

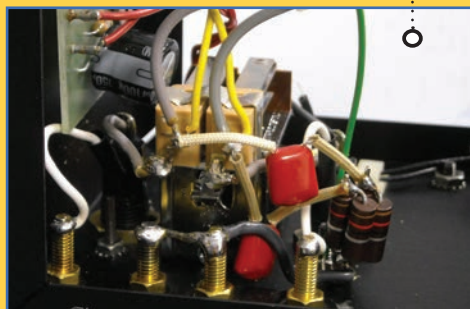
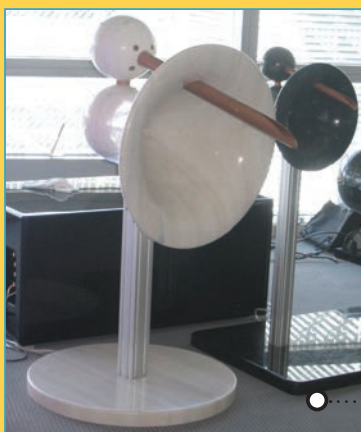
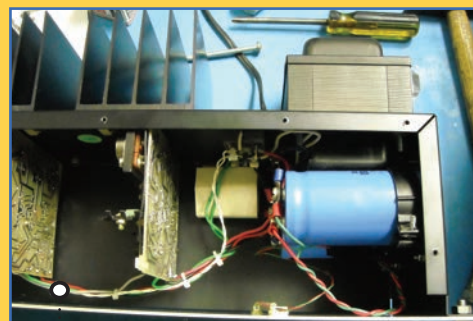
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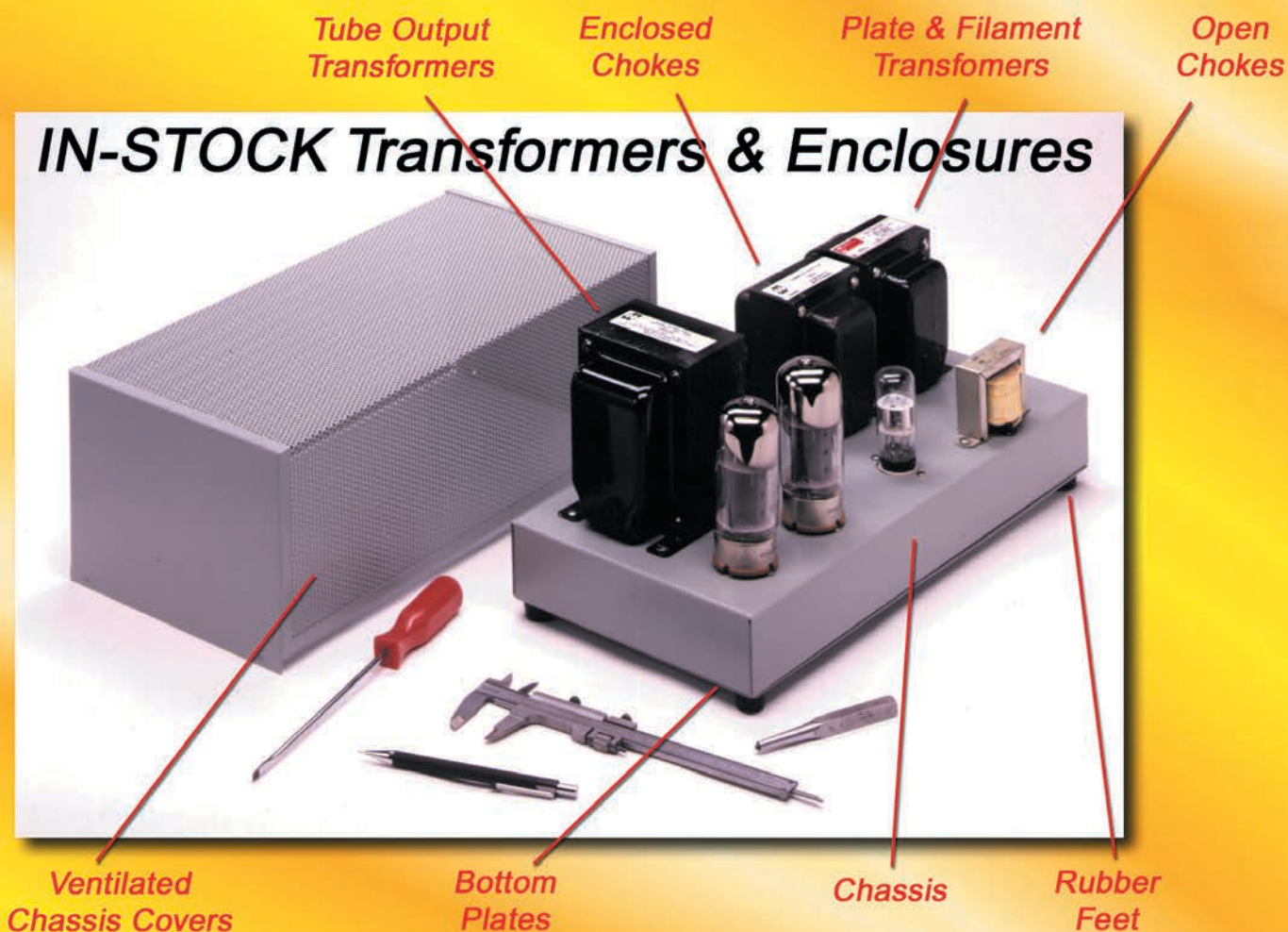
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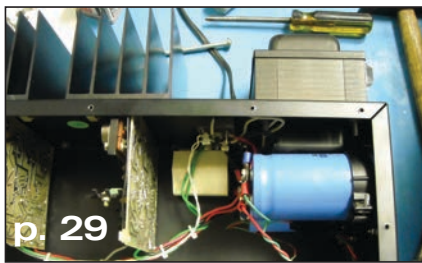
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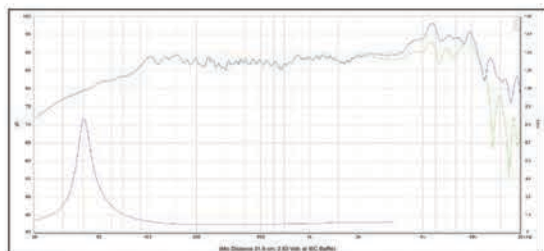


5" SB15MFC30-8

WHAT'S NEW



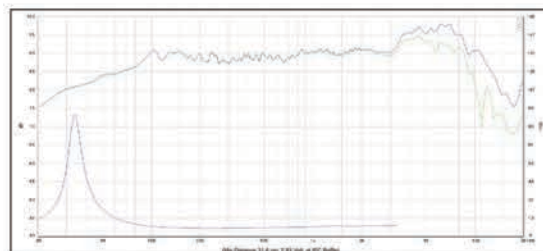
6" SB17MFC35-8



Specs :

Nominal Impedance	8 Ω	Free air resonance, F _s	41 Hz
DC resistance, R _e	5.7 Ω	Sensitivity (2.83 V/1m)	87 dB
Voice coil inductance, L _e	0.14 mH	Mechanical Q-factor, Q _{ms}	5.5
Effective piston area, S _d	88 cm ²	Electrical Q-factor, Q _{es}	0.4
Voice coil diameter	30.5 mm	Total Q-factor, Q _{ts}	0.37
Voice coil height	15 mm	Moving mass incl air, m _d	9 g
Air gap height	5 mm	Force factor, Bl	5.7 Tm
Linear coil travel (p-p)	10 mm	Equivalent volume, V _{as}	18.7 liters
Magnetic flux density	1.0 T	Compliance, C _{ms}	1.7 mm/N
Magnet weight	0.54 kg	Mechanical loss, R _m	0.4 kg/s
Net weight	1.47 kg	Rated power handling	50 watt

The parameter are measured on drive units that are broken in



Specs :

Nominal Impedance	8 Ω	Free air resonance, F _s	34 Hz
DC resistance, R _e	5.7 Ω	Sensitivity (2.83 V/1m)	88 dB
Voice coil inductance, L _e	0.15 mH	Mechanical Q-factor, Q _{ms}	5.5
Effective piston area, S _d	118 cm ²	Electrical Q-factor, Q _{es}	0.4
Voice coil diameter	35.5 mm	Total Q-factor, Q _{ts}	0.35
Voice coil height	16 mm	Moving mass incl air, m _d	11.8 g
Air gap height	5 mm	Force factor, Bl	6.2 Tm
Linear coil travel (p-p)	11 mm	Equivalent volume, V _{as}	37.5 liters
Magnetic flux density	1.0 T	Compliance, C _{ms}	1.89 mm/N
Magnet weight	0.54 kg	Mechanical loss, R _m	0.5 kg/s
Net weight	1.56 kg	Rated power handling	60 watt

The parameter are measured on drive units that are broken in

THE
SPECS



Specs :

Nominal Impedance	6 Ω	Free air resonance, F _s	20 Hz
DC resistance, R _e	4.5 Ω	Sensitivity (2.83 V/1m)	89 dB
Voice coil inductance, L _e	3.0 mH	Mechanical Q-factor, Q _{ms}	4.5
Effective piston area, S _d	312 cm ²	Electrical Q-factor, Q _{es}	0.31
Voice coil diameter	75.6 mm	Total Q-factor, Q _{ts}	0.29
Voice coil height	28.5 mm	Moving mass incl air, m _d	132 g
Air gap height	6 mm	Force factor, Bl	15.4 Tm
Linear coil travel (p-p)	22 mm	Equivalent volume, V _{as}	86 liters
Magnetic flux density	0.63 T	Compliance, C _{ms}	0.48 mm/N
Magnet weight	2.1 kg	Mechanical loss, R _m	3.7 kg/s
Net weight	5.38 kg	Rated power handling	200 watt

The parameter are measured on drive units that are broken in

10" SB29SWNRX-S75-6
Drivers



Specs :

Nominal Impedance	6 Ω	Free air resonance, F _s	19 Hz
DC resistance, R _e	4.5 Ω	Sensitivity (2.83 V/1m)	88 dB
Voice coil inductance, L _e	3.0 mH	Mechanical Q-factor, Q _{ms}	5.0
Effective piston area, S _d	508 cm ²	Electrical Q-factor, Q _{es}	0.34
Voice coil diameter	75.6 mm	Total Q-factor, Q _{ts}	0.32
Voice coil height	28.5 mm	Moving mass incl air, m _d	154 g
Air gap height	6 mm	Force factor, Bl	15.4 Tm
Linear coil travel (p-p)	22 mm	Equivalent volume, V _{as}	164 liters
Magnetic flux density	0.63 T	Compliance, C _{ms}	0.48 mm/N
Magnet weight	2.1 kg	Mechanical loss, R _m	3.7 kg/s
Net weight	5.55 kg	Rated power handling	200 watt

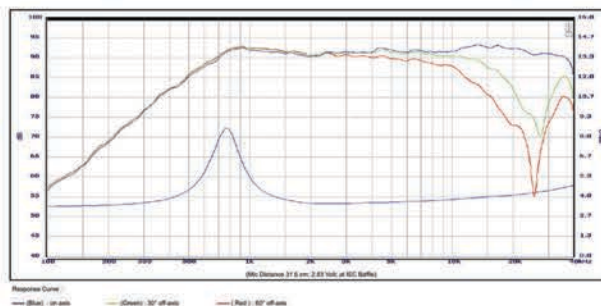
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12" SB34SWNRX-S75-6
Drivers



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Audio Events, Tech, and Projects

As many of you know, the Elektor group, which owns this publication, also publishes several other distinguished periodicals, including *Elektor*, *Voice Coil*, *The World Tube Directory*, *The Loudspeaker Industry Sourcebook*, and *Circuit Cellar*. Although each magazine has its own focus, many readers will be interested in more than one of them. Why? Two commonalities stand out. One is the technical nature of the content we present. We deliver essential information for competent professionals, hobbyists, and enthusiasts on a variety of technical topics so they can excel at their workplaces and home workbenches. The second similarity is the international scope of each publication. This isn't

a coincidence. The editorial staffs of all the magazines search the globe on a daily basis to find the most relevant content for their readers. In turn, each magazine features articles about exciting ideas, topics, and technologies from talented authors from around the globe.

