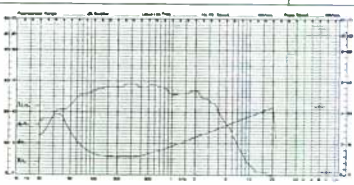
- Aluminium Voice Coil Former
- Vented Magnet System
- Polypropylene Cone
- Poly Dust Cap
- Coated Foam Surround
- Optimized for Vented Box

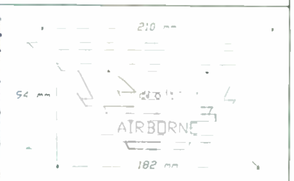
Parameters

Nominal Impedance		4 Ohms
Nominal Power		80 Watt
Music Power		120 Watt
Frequency Range		30-3.0 KHz
Sensitivity	1W/1m	89 dB
Magnet Weight	20 oz	566 g
Moving Mass		25.0 g
Effective Cone Area		212 cm2
Voice Coil Diameter		38 mm
Voice Coil Lenght		16 mm
Air Gap Height		6 mm
Voice Coil Resistance		3.3 Ohms
Voice Coil Inductance		62 mH
Free Air Resonance		30 Hz
Vas		67.8 ltr
Qts		0.32
Qms		2.95
Qes		0.36

Impedance Compensation

Resistor	3.3 Ohms
Capacitor	51 mfd





Recommended Vented Box Size

Type	Box Vol	Fb/Fc	F3	Peak	Vent Dia	Vent Lenght
B4	32 ltr	39 Hz	40 Hz	0 dB	5.0 cm	8.8 cm
SBB4	30 ltr	30 Hz	47 Hz	0 dB	5.0 cm	18.9 cm
SC4	28 ltr	33 Hz	45 Hz	0 dB	5.0 cm	16.1 cm
QB3	28 ltr	37 Hz	43 Hz	0 dB	5.0 cm	12.3 cm

AIRBORNE Loudspeaker Driver Unit — **PRELIMINARY DATA**

25WP38/4 — **25 cm WOOFER**

Features

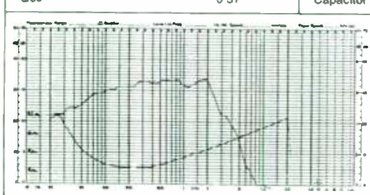
- Aluminium Voice Coil Former
- Vented Magnet System
- Polypropylene Cone
- Poly Dust Cap
- Coated Foam Surround
- Optimized for Vented Box

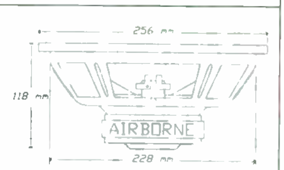
Parameters

Nominal Impedance		4 Ohms
Nominal Power		100 Watt
Music Power		150 Watt
Frequency Range		25-2.5 KHz
Sensitivity	1W/1m	91 dB
Magnet Weight	28 oz	792 g
Moving Mass		34.0 g
Effective Cone Area		344 cm2
Voice Coil Diameter		38 mm
Voice Coil Lenght		16 mm
Air Gap Height		6 mm
Voice Coil Resistance		3.3 Ohms
Voice Coil Inductance		62 mH
Free Air Resonance		26 Hz
Vas		176 ltr
Qts		0.32
Qms		2.54
Qes		0.37

Impedance Compensation

Resistor	3.3 Ohms
Capacitor	51 mfd





Recommended Vented Box Size

Type	Box Vol	Fb/Fc	F3	Peak	Vent Dia	Vent Lenght
B4	85 ltr	33 Hz	35 Hz	0 dB	7.5 cm	9.2 cm
SBB4	80 ltr	27 Hz	41 Hz	0 dB	7.5 cm	18.1 cm
SC4	75 ltr	30 Hz	39 Hz	0 dB	7.5 cm	15.0 cm
QB3	76 ltr	33 Hz	38 Hz	0 dB	7.5 cm	11.4 cm

AIRBORNE Loudspeaker Driver Unit — **PRELIMINARY DATA**

30WP50/4 — **30 cm WOOFER**

Features

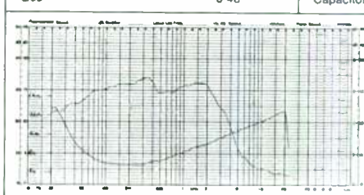
- Aluminium Voice Coil Former
- Vented Magnet System
- Polypropylene Cone
- Poly Dust Cap
- Coated Foam Surround
- Optimized for Vented Box

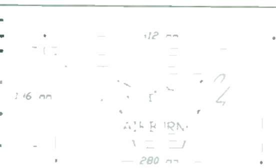
Parameters

Nominal Impedance		4 Ohms
Nominal Power		120 Watt
Music Power		180 Watt
Frequency Range		20-2.0 KHz
Sensitivity	1W/1m	93 dB
Magnet Weight	40 oz	1132 g
Moving Mass		56.0 g
Effective Cone Area		494 cm2
Voice Coil Diameter		50 mm
Voice Coil Lenght		20 mm
Air Gap Height		8 mm
Voice Coil Resistance		3.3 Ohms
Voice Coil Inductance		62 mH
Free Air Resonance		22 Hz
Vas		232 ltr
Qts		0.33
Qms		3.46
Qes		0.46

Impedance Compensation

Resistor	3.3 Ohms
Capacitor	51 mfd





Recommended Vented Box Size

Type	Box Vol	Fb/Fc	F3	Peak	Vent Dia	Vent Lenght
B4	120 ltr	27 Hz	28 Hz	0 dB	10 cm	20.4 cm
SBB4	111 ltr	22 Hz	33 Hz	0 dB	10 cm	37.8 cm
SC4	105 ltr	24 Hz	32 Hz	0 dB	10 cm	31.5 cm
QB3	107 ltr	27 Hz	30 Hz	0 dB	10 cm	24.9 cm

Fast Reply #KG1469

World Radio History

Continued from page 48
sistance to the amplifier internal output impedance. The value of output impedance also includes any impedances connected between the output wiring terminals and the actual output and ground nodes of the circuit." By implication, the last sentence should be expanded to include the impedance of the wiring between the output terminals and the loudspeaker.

There isn't a wealth of material on this subject, but of the sources I've cited, only one, Tremaine, is in agreement with Mr. Crawford. Why would Tremaine, the oldest of these sources, offer an explanation which contradicts the more recent sources?

The answer may lie in the types of amplifiers used by the various authors. Tremaine's book was written in the vacuum tube era. Both series and parallel relationships can exist between the loudspeaker impedance and the amplifier source impedance, and the exact nature of the relationship will depend on the design of the particular amplifier, including the feedback circuit, as well as the phase angle of the reactive load driven by the amplifier. This relationship can be quite different with vacuum tube amplifiers than with solid state types.

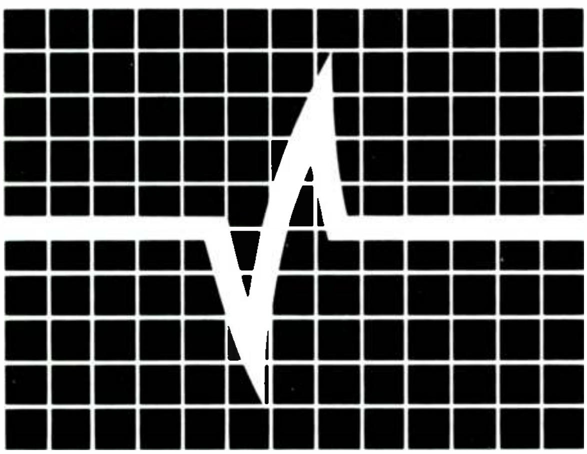
I thought it would be worthwhile to get an amplifier manufacturer's opinion on this subject, so I phoned C. Victor Campos, Director of Product Development at NAD. Previously, Victor held the same title at Adcom, where he oversaw the development of their entire current power amplifier line.

When I asked Victor about damping factor specifications, he said he determines damping factor by dividing 8Ω by the amplifier source impedance. To the best of his knowledge, every other amplifier manufacturer does it the same way, operating under the assumption that the loudspeaker is an 8Ω resistive load in parallel with the amplifier source impedance. A precise model for damping factor can only be found by considering a *specific* amplifier topology and a *specific* loudspeaker. Since this is impractical if not impossible, amplifier manufacturers choose an approximation.

Of course, the effect of fuse resistance on damping factor will be no different from the effect of the loudspeaker cable, and should be considered in the context of all of the above. Mr. Crawford raises an excellent point regarding measurable distortion in fuses, and I completely agree that fuses, if they are to be used at all, do the least damage if they are placed in the amplifier's feedback path.

There's a real need for amplifier and loudspeaker-specific discussions of damping factor. I hope this exchange will encourage Mr. Crawford and others to pursue the problem further. The sidebar in my article expands upon recent conventional definitions, and is consistent with the approximation used by nearly every power amp manufacturer.

The Perfect Pitch



A ONE YEAR SUBSCRIPTION TO HI-FI NEWS & RECORD REVIEW COSTS £24.80 FOR SURFACE MAIL AND £42.50 FOR AIR MAIL

. . . SUBSCRIBE TODAY!

Please send me 12 monthly issues of **Hi-Fi News & Record Review** commencing with the next available issue

☐ £ 34.00 ($58 US) Surface Mail
☐ £ 54.00 ($92 US) Air Mail

I enclose a cheque/International money order payable to Link House Magazines Ltd. or debit my credit card

☐ VISA ☐ ACCESS/MASTERCARD ☐ DINERS ☐ AMEX

Credit card no Expiry date

Signature

(Please print in block capitals)

Name

Address

(HF 02)

To **Hi-Fi News & Record Review**, Subscription Department
Link House Magazines Ltd
120-126 Lavender Avenue, Mitcham, Surrey CR4 3HP England

I understand that I am committed to one year's subscription and should I wish to cancel no refund will be made

Registered in England and Wales No 1341560

HI-FI NEWS & RECORD REVIEW

A LINK HOUSE PUBLICATION

JOB SEARCH

I have a keen interest in sound reproduction, and have, like many other readers, built my own speakers. While constructing them I learned a lot, but was enlightened by the fact that many intriguing aspects of sound reproduction were marginally beyond my present comprehension. For this reason I decided to return to college.

I am a mature student and due to my previous experience in engineering, I am entering the second year of a four-year sandwich degree course in Applied Physics at Portsmouth University in England.

Next year (academic year '93-94) I am required to find an industrial placement. If any readers—anywhere in the world—are or know anyone who is in a position to offer me a year's work in the audio reproduction industry, I would be grateful if they wrote to me for further correspondence.

Simon Pettman
91 Wirehill Dr., Lodge Park
Redditch, Worcs. B98 7LR England
Tel. 44 0527 29079

WHAT'S A KIT?

(Recently I asked Mike Dzurko to write a short note regarding his use of the terms "Speaker Kit" and "Speaker Project". He replied as follows.—Ed.)

Here at Audio Concepts, Inc. "projects" contain drivers, crossover parts (often in matched sets, assembly optional), damp-

World Radio History

ing materials and instructions. Projects are designed with the aid of computer modeling tools and have been prototyped, tested and refined.

Our "kits" generally boast longer and more detailed development. Kits are complete, containing assembled and tested crossovers. "Parts kits" do not include cabinets or grilles but are otherwise complete. "Full kits" also include completely assembled cabinets, grilles and all hardware needed.

To us, a kit should require no expertise to put together other than being able to follow written step-by-step instructions. Kits should contain everything necessary to complete the system. Of course a kit builder electing to build his or her own cabinet must possess the requisite woodworking skills.

Mike Dzurko
Audio Concepts, Inc.
La Crosse, WI 54601

SUPER DISTORTION

Your editorial on Horse and Buggy Sound (*SB*, 4/92, p. 8) is unfortunately very appropriate. In many cases, the situation is worsening instead of improving. The trend today is to build large "superstores," "megastores," or "warehouse" stores which are very large and have no finished ceilings. They acoustically resemble large gymnasiums, and their PA systems use re-entrant horn-type speakers. Horn speakers sound more horrendous than any cone speaker, and I frankly can't see why anyone in his or her right mind would play music through them.

Furthermore, most new or remodelled stores use the telephone system, instead of dedicated microphones, to make the paging announcements. These phone systems generally distort the voices much more than a directly connected dynamic microphone would. This is especially true if the phone and PA systems are not properly interconnected or if the level controls between them are misadjusted.

Dominick's Finer Foods opened an 85,000 square foot Omni Superstore in town, and its paging system is so badly clipped and distorted that announcements are almost unintelligible. The few times I've shopped at this place, I've worn earplugs. What radio reception is possible through the steel and concrete walls would be drowned out by radio frequency hash from the point-of-sale data processing system and other microcomputer-based equipment.

In another unrelated incident, a nearby 1969 vintage Jewel food store updated its paging system to a new Aiphone model which begins each paging announcement with a chime sound. I wrote this store manager a letter politely indicating my objections to this tone. Although it may have been turned down a few decibels, it still continues.

Michael Kiley
Crestwood, IL 60445

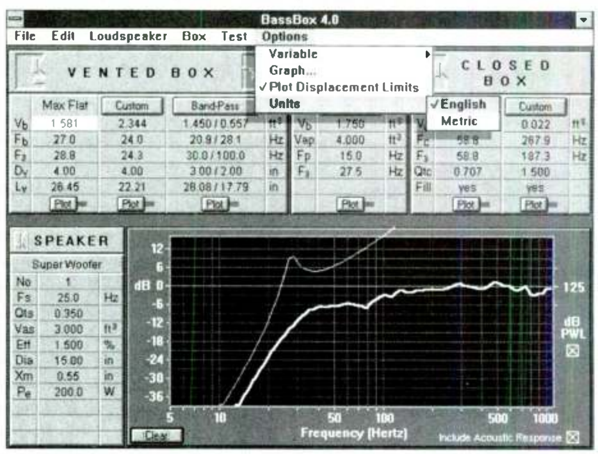
GASKET TIPS

I've finally followed my own suggestion and ordered a set of Norsorex speaker mounting gaskets made by Polydax and installed them on near-field monitors. Let me report the experiment's outcome.

First, I replaced the gaskets on only one speaker, and then set them up side-by-side and played a mono signal through them. I could switch between speakers using the balance control to listen for differences. The test CD was "French Opera Highlights" on Mercury Living Presence, 432 014-2, conducted by Paul Paray. By the first part of the third track, I had shut off the system and replaced the gaskets in the second speaker.

When installing the Norsorex gaskets, I used rubber grommet halves as resilient washers under the screw heads for both the woofers and the tweeters. I believe that sticking the gaskets onto the rear of speaker frames is the best technique.

BassBox™ 4.0 **for Microsoft® WINDOWS™**



IMPROVED!

The easiest-to-use loudspeaker enclosure design program is now easier to use and more flexible than ever!

As a Windows 3.1 application it uses hi-res color graphics and supports all video controllers, mice and printers supported by Windows.

BassBox is a fast, accurate computer program which helps you design loudspeaker enclosures. Enter just three speaker parameters (Fs, Qts, Vas) and in seconds you can compare several enclosure designs and overlay their response curves.

More Design Types:
Maximally Flat Vented box
Extended Bass Vented box
Custom Vented box
4th and 6th-order Bandpass Vented boxes
Passive Radiator box
Optimum Closed box
Custom Closed box
3 Multiple Woofer boxes

More Test Procedures:
Test and calculate speaker parameters*
Test and calculate passive radiator parameters*

More Design Options:
Small and large-signal analysis
Examine one speaker in several different boxes or...
Examine several different speakers in the same box
Manual override available for vented box tuning
Multiple ports
Box dimension calculator with 15 different volume shapes
Enter speaker amplitude (acoustic) response
Use English or metric units
Read BassBox 3.0 files
Save and recall designs

System Requirements:
MS-DOS 5.0, Microsoft Windows 3.1 and compatible computer (IBM® PC with a 386SX or better CPU) and mouse. 4 MBytes RAM recommended.

*Basic test equipment is required to use the built-in test procedures in BassBox (sine wave generator, frequency counter, power amplifier, 1 kohm resistor, voltmeter, ohmmeter, test box).

Copyright © 1992 by Harris Technologies. All rights reserved worldwide. BassBox is a trademark of Harris Technologies. Other trademarks are the property of their respective companies.

Order today
and receive a free Windows Passive Crossover Calculator!
(Available for a limited time only.)

$89.00 (US)
(upgrades $45.00)
plus $4.00 S&H.
Overseas orders add $12.00
Michigan residents please add sales tax.

MasterCard VISA

Telephone:
616-641-5924
Fax:
616-641-5738

Harris Technologies
P.O. Box 622
Edwardsburg, MI
49112-0622 USA

Harris Technologies reserves the right to make changes without prior notice.

World Radio History

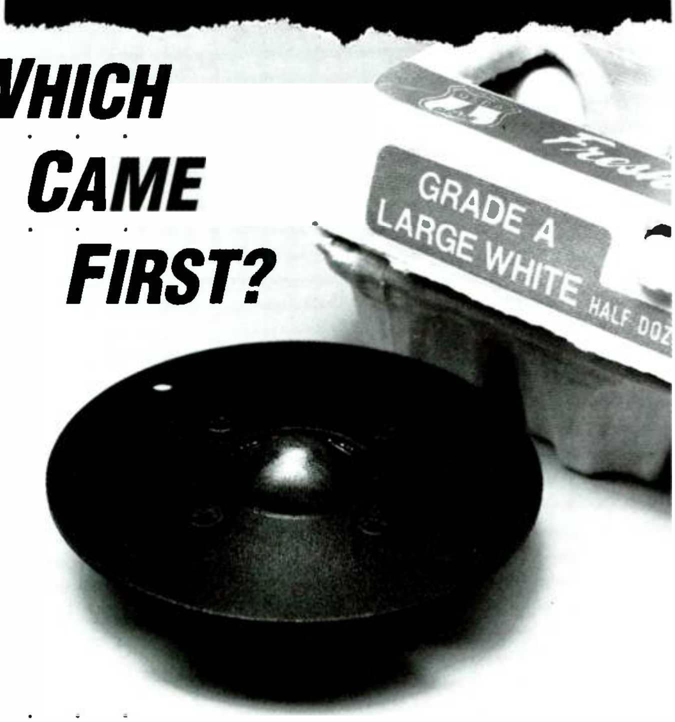
Before this change, instruments were slightly muddy in the midrange and slightly lumpy in the bass. Now the bass is well integrated, separate instruments stand out cleanly, and the image is more precise. Evidently these gaskets absorb speaker frame resonances much better than the foam plastic draft blocking tape I used before. I had been frustrated by a generally smooth response, with added small resonances that were difficult to pin down by ear, since music did not excite them continually. But now the smooth response is clean and neutral, and the tonal and harmonic structures of the different instruments stand out as intended.