This issue highlights just how well *audioXpress* fits in the Elektor group's catalog of publications. We're delivering on the promise I made in the September issue. You're getting more content and we're broadening *audioXpress*'s coverage. Let's review.

This issue has an international flavor, with authors from the U.S. and The Netherlands. We also provide coverage of audio events in such diverse cities as Orlando (p. 32) and Munich (p. 36).

In addition to useful product updates and audio event reviews, we're running technical articles on a test of a 6.5" full-range driver (p. 8), an upgrade of a Phase Linear 200 amp (p. 26), and a simple hybrid amp design (p. 30). I also hope you'll enjoy the two special sections we included. On page 17 we're presenting an in-depth interview with publishing legend Ed Dell. And on page 42, we test your audio tech skills with a crossword puzzle.

I'm confident you'll enjoy this issue. I promise it's both educational and entertaining. Let me know what you think!

Regards,

C. J. Abate
editor@audioxpress.com

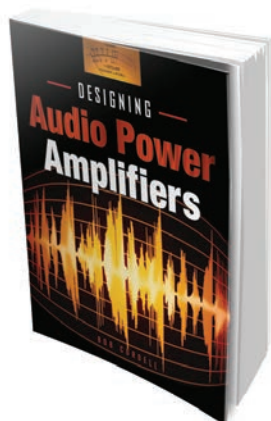
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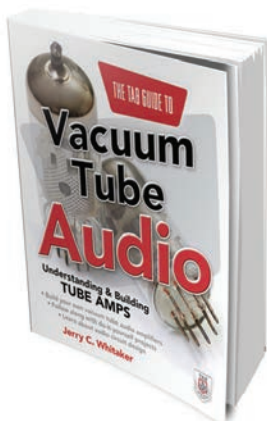
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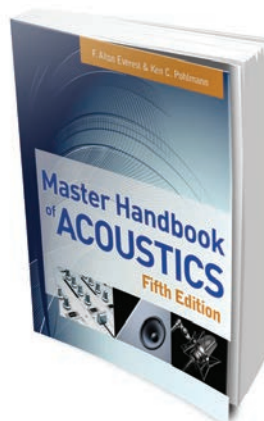
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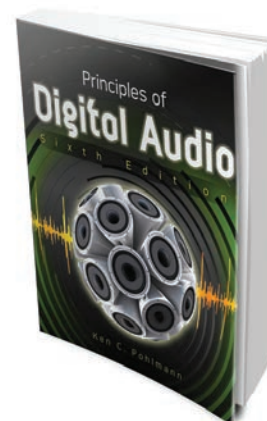
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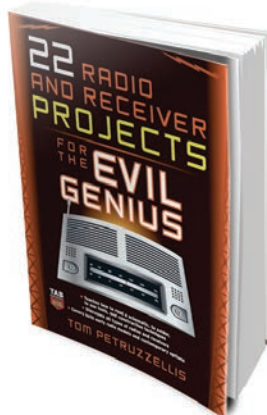
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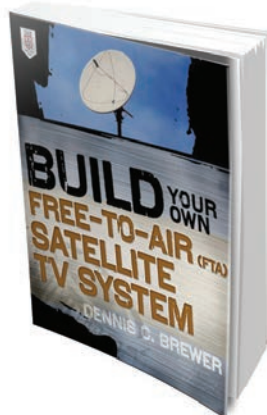
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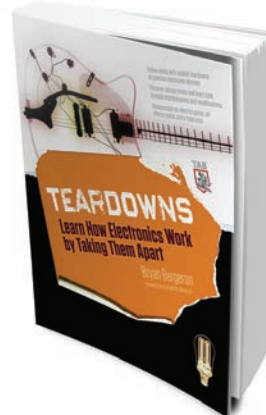
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Full-Range Driver Test

A test of the Dayton Audio 6.5" PS180-8 full-range driver

The driver I am testing is a new one from Dayton Audio, the full-range 6.5" PS180-8 (Photo 1). Large diameter (5.25"-8") full-range drivers have a rather cult following in the world of audiophile home speakers, both manufactured and DIY built. Fostex was probably one the early providers of transducers for this type of driver and is still popular today. Other driver manufacturers such as Lowther and Mark Audio have also figured prominently in this type of format.

When I was a judge at one of Parts Express's sponsored DIY speaker contests a few years back, certainly large diameter (6.5" and 8") full-range drivers were well represented. The feeling among the group of practitioners in this narrow spectrum of loudspeaker design formats is that a well executed full-range 6.5" is capable of providing the most "realistic" audio experience of any other format. Enter the new Dayton PS180 full-range 6.5" neodymium motor transducer.

Starting with the frame, PE utilized cast aluminum frame incorporating six 5-mm diameter vent holes in the area below the spider mounting shelf, plus the frame well as providing a heat-sink for the neodymium motor. The cone assembly is comprised of a lightweight paper cone and paper whizzer cone to extend the upper frequency

response. Compliance is provided by an "M" shaped pleated cloth surround, making the format a lot like a pro sound driver, using the same techniques to achieve high efficiency. This was done so as to make the driver easier to drive with low Watt class A amplifiers such as single triode tube designs. Remaining compliance comes from a 3.5" diameter flat cloth spider.

The motor design on the Dayton PS180 is rather sophisticated (due in part to the transducer consulting work performed by Patrick Turnmire of Red Rock Acoustics) and includes an undercut T-pole with a copper cap as well as a copper-plated articulated phase plug/shorting gap glued to the top of the pole (this will be obvious when you see the shallow reactive upper rise in the driver's 1-V impedance curve).

The neodymium ring magnet motor is FEA designed using a 1" diameter voice coil with copper wire wound on a non-conducting Kapton former. Motor parts, the T-yoke and front plate are coated with a black heat emissive coating for improved cooling (no other



Photo 1: The new full-range 6.5" PS180-8 driver from Dayton Audio

vents such as pole or peripheral back plate vents are used.) Last the voice coil is terminated to a pair of chrome-color coated push terminals. Cosmetically speaking, this is very good-looking driver.

I began analysis of the PS180 using the LinearX LMS analyzer and Vibox to create both voltage and admittance (current) curves with the driver clamped to a rigid test fixture in free-air at 0.3 V, 1 V, 3 V, 6 V, and 10 V. As with almost all 6.5" drivers, the 10-V curves were too nonlinear for LEAP to get a reasonable curve fit and were discarded.

As has become the protocol for Test Bench testing, I no longer use a single

Table 1: Dayton Audio PS180-8 full-range

	TSL model		LTD mode		Factory
	sample 1	sample 2	sample 1	sample 2	
F_s	55.9Hz	51.7Hz	54.2Hz	50.1Hz	48.2Hz
R_{EVC}	6.38	6.18	6.38	6.18	6.32
S_d	0.0137	0.0137	0.0137	0.0137	NA
Q_{MS}	4.16	5.91	4.09	6.13	3.86
Q_{ES}	0.31	0.27	0.34	0.30	0.24
Q_{TS}	0.29	0.27	0.31	0.29	0.23
V_{AS}	29.9 ltr	35.0 ltr	2.1 ltr	37.6 ltr	40.5 ltr
SPL 2.83V	94.2dB	94.3dB	93.6dB	93.8dB	94.7dB
X_{MAX}	4.6mm	4.6mm	4.6mm	4.6mm	4.6mm

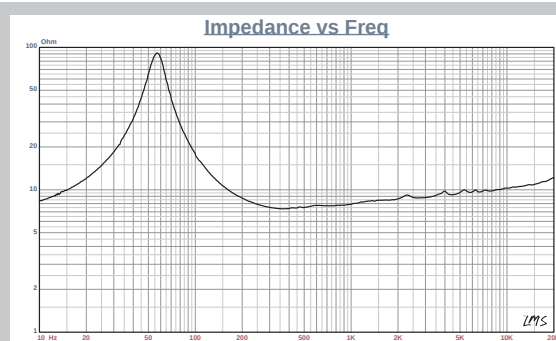


Figure 1: Dayton Audio PS180 full-range, free-air impedance plot



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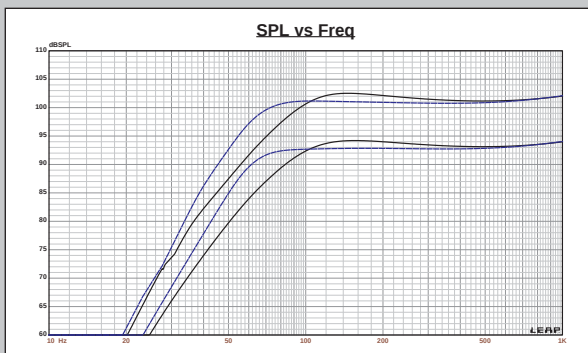


Figure 2: Dayton Audio PS180 computer box simulations (black solid = vented 1 at 2.83 V; Blue dash = vented 2 at 2.83 V; black solid = vented 1 at 7.5 V; blue dash = 2 vented at 7.5 V)

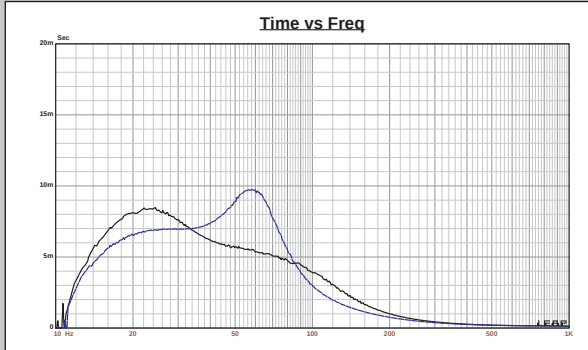


Figure 3: Group delay curves for the 2.83-V curves in Figure 2



Figure 4: Cone excursion curves for the 7.5-V curves in Figure 3

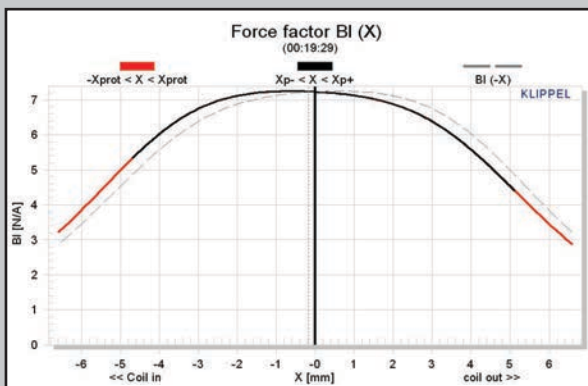


Figure 5: Klippel Analyzer BI (X) curve for the Dayton Audio PS180

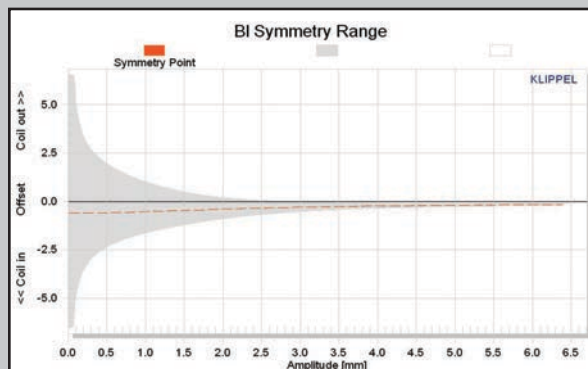


Figure 6: Klippel Analyzer BI Symmetry Range curve for the Dayton Audio PS180

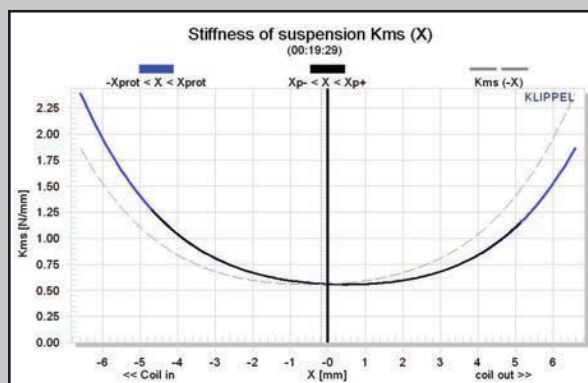


Figure 7: Klippel Analyzer Mechanical Stiffness of Suspension Kms (X) curve for the Dayton Audio PS180

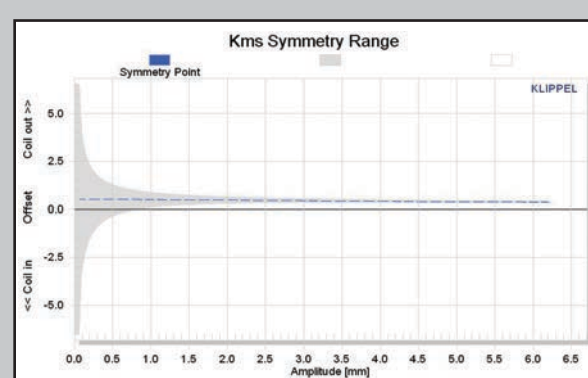


Figure 8: Klippel Analyzer Kms Symmetry Range curve for the Dayton Audio PS180

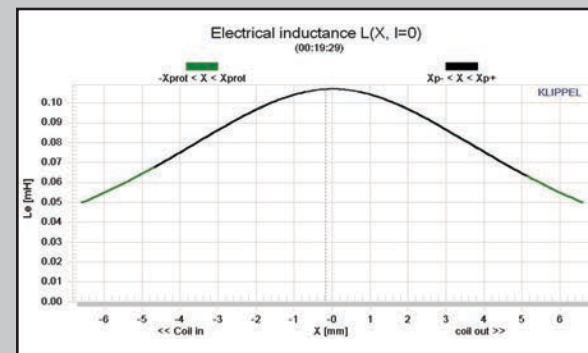


Figure 9: Klippel Analyzer L(X) curve for the Dayton Audio PS180

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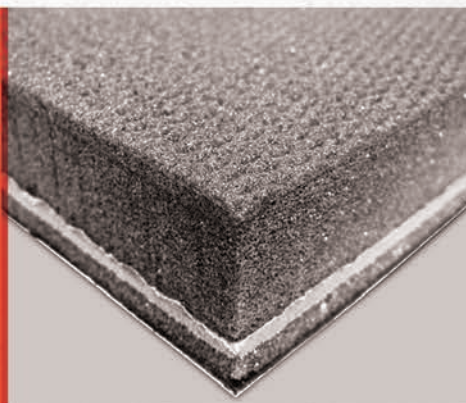
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added mass measurement and instead used actual measured mass, but the manufacturer's measured Mmd data (6.28 grams). Next, the remaining eight 550-point stepped sine wave sweeps for each PS180 sample were post-processed and the voltage curves divided by the current curves (admittance) to derive impedance curves, phase added by the LMS calculation method, and along with the accompanying voltage curves, imported to the LEAP 5 Enclosure Shop software.

Since the most Thiele-Small data provided by the majority of OEM manufacturers is generated using either the standard model or the LEAP 4 TSL model, I additionally created a LEAP 4 TSL parameter set using the 1-V free-air curves.

The complete data set, the multiple voltage impedance curves for the LTD model (see **Figure 1** for the 1-V free-air impedance curve) and the 1-V impedance curve for the TSL model were selected in the transducer derivation menu in LEAP 5 and the parameters created for the computer box simulations. **Table 1** compares the LEAP 5 LTD and TSL data and factory parameters for both PS180-8 samples.

LEAP parameter Qts calculation results for the PS180 were somewhat higher compared to the factory data. Although the preliminary factory data showed some variation, I followed my usual protocol and proceeded setting up computer enclosure simulations using the LEAP LTD parameters for Sample 1. Two computer vented box simulations were programmed into LEAP 5, one QB3 with a 0.34 ft³ volume tuned to 67 Hz and an Extended Bass Shelf (EBS) vented enclosure with a 0.73 ft³ volume tuned to 60 Hz, both enclosures simulated with 15% fiberglass damping material.

Figure 2 displays the results for the Dayton PS180-8 in the two vented boxes at 2.83 V and at a voltage level sufficiently high enough to increase cone excursion to Xmax + 15% (5.3 mm for the PS180). This produced a F3 frequency of 89 Hz (F6 = 75 Hz) for the QB3 enclosure and -3 dB = 60 Hz (F6 = 53 Hz) for the EBS vented simulation.

Increasing the voltage input to the

simulations until the maximum linear cone excursion was reached resulted in 102.7 dB at 7.5 V for the QB3 enclosure simulation and 101 dB for the same 7.5-V input level for the larger vented box (see **Figures 3** and **4** for the 2.83 V group delay curves and the 7.5-V excursion curves). Note that because both drivers reach maximum excursion at about 20 Hz, a steep 24 dB/octave high-pass filter would increase the power handling of both box examples but a substantial margin.

Klippel analysis for the Dayton 6.5" full-range (our analyzer is provided courtesy of Klippel GmbH), performed by Pat Turnmire, Red Rock Acoustics (author of the SpeaD and Rev-SpeaD software) produced the Bl(X), Kms(X) and Bl and Kms Symmetry Range plots given in **Figures 5** through **8**.

This data is extremely valuable for transducer engineering, so if you

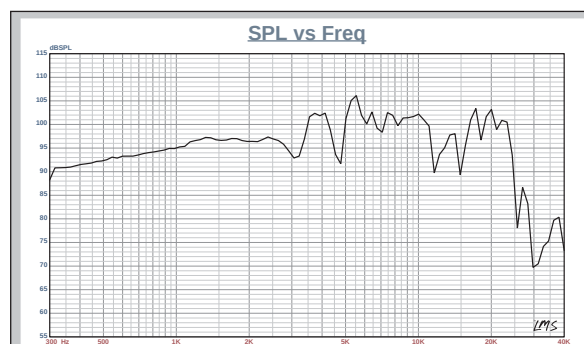


Figure 10: Dayton PS180 on-axis and off-axis frequency response

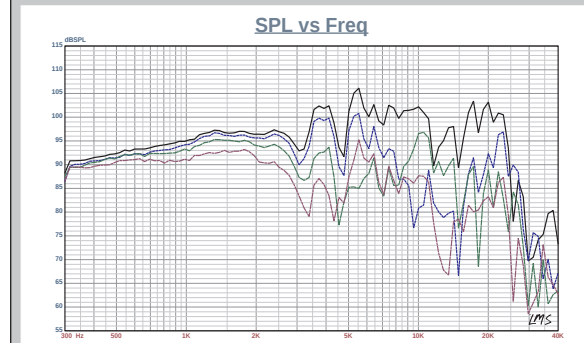


Figure 11: Dayton PS180 horizontal on and off-axis frequency response (0° = solid; 15° = dot; 30° = dash; 45° = dash/dot)

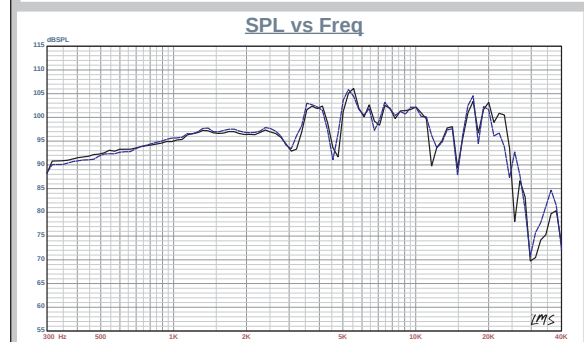


Figure 12: Dayton PS180 two-sample SPL comparison

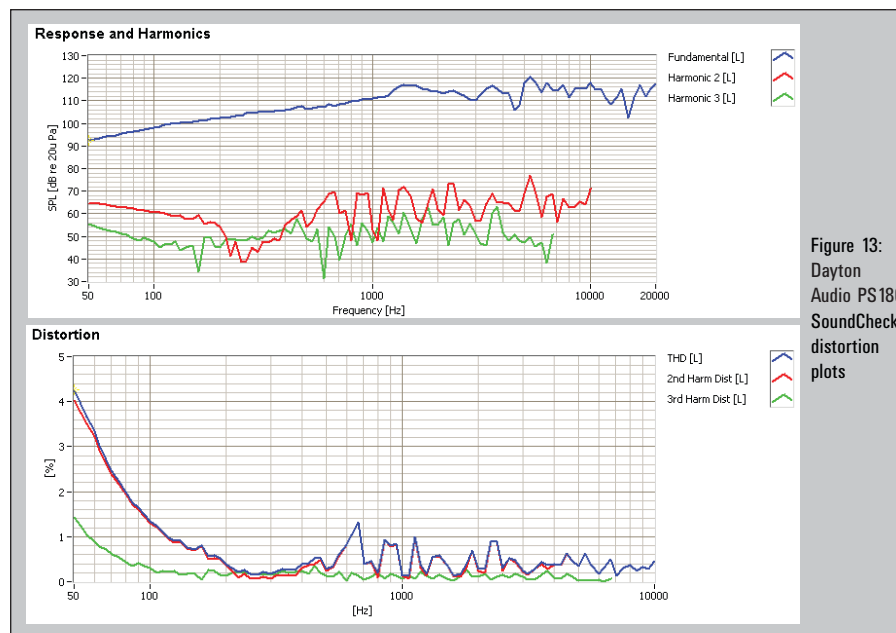


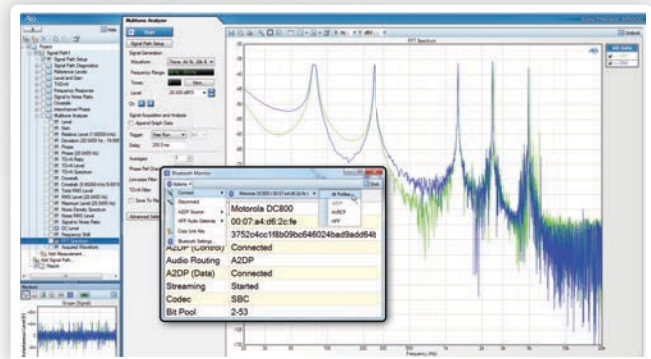
Figure 13: Dayton Audio PS180 SoundCheck distortion plots

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don't own a Klippel analyzer and would like to have analysis done on a particular driver project, Red Rock Acoustics can provide Klippel analysis of most any driver for a nominal fee beginning at \$100 per unit. For contact information, visit the Red Rock Acoustics website at www.redrockacoustics.com.

The B1(X) curve for the PS180-8 (**Figure 5**) is symmetrical and actually moderately broad compared to most 6.5" woofers. Looking at the B1 Symmetry plot (**Figure 6**), this curve shows a small 0.6-mm coil-in offset at the rest position increasing to a trivial 0.21-mm coil-in offset at the Xmax position that stays constant throughout the remaining operating range of the driver.

Figures 7 and 8 show the Kms(X) and Kms Symmetry Range curves for the PS180. The Kms(X) curve is likewise very symmetrical in both directions, but with a small forward (coil-out) offset of about 0.5 mm at the rest position decreasing to 0.47-mm coil-out offset at the physical

Xmax position, which means it stays mostly constant, suggesting a physical offset of magnetic center, but probably within production tolerance. Displacement limiting numbers, calculated by the Klippel analyzer for the PE PS180, were XBI @ 82% BI = 3.6 mm and for XC @ 75% Cms minimum was 2.6 mm, which means that for this Parts Express full-range, the compliance is the most limiting factor for prescribed distortion level of 10%.

Figure 9 gives the inductance curves Le(X) for the PS180-8. Inductance will typically increase in the rear direction from the zero rest position as the voice coil covers more pole area; however, inductance decreases in both directions for this driver due to the intensely effective multiple shorting devices. What you see as a result is a very minor inductance swing with inductive variation of only 0.038 mH from the rest position to the in and out Xmax positions, which is about as good as it gets.