I made A/B comparisons of the monitors against the Vortex screens and the Rogers LS3/5As. At the time, the screens were slightly more neutral, and the Rogers had a cleaner upper midrange. Now I must make A/B comparisons of the near-field monitors again to test their improved sound; I believe they will sound much closer to the screens. The LS3/5As have no bass, a warm midrange, and slightly prominent treble, which is fine for monitor speakers in a van. I did not aim for this sound in my own design.

In summary, I recommend the Norsorex speaker mounting gaskets for the drivers in my near-field monitor design. Polydax makes a gasket specifically for the tweeter, and their generic size for American 6½" woofers fits the Peerless TP165R woofer-midrange. You won't be disappointed.

Victor Staggs
Orange, CA 92669

WHICH CAME FIRST?



In our case the egg came later. Working to improve the quality of our soft dome tweeters, it became apparent to us that Mother Nature had done her homework when she created the egg.

The maximum strength of an egg shell is found at the pointed tip. This shape, which is defined as a catenary, or in French as a chainette, was applied to the dome profile on our new TWO25A tweeter. By optimizing the stiffness of the diaphragm, our engineers ensured that the dome will act like a perfect piston at all frequencies, with no out-of-phase breakup at the tip.

Improving on the standard of quality we set with our one inch soft dome tweeter 15 years ago was no easy task. If you ask us whether it's possible to build a better tweeter than our new TWO25A, we could only respond that we are not counting our tweeters before they hatch.

You simply cannot find a tweeter with lower distortion, smoother frequency response and better sound quality.

polydax
SPEAKER CORPORATION
10 Upton Drive
Wilmington, MA 01887

Available now at your local distributor...

Fast Reply #KG1112

C-15W ASSISTANCE

I have just read James Annal's letter to the editor in *Speaker Builder* 4/92 (p. 72), in which he requests information on the University CW15 woofer. If he is actually referring to the 15" model C-15W dual impedance woofer then I may be able to help. I purchased two of these woofers in 1969 to use in a critically damped three-way design in an infinite-baffle enclosure. I designed a passive equalizer to extend the low frequency response to 30Hz. The woofers were intended for my new house, which was under construction at the time.

I measured the woofer parameters in both impedance configurations. University stated in their literature that the parallel voice coil configuration was "4-8Ω use" and the series configuration was for "10-20Ω use." Remember that these were the days of tube amplifiers which were not good at driving a low impedance load. The University literature provided almost none of the technical specifications I needed, so I wrote to them asking for the free-air resonance F_O, the DC resistance of the voice coil R_E, the electromechanical force factor BL, the mechanical compliance of the suspension C_{MS}, and the effective radiating radius of the diaphragm R_D. Their reply was surprising: "The information requested in your recent letter to our technical service department is considered to be proprietary design information, and, as such, cannot be released."

I had no choice but to make the measurements myself. A colleague and I followed the instructions in Beranek's acoustics book and measured these and other parameters so that I could predict the performances of my enclosures. I installed these woofers using the series configuration (to avoid the low parallel R_E) and they performed quite nicely.

Here are my results. I believe my measurements are accurate to about 5% except for the Q_M, which is about 10%. The values of Q_L and V_{AS} were not measured directly but were derived from the other related parameters. The variation between the two woofers is typical of production variances.

In theory, Q_E and Q_M should be independent of the impedance configura-

World Radio History

tion, but they weren't because the measured BL values didn't differ by exactly a factor of two. Refer to p. 133 of the fourth edition of Dickason's book for the equations relating these parameters. I have noticed the discrepancy occasionally in other measurements of dual-impedance woofers as well. The measurements were made carefully, so I accept them as valid even though I don't have a good explanation. For design purposes, I suggest that the results in the following table be averaged.

Thiele/Small/Beranek Parameters for C-15W Woofers

	Woofer 1		Woofer 2	
	10–20Ω	4–8Ω	10–20Ω	4–8Ω
F_O (Hz)	58	58	62.5	62.5
R_E (Ω)	5.52	1.38	6.7	1.67
BL (W/M)	17.5	7.13	19.6	8
Q_E	0.23	0.34	0.16	0.25
Q_M	3.4	5.3	*	*
C_{MS} (mm/Nt)	0.22	0.22	0.27	0.27
V_{AS} (ltrs.)	232	232	286	268
L (mH)	0.26	*	*	*
R_D (M)	0.17	0.17	0.17	0.17

* not measured

Joseph Janni
Albuquerque, NM 87122

(The books mentioned by Mr. Janni are Acoustics *by Leo Baranek [available from Old Colony Sound Lab as #BKAC1, $44.95 plus $3 S/H] and* The Loudspeaker Design Cookbook *by Vance Dickason [OCSL, #BKAA2, $29.95 plus $3 S/H].—Ed.)*

James M. Annal replies:

Since my retirement in 3/90, I'm getting back into the hi-fi construction hobby again. I'm currently building pairs of ARIA 5Ti and ARIA 10 subs. Thanks to professionals like Joseph D'Appolito and Kimon Bellas who have provided both plans and schematics for hobbyists to build and enjoy. I'd appreciate a follow-up project, the electronic crossover for the ARIA 5/ARIA 10 combinations mentioned by Joe D'Appolito in *SB* 4/92, p. 70.

I appreciated Joseph Janni's prompt response to my request for performance specs on the University C-15W. This data will enable me to get this project on line.

Kudos to Marc Bacon for his "The Danielle" construction article (*SB* 4/92, p. 22; *SB* 5/92, p. 34). The listening room dimensions and geometry closely match those of my living room. Marc's detailing of the rationale behind the design enables craftsmen like me to learn while building quality audio projects. Hopefully Marc has received some Focal Kevlar mid-bass drivers and titanium tweeters for evaluation and experimentation.

The construction articles offered in *SB* make this hobby both interesting and affordable.

LMP EVOLUTION

The "Related Products" sidebar in Marc Bacon's excellent "The Danielle" article (*SB* 4/92, p. 22) listed the versions of my Loudspeaker Modelling Program (LMP) available through Old Colony Sound Lab.

If you should have a *TECHNICAL QUERY...*

about an article appearing in this magazine, write it clearly, leaving space for a reply and referencing the magazine, the article and the page about which you are inquiring. Enclose a self-addressed stamped envelope and send these to *Speaker Builder*, PO Box 494, Peterborough, NH 03458.

If it's warranted, we will forward your query to the author or a Contributing Editor for a prompt reply.

Help us by not calling in your question. We have neither the staff nor the time to respond to technical questions by phone.

BETTER OFF DEAD!

NO VIBRATIONS! NO AIR LEAKS! NO KIDDING!

Our Norsorex gaskets lead the battle to seal and isolate your loudspeaker components from the enclosure, putting vibrations and air leaks to rest for good.

Originally developed as a surround material for our highest quality loudspeakers, Norsorex is a super-damped (or dead) material. By mounting between the loudspeaker frame cabinet, the Norsorex gaskets completely decouple the loudspeaker from all vibrations and resonances of the cabinet, achieving pure sonic quality.

Isn't your system worth it? You don't have to take our word for it. Try one of our ***FREE*** "Dead As A Doornail" demonstration kits and see the difference Norsorex possesses.

Gaskets are available for all Polydax standard drive units. And we are now proud to introduce gaskets for various standard American size woofers (6 1/2", 8", 10", & 12").

DEAD SOUNDS PERFECT!

*For a **FREE** Test Kit Call or Write:*

polydax
SPEAKER CORPORATION
10 Upton Drive
Wilmington, MA 01887
Tel 508 658-0700
Fax 508 658-0703

Fast Reply #KG1445

World Radio History

I'd like to make a minor correction to this listing, and outline the evolution of this program.

LMP was introduced in a three-part series beginning in *SB* 1/87 ("An Introduction to Frequency Response and LMP, Part I," p. 18) to enable nontechnical users to correctly include driver characteristics in their crossover design. I originally wrote it in Microsoft BASIC, being careful to rely as little as possible on features only available in this dialect of BASIC. The interface was generic "question and answer," and the output graph was a program easily converted to run on different computers: Macintosh, PC-compatible, Apple II, Commodore 64 (by Steven Kruger), and VAX/VMS BASIC (by Jeff Reyer—send E-mail to the Internet address: gonzalez@clam.rutgers.edu for a shareware copy).

I modified the Macintosh (LMP2M3) and PC-compatible (LMP2B5) versions to produce high-resolution graphics output, though they retained the old-style user interface. The sidebar in Marc Bacon's article incorrectly listed these versions "w/out graphics." I later wrote a new souped up version for the Macintosh which includes the graphical user interface Macintosh users have come to expect (LMP3M36). Bill Fitzpatrick likewise rewrote the PC version to provide a graphical user interface (LMP3B5G).

Ralph Gonzalez
Wilmington, DE 19803

CLOSE COUPLING GAIN

Figure 1 shows a configuration of a vented compound woofer system where the vent terminates in the tunnel space between

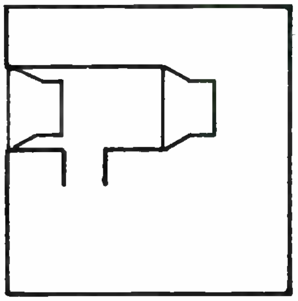


FIGURE 1: Configuration of a vented compound woofer system.

the woofers. I have found some efficiency is gained when the vent output is close coupled to the woofers.

Jim Walker
Los Angeles, CA 90022

MITEY METER MATE

I recently bought the D'Appolito Mitey Mike text microphone kit from Old Colony Sound Lab. While assembling it, I began to look for a voltmeter to accompany my microphone. Any meter used with the Mitey Mike must have a flat frequency response from 20Hz–20kHz. In addition, I needed to measure sound levels as low as 90dB SPL; given the Mitey Mike's sensitivity of 770mV at 120dB SPL, 90dB SPL equates to a microphone output of 25mV.

Most hand-held multimeters are meant to be used to measure AC power (60Hz and 400Hz), not communication signals. Generally they are flat from 20Hz–1kHz, which is inadequate for use with the Mitey Mike. Although you can buy wideband AC voltmeters, these units are designed for signals in the MHz region, which means they are expensive.

I paid $170 for Protek A-445 Digital/Analog Multimeter from Olive Electronics. It has a digital display and an analog needle indicator, it is advertised as flat from 20Hz–20kHz, has an AC voltage sensitivity of 1mV and a maximum of 750V, and reads true RMS.

OUR RECORDS ARE CHANGING

Dear Subscriber,

You will notice some changes in the way we communicate with you. Our subscription software has changed which will help us provide better service to you.

1. Your MAGIC number has now been changed to an account number. This will appear in the upper left hand corner of your labels, it starts with the letter A. You should have only ONE account number for all of your magazine subscriptions. If you have more than one, let us know.
2. Should you let your subscription expire, your renewal will start with the CURRENT issue, not the first issue of the year. The missed issues will be available for a price plus postage and handling. Please, renew when you get your notices if you don't want to miss issues!
3. Your renewal reminders will look quite different. Our photocopied postcards are gone and you will start getting some rather official looking invoices instead.

And though our software has changed, we have not. As always, we like to hear from you, favorable or otherwise.

World Radio History

My wife and I tested this unit to verify its frequency response, and we found it performed better than expected, being very accurate between 20Hz and 20kHz. We verified the voltage readings with a calibrated Hewlett-Packard 3400A RF voltmeter, and a calibrated Tektronix 500MHz oscilloscope. The results were as follows:

1. At 500mV, the Protek measured flat from 20Hz–50kHz, followed by a gradual rise to +3dB at 600kHz and a rapid rolloff above 600kHz. The true-RMS feature was verified with square and saw-tooth waves.

2. At 50mV, the unit was flat from 20Hz–20kHz, gradual drop to −1dB at 100kHz, −3dB at 300kHz, and a rapid rolloff above 300kHz.

3. At 10mV, the unit was flat from 20Hz–20kHz, with a gradual drop similar to the 50mV condition, except the rapid rolloff occurred at 100kHz.

The Protek A-445 is a lot of meter for the money. If you can't find a distributor in your area, contact the good people at Olive Electronics, 2555 Metro Blvd., Maryland Hts, MO 63043, (314) 997-7709.

James Bohn
Hazelwood, MO 63042

ADDING RESISTANCE

I am responding to G.R. Koonce's note in *SB* 3/92 (p. 73) in answer to Ray Montoro's questions.

First, when trying to make two different drivers sound the same by adding a series resistance, one must also take into account their different voice coil inductances. Changing just the series resistance alone will not make them sound the same.

I had this problem when I helped a friend rework a pair of Altec 604E monitors. One voice coil was wound with 10% too few turns, and the other with 10% too many, yielding a 20% difference. I designed a network for one driver to do three things:

a) make the driver Q_{TS} the same;

b) make the input DC resistance the same;

c) make the input voice coil inductances the same.

With this circuit the speakers had the same efficiency and loaded the crossover network the same. Later the owner replaced the original Altec crossovers with a pair of Mastering Lab crossovers and put the speakers into professional mixdown service. One track he engineered has appeared on a CD release and was singled out for best sound by a reviewer, so the Altecs seem to be working well.

Second, I have designed two full-size speaker systems with the fourth-order

SPEAKERWORKS

YOUR CURE FOR SPEAKER *HEADACHES!*

- FACTORY AUTHORIZED SERVICE: Advent, B•I•C, Cerwin Vega, EPI, Genesis, JBL, & RTR
- Polypropolene Cones For Reconers 8", 10", 12" & 15"
- Parts & Adhesives
- We Buy Blown Speakers
- Call Us For Hard To Find Parts
- WE RECONE, RESURROUND AND MANUFACTURE
- WE BUY, SELL AND TRADE MARANTZ, McINTOSH, Tube Equipment
- 25 Years Audio Experience
- Custom Grilles for B•I•C, JBL, Marantz, Altec, & Cerwin Vega From $29.95 Each

MasterCard 1-800-526-8879 VISA

4931 A-1 South Mingo • Tulsa, Oklahoma • 74146

PCBoards

PCB ARTWORK MADE EASY!

"Are you tired of laying down tape or wire wrapping to make printed circuit art? End the nightmare with the PCBoards Circuit Layout Program for just $99.00! Easily create single or double-sided circuit boards with professional results."

- Herc, CGA, EGA, VGA, & SuperVGA
- Use mouse and/or keyboard
- Built-in help screens
- Dip and Sip footprint libraries
- Build custom parts easily
- Copper flood for building ground planes
- Block move, copy, rotate, save, etc.
- Comes with dot-matrix & laser output
- Make your own films with 1x laser art
- Gerber and Excellon output available

Requirements: DOS 3.0 or later, 1 disk drive, 384k of RAM, IBM-PC or compatible

Download Demos from our 24hr BBS at (205) 933-2954

PCBoards Software Prices:

PCBoards Layout	99.00
Gerber and Excellon Drivers	49.00
Plotter Drivers	49.00
Demo Package (all software)	10.00

Add on Software:

PCRoute Autorouter	99.00
PCRoute+ Autorouter	149.00
SuperCAD Schematic	99.00
SuperCAD+ Schematic	199.00

Use PCBoards, PCRoute, and SuperCAD as a "system" to create pcb art from a schematic!

PCBoards - 2110 14th Avenue South, Birmingham, AL 35205 / Ph. (800)473-PCBS Fax (205)933-2954

Fast Reply #KG1361

World Radio History

Bessel alignment—one with a 12" woofer and another with a 10" woofer. The 10" woofer size is more practical, because the 12" size with the right Thiele/Small parameters is more efficient than most midrange and tweeter drivers.

So far, only the Telarc "Chiller" CD has caused the 10" woofer to bottom, and then only on the thunder and lightning track at high volumes. They remain very well loaded on all normal music. A friend's system with 15" JBL theater drivers does not bottom at all on the thunder track, and it is Bessel-aligned.

Adding large resistances in series with the voice coil affects more than the damping of the fundamental resonance. Diaphragm and frame resonances are also damped by the voice coil, and they will sound more prominent with an added external resistance under some circumstances. However, the presence of a divided network can also affect the damping of these unwanted higher frequency resonances.

I can only second your comment about weaning designers away from the ubiquitous Butterworth, Chebyshev, and QB3 alignments. There is a continuum of possible alignments that can be exploited to help control driver excursion and help account for the woofer's interaction with the room.

Victor Staggs
Orange, CA 92669

Contributing Editor G.R. Koonce responds:

I want to thank Victor Staggs for writing *Speaker Builder* to share his insights and experience. I am generally in agreement with the points he makes. We agree completely that adding large amounts of resistance in the woofer circuit is a bad thing, and he offers more insight into why this may be so.

If you add resistance to one driver of a pair to match its mate, you must worry about its effects on efficiency and the crossover design. I had understood the question posed by Ray Montoro to refer to adding resistance to both drivers in a pair, and had only raised the question of driver matching in my response because it represented some of my limited experience with adding resistance. I thank Victor Staggs for raising this point; it should have been addressed.