With the Klippel testing completed, I mounted the PS180 full-range in an enclosure which had a 15" x 8" baffle and was filled with damping material (foam) and then measured the device under test (DUT) on and off-axis from 300 Hz to 40 kHz frequency response at 2.83 V/1 m using the LinearX LMS analyzer set to a 100-point gated sine wave sweep.

Figure 10 gives the PS180's on-axis response indicating a smoothly rising response to about 3 kHz. Above that frequency the whizzer cone start coming into the circuit, so the response is fairly uneven above that point, normal for this genre of driver. **Figure 11** displays the on and off-axis frequency response at 0, 15, 30 and 45°. And finally,

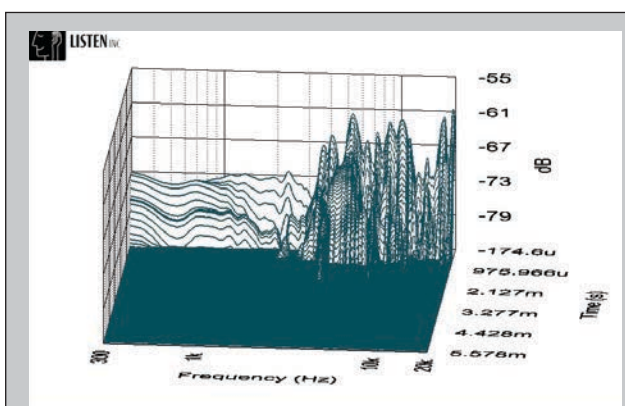


Figure 14: Dayton Audio PS180 SoundCheck CSD Waterfall plot

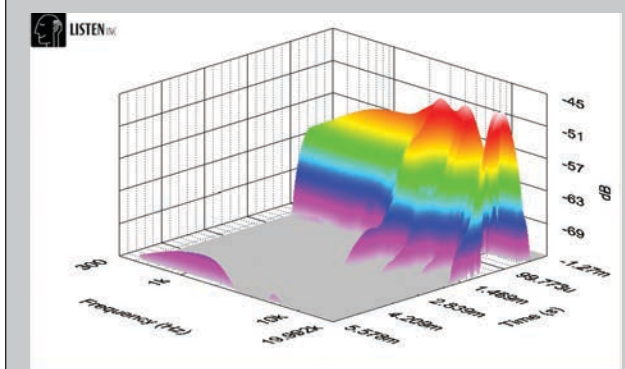


Figure 15: Dayton Audio PS180 SoundCheck Wigner-Ville Surface intensity plot

Figure 12 gives the two-sample SPL comparisons for the 6.5" Dayton driver, showing a mostly close match throughout the operating range.

For the remaining series of tests on the PE PS180, I employed the Listen, Inc. SoundCheck analyzer and SCM microphone (courtesy of Listen, Inc.) to measure distortion and generate time frequency plots. For the distortion measurement, the 6.5" full-range driver was mounted rigidly in free-air, and the SPL set to 94 dB at 1 m (1.83 V) using a noise stimulus, and then the distortion measured with the Listen, Inc. microphone placed 10 cm from the phase plug.

This produced the distortion curves shown in **Figure 13**. I then used SoundCheck to get a 2.83 V/1 m impulse response for this driver and imported the data into Listen, Inc.'s SoundMap Time/Frequency software.

The resulting CSD waterfall plot is given in **Figure 14** and the Wigner-Ville (for its better low-frequency performance) plot in **Figure 15**. For more on this and other Dayton Audio drivers, visit the Parts Express website at www.partsexpress.com. *ax*

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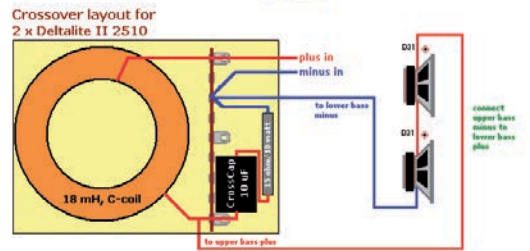
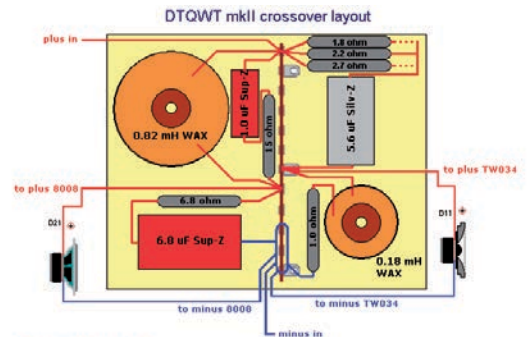
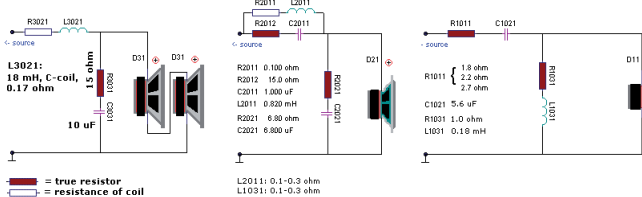
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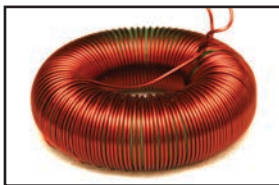
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An Interview with Edward T. Dell

In my audio library, I have several feet of bound magazines: *The Audio Amateur*, *Speaker Builder*, *Glass Audio*, and recently, *audioXpress*. All of them were published for over 40 years by Edward T. Dell, Jr. Who is this man who single-handedly did more for the audio construction hobby than anyone else? To answer this question and more, I visited him in beautiful New England and spent many fascinating hours talking about audio, life, and everything.

Jan Didden (JD): Mr. Dell, we have been communicating, on and off, for almost 30 years, and what has always intrigued me was why you decided to take up publishing about audio design and construction.

Edward T. Dell (ETD): You got a few hours? Seriously, the one red thread through my life is that I am extremely curious about how things work. I wonder how things work. That curiosity has been the basis of most of what I did in my life. My dad worked for Western Electric, the installation division of Western Telephone. We moved all the time. We went to Washington in '42; we moved 27 times before junior high! I know that because I published my dad's memoirs. He was one of the experts who knew how to put in a PABX, shifting over from operators to automatic exchanges so once the job was done we moved again, sometimes after a few months. It became such a habit we kept on moving all the time! Anyway, when I went to college in 1941, we lived in Miami, and I ended up working all summer at Western Electric. I worked on converting Miami Beach telephone exchange from 5 digits to 6 digits. Great experience because I learned color codes, I learned to solder, and learned to do extremely accurate and clean work. For the telephone company, you either



Edward T. Dell in his home office

do it right or you do it over.

JD: How did printing figure in to your education?

ETD: To get through grad school, I took up contract printing. I took on a job for the Psychiatric Association, and finished the job in two weeks. Then I took a printing job for Railway Express in Washington, and I charged them \$9,000 for it! So, literally, printing put me through my education!

JD: I understand that at a certain point you became interested in theology?

ETD: Yes, since I was growing up in a very religious family, I thought I had to be a minister. I earned two bachelor degrees, Arts and Theology. I went to graduate school at Boston University and struggled and slowly earned my grad points. Now, theology is somewhat related to philosophy, same type of questions being asked. But I wasn't really happy in my situation; I was doing what is called supply work in Methodist churches, tak-

ing Sunday services, early Sunday morning, did the service and preach. This was late '40s. I was also teaching in a high school, in Boston, as assistant in the philosophy department, teaching English and Philosophy.

But somehow, I wasn't happy in the fundamentalist atmosphere I grew up in. One time, I was an officer in the State Student Council in Florida and the Continental Convention came to Florida, and we had to entertain student members from across the nation. My parents turned up at a dance and marched me home saying I couldn't even stay to watch. Then, I discovered the Episcopal Church in Boston, in a setting so radically different from what I knew. Two years later, I started to work as a chaplain in Boston. We had a beautifully church, and we did great things. I learned all these interesting things about the history of the Episcopal Church and I was captivated and found this was something I wanted to do. The parish was 50% white and 50% black; it was a great place for reconciliation, for understanding. This was the early '50s, the



Edward T. Dell at work

world was about to go to hell. I worked there for two years, and we worked hard and did well, but they sent in a total idiot as my successor. He destroyed everything I had built up, and I came to realize that you can't count on anything that you do to survive. Nothing really survives.

JD: I remember that the first issues of *The Audio Amateur* came from Old Jaffrey Road in Swarthmore, PA. How did you end up there?

ETD: In my last year in the suburbs, I got a call from a former classmate from seminary. He had just been appointed to a parish in Swarthmore, PA. It is a town half way between Philly and Delaware. He wanted us to come down and visit, and of course, clergy always visits during the week because on the weekends it's business for them!

They had these "parish neighborhood meetings," and I went to one of them. By sheer chance, I ran into the managing editor of the national edition of a brand new magazine *The Episcopalian*. We started talking, and we talked, and talked, and I mentioned C.S. Lewis. Lewis was a phenomenon. I stumbled on him in 1943 when I found his book *Screwtape Letters*. He wrote things about Christianity that were totally different than what had been written in the previous 100 years. I started to get more books by him, every book by him, and there were a lot. [Yes, there's a whole bookcase of them in Mr. Dell's residence!—JD] Lewis became a lifeline for me, the voice of rationality. *Screwtape Letters* discusses Christianity from the viewpoint of the

devil. He talks about how to get this God back into his fold and away from being a Christian. Anyway, to make the story short, I was asked to be book editor for the *Episcopalian*, working from home but meeting with the staff in New York once a month.

JD: What sort of periodical was *The Episcopalian*?

ETD: *The Episcopalian* was a magazine talking about real life for real people in their living rooms. Trying to offer the layman a Christian point of view for what he was seeing, what he was reading, what he did, what he saw in the news, and somewhat about what the Church was doing. But we tried to be independent and not be a house-organ, which in the '60s was no mean trick. The Church, which is supposed to be about communicating the good news of Jesus as the savior of the world is doing a lousy job of it. We were very passionate about it, how we convey the gospel, and those things happening in the street that were part of that gospel.

JD: So there you were an editor!

ETD: Yes, this was my entry into the circle of professional editors; they were all professionals except me. *The Episcopalian* went quite well and got to a 100,000 circulation. In the '60s, my career was very much influenced by my travels. I had saved up some money and bought a ticket on the Queen Mary to England. I was an Anglophile before I got there! This was the early '60s. I walked into the Selfridges store and

found a book called *A Grief Observed* by N.W. Clerk. I knew exactly who that was because he had used that pseudonym before. Lewis wrote poems for *Punch* in the '60s under the *nom de plume* N.W. Clerk. A year before that, I had written to Lewis offering my condolences because his wife Joyce had died and I had expressed my hope he would write something about grief. And this was the book! I called his agent and got an appointment and said I was looking for rights for a book by Lewis. Then I asked about *A Grief Observed* and the man was horrified. I was ushered into the boss' office, and they were scared I was going to blow the whistle. So I bought the rights to it for the *Episcopalian* for \$500 or so, on the condition that I not reveal the pseudonym. I started to write to Lewis in 1945 or thereabouts, and he answered my letters. This was a breakthrough for me because it was an intellectual confirmation that I was on the right track. I visited him twice, once when he was in the hospital. Lewis died the same day Kennedy was killed.

I started to work in Swarthmore six months before I went to England. Our boss at the time was convinced his people should go out in the world. Se gave each of us a major assignment, and we were all sent abroad once in a while. One of us went to Haiti; one went to South America, etc. I was sent to the Pacific, best trip I ever had and I did stories about Hawaii, Philippines, Taiwan, Okinawa, and Tokyo. I travelled 25,000 miles and lost 30 pounds in the process! I learned a lot about Taiwan and gained a deep respect for the country and its people. This trip really changed me; and later on I spend time in France, Denmark, and The Netherlands. Such trips are important and shape your outlook.