Generally I find that driver pairs are not sufficiently matched when designing the crossover; they can be treated as identical even when external resistance is not added. Two summers ago I built three pairs of the "same" three-way system with other individuals. While the woofers in the systems were matched units selected from 20 available drivers and the tweeters were matched for impedance, all six crossovers had slightly different values when the speakers were completed.

I have a problem with reference to matching the voice coil inductance. Voice coil inductance is a term I see regularly, but I am not clear on exactly what it means. All the woofers I have measured show an "inductance" that varies with frequency. My views on this topic are covered in "Crossovers for the Novice" (*SB* 5/90, p. 26). I believe in John Vanderkooy's "semi-inductance" concept and cringe every time a computer program asks me to enter the voice coil inductance.

Mr. Staggs and I also agree on encouraging people to move away from the "standard" alignments in the design of vented box systems. I was interested in his experience with the Bessel alignment, which I will try when I find the proper drivers. Certainly the "Alignment Jamming" concepts (*SB* 4/92, p. 14) increase the range of drivers that can be used with the Bessel alignment.

ARIA 5 CROSSOVERS

Some time ago I purchased a pair of ARIA 5s which came with T90k Kevlar tweeters. I've been very happy with their performance although, like other listeners, I noticed the tweeter was a little harsh-sounding on the top end. Having the op-

Continued on page 58

The TRAPEZ Xi

Complete Kits:

Natural Lacquered Beech Cabinet: $999 ea.

Unfinished NRFB Cabinet: $699 ea.

Trapez Xi Assembled: $2400 set

PBN SPEAKERS *For more info call:*

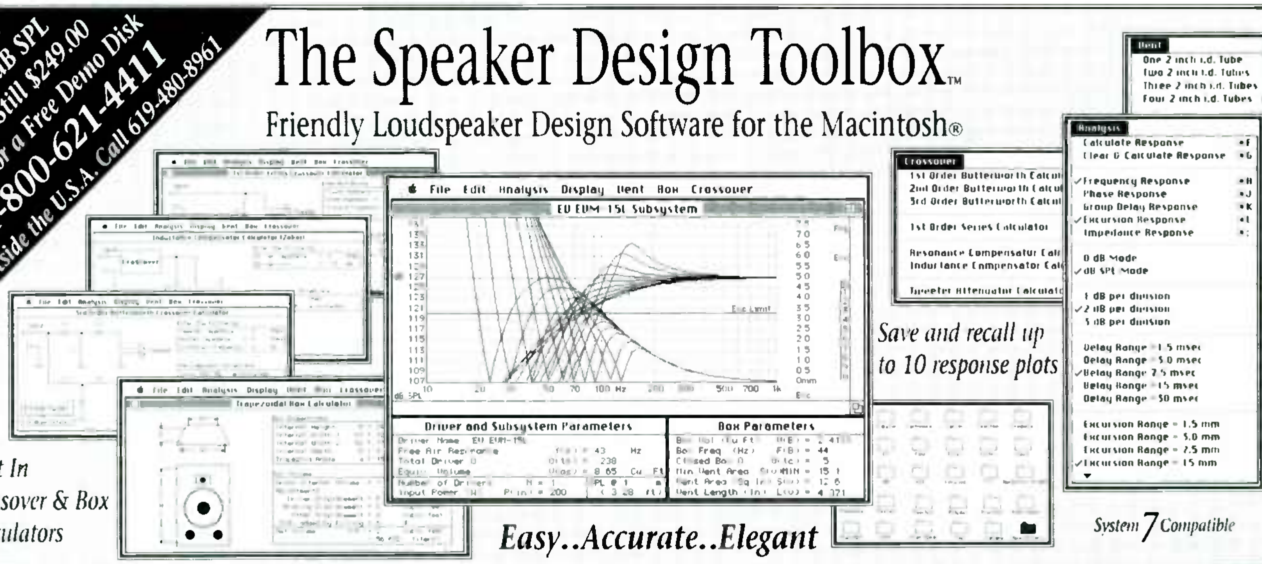
16619 Wikiup Road • Ramona, CA 92065
Tel: 619-789-8237 Fax: 619-789-3784

Fast Reply #KG1426

Now! with dB SPL v2.5 Still $249.00
Call for a Free Demo Disk
1-800-621-4411
Outside the U.S.A. Call 619-480-8961

The Speaker Design Toolbox™

Friendly Loudspeaker Design Software for the Macintosh®



Save and recall up to 10 response plots

Built In Crossover & Box Calculators

Easy..Accurate..Elegant

System 7 Compatible

MacSpeakerz™ from True Image Audio™ 349 West Felicita Avenue, Suite 122, Escondido, California 92025 U.S.A.

Fast Reply #KG544

World Radio History

SpeakerBuilder

BACK ISSUES

1981 A Testing Unit for Speaker Parameters • Variable-Volume Enclosure • Thiele/Small Theory (in 3 parts) • Easy to Make Enclosure Using Concrete Blocks • The Tractrix Horn: Good Dispersion Bass From an Old Design • Diffuser Port for Small Boxes • Mini-Speaker Made From PVC Tubes • Closed vs. Vented Box Efficiency • Interview with P.G.A.H. Voigt • Dual 8" Symmetrical Air Friction Enclosure • Thiele/Small Calculator Computations • Thiele/Small Parameters for Passive Radiators •

1982 Transmission Line Theory • Thiele/Small Sixth-Order Alignments • The Quad 63 • Table Saw Basics • AR-1 Modifications • Active Crossovers and Phase • Three Transmission Line Speakers • A Beginner's First Speaker • How Passive Networks Interact with Drivers • Horn Loaded Heil • Phase Correcting Active Crossover • Wind Your Own Inductors • Series and Parallel Networks • High Performance Corner Speaker • Using Zobels to Compensate for Driver Characteristics •

1983 Building the Two-Way Dynaudio • A Crossover That Offsets Speaker Impedance • Using a Calculator for Box Design • Choosing a Calculator • A Simple Peak Power Indicator • A Small Horn Speaker • Audio Pulse Generator • How to Use Speaker Pads and Level Controls • An Easy-to-Build Voltmeter for Speaker Measuring • Nomograms for Easy Design Calculations • Interview with KEF's Raymond Cooke • Build a Simple Wattmeter • A New Type of Speaker Driver •

1984 Build an Aligned Satellite/Woofer System • BOXRESPONSE: A Program to Calculate Thiele/Small Parameters • Casting with Resins • A Phase Meter • An Interview with Ted Jordan • Building the Jordan-5 System • Self-Powered Peak Power Indicator • Closed Box Design Trade-offs • How to Build Ribbon Tweeters • Build a Dual Measurement Impedance Meter • A High-Power Satellite Speaker System • Build and Use a White/Pink Generator • Sound Pressure Level Nomographs •

1985 Compact Transmission Line Subwoofer • Bullock Crossovers, Passive and Active, three parts • Drive Attenuator, Computer-Designed • Curved Vertical Array • Sontek Powered Subwoofer • An Isobarik System • Modifying Strathearn's Ribbon • Ambience Systems • Experimental Transmission Line • Small Double-Chamber Reflex • Loose Walled Speaker • Modifying the Daline •

1986 The Edgar Midrange Horn • Sand-Filled Stands • Crossover Networks: Passive and Active • 5-Sided Boxes • A 2×4 Transmission Line • The Free-Volume Subwoofer • Notch Filters • By-Wiring the LS3/5A • A Push-Pull Constant Pressure System • Current and Power in Crossover Components • The Unbox (Egg) • Upgrade Speakerlab's S-6 Crossover • Measure Speakers with Step Response • A Gold Ribbon System • A Visit with Ken Kantor • A Tractrix Horn Design Program • Reviews: Audio Concepts "G"; Seven T.L. Midranges; Focal's Model 280; the Audio Source RTA-ONE. •

1987 A Compact TL Woofer • Frequency Response and Loudspeaker Modeling (three parts) • A Manual Coil Winder • The Model-One Speaker • Designing a Listening Room • A Six-Order Vented Woofer • Tapered Pipe Experiments • Visiting Boston Acoustics • A Vented Compound System • The Octaline • Spreadsheets for Speaker Design • In Memoriam: Richard Heyser (two parts) • Using Non-Optimum Vented Boxes • Building Speaker Stands • Evaluating Driver Impedance Compensation • Tuning Bass-Reflex • Six Woofers Compared • Bullock on Passive Crossovers: Alternate Bandpass Types • Fast, Easy Filter Calculations • A Mobile Speaker • Modifying the Polk 10 •

1988 Electronic Turns Counter • Two-Way Design • Minimus-7 Mod • Dome/Midrange/Tweeter Array • Plotting Complex Impedances • A Driver Design Primer • A Cabinet Primer • Tuning Up Old Systems • Low-Cost AR-3 Upgrade • Electronic Time Delay • Enclosure Shapes and Volumes • Minimum-Phase Crossovers • Spot Sound Absorbers • How to Add a Subwoofer • The Swan IV System • Sub-Bass Power Boosting • The Unline: A Short TL • Active Filter Computer Design Program • Low-Cost Two-Way Ribbon • Amp-Speaker Interface Tester and Construction Plans • The QB_3 Vented Box is Best • A Pentagonal Box System • Keith Johnson Profile • Sheathed Conductor ESL • A Symmetrically Loaded System: Part I • Ceramic Enclosure • Inductance Measuring Technique • Polk 10 Mods •

1989 A Middle/Side Speaker • A Satellite/Woofer System • A T/S Driver Program • All About Cordless Drills • Symmetrically Loaded System, Part 2 • Adjusting Auditorium Acoustics • The Audio Laboratory Speaker System • A Passively Assisted Woofer • Digital Filter Tutorial • The Listening Arc Alignment • Small IC Power Amp & Crossover • Easy Surround Sound • Building Speaker Spikes • An Isobarik in a Thunderbird • Sheetrock Cabinetry • A Picket Speaker • Servo-Controlling AR-1 • Silent, Safe Muting System • Equalizing the Klipsch Cornwall • A Test Switcher • Visiting the Klipsch Kingdom • Rehab for Kitchen Music • Spreadsheet Design • A Subwoofer/Satellite System • Impedance Measurement as a Tool • Practical Passive Radiators • A Symmetrical Dual Transmission Line Parts 1 & 2 • The Microline • A Voice Coil Wheatstone Bridge • Tweeter Q Problems • A Dipole Subwoofer for the Quad • Adjusting Woofer Properties • Modifying Paradigm's 7se •

1990 Acceleration Feedback System • Cylindrical Symmetric Guitar TLs • Compact Integrated Electrostatic TL (Parts 1-3) • Minimus-7 Super Mod • The Show (Bass Horn) • A Small Two-Way System • Helmholtz Spreadsheet • Heresy Upon a (Klipsch) Heresy • Beer Budget Window Rattler • Contact Basics • MDT Mini-Monitor Speaker System • Titanium + TPX + Polypropylene = Fidelity • Tom Holman, Skywalker, and THX (Parts 1, 2) • Bud Box Enclosure • Klipschorn Throat Riddle • Modular Three-Way Active Speaker • CD Speaker System • SPEAKER DESIGNER Software • Symmetrical Isobarik • Novice Cross-vers • Triamplified Modular System • Magnetic Crosstalk in Passive Crossvers • Mitey Mike Loudspeaker Tester • Symmetrical Loading for Auto Subwoofers • Improved Vented Box with Low Q_{TS} Drivers • BOXMODEL Woofer System Design Software • Four Eight By Twos • Dynaco A-25 Mod • Klipschorn Throat Revisited •

1991 Student Systems • Developing Servo Subwoofers • Apartment TLs • L-R Crossover for the Swan IV • More Power for Less • Guidelines for Vented Box Construction • The Pipes • MacIntosh Programs for Speaker Design • Octaline Meets D'Appolito • Small Loudspeakers for a Small Room • Creating Grilles • Measuring Drivers with Radar • Deep Bass for GMC • PSpice LF Calculations • Pipe & Ribbon Odyssey • Delac S10 • Infrared Remote Volume Control • Back-Loaded Wall Horn • Integrite • Upgrading a Bronco's Sound System • Mod for Minimus 7s • Fibrous Tangle Effects on Acoustical TLs • DOALS Party Speaker • Loudspeaker Cable • Speaker-to-Ear Interface • Quasi Electronic Crossovers • Vented Box Sensitivity • TL Evaluation • Subwoofer/satellite system • Cable & Sound Delivery • Reviews: Little V • Precise Monitor 10 •

Please send me the following back issues of *Speaker Builder*:

☐ **1991 $25**	☐ **1987 $18**	☐ **1983 $15**
☐ **1990 $25**	☐ **1986 $18**	☐ **1982 $15**
☐ **1989 $23**	☐ **1985 $18**	☐ **1981 $15**
☐ **1988 $23**	☐ **1984 $15**	

Speaker Builder Magazine
PO Box 494, Dept. B92,
Peterborough, NH 03458-0494 (603) 924-9464 FAX: (603) 924-9467
Answering machine for credit card orders only–before 9:00 a.m., after 4:00 p.m. and weekends. Please have all information plus MC/VISA available.

SHIPPING: BACK ISSUES
UPS: Domestic ground service by value of order:
Less than $60.00—$4.00 $131.00–$220.00—$ 8.00
$61.00–$130.00 —$6.00 $221.00 + —$10.00
Canada: Add $6 per year.
Foreign Air:
Europe: 40% of total order.
Other destinations: 50% of total order.
Foreign Surface: 20% of total order.
Rates subject to change without notice.
All remittances must be in US $ only. ☐ MC ☐ VISA ☐ CK/MO

Total Magazines ________
Postage ________
Total enclosed $ ________

NAME ________ MAGIC NO ________
STREET & NO. ________
CITY ________ STATE ________ ZIP ________
MC/VISA ________ EXP ________

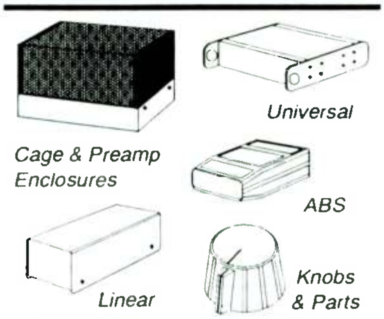
World Radio History

ELECTRONIC ENCLOSURES

Complete line in Aluminum, Steel & ABS; also Hardware, Silkscreening, Hand Tools, Custom Fabricating

Call for our FREE Full Color Catalog

(800) 800-3321 (216) 425-1228 Fax



Project Pro

1710 ENTERPRISE PKWY TWINSBURG OH 44087

Fast Reply #KG1406

MAHOGANY SOUND

ACOUSTA-STUF

THE VERY BEST DAMPING MATERIAL AVAILABLE FOR SPEAKER SYSTEMS. COST IS $ 8.00 PER POUND. CANADIAN RESIDENTS ADD $ 1.00 PER LB. FOR SHIPPING. WE ACCEPT CHECKS, MONEY ORDERS, AND C.O.D.'S BY PHONE.

" THE HATCHBACK "

8" 2 WAY VENTED AUTOSOUND SYSTEM

$ 450.00 COMPLETE KIT

SPEAKER KITS

WE NOW HAVE SIX SPEAKER SYSTEM KITS, INCLUDING TWO AUTOSOUND SYSTEMS. ALL KITS ARE COMPLETE WITH CABINETS, CROSSOVERS, AND ACOUSTA-STUF DAMPING MATERIAL. CALL OR WRITE FOR A FREE CATALOG.

MAHOGANY SOUND

2610 SCHILLINGERS RD. # 488
MOBILE, ALABAMA 36695
(205)-633-2054 AFTER 5 PM CST

Fast Reply #KG73

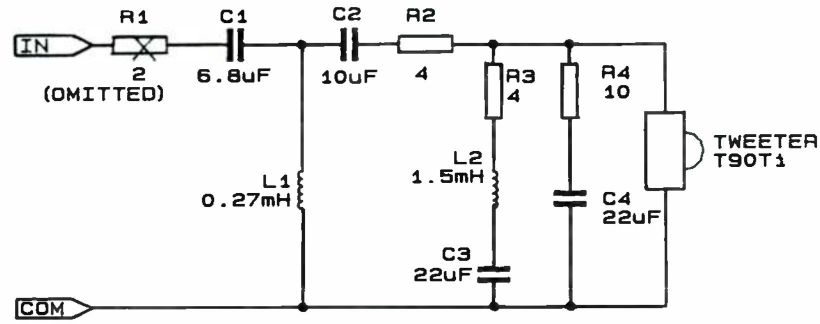


FIGURE 1: Circuit mod for the T90Ti.

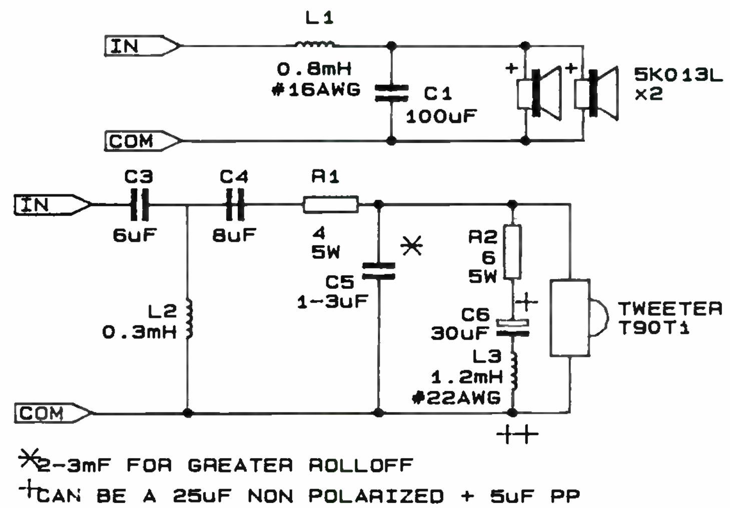


FIGURE 2: ARIA 5Ti crossover.

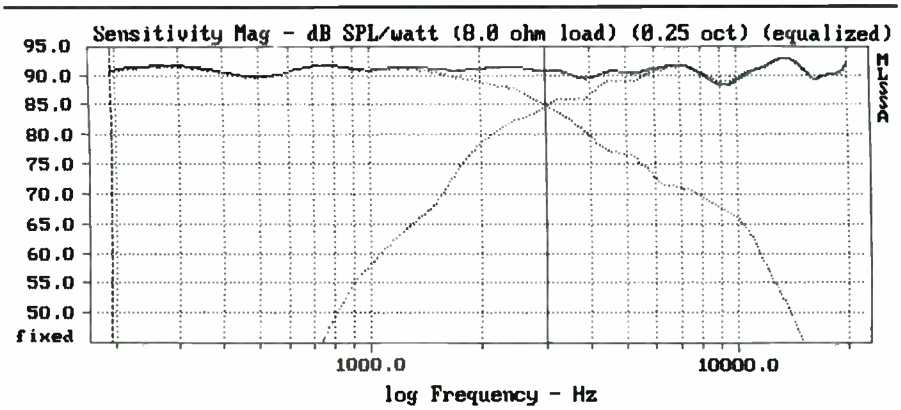


FIGURE 3: ARIA 5Ti response (solid). Woofers/tweeters (dotted).

Continued from page 56

portunity to try a pair of T90Ti titanium tweeters, I swapped out T90ks and, with crossover modifications recommended by Zalytron, gave them a listen. While there's no doubt that the T90Ti tweeters are smoother and more listenable, something is missing. The tweeters level seems more recessed and without as much air about the high end as I would like.

There was also a favorable quality in how the T90ks sounded in the midrange just above crossover frequency. I think the problem might be due to the crossover mods. I've double checked the wiring and everything looks correct. I omitted the 2Ω padding resistor, ahead of the series caps, which helped bring up the high end a little, but it's still not where I would like it. Please refer to *Fig. 1*, the circuit mod for the T90Ti. Could someone verify that this circuit is indeed correct and, if so, are there any further changes I can make to bring up the high end and improve the tweeter's otherwise excellent sonic characteristics?

David Delzotto
Seattle, WA 98155

Contributing Editor Joe D'Appolito replies:

The ARIA 5Ti is a complete redesign of the ARIA 5 using the new Focal T90Ti tweeter. See *Fig. 2* for the official crossover for this system, which I de-

Continued on page 60

World Radio History

THE WILLIAMSON AMPLIFIER

D.T.N. Williamson BKAA6

In April 1947, Williamson's power amplifier, using excellent-quality push/pull output tubes, a special output transformer, and a highly filtered power supply, became an overnight success. The author takes the reader deep into his design considerations, offering practical advice on how to build the units plus concise instructions on setting up the new amp. A cult classic.

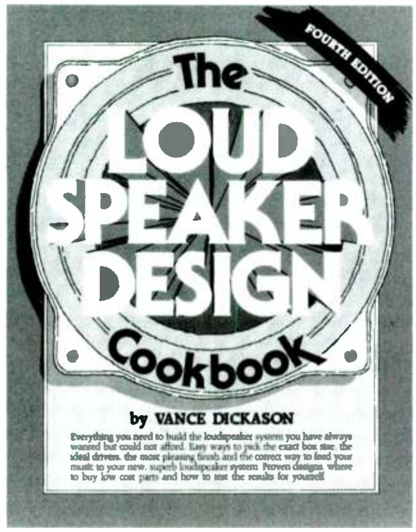
Year 1947, 1990 Pages 40
0-9624-1918-4 Softcover 8½ x 11 US $4.95

AUDIO AMATEUR LOUDSPEAKER PROJECTS

Audio Amateur Magazine BKAA1

A collection of the 25 best speaker articles from Audio Amateur during the decade of the 1970s, proof that great designs are never out-of-date, a rich source of both theory and practice as well as design. The electrostatic and transmission-line pieces are particularly interesting and useful.

Year 1985 Pages 135
0-8338-0193-7 Softcover 8½ x 11 US $20.00

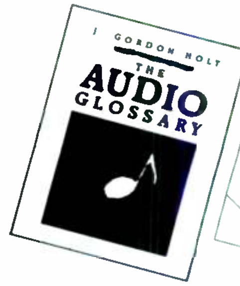


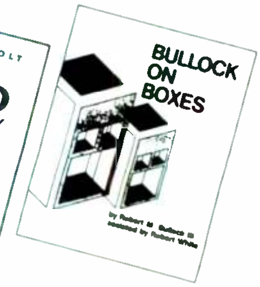
THE LOUDSPEAKER DESIGN COOKBOOK

Vance Dickason BKAA2

This new fourth edition of speaker designing's "bible" is twice as big as its predecessors and features brand new chapters on how loudspeakers work and loudspeaker design software. Other chapters cover closed and vented boxes, passive radiators, transmission-line systems, cabinet construction, drivers, crossovers, and loudspeaker testing, plus a complete resources listing. By far, the best-selling book in the field.

Year 1991 Pages 152
0-9624-1917-6 Softcover 8½ x 11 US $29.95





THE AUDIO GLOSSARY

J. Gordon Holt BKAA7

Authored by the founder of Stereophile magazine, this new best seller is a comprehensive overview of over 1,900 technical and subjective audio terms explained in precise yet at times humorous fashion. Three editions: Softcover (S); Hardcover with Dust Jacket (H); and Limited, Autographed Hardcover with Gold-Embossed Binding and Dust Jacket (L).

Year 1990 Pages 152
0-9624-1914-1(S) Softcover 5¼ x 7½ US $9.95
0-9624-1914-1(H) Hardcover 5¾ x 8 US $17.95
0-9624-1914-1(L) Limited 5¾ x 8 US $30.00

BULLOCK ON BOXES BKAA8

Robert M. Bullock III, with Robert White

An easy-to-read guide to designing and building vented-box systems based on Thiele/Small models, this book is a collection of Dr. Bullock's Speaker Builder magazine articles. Includes theory, model descriptions, plus related information from numerous sources, especially computer modeling from the authors' BOXRESPONSE and BOXMODEL programs.

Year 1991 Pages 72
0-9624-1915-X Softcover 8½ x 11 US $10.95

LOUDSPEAKERS: THE WHY AND HOW OF GOOD REPRODUCTION

G.A. Briggs BKAA5

This easy-to-read classic, last revised in 1949, introduces the reader to concepts such as impedance, phons and decibels, frequency response, response curves, volume and watts, resonance and vibration, cabinets and baffles, horns, room acoustics, transients, crossovers, negative feedback, Doppler and phase effects, and much more. A provocative survey of the right questions about sound reproduction.

Year 1949, 1990 Pages 88
0-9624-1913-3 Softcover 5½ x 8½ US $6.95

KILLER CAR STEREO ON A BUDGET: AN EASY CURE FOR HO-HUM AUTO SOUND

Daniel L. Ferguson BKAA4

Providing quick and tested methods for upgrading your car's sound, this manual provides an excellent, easy-to-understand, hands-on treatment of the cost-effective design and installation of high-quality vehicle sound systems. Included are Getting Started; Sedan, Hatchback, and Pickup Truck Systems; Speaker Cabinet Design; Filter Crossovers; and Installation.

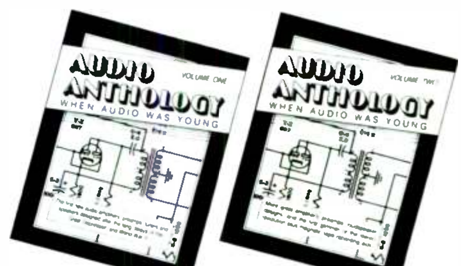
Year1989 Pages 118
0-9624-1910-9 Spiralbound 5½ x 8½ US $9.95

HARD-TO-FIND AUDIO BOOKS— AND MORE!

OLD COLONY SOUND LAB

- IN USA, PLEASE ADD $2 SHIPPING FOR FIRST BOOK. IN CANADA, $4.50. OVERSEAS SURFACE, $10. OVERSEAS AIR, $20. ALL CUSTOMERS PLEASE ADD US $.75 FOR EACH ADDITIONAL BOOK.
- ASK TODAY FOR YOUR FREE CATALOG OF KITS, COMPONENTS, CABLE, SOFTWARE AND TEST CDs!
- MC/VISA WELCOME! CHECKS/MONEY ORDERS IN US FUNDS DRAWN ON US BANK.

OLD COLONY SOUND LAB
PO BOX 243, DEPT. B92
PETERBOROUGH, NH 03458 USA
24-HOUR LINES:
TEL (603) 924-6371
FAX (603) 924-9467



AUDIO ANTHOLOGIES, VOLS. 1-4: WHEN AUDIO WAS YOUNG

C.G. McProud, editor BKAA3

These are the outstanding articles from Audio Engineering magazine during 1947-1957. Amps, preamps, tuners, speakers, and more. Vol. 1 covers 1947-50 and 38 articles. 2: 1950-1952, 45. 3: 1952-1955, 43. 4. 1955-1957, 34.

Year 1950, 1987 Pages 124
0-8338-0195-3 Vol. 1 Softcover 8½ x 11 $16.95

Year 1952, 1989 Pages 124
0-8338-0197-X Vol. 2 Softcover 8½ x 11 $16.95

Year 1955, 1990 Pages 124
0-9624-1911-7 Vol. 3 Softcover 8½ x 11 $16.95

Year 1957, 1991 Pages 144
0-9624-1919-2 Vol. 4 Softcover 8½ x 11 $16.95

MANY LOUDSPEAKER COMPUTER PROGRAMS AVAILABLE! PLEASE INQUIRE!

World Radio History

CIRCUIT BOARDS

Old Colony's boards are made of top quality epoxy glass, 2 oz. copper, reflowed solder coated material for ease of constructing projects that have appeared in *Audio Amateur* and *Speaker Builder* magazines. The builder needs the original article (indicated by the date in brackets, i.e., 3:79 for articles in *Audio Amateur* and SB 4:80 for those in *Speaker Builder*) to construct the projects.

C-4: ELECTRONIC CROSSOVER (DG-13R) New 2×3¼" board takes 8-pin DIPs. Ten eyelets for variable components. [2:72] $10.00

F-6: 30Hz FILTER/CROSSOVER (WJ-3) 3×3" [4 75] High pass or universal filter or crossover. $10.00

H-2: SPEAKER SAVER (WJ-4) 3¼×5¼" [3 77] $13.25

J-6: SCHROEDER CAPACITOR CHECKER (CT-10) 3¼×6" [4 78] $9.95

K-3: CRAWFORD WARBLER 3¼×3⅜" [1:79] $11.20

K-6: TUBE CROSSOVER. 2×4½" [3 79] Two needed per 2-way channel Each $12.50 Four $40.00

K-7: TUBE X-OVER POWER SUPPLY 5×5⅝" [3.79] $12.95

L-2: WHITE LED OVERLOAD & PEAK METER 3×6" [1:80] One channel. $18.70

L-6: MASTEL TONE BURST GENERATOR 3½×6⅝" [2:80] $15.75

L-9: MASTEL PHASE METER 6⅝×2⅜" [4:80] $11.25

SB-D2: WITTENBREDER AUDIO PULSE GENERATOR 3½×5" [SB 2:83] $11.85

SB-E2: NEWCOMB NEW PEAK POWER INDICATOR 1×2" [SB 2:84] $3.90

SB-E4: MULLER PINK NOISE GENERATOR 4⅛×2³⁄₁₆" [SB 4:84] $9.40

More than 65 boards in stock. Write for complete list.

Ordering Information: Please print *in clear block capitals* quantity needed, board number and price. Total the amounts and **REMIT IN US $ ONLY** by MC/VISA, check or money order. Postpaid in US, in Canada, please add 10% of total cost; overseas, add 20%.

ORDERS UNDER $10, PLEASE ADD $2.

☐ MC ☐ VISA ☐ CK/MO

NAME ______ MAGIC NO. ______

STREET & NO. ______

CITY ______ STATE ______ ZIP ______

MC/VISA ______ EXP. ______

QTY. PRICE

______ board(s) # ______ $______

______ board(s) # ______ $______

______ board(s) # ______ $______

Shipping ______

TOTAL $______

OLD COLONY SOUND LAB

OLD COLONY SOUND LAB

PO Box 243, Dept. B92, Peterborough, NH 03458-0243

(603) 924-6371 FAX: (603) 924-9467

Answering machine for credit card orders only: (603) 924-6371 before 9:00 a.m., after 4:00 p.m. and weekends. Have all information plus MC/VISA available.

Continued from page 58

signed and ORCA Design & Manufacturing published. The crossover you are using appears to be an unsanctioned modification of the original ARIA 5 crossover put out by Zalytron. It appears that the Zalytron crossover is too low in frequency and has too much tweeter attenuation.

You do not show the low-pass section you are using, but I assume it is that of the original ARIA 5. The new low-pass section has been greatly simplified, incurring much less phase shift and producing a very smooth crossover with seamless driver integration. The response curves in *Fig. 3* show overall ARIA 5Ti response from 200Hz-20kHz and a picture-perfect crossover at 3kHz. The optional capacitor of 1-3μF is used for high-frequency roll-off of the tweeter preferred by some listeners.

Without redoing the entire crossover, I recommend you remove the series combination of 10Ω and 2μF shunting the tweeter in your present crossover. This will pick up response by about 1dB at 10kHz and 3dB by 20kHz.

CABINET BRACING

Victor Staggs' "The Disappearing Loudspeaker: An Optimization Odyssey" (*SB* 3/92, p. 42) interested me and I plan to build his design. I have a few questions before I begin.

Cabinet bracing has an effect on cabinet resonances which, in turn, can affect overall frequency response or other aspects of loudspeaker performance. Mr. Staggs wasn't clear as to the method he employed in his article. His attention to seemingly obscure details led me to think that cabinet bracing can have a notable effect when used in his design. What does he recommend? Why was metallized Mylar film used to cover the beveled edges?

Figure 1 is a simplified version of the B&W Matrix I'd like to use in Mr. Staggs' design. There will be circular cutouts in all the panels and recesses to fit the drivers.

Anthony Cinturati
Astoria, NY 11102

Victor Staggs replies:

I am glad that you are considering building my design with your creative input. My speakers had no internal bracing, except for the front panel mounting ledge and the 14 glue blocks/cabinet. I thought this was adequate for a small enclosure made of highly-damped material.

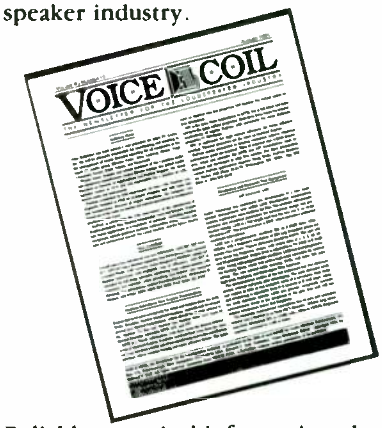
The Matrix structure you suggest in your drawing looks effective. You should calculate the volume it displaces and increase the internal volume of the enclosure by this amount by increasing the depth. You should also locate the dividing network externally.

How much foam damping material you use and how to attach it now becomes a problem. B&W filled their open volume completely with plugs of foam, but my ported system may be too highly damped with that treatment. I only recommend

VOICE COIL
THE NEWSLETTER FOR THE LOUDSPEAKER INDUSTRY

The Newsletter for the Loudspeaker Industry

Voice Coil, the monthly 4 page newsletter for loudspeaker people, is now four years old. Most experts agree editor Vance Dickason is a world class authority on the technology and exploring the significant news and advances which are vital to the loudspeaker industry.



Reliable, practical information about the major changes in the loudspeaker industry is the primary priority. ***Voice Coil*** is a collection of information from and about loudspeaker and peripherals manufacturers. It represents the most up-to-date information and developments in the industry—FAST. Each issue features new products, new patents, product reports, reviews of all the new computer aided design and test software, meeting highlights and much more.

It will be the very rare issue where you won't find something you didn't know.

☐ **Yes, start my subscription to VOICE COIL**

☐ **Two years @ $90 (24 issues)**

☐ **One year @ $50 (12 issues)**

NAME ______

COMPANY ______

STREET & NO. ______

CITY ______

STATE ______ ZIP ______

MC OR VISA ______ EXP ______

VOICE COIL
PO Box 176, Dept. B92
Peterborough, NH 03458-0176
(603) 924-9464 FAX: (603) 924-9467

Answering machine for credit card orders only: before 9:00 a.m., after 4:00 p.m. and weekends. Have all information plus MC/VISA available.

World Radio History

AudioAmateur

THE JOURNAL FOR AUDIOPHILE CRAFTS

The innovative, independent audiophile journal for the thoughtful and capable music lover

Audio Amateur's articles deal with how audio equipment works, as well as how to build or modify it. Construction and modification articles are plentiful, supplying all needed parts, performance and assembly details. Exceptionally high quality designs.

Audio Amateur offers a number of features in each issue that abound with useful ideas. The ***Letters*** column is an open forum for problem solving and information interchange; ***Classic Circuitry*** reprints schematics of state-of-the-art gear—old and new; ***Audio Aids*** relates readers' experience with simple modifications to equipment and construction techniques. We also feature many useful and practical hi-fi accessories you can build to further your audio enjoyment.

For a small investment you can make your music system sound better—very probably a lot better.

AUDIO AMATEUR

☐ **Two years** (8 issues) **$35**
☐ **One year** (4 issues) **$20**

Canada add $4 per year postage

NAME

STREET & NO.

CITY

STATE ZIP

MC OR VISA EXP.

AUDIO AMATEUR PUBLICATIONS
PO Box 576, Dept. B92
Peterborough, NH 03458-0576
(603) 924-9464 FAX: (603) 924-9467

Answering machine for credit card orders only: before 9:00 a.m., after 4:00 p.m. and weekends. Have all information plus MC/VISA available.