JD: What prompted you to start *Audio Amateur*? When was that?

ETD: *Stereophile's* Gordon Holt lived across the street from me, and we met early on. He was fussy about usability before everybody else was talking about it. I was still going to New York once a month, to the area where the Twin Towers later stood, and there were any number of surplus stores with great mil-spec electronics parts for very little money.

I sat down one time with Gordon and said, what's wrong with us? We put the absolutely very best parts in stuff that we never use and it is thrown away when obsolete; yet, we put the crappiest parts in consumer stuff that's used daily, only because we want to sell them another amp in a few years time. So I said to Gordon, what would happen if we take all these marvelous mil-spec parts and build the same exact amplifier that Dynaco builds (Dynaco Stereo 70) but with all those hermetically-sealed, oil-filled caps, Holtek potted filament transformers, and expensive high-quality resistors and switches? So I built it and Gordon drew the schematics, it was a centerfold just for the circuit, and we published it in *Stereophile*. It's a Dynaco 3-tube circuit and the layout clearly shows the influence of Western Electric. It has separate supplies for each channel, DC filaments, delayed DC switch on, the works. Gordon got a storm of criticism for the article and he said, we're not going to publish these construction articles again! So that probably is the first time that the idea of *Audio Amateur* started to grow in my mind. (*A Mr. Landers built this amplifier from the Stereophile article, and his project was published as "The Super Brute" in The Audio Amateur, Issue 3, 1973, still available from www.audioamateur.com—JD*) I called Gordon a few days later when he had cooled off and I said I should start a magazine for people who like to build things. Gordon said it was a great idea, and he lent me his subscriber list, 5,000 people, and that helped get me started. That was really the beginning of *Audio Amateur*.

JD: How difficult was it to combine your day job work with publishing *The Audio Amateur*?

ETD: I worked for the *Episcopalian* for 14 years, and then in 1970 I started *Audio Amateur* as a moonlighting project, a quarterly. As we were living in Swarthmore, I had to commute into Philly daily by train. Those trains had nice seats and you can work for 30 minutes during the ride, not being disturbed. I was, at that time, also manuscript editor for the *Episcopalian*; I did a lot of my editing work during those

train rides!

JD: Looking at the early issues, I see what looks like your entire family on the masthead. Why?

ETD: It really WAS a family affair in those early years! The kids used to help me with it. We got the first issue from the printer in my car, and that evening, we all got together, the kids, and some friends. We had an abandoned Scriptomatic addressing system, which I had bought from the *Episcopalian*. It was a two-part machine. You inserted an address card, ran that through the machine, and the address appeared in purple ink on the magazine. Once we got the magazines addressed, we had them bundled by area code, put them in mailing bags, labeled the bags, put them in the station wagon, and took them to the post office. Then, we would go downtown to Greens Delicatessen on Chestnut Street, and the kids could have anything they wanted. This was their pay, and we really had a ball! Having the whole family on the magazine masthead is a good American tradition!

JD: So you picked up your printing skills again from your teenage years!

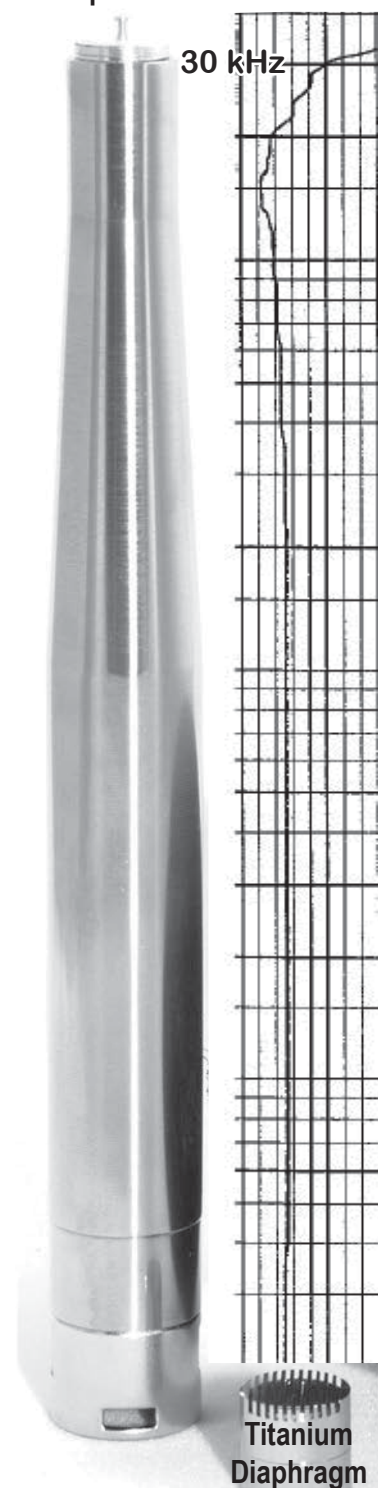
ETD: Yes indeed! I was going to set *Audio Amateur* on a Selectric typewriter, 6 squares to the inch. We pasted up pages that were going to be reduced in a camera on 17 × 22" sheets of cardstock. We reduced it to 75% or 66%. It was black and white to begin with, 24 or 36 pages. I spent \$500 savings to print 100,000 promotional pieces 11 × 17 folded twice with a pitch for the magazine, including a sign-up part that was supposed to be cut off and returned with a check! We found a distributor of technical equipment in Long Island who sent out a newsletter every three months or so. There was a McIntosh page in there every time and I contacted them, and it turned out McIntosh had one of the largest newsletter distributions that went out through their dealers. The equipment distributor agreed to let us include our flyer with his mailings. So we got our flyers out to each of those dealer addresses, and I remember being on the floor with the kids folding 80,000 flyers! Then, we went up to our cot-

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tage in Vermont, but before we left, we asked our Postmaster to forward any of these reply envelopes to us in Vermont. I remember, the first day we got the mail in Vermont there were eight subscriptions, at \$5 each, for four issues. We got 5,000 subscriptions out of the 80,000 flyers. That was our subscription core. That's how it started. We didn't get up to schedule with publishing until 1976 I think.

Now, I was working days in Philly and doing everything myself. But people would turn up on my door step and offer help. One person who turned up told me: "You need me; I need to do all this typing for you." She turned out to be absolutely invaluable and critical to our success. She had a degree in English from the University of London. She became, and still is, very dear to me (*She became vice president of Audio Amateur, Inc. —JD*)

So, when I got flak from someone like Reginald Williamson about grammar or spelling, I would say, "Well, the person doing the copy editing has a degree in

English, how about you?"

At one time we sold about 15,000 copies through stores, newsstands and subscriptions. From all our publications, *Voice Coil* is the most lucrative, next is the *Loudspeaker Source Book*. We also got a lot of interest for *Loudspeaker Design Cookbook*, of which we sold more than 100,000 copies. We also have a good book that we can't sell because of the wrong title, *Loudspeaker Recipes*, but it really is a book on computer-designed speakers.

JD: Why a move from Philadelphia to New Hampshire?

ETD: I quit my job in 1974 when *The Audio Amateur* was making enough money to support me and my family. In February 1975, my wife and I said we have to go back to New England. Massachusetts is known as Taxachusetts, it's a great place to live IF you can afford it. So, we looked to New Hampshire: at that time they had no income tax, no sales tax, everything comes out of property tax. We ended up in Peterborough, in this four-bedroom house built in 1812. It was only an hour and a half from Boston. We also discovered that there were some 30 magazine headquarters there as well! That's interesting in that if one industry comes to a town, in time, some of the employees will decide, hey, I can do that, and set up shop for themselves, and the whole thing blooms.

There's an interesting background here, in that this proliferation of periodicals in this country was partly possible because of the 2nd class postage rates we had. In the UK there is no 2nd class periodicals mail rate, you know why? The British never had the need to educate the masses through periodicals, being originally a Victorian society. At the time of our revolution a much larger proportion of the population had a right to vote, even if they had no property. If you say in the Declaration of Independence that the government derives its powers from the consent of the governed, you better provide the means for the governed to inform and educate themselves! Franklin set up the U.S. mail system to make it possible to mail a newspaper over 100 miles for a penny! So that contributed to the growth of

periodicals and newspapers in this country.

JD: Your interest in, and profound knowledge of, national history shines through!

ETD: That's true; I always have been fascinated by historical events and persons! If you read the biography of Benjamin Franklin, he went to Paris, he befriended the King and he drained the French treasury. They probably didn't even realize it! Of course he also borrowed from the friendly Dutch, but I don't think we drained their treasury. It's a pity that not more people are interested in the history of their nation, where they come from, how their culture was formed. It would make it easier to live in your society, and understand what happens, and how you can handle, and accept that. The Dutch presence in Manhattan, and along the Hudson, was snuffed out a long time ago, but the influence is still there. New York is different, they are more kind of let's get it done, let's go ahead, don't mess about. And, also very tolerant, more so than the surrounding areas.

JD: Anyway, you decided for New Hampshire.

ETD: Yes; we filled four of the largest U-hauls we could find, plus a large moving van, and in August '75 we moved there.

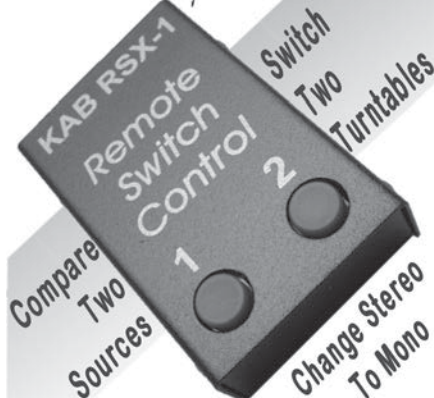
JD: If I may ask, what was the connection of *Audio Amateur* with Old Colony Sound Lab? I remember that OCSL sold parts and kits for AA designs.

ETD: The OCSL business was part of something I did before I started AA. I devised a record filing system consisting of small labels and a special stamp. You could use alphabetical characters for instance to establish at which shelf a particular record was stored, and numbers for indexing the shelf. I printed special cards with what we call "bleed boxes" where the ink bleeds across the edge of the card, so you can see the indications by looking at the card edge. So this was a system where you could find your particular recordings quickly. I sold several hundred copies, and it was even re-

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viewed in *High Fidelity* by Gordon Holt who gave it a good review. The name OCSL came from the Old Colony name of Massachusetts where I worked at the time.

So when I started AA, I thought we ought to provide the means for people to build the designs and we used OCSL initially to provide circuit cards. Eventually, we had people working in my cellar etching simple circuit boards! One design was the Quad Pod by Joshua Goldberg, who lived directly across of the street from me. He was an engineer at Boeing in their Surface Transport Division in Philly. Wonderful guy, I still correspond with him. He used to say: "Every engineer has a favorite resistor, and he uses it all the time!" We did a follow-up for an encoder to the Quad Pod and a matching amplifier feeding two ambience speakers in the back. We sold several hundred of those as well, it was very popular. We had a deal with ElectroValue in the UK who also sold our kits. The owner actually found a French source for us for very good quality log taper pots, much better than anything you could buy in the States at the time. They were available in dual concentric also, very well done.

JD: You've carried many audio-related books and reprints.

ETD: We have a CD version of *The Radiotron Designers Handbook*, 1,500 pages, the scanning alone cost us \$5,000! I once got called from a British publisher of the book version who said it had a 1942 Australian copy right. They reprinted it in a two-volume set. But we used the U.S. RCA edition. I consulted counsel and nowhere could we find any trace of a U.S. copyright for the book! I think we probably sold 1,400–1,500 copies. We also sent two copies of *Loudspeaker Design Cookbook* to Beijing for translation into Chinese. We had also had it translated into Dutch and French. Interestingly, the French complained that some of the equations were wrong. They were correct in the original so it's easy to make mistakes in translation. Interestingly, *LDC* isn't translated in British English and it is not sold in England. I don't know why.

On the subject of copyright: We pub-



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lished *The Birdhouse*, a speaker enclosure design by a teacher from Arizona, I think, and we got attacked by Bose! Now, the author hadn't copied it, he had figured the principles out himself, as a labyrinth style. Bose told me to pull back all issues, destroy them etc. My lawyer said it was ridiculous, the man built just one copy and Bose would have to prove that damage was done. So nothing further came of it, but later, I thought I should have used it for free publicity, you know, like this tiny publisher attacked by this giant corporation about nothing really.

JD: I remember your editorials in those early days. Not always related to audio, but always related to human endeavors.

ETD: I don't believe in writing editorials if you have nothing to say. Sometimes I get moved, something strikes me, and then I write about it. That's why I don't believe in columns. In the '90s I collected my editorials in a small booklet, "Of Mockingbirds and Other Irrelevancies," (available at www.cc-webshop.com) and it's amusing to read it these days. The first one is pathetic as it predicted a sudden interest in guitars. [*He paused to write down "gui-tar" in his notebook.—JD*] The second was on fidelity and perception, and the composer Charles Ivens. He wrote difficult to understand music. He wanted you to listen to ALL the sound, and not let your ears pick only this or only that part. He said that if you hear two bands marching, listen to them both. And, you can hear that in his music. You can hear two bands, different tempo, and different rhythms. I thought at the time that he would steadily advance in appreciation, but it didn't happen. He has been recorded several times, but it was too controversial I guess. He went to Yale and wrote a symphony. His teacher didn't like it and told him he'd never go anywhere with it! But, Ivens thought that aping the European musical culture was nonsense.

Anyway, Ivens heard his own symphony, directed by Leonard Bernstein, only once on the radio. His music is still being explored to this day, and I think he was one of the greatest composers of this country.

I was flattered when the *Boston Audio*

Society picked up one of my editorials from 1978. It said essentially that people often say "this magazine is paid for by the advertisers," but that's not true! Every dollar the advertisers and manufacturers have is coming from the customers. Everything, magazines included, is paid for by the customers' dollars! This is important to remember. The advertiser/manufacturer has an obligation to be honest and forthright to readers and customers, and produce a good product.

JD: What do you think of the state of high-end audio these days?

ETD: One thing that becomes increasingly difficult is to experience a first-class system. You need to find a high-end dealer in your area who has some choice of high-quality equipment. I mean, it was so much easier when HiFi was young. When Edgar Villchur designed the Acoustic Research acoustic suspension bookshelf speakers, they had a demo room right in Grand Central Station in New York City. Can you imagine how many people got introduced to high-quality music reproduction through that? Briggs in the UK did something similar. He organized comparative listening tests between live musicians and the reproduced music.

JD: How did you become interested in music in the first place?

ETD: That goes back to my junior college years. My next door dormitory neighbor would play classical music and I had never heard that music growing up in the south. I thought: "What is this?" The guy would go on the street car to the Quincy library every week to borrow 78s. They were heavy and four minutes per side. I remember how heavy the Messiah was! He also had to go to the music building on campus and borrow a player. He had to return them the same day, so he played them several times on that day. Later on, you could buy equipment from a place called Radio Shack at 167 Washington Street. Fairly soon, there was a second Radio Shack and this leather dealer from Texas bought them and expanded the chain. I worked for them in grad school; they had a policy that they would build something like a

preamp, all tubes, copper-coated chassis, and 1% film resistors, put it in box, fly it over to Tokyo, and sell it for \$39.95 and make about 60% on them. They sold them like hot cakes. They also sold Bozak speakers, Janszen electrostatics, and Ampex 320's to the Boston Symphony. This really spread the interest in live music, classical music throughout the country. I used to gather friends on Saturday evening, listen to Boston Symphony on my Altec Lansing 604Cs in open back boxes. All of us sat around and listened to the broadcast. Now, Boston Symphony is a phenomenon as a prime source of classical music, organized by a layman, not a musician. He had the Sydney music hall built with architectural and acoustical advice from Sabine, based on scientifically derived acoustical principles. Sabine later developed the Sabine reverberation equation.

JD: I wonder whether you are a printer, a publisher, or an audio amateur?

ETD: Well, I am what is officially known as a dilettante! Like a butterfly, going to one thing after the next. I've taken courses at Swarthmore in Cobol programming, even!

You remember, when I worked for the *Episcopalian*, I had been going to Washington regularly where they typeset the *Episcopalian* in lead, and at that time the whole issue of machine typesetting coupled to a computer was very much in flux. I went to a seminar about typesetting and picked it up. We were paying wages for someone to do the monotype typesetting for the *Episcopalian* to the tune of \$27,000 a year at that time. I made a pitch during the quarterly meeting for the publishers of the other religious magazines (there were nine of them present), and I said, look, I think it would be smart for us to set up an electronic typesetting facility pool. There were already two or three systems available at the time. They didn't do it, but I convinced my boss to lease a Selectric Composer for the *Episcopalian*. I said, instead of having this lady type in all manuscripts, then have to correct it in whiteout, and type in the words again, why don't we have her type it in the Selectric Composer. You had to type it in, then run it again with corrections

when it does the justification. My boss looked at me one day and he said “if there is one thing that makes me sick it’s an editor who tries to sound like a printer!” I didn’t say anything because I had been a printer 25 years before that already.

One disadvantage of computer typesetting is that anyone can do it, which means that the true art of typesetting is slowly being lost. At one time I wrote a letter to *The Economist* because their kerning was out of whack. These electronic machines do kerning beautifully, as long as you specify it sensibly. *The Economist* was placing the period far too close to the numeral before it. So you couldn’t see whether it was 1.0% or 10%. This is a simple example, and often it’s worse. With computer typesetting, you can do anything, and anything, nine out of 10 times, is ugly.

After we came to Peterborough, we bought our first computer in 1980 I think it was, from Ohio Scientific. The day we set an entire page with all the characters and symbols on one piece of paper was a very exciting day.

[Mr. Dell takes out his small notebook again and writes something down. Intrigued, I asked what it is, and he confided that he “collects words,” words that strike him as interesting. He now writes down de-tail (accent on the 1st syllable) and de-fence; earlier it used to be de-tail, de-fence.—JD]

JD: Did audio give you an excuse to become a printer/publisher, or did you get so excited about audio that you wanted to tell the world about it?

ETD: This fascination with audio reproduction occurred before I really became fascinated with music. As soon as the LP came out, I bought a small clamshell player from Columbia. I got a lot of chances to compare things, when I worked for Radio Shack, which at the time, had great equipment. I wrote to WXCR and said that there was too much distortion in the latest Columbia records, so they called me and invited me for lunch with a few station guys. We went into a room with a Voice of the Theater and a Brooks amplifier, put the record on, and put

it all the way up. Then I realized that musicians hear things very differently. Listening to this music at full blast, they couldn’t have heard the distortion if their lives depended on it! The love of music is my prime mover, and I also like to read a good electronics article. Like a nice 20 W power amp you could build yourself. I think the difference between the original Dynaco 70 and my Brute version was mainly due to the large separate power supplies for each channel in the Brute. I didn’t have the right test equipment to verify it, although I did collect some Heathkit test equipment at the time. Reggie (Reginald Williamson) would say, you know, that Heathkit generator is a nice piece of equipment but it needs fixing. I loved building kits, and in one of my early issues I carried a visit to Heathkit, showing all the girls putting all these parts in separate bags. There was a relation to my Brute because the early Heathkits had lots of surplus military parts.

JD: How did you find authors?

ETD: I was amazed how authors appeared, like out of nowhere. I have an author file of 850 authors! Also, I kept an eye out for articles in other periodicals like in Europe. Over time, I got introduced to Peter Baxandall and Peter Walker by Reggie Williamson, who always was a good source of interesting articles. We also had a deal with *Wireless World* where we used some of their material and we printed a one-column ad for them as payment.

JD: How did *Voice Coil* start?

ETD: Well, in the late ’70s you began to see a lot of articles on speakers as people started to explore Thiele-Small parameters. It started in Australia in the late ’60s but didn’t appear here in the AES journal until the early ’70s. So this started to percolate and at a certain point Gary Galo send me a copy of the *Loudspeaker Design Cookbook*. Vance Dickinson had already published it before I found out about it. I sent it to Robert Bullock and things began to happen. I am not sure about the sequence but I became convinced that

there was enough interest in speakers to support a magazine on its own and I started it in 1979 and it was well received. It started a speaker DIY movement by people like Madisound who were very expert on the subject. Then Bullock’s reviewed Vance’s book. So I contracted Vance for a revised version, we published it and it began to sell it, and Elektor in The Netherlands translated it and started to sell it as well. We had some attempts to have a Turkish and Polish language version but that didn’t succeed. But *Speaker Builder* eventually became as large as *Audio Amateur*.

Then I had a special section on tubes in *Audio Amateur* in 1989, and that was well received and we started *Glass Audio*. But, in publishing you don’t want to go to press unless you have advertising, and we actually had fractured our audience. So in 1999, we decided to bring the three magazines together. Lots of people were disappointed, but it was a necessity.

JD: Has the editing that you need to do changed over those years?

ETD: There are authors who need a lot of editing. There are authors who want to write for you who are smart enough to first study the magazine. I am still amazed that there are people who have never seen the magazine who want to write for us.

We don’t like the passive voice. If you write scholarly papers, you must be invisible, but we write for human beings and you are addressing them as clearly and concisely as possible. Getting the right analogies to make that clear to potential authors who don’t know as much about it as you do is the trick. But, sometimes I have a whole list of things for the author: could you write captions, could you do this, that. Some guys are really spectacular, do everything just right, and you don’t really have to do anything. Sometimes people have little habits. For instance, I don’t like infinitives, split left, right, and center. I’m not too strict on grammar, but some authors, who should remain unnamed, have certain circumlocutions that they use like “the reason for that is this” instead of “therefore.”

My mother was from North Carolina and they have a tradition of good speech, and I think I picked up on it. I have a facility for finding the right words. I speak extemporaneously without great difficulty. I try to leave the flavor of people's text intact, but I find the right words easily. I think text ought to read well. I think of text in terms of its being read rather than as prose. The verbal form of language is the primary one, but good writing can also carry a great deal, and always has an appeal to the senses.

So, these are some of my principles in this, but that said, I am much divided in my mind about principles. One of my favorite quotes is: "The first thing a principle does is kill somebody" or "This is my principle and I am standing on it!" I much more like that one principle of British behavior: "The importance of not being earnest."

JD: Mr. Wilde paraphrased.

ETD: Yes, in fact, *The Importance of Being Earnest* is one of the funniest plays I ever heard. I keep on going back to it again and again, and I still enjoy it a lot. The summer theater here has a patio paved with bricks and people buy bricks for it and engrave them. My daughter Sarah bought a brick and it has my name on it and says: "A handbag!" (Pronounces "handbag" as a four-syllable word). I really love the way Lady Bracknell exclaims that! We're so lucky to have our summer theater.

JD: Going back to do-it-yourself in general, why does that interest you so much?

ETD: I believe that the building of things, the building itself, the act of building, is one of the most human activities you can do. There are a lot of things that distinguishes us from other creatures. Not that animals don't have tools, some do. But it's the building of things that's significant.

I think the best expression of that is on the front of harpsichords. It's either engraved, or painted on the cover of the keyboard or on the board below. It says: "[Name] has created me," where [name] is the name of the person who built the

instrument—and of course, it would be in Latin. That pushes the whole idea that this is something you have a creative relationship to. I don't think there is anything that replaces Homo Faber, Man the Maker. That's the whole point of it.

JD: What's so great about audio do-it-yourself?

ETD: Well, there are several aspects to it. There is the obvious money saving part, but also the fact that you can make your own equipment more reliable than commercial stuff, and when it fails, you can easily repair it yourself. But also I believe that building or constructing something yourself is a very satisfying human endeavor. My personal motivation is the music I listen to as well as the electronics and construction and fixing part. Slowly but surely circuits disappear inside chips, which is good for quality but not for the fun of DIY. One of the appeals of tubes is that you can actually "build the circuit," so to speak.