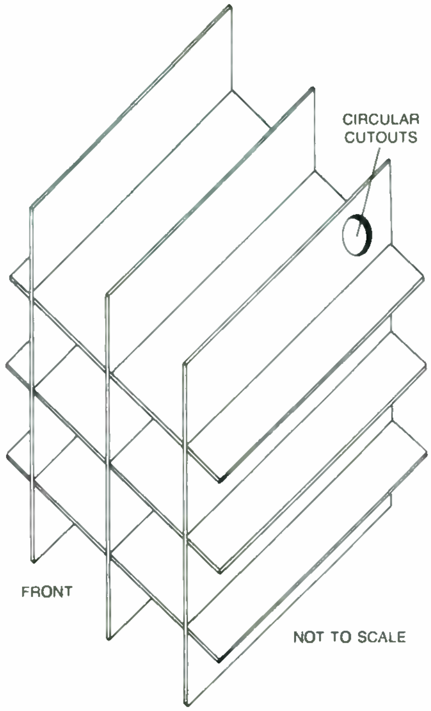


FIGURE 1: A simplified version of the B&W Matrix, with circular cutouts in panels and recesses to fit drivers.

foam lining on the inner surface of the back and sides. You could try the boxes sealed, not ported, but they sound a bit dry and restricted. If you used a subwoofer, this would not be a problem.

My boxes have their quota of wall resonances, but these are of high Q and seem not to fall on musical frequencies. You might try the new energy-absorbent speaker mounting gaskets available from Audax. Also, I chose Mylar film to cover the enclosures because it was cheaper than paint, and I have the option of peeling it off if I decide to use real veneer.

Toyota Upgrade

continued from page 24

four mains. The judges liked the sound but were unhappy about the factory head unit and the inexpensive graphic equalizer. Also, they said it lacked warmth. I had the subwoofer level adjusted for reasonable balance, which was very different from the rest of the thumpers I heard there. I think "warmth" translates to "thump."

How does it really sound? Pretty darn good, considering that the upgrade cost a total of $400. For demonstration purposes, I'll retain the Toyota deck a while longer, but in a few months, I'll probably cave in and order that new Clarion I've had my eye on. I'll probably also upgrade the graphic equalizer. It's always nice to have something to look forward to.

CLASSICAL disCDigest

The new publication on the best of...
Classical Music Recordings.
Reviews On Latest Releases.
Feature Articles on the Music, the People, and High-Fi Audio.

A quality written journal for the collector/audiophile who shares our passion for classical music CD's.

Presented in a large 8-1/2 x 11 format with exciting graphics and illustrations.

Let Classical disCDigest become an important part of your pursuit of musical pleasure.

Send today for...
6 issues Subscription $14.95.
(Over half-off $6.95 cover price.)
Call toll free USA and Canada
1-800-635-4550...or mail to:
Classical disCDigest
Box 192, Ringwood, NJ 07456

Products for the Constructor

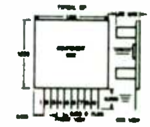
RACK CHASSIS

MODEL	DESCRIPTION	PRICE $
1RU5	19 X 5 X 1.75	29.40
1RU7	19 X 7 X 1.75	31.50
1RU10	19 X 10 X 1.75	33.60
2RU5	19 X 5 X 3.50	31.50
2RU7	19 X 7 X 3.50	33.60
2RU10	19 X 10 X 3.50	35.70
3RU5	19 X 5 X 5.25	39.90
3RU7	19 X 7 X 5.25	42.00
3RU10	19 X 10 X 5.25	44.10

METAL CABINETS

MODEL	DESCP.	PRICE $
MC-1A	4 X 3 X 2	15.75
MC-2A	6 X 3 X 2	17.85
MC-3A	8 X 3 X 2	19.95
MC-4A	4 X 4 X 3	17.85
MC-5A	6 X 4 X 3	19.95
MC-6A	8 X 4 X 3	22.05
MC-7A	4 X 6 X 4	19.95
MC-8A	6 X 6 X 4	22.05
MC-9A	8 X 6 X 4	24.15

AUDIO SIPS



There four construction books available, covering subjects like mixers, -10 to +4 conversion, mic-drivers, listening box and Field news bridge. These books are $4.95(post paid). They contain sheet metal layouts, PC board layouts and construction details.

MODEL	DESCRIPTION	PRICE $
SIP-1	Dual gain general purpose amplifiers	31.50
SIP-2	Dual electronic balanced input (mic's)	41.25
SIP-3	Dual electronic balanced input (line's)	41.25
SIP-4	Dual electronic balanced output (line's)	35.00
SIP-5	Line amplifier with current driver	34.00
SIP-6	Dual summing amplifiers	26.50
SIP-7	Dual headphone amplifers ½ watt	34.75
SIP-8	Automatic level control amp for line level	36.00
SIP-9	Dual voltage control amplifiers	31.50
SIP-10	Four common buffer amplifiers	29.25
SIP-11	Dual electronic switches SPST (cmos type)	33.50

Audio SIP's are a brand new product line from Sescom. These eleven new products employ the latest surface mount technology. With this miniaturization, complex circuits can be built into a very small package. They require a dual rail power system. All input and output and power supply decoupling capacitors are installed on the unit. They are packaged in a 9-pin single in-line sealed unit.

SEND FOR NEW AUDIO CATALOG

SESCOM, Inc. VISA & MC accepted.
2100 Ward Dr.
Henderson, NV 89015 U.S.A.

702-565-3400 FAX 702-565-4828
ORDERS 800-634-3457

Fast Reply #KG499

World Radio History

Classified Advertising

TRADE

ORIGINAL QUALITY refoaming/reconing, (412) 375-9203. T1/93

$$ I WANT IT ALL AND I WANT IT NOW—$$—at a price I can afford! So Audio Research and Krell are pretty good, right? But also pretty expensive. Try the best of both worlds in a price-busting way! Convert your Hafler, B&K, Adcom, or other amp to TUBE hybrid design. Design by Greg Miller. (818) 982-6477 ***LAZARUS TUBE-HYBRID CONVERSIONS***: $799. T1/93

CUSTOM FOAM SPEAKER GRILLES—any size, thickness, design, color, or quantity. Brochure 50¢. ***R. SHAFFER***, Box 463026, Mt. Clemens, MI 48046, (313) 463-5039. T6/93

ELECTRO-VOICE ST350B tweeters. Brand new, never been used, 8Ω, $89/pair, delivered. Visa/MC accepted. Call ***SOUND TECH***, (800)-USSOUND, extension #131, #132. T6/92

SPEAKER RECONING. All makes, models, stereo and professional. Fast service. Kits available, low rates. Refoaming $18. ***ATLANTA AUDIO LABS***, (800) 568-6971. T5/92

OMNIDIRECTIONAL ADD-ON SUPERTWEETER 7 to beyond 20k, extremely smooth. ***G. MUELLER***, RR 3 Box 541, Glen Gardner, NJ 08826, (908) 537-6245. T3/93

15% COMMISSION paid to any one who sends me a referral that ends in a sale! **MACH 1 ACOUSTICS** loudspeakers, **BOULDER** amplifiers and **MONARCHY** DACS. The **DM-10** is the most revealing speaker designed to date, **ACCUTON**™ ceramic midrange and tweeter. Field rep and dealer inquiries invited. ***MACH 1 ACOUSTICS***, RR2 Box 334A, Wilton, NH 03086, (603) 654-9826. T1/93

ARE YOU MOVING?

Let us know in advance, replacement magazines cost $5.

OLD ADDRESS (attach your label)

NAME ____________________

STREET ____________________

CITY ____________ ST ____ ZIP ____

NEW ADDRESS

NAME ____________________

STREET ____________________

CITY ____________ ST ____ ZIP ____

Change effective ____________

Please let us know 4–6 weeks in advance so you don't miss any issues.

Thank you.

SPEAKER BUILDER CLASSIFIED ORDER FORM

PLEASE FILL OUT IN CLEAR BLOCK LETTERS OR TYPE. PLEASE SPELL OUT ENTIRE WORD.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

☐ Private For Sale ☐ Private Wanted ☐ If Trade, please indicate # of insertions ______

Private For Sale ads are for *non-profit* use. Individuals selling items for retail/profit should be using **Trade** ads. **Private For Sale** and **Private Wanted** ads are on a one-time insertion basis. Ads **must** be resubmitted for renewal. **Ads will not be taken over the phone. ILLEGIBLE ADS WILL BE DISCARDED.**

Definition of a word: A series of letters with a space before and after. Count words, not letters. Any words over 50, 20¢ per word. Trade ads are 90¢ per word and indicate number of insertions. Deduct 10% for a 6 × contract in *Speaker Builder*. **Payment MUST accompany ad. No billing.**

Please remember to include your name, address and telephone number. In order for Private For Sale and Want ads to be **free**, you must be a current subscriber.

Please charge to my MasterCard/Visa:
Ten dollar minimum for charge card orders.

CARD NUMBER ____________ EXP. DATE ______

☐ *Check/Money Order Enclosed* ☐☐☐☐☐☐ Magic No.

NAME ____________________

PHONE ____________________

COMPANY ____________________

STREET & NO ____________________

CITY ____________ ST ____ ZIP ____

World Radio History

PREMIUM GRADE PARTS for modifications and upgrades, MIT/Cardas chassis wires for wiring speakers/electronics. MIT MultiCap, Solen Cap, RelCap, WonderCap/ wire/solder products. Holco, Caddock, Resista, Vishay resistors and trim pots. Edison Price, WBT, Vampire, Cardas, etc. connectors. RAM tubes, silver contact toggle and rotary switches. Wide selection of parts and accessories, prompt service, catalog available. ***MICHAEL PERCY***, Box 526, Inverness, CA 94937, (415) 669-7181, FAX (415) 669-7558. T6/92

CABINETS, KEVLAR DRIVERS, CROSSOVERS, etc. ***SPEAKERWORLD TECHNOLOGY***, (510) 490-5842, FAX (510) 490-1961. T2/93

MYLAR FILM ½ mil, genuine DuPont, 48" wide, $1 per running foot; also ESL transformers. ***ROGER SANDERS***, R1, Box 125, Halfway, OR 97834, (503) 742-5023. T4/93

FOR SALE

Carvin FET1000, 300W/channel (8Ω), level controls, THD: point 1, ideal for driving woofers in a bi-amp system, trouble-free amp. Leonard, (503) 664-6195 after 1 p.m. PST.

Toroidal power transformers: Avel-Lindberg 40-3021, dual 22V, 2.8A sec, dual 115 60Hz pri, totally enclosed, 12" flying leads, great for preamps or small power amps, $13 plus $4 per transformer. Jerry McNutt, 519A Cook St., Philadelphia, MS 39350, (601) 646-9277.

Mint Audio Control C-101, $300. Robert, (602) 458-1470.

Speaker Builder magazine, from 1980, complete set, impeccable condition, BO. Terry, (212) 226-0199.

Apature digital interconnects, 1M and 2M, $200 retail, $85; Phase Linear 4000 SII, $175; Audio Control C101, $200; 1,000' coax cable, $35; Heath AD1013 Audio scope, needs work, $75. (414) 458-2057, 6–9 p.m. CST.

Rare and unusual model K-2 KEF Celeste MKII two-way vintage speakers made 1966 in England, solid wood, first class condition for collectors, price $200/pair; (2) turntables, Azden phones, $50 each; NEC AV-250 surround sound processor, $100. Ed, (305) 891-2267.

EMIM midrange units from Infinity, excellent condition, with Infinity Schematic for Beta System, $175/pair; Jantzen U-130 Electrostatic modules, (4) 5" square panels/unit, including schematic and original brochures, $200/pair; prices firm, split shipping. Paul Champlin, 1016 Quail Gardens Ct., Encinitas, CA 92024, (619) 632-7463.

Pair "Black Dahlia" MKII designed by Dick Olsher of *Stereophile*, 1½" MDF cabinets, "Sand-Fillable" stands included, $475/OBO; MBMCD51M titanium midranges, $75/pair. Jerry, (601) 264-6971.

Equalizer; Azden GX36, 10-band, 15dB, post and pre outputs, also preamp; Sherwood S-6020, many features, both pieces unblemished and in perfect working order, BO/trade. Mike, (203) 646-4244, if young lady answers, leave message, will return call.

(2) SpeakerLab ribbon speakers mounted in two open back, oak "wing" enclosures, includes crossovers, over $1,500 invested, sell for $1,000. Tom, (715) 479-7532.

Audio Concepts Orion speaker system (Saturn subwoofer), $1,500; Swan IV system, $1,000; Infinity SS-1A (electrostatic) with subwoofer, $1,500; Swan 305 12" woofer in bass reflex, $200/pair; Audio Research EC-2, electronic crossover, $300; PAS regulated supply, gold sockets, $300; Dyna MKIII, new KT88 CCDA mod, $450/pair. Alan Porter, (805) 492-2781 PST.

Spectral DMC-10 Alpha, $750; NAK OMS-7AII, near mint, $550; Techniques SL-1200 MKIIS mint boxed, $400; Swan 305 woofers, mint, 4/$155, BO. Steve, (203) 397-3888, CT.

(2) Crown PSA-2 amps; (2) Altec 1270 amps; Yamaha four-way switchable crossover; Dyna ST-70 tube amp; Altec 604 coaxial speakers, no cabinets; Altec 811 horns, 806 drivers; Altec 500Hz crossover; Tascam CD player with balanced outs; Teac 2-5000 top quality cassette deck. David, (914) 688-5024 EST.

ACTIVE ELECTRONIC CROSSOVERS

MODEL 120 CABINET & NEW 120-R "RACK AND PANEL" DESIGNS

Plug-in Butterworth (maximally flat) filters 6 db., 12 db., or 18 db. per octave slopes, any specified frequency. Model 120 instrument style case or 120-R "Rack and Panel" case with all terminations and regulated power supply.

Made in monaural or stereo bi-amp, tri-amp, or quad-amp with optional level controls, subsonic filters supplies with or without bass boost, and summers for "single woofer" systems. Also available, 500 Series filters, plug-in filters, regulated power supplies.

New catalog and price sheet. Free!

DeCoursey Eng. Lab.
11828 Jefferson Bl, Culver City, CA 90230
PHONE (310) 397-9668

ESS Amtiam with Focal woofers, electronic crossovers, Borbely DC-100 dual mono, Lang amp dual mono, $650, you pick up; Magnavox 650 beyond POOGE, 4 separate Jung-Galo analog supply, $375. Bob, (916) 756-3296.

Dynaudio D52AF dome midranges, $70/pair; Focal 5N313 cone midranges, $70/pair; Precision Loudspeakers, Inc., TA305F 12" woofers, $60/pair; sound absorbing foam by Soundcoat, adhesive backed ¼" × 24" × 54", charcoal gray, excellent for cover speaker baffle to control diffraction and serve as gasket, $12 per sheet. Andy (508) 433-2283, home; (603) 886-4103 work, EST.

Infinity servo static speakers, $300/pair; MAC225, $700, excellent condition; shipping extra. Brian, (401) 381-5272, evenings/weekends.

ReVox A-77 ¼-track with remote, mint, $600; Sound craftsman SE450, $75; 7N313 mids, $100/pair; 5N313 mids, $70/pair; biamp SM-23 electronics crossover, $100; Hewlett Packard 5325B universal counter, $125; shipping extra. Jim, (708) 425-6719.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION. (Required by 39 U S C 3685) Date of Filing, Sept 30, 1992. Title of Publication. SPEAKER BUILDER. Frequency of issue: Bi-monthly

Annual subscription price $25. Location of the headquarters or general business offices of the publishers. 305 Union St., Peterborough, NH 03458. Publisher: Edward T Dell, Jr., PO Box 494, Peterborough, NH 03458; Managing Editor. Mary Wagner. Owner: Edward T Dell, Jr., PO Box 494, Peterborough, NH 03458. Known bondholders, mortgagees, and other security holders owning 1 percent or more of total amount of bonds, mortgages or other securities: None

	Average # copies each issue during preceding 12 months	Single issue nearest to filing date
Total # copies printed	14,250	15,000
Newsdealer sales	114	115
Mail subscriptions	9,099	9,204
Total paid circulation	9,213	9,319
Free distribution complimentary	137	141
Total distribution	9,350	9,460
Office use, leftover	4,900	5,540
Return from news agents	0	0
Total	14,250	15,000

I certify that the statements made by me above are correct and complete

Publication No. 01997920 Edward T Dell, Jr., Publisher

One each, bridge stereo Pass A40 built as dual mono with 800VA toroidal transformer and 6kμF in each channel, built in nice black steel box *a/a* Krell, output 150W, pure Class A/channel, $600; Borbely DC100 MOSFET built as dual mono with 465VA toroidal transformer and 72kμF in each channel, built in nice black steel box *a/a* Forte, output 100W channel, $350. Peter, (619) 558-7558.

Tube equipment collection of amps through tuners, over 275 pieces, Fisher, Lafayette, McIntosh, Scott, etc.; call or send 52¢ SASE. Dennis Boyle, 1707 S. Ervay, Dallas, TX 75215, (214) 428-3901.

Eton 11-580 hex 11" woofers ($225), $145 each; Boulder 250AE power amps ($2,700), $1,850; Boulder L3 preamp ($1,500), $1,100; Monarchy DAC ($1,000), $750. Marc McCalmont, RR 2 Box 334A, Wilton, NH 03086, (603) 654-9826.

Ret-O-Kut N33H turntable with wood base and S-120 tonearm; ReVox A-77 tape deck; ADC 3500RVC record changers; dbx NX-40 tape noise reducers; dbx SX-10 dynamics enhancer; dbx SX-20 impact restorer; dbx SX-30 bass enhancer; STAX SR-3 SRD-5 headphones; Vac-O-Rec. Aaron Shipow, 3408 Ramstad Dr., San Jose, CA 95127.