JD: I wonder how many people are in DIY audio for the music or for the engineering.

ETD: There's always some looking down the nose to those engineering types, as if they do not spend enough time with music or go to live performances. If you are serious about music, you ought to go to listen to the real thing once in a while.

JD: But do you not think that reproduced music is a kind of art form on itself? If you go to a live performance, it's the total event—music, the ambience, the well-dressed ladies, etc.—that determines your musical experience and you cannot ever reproduce that in your home. On the other hand, reproduced music, when done very well and well recorded, could exist on its own as art, but it is not the same as live music and it never will be.

ETD: But music recorded for reproduction in the home is often tinkered with, and people were not realizing how much this was being done. When the recordings Columbia did in the '70s came out on CDs, it revealed the extent

of embarrassing engineer manipulation. They made a lot of changes in the final mix, with multi miking. I remember an AES presentation by a former Columbia engineer admitting that the constant moving of control sliders was making the music pretty much unlistenable. This became evident after we got the resolving power of the CD. We found that our precious music was heavily doctored. Coming back to your original question, in terms of how these arts are valued, I find that the inner circle of not only professionals, but also very knowledgeable amateurs, nowadays show an intimate knowledge of these processes. They have a great regard for talented engineers who do the mixing with minimal processing of the signal.

I once sat through a musical recording of Petrusca by Decca in Montreal, in the cathedral. I was sitting in the control room. They had homemade mixers, adapted an Apple to handle the two video recorders. Lots of control tables and lots of mikes. But the engineer barely moved any controls through the recording.

JD: What do you find so satisfying in the publishing vocation?

ETD: I do like very much to communicate and interact with people. I don't know what would have happened had I pursued a clerical career. In retrospect, I don't think I would have had the required skill sets. Yet, publishing is a different way to communicate, and the great thing is, you get to read all the articles first! Of course, now the Net gives anybody the chance to be a publisher and this has had a great effect on people's ability to learn how to communicate and interact.

JD: Mr. Dell, thank you for your frankness and your time. And, on behalf of many tens of thousands of readers, thank you for bringing us 41 years of interesting, intriguing and enjoyable articles! aX

Editor's note: This interview was recorded in the fall of 2009. Almost two years later, Audio Amateur, Inc. was acquired by the Elektor Group and Ed Dell retired after 41 years of publishing audio-related DIY journals.

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Upgrading the Phase Linear 200 Amplifier

Upgrade tips to keep your classic PL amp humming

Most owners are satisfied with the performance of their Phase Linear 200B amplifiers. But if you are not, or your amplifier is in need of some repairs, why not repair or upgrade it? Who wouldn't like a few more clean watts to have in reserve?

Note: You can find an excellent guide on the repair of power amplifiers at <http://synthetizer-sche.cherz-alice.fr/power%20ampli/phase%20linear/repair.htm>. It offers many good pointers and safety precautions, and the intent of this article is to expand, rather than summarize, this link.

DRIVER BOARD

Unless you have recently “gone through” your amplifier, replace all of the electrolytic capacitors on the driver board. It is very cheap insurance when dealing with amps in this power class. Use high-grade 105°C parts.

If your driver board has transistor problems, upgrade the transistors, too. I used ZTX694Bs for the input differential pair. Buy at least 10 of each and match them as closely as possible in pairs of equal gain. (A cheap DMM with transistor test is sufficient.) This will help minimize the output offset of the amp. I typically see much less than 10 mV of DC offset after this upgrade.

And be sure to check the TO39 transistor's heatsink for a tight fit. If loose, just pinch each of the fins with a pair of needle-nose pliers to tighten and then reinstall them. Check the TO220 driver transistor's heatsinks as well.

OUTPUT TRANSISTORS

The original devices were low gain, typically rated at 5 A, 100 W, good for 40 years ago. New parts are 16 A, 250 W, such as the ON Semiconductor MJ12024, which is a good device, but you can do

even better! The STMicroelectronics 2ST5949 (www.st.com) has virtually identical SOA ratings, 1 A higher current rating, a Ft (bandwidth product or transition frequency) of 25 MHz instead of 4 MHz, and—more important—a much higher and much more linear Hfe curve (gain or beta)—80 versus 15 into the 7–8 A range. And it is usually cheaper! The higher gain also lessens the demands made on the drivers.

Choose between the mica washer and grease or silicon rubber insulators because there is debate as to which is better. You probably will also need to increase the line-fuse value; too, if you push the amplifier to its new limits

or use lower impedance speakers (which it can now handle more easily). I went with 8 A on the AC supply fuse.

When you replace the output transistors, you will see that the heatsink was thermally coupled to three diodes

on the driver board with silicon thermal grease, which probably dried out years ago. The solution is to thoroughly clean the old grease off the diodes and then file the anodize finish off the heatsink in the area of contact. Then apply a *thin* coat of gray JB Weld epoxy (filled with iron particles but non-conductive) between the diodes and heatsink. Do not apply so much that it contacts the board because this would heatsink

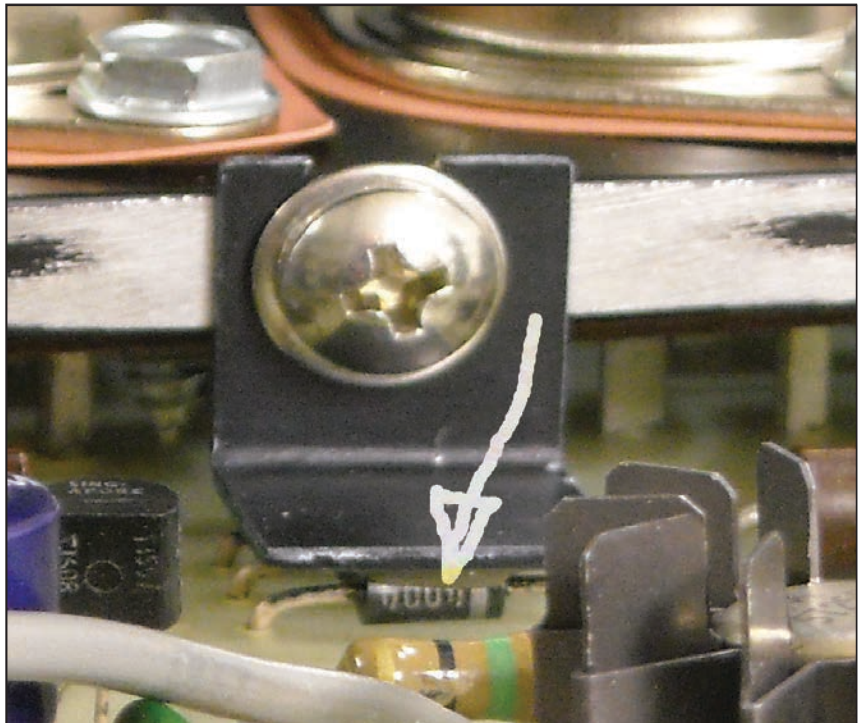


Photo 1: Thermal link



Photo 2: New in-out connection



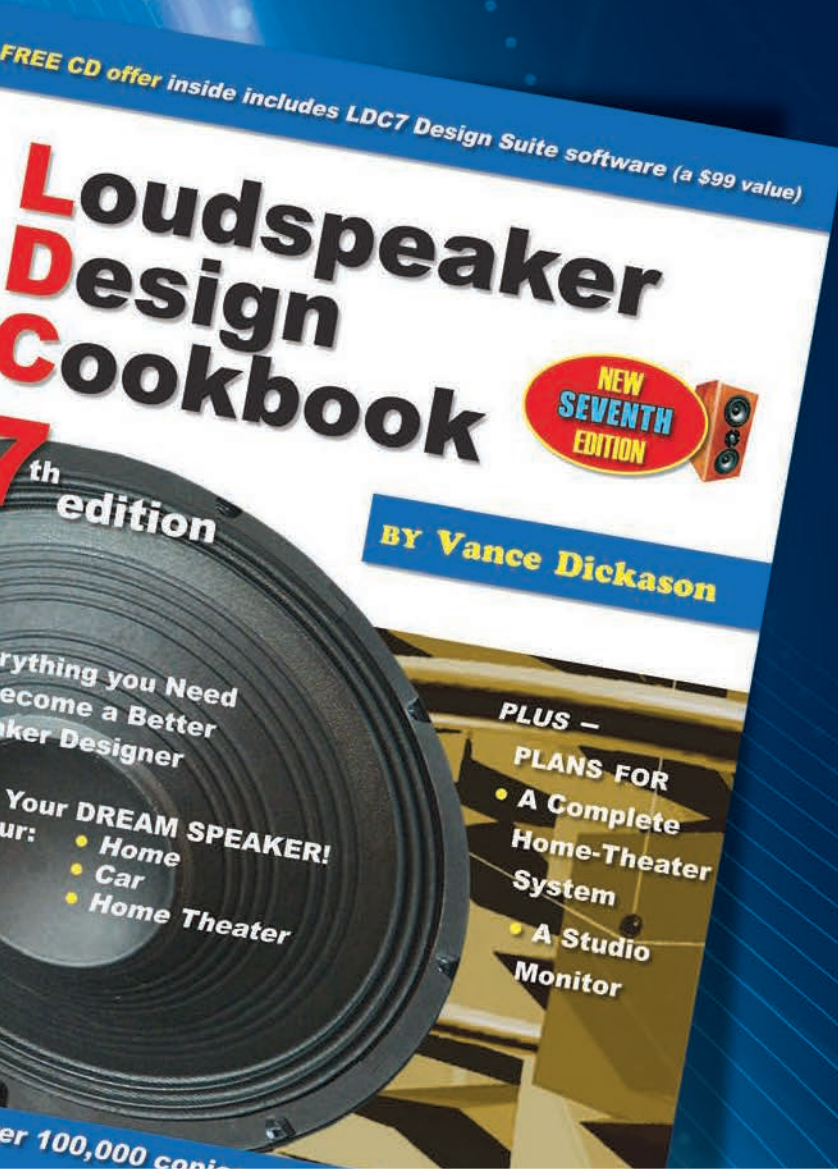
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the diodes to the board and reduce the effectiveness of this thermal feedback scheme (**Photo 1**).

Replace all the electrolytic capacitors on the speaker protection/on delay PCB. One symptom of bad capacitors on my unit was that low-frequency signals caused the relay to chatter.

Add two AGC fuse holders and 5 A FB fuses in line with the speaker outputs. My unit had a cover plate for the feedback and meter switches which were deleted in production. I used a file to enlarge the switch holes to accommodate two standard AGC fuse holders (**Photos 2 and 3**).

POWER SUPPLY

The original 3,000-mF/75-V DC capacitors were compact, 1.4" in diameter and 3.1" long. They were held in place with spring clips riveted to the transformer end cap (**Photo 4**). Luckily, there is plenty of space in this chassis.

My choice for replacement was the 10,000-mF/100-V DC with a 2.00" diameter, and 3.70" long. They were a great find on eBay. For the upgrade, first remove the spring clips and carefully drill out the rivets. Then dismount and open the transformer in order to retrieve rivet heads. You don't want any unexpected shorts! Then remount it.

Mark the side panel for the mounting holes of capacitor mounting rings, drill, and mount the capacitors. Note: You may need to lengthen the wires from the chassis to the common sides (ground) of the capacitors. If you have trouble with the mounting hardware in the rear corner, consider "speed nuts" on the capacitor mounting rings. These are available in auto supply and hardware stores (**Photo 5**).

If you have gone this far, you may choose to replace the old 25-A 200 PIV bridge rectifier with a 35-A 600 PIV and add a little thermal grease under it to improve the heatsinking. The bigger capacitors will have higher inrush currents.

Replace the old binding posts with new heavy-duty, gold-plated ones (eBay). In my case they fit in place of the spring terminal strip with just a little filing. There was a small—although not objectionable—gap between the two pairs of binding posts (**Photo 2**).