30" diameter, Monster woofer, EV-30W, biggest, most-efficient woofer ever made, 18Hz free-air, front panel for EV specified cabinet 4' × 5' × 2½', $250 plus shipping, SASE for published article. Audio Monster, 4 Fieldwood Dr., Bedford Hills, NY 10507.

Tascam 25-2 recorder ½-track with Type I dbx, $500; ReVox A77 ¼-track, $200; Crown CX preamp with Magnecord 1028 transport with track sync, $200; dbx 150 Type I noise reduction system, $125; various 2-50A Hewlett Packard 122AR scope. Andy, (313) 437-8285.

Brand new drivers; (2) Focal T120KT tweeters, $25 each; (2) Dynaudio D76 midranges, $30 each; (2) Audio Concepts' AC-12 woofers, $25 each; all in boxes; call or write: Steven. 7375 Rollingdell Dr. #26, Cupertino, CA 95014, (408) 253-2699.

Audio Research Tympani 1-D, $649; Carver ribbons, $399; Shadow Engineering 18dB/octave electronic crossover, $199; ADS 4" woofer, $40; 1" tweeter, $40; metal 200X case, $40; 2002 biamp board, $100; Nakamichi 250 with Dolby "C", $150; Infinity RSA693K, $129/pair; RSA 120, $149; SWTP Tiger amp (12V), $79. Michael, (703) 641-5824.

Dynaudio 17W75/8, $90/pair; 30W100, $275/pair; D28/AF, $65/pair; D52AF, $100/pair; Pioneer SF-850 electronic crossover, $100; custom made rosewood Duntech Sovereign-2001 cabinets, $200 each. Bob Smith, (206) 937-8120.

CASP'er

Computer Aided Sheet Planner

Panel Cutting Software

Optimizes, Files, Prints Layouts, Lists, Labels and More! **$249 + S&H**

ROGER DRUMMOND

10 Pike Street • Herminie, PA 15637

Phone/Fax (412) 446-0159

Sony mobile ES system, XES-P1 DSP processor, XES-X1 digital crossover, XES-C1 digital CD changer, XES-T1 digital tuner, all brand new, $2,000, will separate; Soundstream Class A100II amplifier, $300; Soundstream MC245 five-channel amplifier, $400; dbx 3BX home audio expander, $100. Call Marty, (803) 224-6220, evenings EST.

Frequency Devices Model 790BT-8-20K, 8-pole Butterworth, 20kHz low-pass filter module (ideal for limiting the bandwidth of audio-noise measurements), new, $30 plus $2 shipping and handling (regularly $126), includes documentation. Bob Berendsen, PO Box 296, Candia, NH 03034, (603) 483-5583.

Electro-Voice T35 tweeters, 8Ω, new style, $79/pair; VMPS, 15" woofer, $39; *Fine Woodworking*, 19 issues, 1980-1985, $25; Baby Advent IIs, mint, $139/pair; Pioneer A339 40W, channel integrated, mint, $199; F449 tuner, mint, $189; *Loudspeaker Anthology*, Vol. 1–25, AES, $12; mint, 60s LPs, classical CDs. (703) 464-1100.

KEF B-139s mint, $180/pair, or trade for good small speakers such as Linn Kans or Snell Ks; nice walnut speaker cabinets, internal dimensions 22½" × 14½" × 9⅛", cutout for 8" speaker black grille cloth, $85/pair; ACE 6000 crossover, 400Hz, $75. Jerry Feldstein, Bronx, (718) 364-3485, 7-10 p.m., no machine.

Gold Ribbons 3.0, two pair $1,250; Dynaudio 24W100, new, $180/pair; 17W75, new, $100/pair; D-21AF, new, $65/pair; EAS 400A leaf tweeters, new, $60/pair. Carl, (916) 967-1065.

Electronic
by
ACE AUDIO CO.
• est. 1973 •
RD3 Box 351
Homer City, PA 15748
write for **free flyer**

Crossovers

Rare Dynaco C-100 unit for the Stereo 416 amp, $100 OBO; free with C-100 is broken Dynaco 416, transistors need replacement; Onkyo DX-2700 CD player, $175 OBO; NAD 1300 preamp, $200 OBO. Ben Arritt, (703) 951-8468.

Snell electronic crossover, $125; pair of D76B0; pair of 15W75B0. John Oliver, 3661 Sheridan Rd., Portsmouth, OH 45662.


The best disc, tape, component storage system in America
Stackable, portable oak units hold all recording formats and audio/video components
Free mailorder brochure
(please mention Speaker Builder)
Per Madsen Design (415) 928-4509
P.O. Box 330101, San Francisco, CA 94133

AR 10π $400/pair; AR MKII, $200/pair; Seguerra MET7 MK II (oak), $300/pair; HK Citation 11II, 12 power amps, $225/pair; JBL drivers: 22H13H bass, $125/pair; 105H3 mids, $50/pair; 035T1 tweeters, $50/pair; Sig 123 bass, $125/pair; LE 5-2 mids $100/pair; 6, LE-25 tweeters, $50/pair; Jordan modules, $100/pair; all in good shape. Dean, (512) 497-7453, TX.

Yamaha DSR 100 Pro Logic Surround decoder, $275; Yamaha four-channel amp, $150. Len, (410) 247-9581.

Tubular 10' crossmain line plastic enclosures fitted with 12", 150W, Eminence woofer with 150W, MOSFET amps, must see to believe, can be disassembled easily, asking $1,000/pair. Jim Thornhill, 2112 S. Beacon, Muncie, IN 47302, evenings (317) 747-9109, days (317) 284-4826.

WANTED

Brochures on Sawafuji Digital Reference series speakers. (414) 458-2057, 6-9 p.m. CST.

I need a source for original Advent white grille cloth, factory no longer has any. Please respond if you know of a substitute. Bryan Hefner, PO Box 6601, Newport News, VA 23606-0601, (804) 865-8694.

Recent Theta Pro; pair TAD TL-1601As; ED-703s; JBL 2370s. Steve, (203) 397-3888.

Altec, RCA, etc. sound/theatre amps, parts and speakers. Dennis Boyle, (214) 428-3901.

Original JBL L100 speakers; used McIntosh 4100 receiver; please state condition and price. Tom Jones, RD 3 Box 88, Newton, NJ 07860, (201) 383-5438, days (201) 386-6330.

NAD 2155 stereo amplifier; VGC. James Gale, Norfolk, VA, (804) 423-8402.

Mid-fi interconnectors, 25'. John Oliver, 3661 Sheridan Rd., Portsmouth, OH 45662.

CLUBS

THOSE INTERESTED IN AUDIO and speaker building in the Knoxville-East Tennessee area please contact Bob Wright, 7344 Toxaway Dr., Knoxville, TN 37909-2452, (615) 691-1668 after 6 p.m.

AUDIOPHILES IN THE DAYTON/SPRINGFIELD, OHIO AREA: We are forming an audio club. Please contact me if you're interested in construction, modifications, testing, recording or just plain listening to music. Ken Beers, 1756 Hilt Rd., Yellow Springs, OH 45387, (513) 767-1457.

ARIZONA AUDIOPHILE SOCIETY Located in Metropolitan Phoenix is a growing and active club in the pursuit and reproduction of recorded music. New members are welcome. Meetings are last Tuesday of each month. Receive monthly newsletter and bi-annual journal. Club discounts with local high-end audio dealers. Send inquiry to Arizona Audiophile Society, PO Box 13058, Scottsdale, AZ 85267, or call Bob Williams, (602) 944-5929.

AUDIO SOCIETY OF MINNESOTA Now in its 15th consecutive year! Serving the many and varied interests of audiophiles in the upper midwest. Monthly meetings, tours, audiophile concerts, special guests. For information and a sample of our latest newsletter, write ASM, PO Box 32293, Fridley, MN 55432 or call our 24 hour "Audio Hotline," (612) 825-6806.

THE CATSKILL AND ADIRONDACK AUDIO SOCIETY invites you to our informal meeting. Join our friendly group of audio enthusiasts as we discuss life, the universe and everything! Toobers, Tranzzeestors, vinyl canyons or digital dots. No matter what your level of interest, experience, or preferences, you are welcome. Contact CAAS at (518) 756-9894 (leave message), or write CAAS, PO Box 144, Hannacroix, NY 12087. See you soon!

CONNECTICUT AUDIO SOCIETY is an active and growing club with activities covering many facets of audio—including construction, subjective testing, and tours of local manufacturers. New members are always welcome. For a copy of our current newsletter and an invitation to our next meeting, write to: Richard Thompson, 129 Newgate Rd., E. Granby, CT 06026, (203) 653-7873.

TUBE AUDIO ENTHUSIASTS. Northern California club meets every other month. For next meeting announcement send a self-addressed, stamped #10 envelope to Tim Eding, PO Box 611662, San Jose, CA 95161.

DRIVER DESIGN LTD

what the music sounds like

Intelligent designs by Phil Jones
built by Gefco in Grayslake, Illinois

Available at:
A & S Speakers
415-641-4038

driver design ltd
1416a ricky rd charlottesville va 22901

THE PRAIRIE STATE AUDIO CONSTRUCTION SOCIETY (PSACS) meets every other month. Meetings feature audio construction, design, and analyses, blind listening tests, equipment clinics, autosound, lectures from manufacturers and reviewers. PSACS, PO Box 482, Cary, IL 60013, call Tom, (708) 248-3377 days, (708) 516-0170 eves.

Audiophile Accessories

DBP-2J (5) • Switch Box $69.95
DBP-2J (5) AU • Switch Box with Gold Jacks $89.95
Selects among up to 5 inputs. When used with DBP-6 or -6MC, allows for selectable loading of cartridges. Alps level control available.

DBP-10 • Phono Alignment Protractor $29.95
Allows adjusting the lateral tracking error of a mounted cartridge to within 1/4 of a degree. Non-technical instructions and case included.

DBP-16 • 12dB Input Attenuators (pair) $12.95

DBP-CK • Cramolin Audio Kit (contact treatment) $19.95

DBP-SC • Souther Record Clamp $19.95

Other Accessories
Gold-plated phono plugs/jacks, banana plugs/jacks, spade lugs, Y adapters, custom cables, many other useful accessories.

Test Compact Discs

We carry almost every worthwhile test CD available, including 5 from the Japan Audio Society (tone bursts and stereo pink noise), 2 from Pierre Verany (1/3-octave warble tones), 3 from Denon (*Anechoic Orchestra*), and *Auditory Demonstrations.*

Electronic Components

We can create electronic crossovers from 6 to 36dB per octave, custom engineered for your application. 24 and 36dB are Linkwitz-Riley "In Phase" design. Models for Snell and Magnepan speakers available.

The renowned DB Systems preamps, power amps, tone controls, head amp, and phase inverter/bridging adapter are also available through dealers or direct.

DB Systems
Main Street, P.O. Box 460
Rindge Center, NH 03461
Phone (603) 899-5121
VISA/MasterCard accepted

THE ATLANTA AUDIO SOCIETY is dedicated to furnishing pleasure and education for people with a common interest in fine music and audio equipment. Monthly meetings often feature guest speakers from the audio manufacturing and recording industry. Members receive a monthly newsletter. Call: Chuck Bruce, (404) 876-5659, or Eddie Carter, (404) 847-9296, or write: A.A.S., 4266 Roswell Rd. N.E., K-4, Atlanta, GA 30342-3738.

ELECTROSTATIC LOUDSPEAKER USERS GROUP is now a world-wide network for those interested in sharing valuable theory, design, construction, and parts source information. If you are interested in building, or have built, your own SOTA ESL we invite you to join our loose-knit organization. For information, send a SASE to: Barry Waldron, 1847 Country Club Dr., Placerville, CA 95667.

GREAT BASIN AUDIO SOCIETY. A club for those interested in better recording and reproduction of music, who live in Northern Nevada and surrounding parts of California, Idaho and Utah. Everyone is welcome to come to our monthly meetings, held in Reno on the last Sunday of each month. We also seek contributions to our quarterly newsletter, *The Singing Sagebrush*. For more info, contact the GBAS, c/o E.A. Barbour, 552 N. McCarran, #284, Sparks, NV 89431 or leave a message on (702) 358-2019.

WASHINGTON AREA AUDIO SOCIETY Meetings are held every two weeks, on Fridays from 19:00 hours to 21:30 hours at the Charles Barrett Elementary School in the city of Alexandria, Va. Prospective members are welcome but must register in advance in order to be admitted to the meetings. No exceptions please. If interested please call Horace Vignale, (703) 578-4929.

SPEAKER BUILDERS/AUDIOPHILES in the Milwaukee, WI area. I am a speaker builder with test gear looking to join or form an audio club. Anyone interested contact, Kirk Rontti, (414) 355-7509 leave message.

World Radio History

THE BOSTON AUDIO SOCIETY the nation's oldest (founded 1972), seeks new members. Dues includes the monthly meeting notice and our newsletter, the "BAS Speaker" (6 times/year). Recent issues cover Carver, a/d/s; the founder of Tech Hi-Fi; Photo CD; plus visits from famous speaker designers; listening tests; measurement clinics; research investigations; and more. Back volumes available. Membership includes engineers, journalists, consultants, and music-loving audiophiles like yourself. For information write to PO Box 211, Boston, MA 02126-0002, USA.

THE COLORADO AUDIO SOCIETY is a group of audio enthusiasts dedicated to the pursuit of music and audiophile arts in the Rocky Mountain region. We offer a comprehensive annual journal, five bi-monthly newsletters, plus participation in meetings and lectures. For more information, send SASE to: CAS, 11685 W 22nd St., Lakewood, CO 80215, (303) 231-9978.

THE HI-FI CLUB of Cape Town in South Africa sends a monthly-newsletter to its members and world-wide subscribers. To receive an evaluation copy of our current newsletter, write to: PO Box 18262, Wynberg 7824, South Africa. We'll be very pleased to hear from you.

THE OREGON TRIODE SOCIETY We are dedicated to the art and craft of music, audio DIY projects, and quality sound reproduction. Our 125+ members meet eight times a year in the Portland area and our news magazine, *Positive Feedback*, has grown to 48 pages of challenging commentary, fun and information and is published six times annually. Ladies and gentlemen, you are cordially invited to join us. For information contact, David Robinson, 4106 N.E. Glisan, Portland, OR 97232, (503) 235-9068 or Ian Joel, (503) 233-1079.

LOS ANGELES AREA ARIA AND SWAN Loudspeakers Users Group. If you have built or plan to build any of the Aria or Swan loudspeakers and would like to meet for listening sessions or have any questions or modifications that you would like to share, please call Geoffrey, (213) 965-9173 or Edward, (310) 395-5196.

NEW JERSEY AUDIO SOCIETY meets monthly. Emphasis is on construction and modification of electronics and speakers. Dues includes monthly newsletter with high-end news, construction articles, analysis of commercial circuits, etc. Meetings are devoted to listening to records and CDs, comparing and A-B-ing equipment. New members welcome. Contact Frank J. Alles, (908) 424-0463, 209 Second St., Middlesex, NJ 08846; or contact Bob Young, (908) 381-6269, or Bob Clark, (908) 647-0194.

PACIFICNORTHWEST AUDIO SOCIETY (PAS) consists of 60 audio enthusiasts meeting monthly, second Wednesdays, 7:30 to 9:30 p.m. at 4545 Island Crest Way, Mercer Island, Washington. Be our guest, write Box 435, Mercer Island, WA 98040 or call Bob McDonald, (206) 232-8130 or Nick Daniggelis, (206) 323-6196.

PIEDMONT AUDIO SOCIETY Audio club in the Raleigh-Durham-Chapel Hill area is meeting monthly to listen to music, demonstrate owner-built and modified equipment, and exchange views and ideas on electronics and speaker construction. Tube and solid state electronics are of interest and all levels of experience are welcome. Kevin Carter, 1004 Olive Chapel Rd., Apex, NC 27502, (919) 387-0911.

THE INLAND EMPIRE AUDIO SOCIETY (soon to become) **THE SOUTHERN CALIFORNIA AUDIO SOCIETY—SCAS** is now inviting audiophiles from all areas of Southern California and abroad to join our serious pursuit for that elusive sonic truth through our meetings and the **IEAS'** official speaker, *The Reference* Newsletter. For information write or call, Frank Manrique, President, 1219 Fulbright Ave., Redlands, CA 92373, (714) 793-9209.

IF YOU ARE an "Organ Music Lover" and like to test your audio system, **SFORZANDO** has room for a few more members. We have about three thousand "Live," on-the-spot, cassette tapes that are not available in the stores. We are happy to lend them to you via the mail. Just ask EA Rawlings, 5411 Bocage St., Montreal, Canada, H4J 1A2.

LONDON LIVE D.I.Y. HI-FI CIRCLE meets quarterly in London, England. Our overall agenda is a broad one, having anything to do with any aspect of audio design and construction. We welcome everyone, from novice to expert. For information contact Brian Stenning, 081-748-7489.

HI-FI COLLECTOR/HOBBYIST seeks "living letters"/audio penpals from other states to correspond via reel-to-reel tape. Non-commercial strictly; make up short monologues on subjects from vintage technology, with regional FM excerpts for background or equipment samples, from personal tales of yard sales scavaging success, repair/restoration tactics and strategies, favorite service centers, general ways to handle the burgeoning obsession with arcane hi-fi gear. All correspondence on 3", 5", 7" reels (¼" tape) will be cheerfully answered and tapes returned via parcel post. James Addison, 171 Hartford Rd., Apt. #7, New Britain, CT 06053.

THE WESTERN NEW YORK Audio Society is an active, long established club located in the Buffalo area. We issue a newsletter and hold meetings the first Tuesday of every month. Our meetings attract many prominent manufacturers of audio related equipment. We are involved in all facets of audio—from building/modifying to exposure to the newest high-end gear, and the chance to hear more types of music. For information regarding our society, please write to WNY Audio Society, PO Box 312, N. Tonawanda, NY 14120.

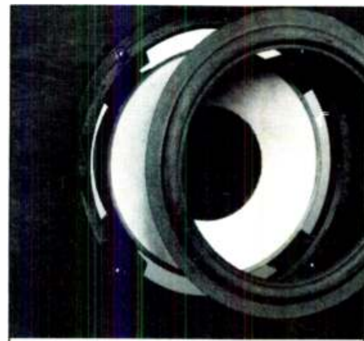
(616) 534-9121

MENISCUS

HIGH FIDELITY SPEAKER COMPONENTS

DYNAUDIO MOREL FOCAL ECLIPSE

2575 28th St., S.W., Unit 2, Wyoming, MI 49509



Save hundreds of dollars on your speaker repairs.

A highly innovative speaker surround system designed for you is now available. All sizes. Easily installed & affordably priced at $27.95/pr. (incl. s/h). No more costly repairs/freight. You can replace ruined surrounds yourself with the SAT system. ORDER NOW. TOLL FREE 1-800-747-3692.

STEPP AUDIO TECHNOLOGIES

PO BOX 1088, Flat Rock, NC 28731

VISA/MC/Check/M.O. • 1-800-747-3692

MEMPHIS AREA AUDIO SOCIETY being formed. Serious audiophiles contact J.J. McBride, 8182 Wind Valley Cove, Memphis, TN 38125, (901) 756-6831.

SOUTHEASTERN MICHIGAN WOOFER AND TWEETER MARCHING SOCIETY (SMWTMS). Detroit area audio construction club. Meetings every two months featuring serious lectures, design analyses, digital audio, A-B listening tests, equipment clinics, recording studio visits, and audio fun. The club journal is *LC, The SMWTMS Network*. Corresponding member's subscription available. Call (313) 544-8453 or write David Carlstrom, SMWTMS, PO Box 721464, Berkley, MI 48072-0464.

Advertising Index

World Radio History

Moran in the Market

PRO ROLLOFFS

By David R. Moran

The rap on pro monitors has gotten out over the last five or so years—or at least it's finally been acknowledged. Most of them don't sound so good. Certainly not as good as numerous well-regarded consumer loudspeakers. A lot sound downright bad. Now, many people in audio have long suspected as much. In recording studios most of us have heard a given JBL or Yamaha or Tannoy which, while capable of extremely loud and clean output, was harsh, boomy, or honked-up in the midrange, or a combination of those defects.

Researchers and others who have measured professional monitors have been appalled, especially by the deeply flawed, unpleasantly rough off-axis responses. This set of problems particularly holds when a large woofer is taken up high toward the crossover, getting beamy. Then the tweeter comes roaring in, maybe at an appropriate and smooth level on-axis but with a nasty flare off-axis. (Remember that, to first order, it's all of these responses in aggregate, especially horizontally—regardless of what you read or hear to the contrary from many "experts"—that produce the sonic balance, the spectral character or overall timbre of the sound.)

A while back the owner of a small studio who specializes in recording local pop groups for demo cassettes, but also does some commercial work, became unhappy with the sound of his in-wall Urei 809s. He asked me to measure and help tune them, if possible, using his White ⅓-octave equalizers. These Ureis comprise a 12" woofer and a horn, and are claimed to be "time-aligned," whatever that might mean for those at listening positions. The gear in this studio is altogether typical, although his large TAC mixing board was much quieter than usual. Other equipment included a Crown amp, dbx and Lexicon and other processing units, Teac recording equipment, little Yamaha speakers atop the board, and so on.

Smoothing the Smooth Enough

In the initial evaluation audition I found the Ureis to sound actually okay: smooth enough, no terrible problems or errors (holes or peaks). They did not really live up to the worst of the bad rap on professional monitors, in other words.

Nonetheless the sound was hardly acceptable. Little detail was present in the very subdued highs, and there was no low end. I took measurements at the console seat, getting the rolled-off curves shown at the top of *Fig. 1*. Then the owner and I played for an hour or so with the White EQ settings, adding and subtracting, eventually converging on the final fine touches: a half dB here, a half there. After each adjustment we would listen again, and remeasure. There are faster ways to work with the dbx RTA-1 and a good ⅓-octave equalizer, but this exhaustive iterative style is slightly more fun and certainly more educational.

It also is a patience-trying experience, one which I would ordain for all those who proclaim that human hearing is so much more acute than test instruments. For just one recent example, see Philip Newell's airy, unsubstantiated assertion (*SB* 6/91, "Cable and Sound Delivery," p. 43): "The combinations of brain and ear have an awesome ability to resolve fine detail, orders of magnitude [!] beyond our best measuring equipment." As an order of magnitude is a factor of 10, Newell has it exactly backwards: our miraculously subtle hearing is many times less sensitive than test gear.

The results of the visit are shown at the bottom of *Fig. 1*, and all present agreed the sound was enormously improved, now almost great; equalization is a wonderful thing. Images snap into focus, with instruments placed as they were in the mix; it becomes ever so much easier to concentrate directly on the source material. Doing so comes naturally, without need to think about it or make a conscious effort.

The owner and I had agreed to aim for flat power at the mixing seat, not for a target curve with some sort of contouring or rolloff. This horn seems unusually beamy, and even though the console chair was not very far from the Ureis, we both figured ear-tweaking would be called for as weeks passed, probably to turn down the treble. I must point out that, since in-wall mounting is so kind to speakers (like old-fashioned bookshelf placement, it happily gets rid of one full reflection set (*SB* 4/92, p. 81, *Fig. 1*), and since the Ureis' total output into this small studio was not so awful to begin with, much of the good we accomplished could have been achieved with low-bass boost and turning up a treble control.

To check just how effective over time such an RTA tuning protocol turns out to be for an experienced studio engineer (and this owner seemed to me to have a very good ear and sonic judgment), some months later I called to chat. Things were great, he said. Changes? Well, he had brought down the 50–125Hz octave-plus one-half dB; had raised the two 250Hz–1kHz octaves 1dB; and finally had brought down 1dB everything above 1kHz—and "it's still a little bright." Which was gratifying news, and not surprising at all. So never hesitate to EQ. Quite apart from your speakers' shortcomings, your room sure does its own EQ; fight back any way you can.

Department of Amplifications

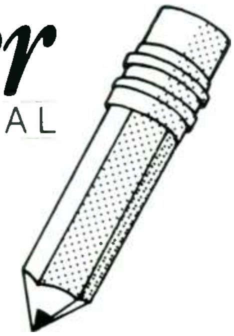
In my long reply to long letters (*SB* 4/92, p. 80) I gave a resume of my playback and test equipment. However, all of the plus-or-minus frequency-response marks got dropped before printing, making components look even better than they are (e.g., my preamp from 20Hz to 20kHz varies less than ±0.1dB, or within 0.2dB, *not* half that, as published without the ±). More importantly—but only for the record, not for how it sounds—I recently had my CD player's frequency response measured with a Urei sinewave plotter, in preparation for measuring the pink noise found on CDs (some of which are shockingly non-flat; see next issue's column). It checked in at *much* less than ±0.1dB. At the same time I measured its low-level linearity myself, and trimmed its DACs to being within a decibel or two at −90 and −100.

In the letters reply I neglected to mention that my 24′ × 13′ × 8′ living room satisfies the IEC 268-13 standard.

Continued on page 68

World Radio History

Speaker Builder
THE LOUDSPEAKER JOURNAL



Subscriber Services

WOULD YOU LIKE TO . . .

Complete the applicable section(s) below and mail to:

Speaker Builder
PO Box 494
Peterborough, NH
03458-0494

❑ SUBSCRIBE?

YES! Just check the appropriate boxes in the "renew" section and fill in name and address.

❑ RENEW?

Fill in the appropriate sections below. For faster service use your mailing label and magic number.

❑ 1 year at $25
❑ 2 years at $45

❑ Check/MO enclosed
❑ Charge MC/VISA

Canada add $6 per year postage
Remit in US $ only
Overseas rates on request

☐☐☐☐☐☐
MAGIC NUMBER

NAME ____________________

STREET & NO ____________________

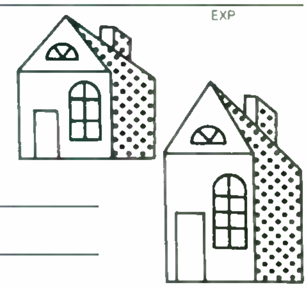
CITY ____________ ST ____ ZIP ____

MC/VISA ____________________ EXP ____

❑ CHANGE YOUR ADDRESS?

Fill in your new address to the right and old address and magic number above.

MY NEW ADDRESS:



NAME ____________________

STREET & NO ____________________

CITY ____________ ST ____ ZIP ____

❑ GIVE A GIFT?

What a thoughtful idea! Fill out your name and address above, the recipient's name and address to the right. We'll even send a gift card announcing your gift.

NAME ____________________

STREET & NO ____________________

CITY ____________ ST ____ ZIP ____

❑ TELL YOUR SPEAKER BUILDING FRIENDS ABOUT US?

Print their names and addresses below.
We'll take care of the rest.

NAME ____________________

STREET & NO ____________________

CITY ____________ ST ____ ZIP ____

NAME ____________________

STREET & NO ____________________

CITY ____________ ST ____ ZIP ____

YOU CAN CALL US
(603) 924-9464
Subscription Department
9-4 Business Days
Answering Machine
All Other Hours
FAX: (603) 924-9467
24 Hours

❑ COMPLAIN ABOUT YOUR SUBSCRIPTION?

Yes, it sometimes happens. We try to avoid it at all costs, but if you have a problem, we want to know. Call or write with all pertinent information.

World Radio History

BOXES & BINDERS

FOR YOUR
TECHNICAL LIBRARY

THE BINDER: A "loose wire" heavy book binder cloth construction case holds twelve issues of your magazines in a readily accessible format. The logo is hot stamped in silver on red cover and spine.

$12 EACH
THREE OR MORE,
$10 EACH

Shipping: Postpaid in US. Canada and Caribbean please add $4 for one, $2 for each additional binder. Overseas, please add $4 per binder.

THE BOX: Library quality boxes, 4¼ × 9¼ × 12" high, brown woodgrain, folding corrugated boxes with label to identify contents. Holds 12 issues of *Audio Amateur, Speaker Builder, Elektor Electronics USA, Glass Audio,* or other valuable magazines in your technical library. Each order supplied with pre-printed labels for each magazine.

$ 8 PAIR
$12 FOUR

Shipping: Postpaid in US. Canada and Caribbean please add $3 for each set of two, $1 for each additional set of two. Overseas, please add $3 per set of two boxes.

QTY.		PRICE
____	Binders @ $12 for __ AA __ SB __ GA __ EEUSA	____
____	Binders @ $10 (3+) for __ AA __ SB __ GA __ EEUSA	____
____	Boxes @ $8 (2)	____
____	Boxes @ $12 (4)	____
	POSTAGE	____
	TOTAL	____

☐ MC ☐ VISA ☐ CK/MO

NAME

STREET

CITY ST ZIP

MC/VISA EXP

Old Colony Sound Lab
PO BOX 243, DEPT. B92
PETERBOROUGH, NH 03458-0243
(603) 924-6371 FAX: (603) 924-9467
Answering machine for credit card orders only: (603) 924-6371 before 9:00 a.m., after 4:00 p.m. and weekends
Have all information plus MC/VISA available.

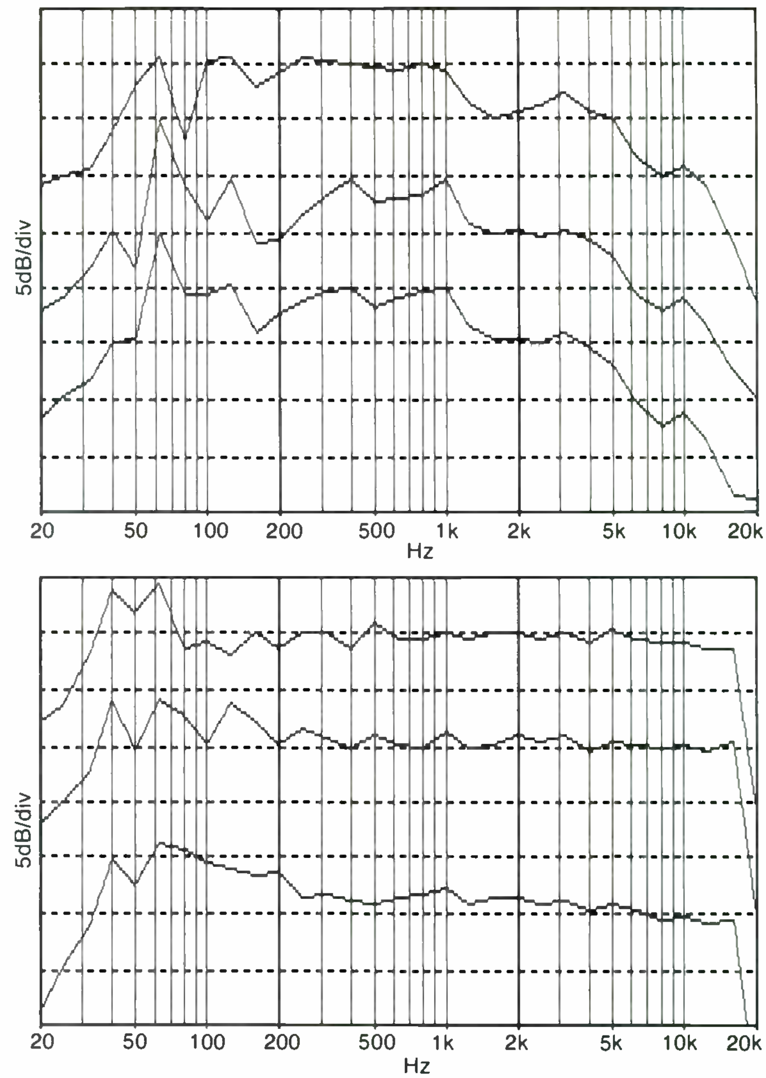


FIGURE 1: At top, frequency response of in-wall-mounted Urei 809s in small recording studio (stereo pink noise, ⅓-octave-averaged), left, right, and both. At bottom, the same after ⅓-octave equalization.

Continued from page 66

I also did not discuss my hearing, recently tested. Even though an audiogram graph looks just like frequency response, audiograms test one's *detection threshold*, and a bad-looking rolloff (decrease) in one's sensitivity to very low-level treble tones is entirely likely to show up in us men. Getting an audiogram for most audiophiles, then, proves a sobering, humbling experience, and may well make you vow never again to talk about distortion above, say, 2kHz. Also, audiograms typically end at 8kHz. A rare practitioner may test the octave-plus above that point, although standardization does not exist to the same degree. (One such audiologist, who happens also to be an engineering-trained audiophile, is Paul Milner, whose Hearing Care Center, in Sharon, Massachusetts, may be reached at (617) 784-1944; for a full report on some of his work with audiophiles, refer to the Boston Audio Society *Speaker* V. 19, No. 1 [write PO Box 211, Boston, MA 02126].)

The bad news was that I do not hear very low-level sounds above 6kHz or so quite as well as the norm for my age, although I process regular-level sound just fine up to 14–16kHz. The American-TV whistle bothers me, but not as much as it does some others. The good news is that, in reading about the listener-selection phase of the Bang & Olufsen/Archimedes/Eureka project as reported on in the July/August 1992 *JAES*, I discovered that by its rather strict criterion my hearing is regarded as otologically normal to 8kHz. Otologically normal for B&O means having 250Hz–8kHz detection thresholds within 15dB of those of a healthy 18-year old with no excessive wax and no known ear pathology or undue exposure to noise.

More on Cubism and Least-Cubism

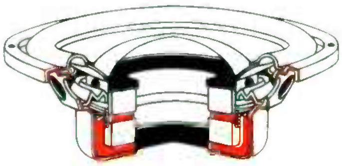
After another of my recent sermons on the desirability of "least-cubes" proportions both for listening rooms and for speaker placement therein (*SB* 4/91, p. 52),

Continued on page 70

World Radio History

MW142

DPC Cone Double Magnet 5″ Woofer



A 5″ unit with a unique design, incorporating an extremely large diameter aluminium voice coil for such a small unit.

Vented double magnet system with steel chassis — damped polymer composite cone — rubber surround — smooth response to upper limit of 5 Khz with excellent on and off axis response and good roll off.

High power handling emanates from this unique design, resulting in a very impressive small bass/mid or mid range unit.

Specification

Overall Dimensions	⌀-142mm(5.5″) x 52mm(2″)
Nominal Power Handling (Din)	150 W
Transient Power — 10ms	1000 W
Voice Coil Diameter	75mm(3″)
Voice Coil Type / Former	Hexatech Aluminium
Frequency Response	48-5000 Hz
FS — Resonant Frequency	52 Hz
Sensitivity 1W/1M	86 dB
Z — Nominal Impedance	8 ohms
RE — DC Resistance	5.2 ohms
LBM — Voice Coil Inductance @ 1 Khz	0.5 mh
Magnetic Gap Width	1.35mm(0.053″)
HE — Magnetic Gap Height	5mm(0.196″)
Voice Coil Height	12mm(0.47″)
X – Max. Linear Excursion	3.5mm(0.137″)
B — Flux Density / BL Product (BXL)	0.6 T / 5.0 NA
Qms — Mechanical Q Factor	2.14
Qes — Electrical Q Factor	0.62
Q/T — Total Q Factor	0.45
Vas — Equivalent Cas Air Load	7 litres (0.25 ft³)
MMS — Moving Mass / Rmec	13gm / 2.06ns/m
SD — Effective Cone/Dome Area	90 cm²
Cone/Dome Material	DPC (Damped Polymer Composite)
Nett Weight	0.97 kg

Specifications given are as after 24 hours of running.

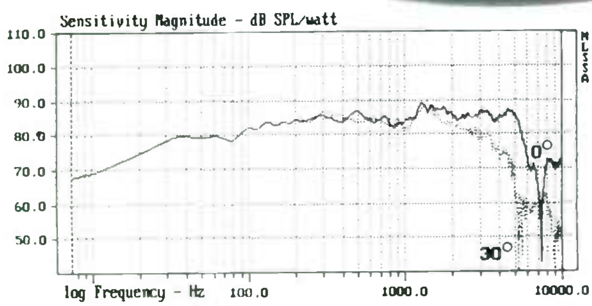
morel

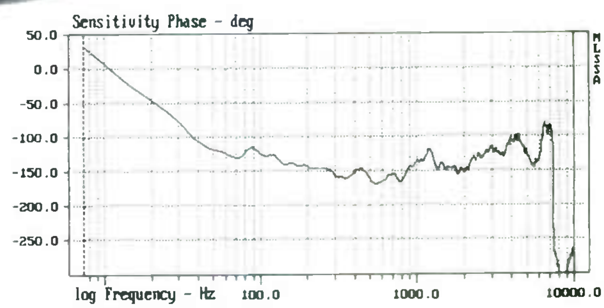
high fidelity
range

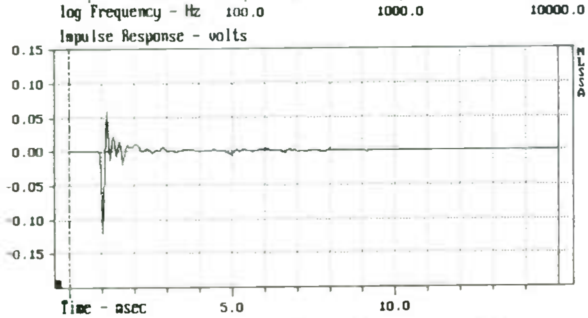
morel (U.K.) ltd.
Foxtail Road,
cton Rd (Ransomes)
ustrial Estate,
wich, IP3 9RT
gland
(0473) 719212
ex:987601 Morel G

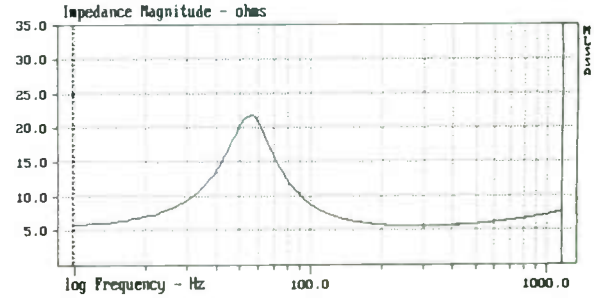
morel acoustics USA
Harvard Street
okline, MA 02146
: (617) 277-6663
X: (617) 277-2415

morel®









Morel operate a policy of continuous product design improvement, consequently specifications are subject to alteration without prior notice. *Fast Reply #KG1407*

World Radio History

Continued from page 68
I was asked from the audience what precisely would be good corner-distance ratios to start with when relocating one's speakers. The free Allison software calculating good and bad boundary augmentation for loudspeaker woofers (*SB* 4/91, p. 52; 5/91, p. 91; 6/91, p. 90; 1/92, p. 82; 2/92, p. 79) recommends beginning with 1:2:3, 1:2.8:4, 1:3:5, or 1:1.75:3.1. Note that all of the middle values are on the upper side (from 1% to 40%) of the geometric mean of the long and short distances (recall that the geometric mean of a and c is b, where $b^2 = a \times c$), so perhaps there is a rule here. Almost any such staggering gives improved results, with wonderfully full, natural lower-midrange and upper-bass sound. It is quite unlike what you probably are used to, especially if your speakers are on stands or your cabinets' woofers are at stand-equivalent height. (Refer also to last issue's B&W problems.)

But what if you must have stands, or their equivalent, out in the room? What can you do? Well, here is a listing of the approximate EQ boosts you will need for accurate playback, should you happen to have an equalizer handy and are willing to use it. (⅓- or ½-octave equalizers work best, but octave units can work okay in this application if you slightly depress the sliders on either side of the boosted one.)

This listing assumes that your 6″ or 8″ woofer is a couple of feet off the floor and that its distances to the side and front wall are equal or nearly so. If that distance is a foot, you will need some 4dB of peaking at 400Hz; for 18″ you will want almost twice that at 200Hz; for 24″ it's worst-case, needing +10–12dB at 160Hz; for 30″ it's +7–8dB at 140Hz and for 36″ it's +5–6dB at 115Hz; for 42″ it's 5dB of boost at 100Hz; and for 48″ placement from front and side walls you'll want +3dB at 200–250Hz, with 6″ woofers probably also needing a general bass boost from 125Hz down.

Obviously, it is preferable to stagger the distances from the near corner, and not have even two of them the same. As mentioned, bookshelf placement with the speaker surrounded by books almost invariably produces amazingly smooth and detailed upper-bass/lower-midrange playback—but ,of course, if you do something like that, everyone will know you can't possibly be a genuine, serious, card-carrying audiophile.

Now, what about a listening room? Again, it helps to compute some geometric means and to think "least-cubes." If you survey the recommendations of the regularly cited researchers L.W. Sepmeyer (*Journal* of the Acoustical Society of America V. 37, No. 3, 1965) and M.M. Louden (*Acustica* V. 24, 1971), domestic rectangular rooms (parallelepipeds, technically) appear to have the most even and euphonious distribution of resonances if their length "l" is 139–233% of their height "h," and their width "w" is 93–110% of the geometric mean of $l \times h$ (i.e., $w^2 = lh$). The venerable 1:1.26:1.6 ratio lies within this continuum. For an approximately 8′ ceiling, then, ideal lengths range from 11′ to 19′ and ideal widths from 9′ to 13′ provided that l and w satisfy the geometric-mean limits just given. Like most shoebox-style living rooms, my main listening room is somewhat too long.

Oh yes, also try to ensure that your listening chair's own placement does not result in your head's being equidistant from floor (that will likely be 3′ or so, of course), back wall, and side wall(s).

More on Clark Johnsen and VMPS

In *SB* 4/92, letter-writer Clark Johnsen complained about my measurements and evaluation of the VMPS Tower IISE loudspeaker at his Listening Studio dealership in Boston. Those who wish to assess the justice of his complaint will want to know that another measurement of the same speaker, taken a year later and by a different audiophile, along with detailed characterization of its sound by yet a third disinterested individual, appears in the BAS *Speaker* V. 19, No. 3.

MCM ELECTRONICS


#53-290

NEW #53-320


NEW #53-325

Introducing
High-Quality Titanium Dome Tweeters From MCM Electronics

These state-of-the-art Titanium Tweeters offer brilliant high frequency response with superior musical clarity. The rigid titanium dome reduces uncontoured tonal qualities often experienced with common cloth dome tweeters. All three of these Titanium Tweeters come with an 8ohm 1″ voice coil and produce a great sound. Call MCM Electronics to get your pair of titanium dome tweeters today!

Order #	Description	Power Handling	SPL 1W/1M	Price (1-3)	Price (4-up)
53-290	Titanium Dome Tweeter with Protective Grill	50W	92dB	$14.95	$12.50
53-325	Titanium Dome Tweeter (Non-Horn loaded)	25W	96dB	12.95	10.95
53-320	Economical Titanium Dome Tweeter	20W	93dB	9.95	7.95

For A Free Catalog Call:
1-800-543-4330
To Order By FAX: 1-513-434-6959
For Product Questions: 1-800-824-TECH (8324)
Prices subject to change without notice.

mcm
MCM ELECTRONICS
650 CONGRESS PARK DR.
CENTERVILLE, OH 45459-4072
A PREMIER Company

SB-06

Fast Reply #KG1416

World Radio History

Parts Express International Inc.

INTRODUCES Dayton Loudspeaker Co.

The Dayton Loudspeaker line was developed with the audiophile in mind. The high tech woofers incorporate a Kevlar reinforced paper cone with a special polymer resin coating that gives it the long life of plastic and the sound performance of paper. And specially developed voice coils, as well as reinforced baskets and vented pole pieces deliver added power handling capability. Choose Dayton Loudspeaker for the quality you can count on day in and day out.

5" High Power Woofer

ligh power woofer featuring a aper cone reinforced with Kevlar fibers and coated with olymer resin for added tiffness. A Kapton voice coil ormer is edgewound with eavy gauge ribbon wire and a ented pole piece allows naximum heat dispersion to eep the voice coil cool and ncrease power handling. he special double reinforced teel basket performs as well s a die-cast, but at a fraction of the cost. Power handling: 450 watts RMS, 35 watts maximum. Resonant frequency: 26.6 Hz. Frequency response: 20-,000 Hz. SPL: 93.8 dB 1W/1M. 2-1/2" voice coil. 80 oz. magnet. 8 ohm mpedance. VAS= 11.3cu ft. QTS= .38, QMS= 12.9, QES= .40. Dimensions: = 15", B= 7", C= 4-1/2, D= 1-3/4". Net weight: 9-1/2 lbs.

#SH-295-050	$135.50 (1-3)	$121.50 (4-up)

2" High Power Woofer

ligh power woofer featuring a paper cone reinforced with Kevlar fibers and coated with polymer resin for added tiffness. A Kapton voice coil ormer is edgewound with eavy gauge ribbon wire and a vented pole piece allows naximum heat dispersion to eep the voice coil cool and ncrease power handling. The pecial double reinforced steel basket erforms as well as a diecast, but at a fraction of the cost. Power andling: 400 watts RMS, 560 watts maximum. Resonant frequency: 7.2 Hz. Frequency response: 20-3,000 Hz. SPL= 92.5 dB 1W/1M. " voice coil. 80 oz. magnet. 8 ohm impedance. VAS= 5.8 cu ft., QTS= 28, QMS= 12.0, QES= .29. Dimensions: A= 12", B= 7", C= 4", D= 1-3/4". let weight: 15 lbs.

#SH-295-040	$117.50 (1-3)	$105.50 (4-up)

" High Power Woofer

his high power woofer features a aper cone reinforced with Kevlar ibers and coated with a polymer esin for added stiffness. A Kapton oice coil former is edgewound vith heavy gauge ribbon wire and a vented pole piece allows naximum heat dispersion to keep he voice coil cool and increase ower handling. The special louble reinforced steel basket erforms as well a die cast, but at a fraction of the cost. Power handling: 250 vatts RMS, 350 watts maximum. Resonant frequency: 48.5 Hz. Frequency esponse: 30-3,000 Hz. SPL= 88 dB 1W/1M. 2" voice coil. 50 oz. magnet. ohm impedance. VAS= .5 cu ft. QTS= .39, QMS= 13.4, QES= .41. imensions: A= 8-1/8", B= 5-1/2", C= 2-3/4", D= 1-1/2". Net weight: 9 lbs.

#SH-295-020	$65.95 (1-3)	$59.50 (4-up)

10" High Power Woofer

High power woofer featuring a Kevlar reinforced paper cone and coated with a polymer resin for added stiffness. A Kapton voice coil former is edgewound with heavy gauge ribbon wire and a vented pole piece allows for maximum heat dispersion to keep the voice coil cool and increase power handling. The special double reinforced steel basket is as rigid as diecast, but at a fraction of the cost. Power handling: 375 watts RMS, 530 watts maximum. Resonant frequency: 31.5 Hz. Frequency response: 25-3,000 Hz. SPL= 92.3 dB 1W/1M. 2" voice coil. 50 oz. magnet. 8 ohm impedance. VAS= 4.6 cu ft., QTS= .38, QMS= 11.3, QES= .39. Dimensions: A= 10-1/8", B= 5-3/4", C=3-1/2", D=1-3/4". Net weight: 10 lbs.

#SH-295-030	$79.50 (1-3)	$71.50 (4-up)

Surface Mount Piezo Super Tweeter Pair

This extremely small tweeter incorporates all the advantages of piezo tweeters into a small package that can be mounted almost anywhere. Ideal for mounting on the back of rearview mirrors in car stereo installations. Frequency response: 5,000-20,000 Hz. SPL: 97 dB 1W/1M. Power handling: 80 watts RMS, when used with a 4.7 microfarad capacitor. When power exceeds 25 watts RMS, a 15 ohm, 20 watt resistor can be used in series. Sold in pairs. Net weight: 1/2 lb.

#SH-265-267	$24.00 (1-3 prs.)	$22.50 (4 prs-up)

Speaker Switching Center

Gives you the ability to switch On or Off up to five speakers simultaneously or individually. Internal resistance network fully protects your amplifier against impedance mismatch and overload. Automatic resetting circuit breakers. 50 watts per channel power rating. Modern design. Pushbutton terminal inputs and outputs. Headphone jack output on front of unit.
Dimensions: 8" (L) x 3-1/8" (W) x 2-1/4" (H). Net weight: 2 lbs.

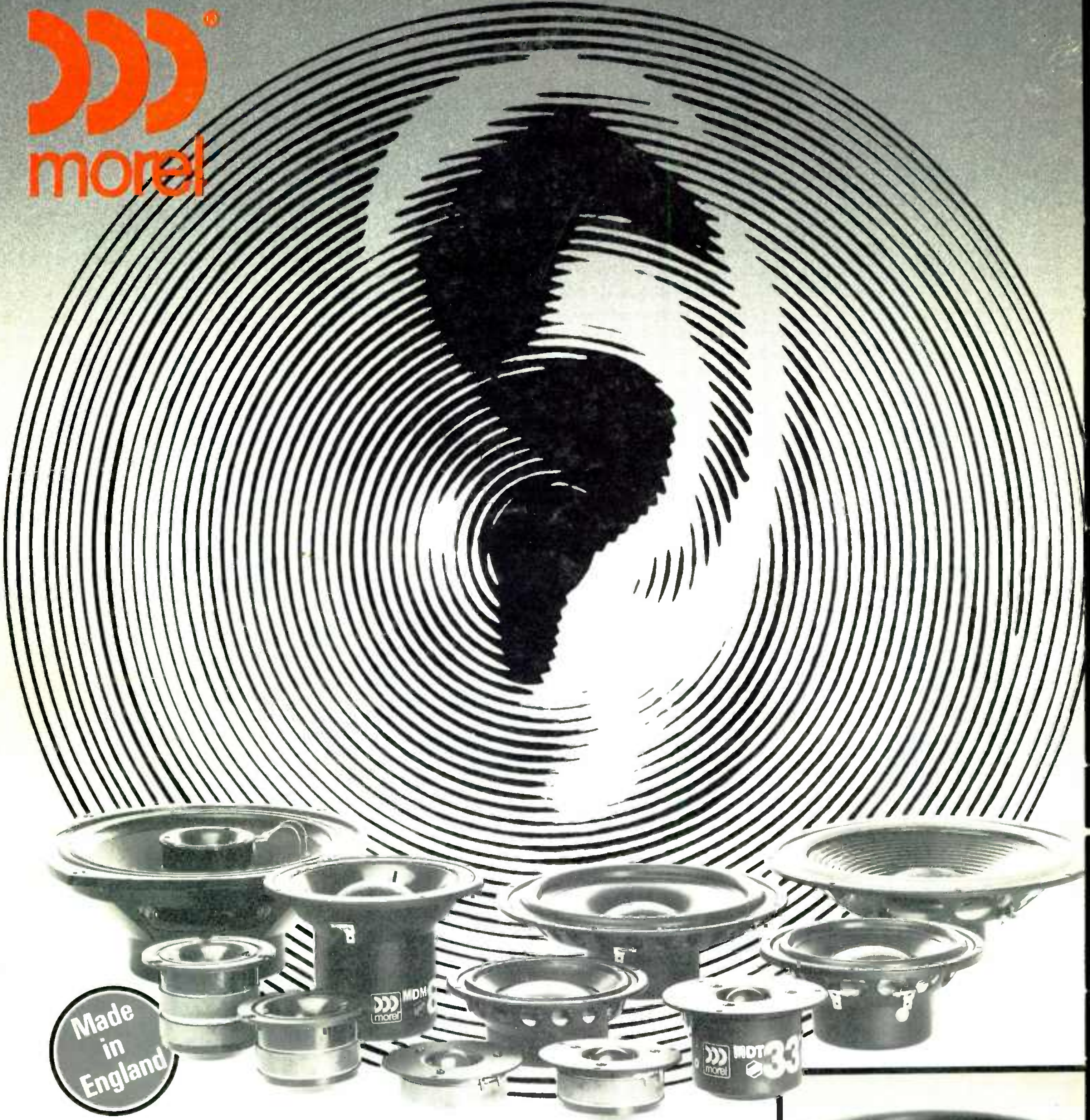
#SH-240-075	$29.95 (1-5)	$27.90 (6-up)

CALL FOR A FREE CATALOG 1-800-338-0531

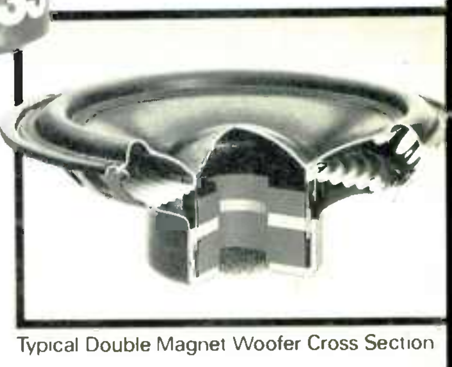
Fast Reply #KG81

Parts Express Int'l. Inc. 340 E. First St. Dayton, Ohio 45402

World Radio History



High-Tech Audiophile Loudspeakers



Typical Double Magnet Woofer Cross Section

For Further Information Please Contact: **morel acoustics USA**

414 Harvard Street
Brookline, MA 02146
Tel: (617) 277-6663
FAX: (617) 277-2415

Fast Reply #KG142

World Radio History