Replace the old phono jacks with new

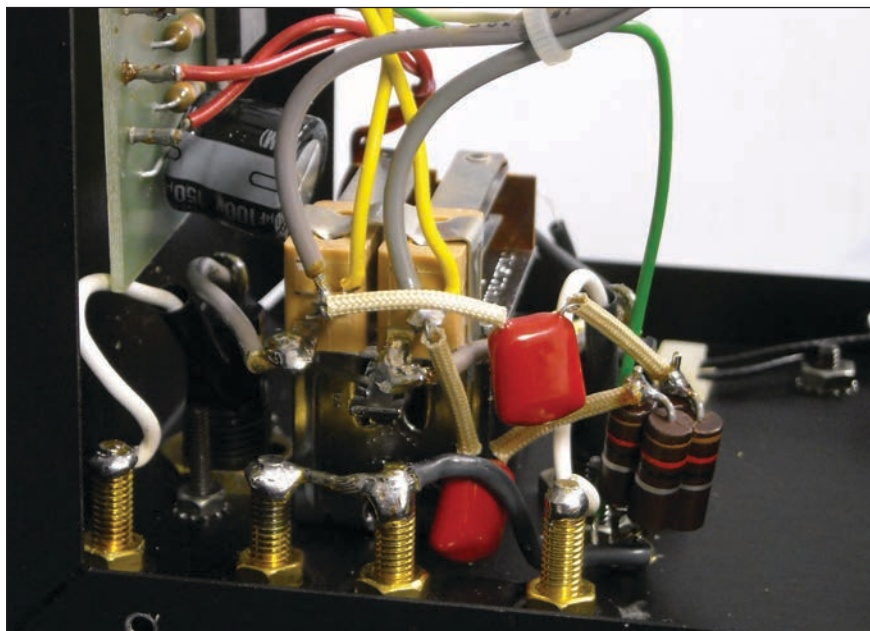


Photo 3: Revised relay

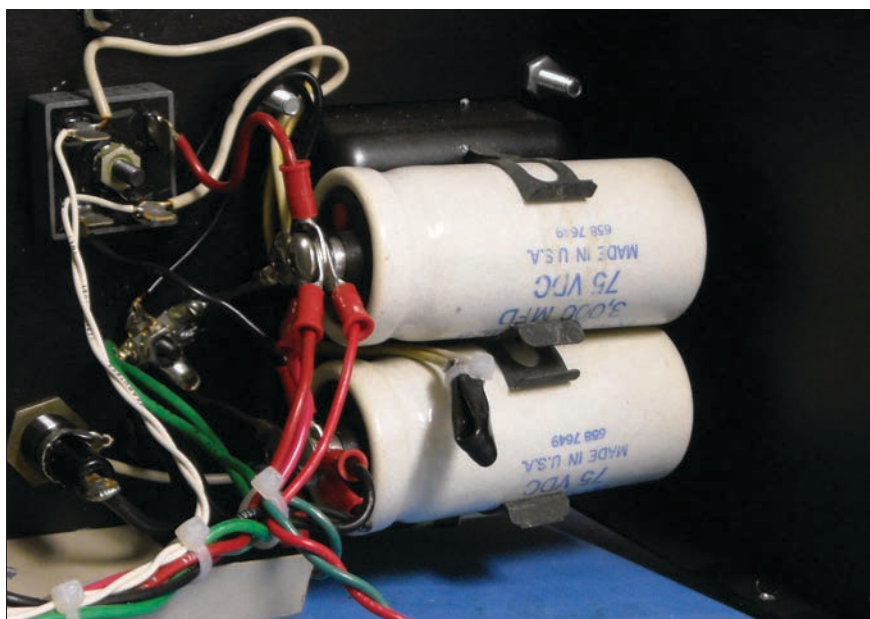


Photo 4: Old caps

gold-plated ones (eBay). I used the supplied flat white shouldered insulating washer (Teflon, nylon?) on the outside to centralize the jack in the hole. While you are at it, you may choose to replace the twisted wire input leads with a short length of shielded cable. I used adhesive-backed wire clamps to position the new wires in place (**Photo 6**).

Upgrade the tired old red LED with a T-1-sized blue one (or the color of your choice). I added a two-pin plug and jack to make the front panel removable for easier service. I replaced the series resistor with a 27-k Ω , 0.25-W component

to get a reasonable brightness. The new blue LEDs are much more efficient than the old red ones (**Photo 7**).

Before epoxying the new LED in place, carefully grind the lens flat and flush with the front pane. This will give a more diffused light instead of a bright directional pinpoint of light. For more diffusion, add a thin coat of white paint or fingernail polish before installing.

I seldom find the aluminum front panel bolts in decent cosmetic condition on most Phase Linear products. Buy some 1/4 20 $\times$ 1/2" stainless steel bolts and nuts. File and then sand (use 400-grit

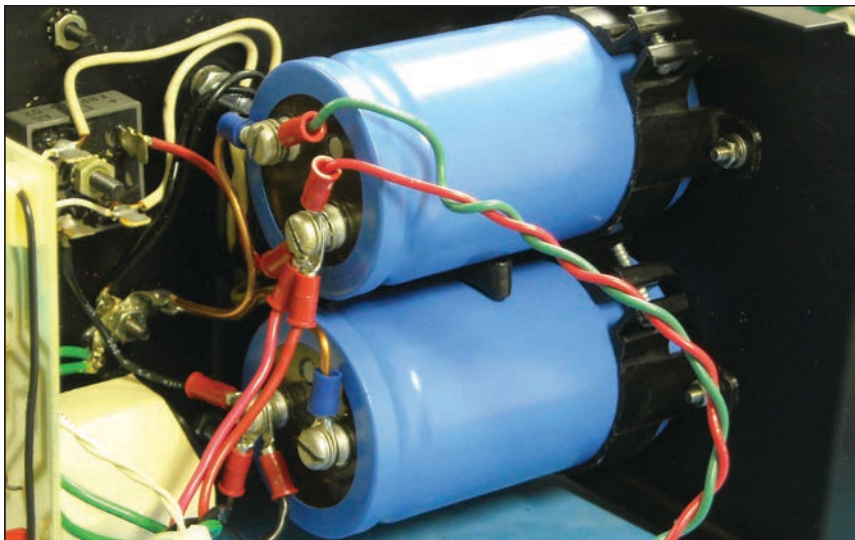


Photo 5: New caps

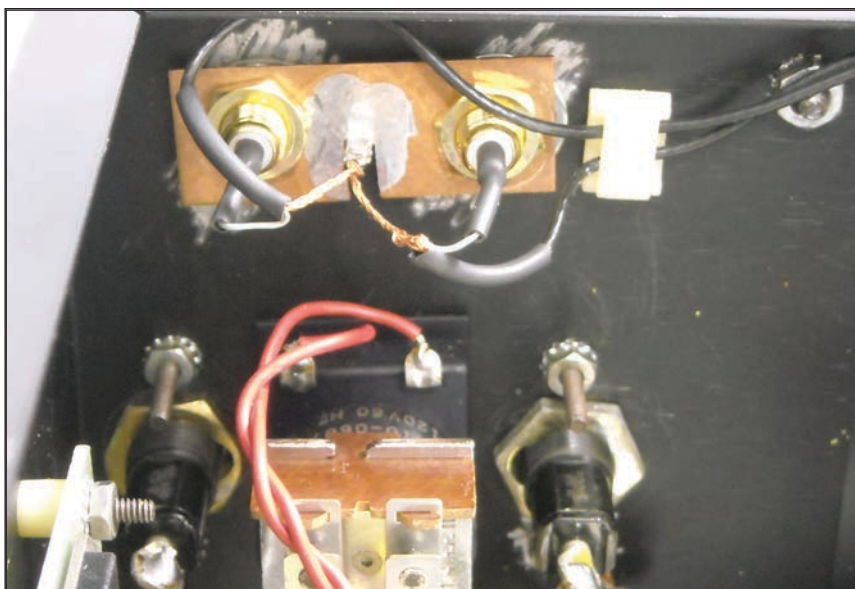


Photo 6: New input cables

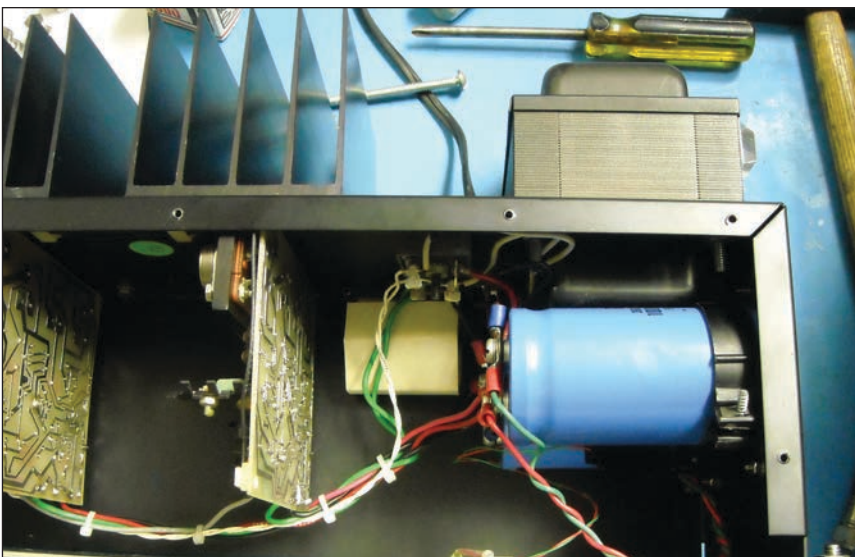


Photo 7: Top view

silicon carbide paper with oil) the heads of the bolts smooth and polish them, using jeweler's rouge on a power buffer, to a mirror finish. They look nice and won't corrode over time.

Finally, bring the unit up with great care. (PLEASE heed the referenced article's suggestions on this.) Don't rush, and double-check your work. Look for bad or loose connections, bad solder joints, shorts, and so on.

Final warning: With these modifications and consequent increased power capability, a loose input cable or plugging in a cable while the amplifier is powered on can deliver a speaker-destroying transient. Expect 150 W per channel into 8 and 4 Ω . Add the speaker fuses to be safe. Good luck! *aX*

SOURCES

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Simple Hybrid Amp

A simple amplifier that uses a valve as a pre-amp and a MOSFET in the output state

The debate continues as to which are better, valves or transistors. We don't intend to get involved in that argument here. But if you can't make your mind up, you should try out this simple amplifier (**Photo 1**).

AMP OVERVIEW

The amplifier uses a valve as a pre-amplifier and a MOSFET in the output stage (**Figure 1**). The strong negative feedback makes the frequency response as flat as a pancake. In the prototype of the amplifier, we've also tried a few alternative components. For example, the BUZ11 can be replaced by an IRFZ34N and an ECC83 can be used instead of the ECC88 (**Figure 2**). In that case, the anode voltage should be reduced slightly to 155 V. The ECC83 (or its US equivalent the 12AX7) requires 2×6.3 V for the filament supply and there is no screen between the two triodes, normally connected to pin 9. This pin is now connected to the common of the two filaments. The filaments are connected to ground via R5.

If you're keeping an eye on the quality, you should at least use MKT types for coupling capacitors C1, C4, and C7. Better still are MKP capacitors. For C8, you should have a look at Panasonic's range of audio grade electrolytics.

P1 is used to set the amount of negative feedback. The larger the negative feedback is, the flatter the frequency response will be, but the smaller the overall gain becomes. With P2 you can set the quiescent current through T2. We have chosen a fairly high current of 1.3 A, making the output stage work in Class A mode. This does generate a relatively large amount of heat, so you should use a large heatsink for T2 with a thermal coefficient of 1 K/W or better.

For L1 we connected two secondary windings in series from a 2×18 V/225 VA toroidal transformer. The resulting inductance of 150 mH was quite a bit more



Photo 1: This simple amplifier uses a valve as a pre-amplifier and a MOSFET in the output stage.

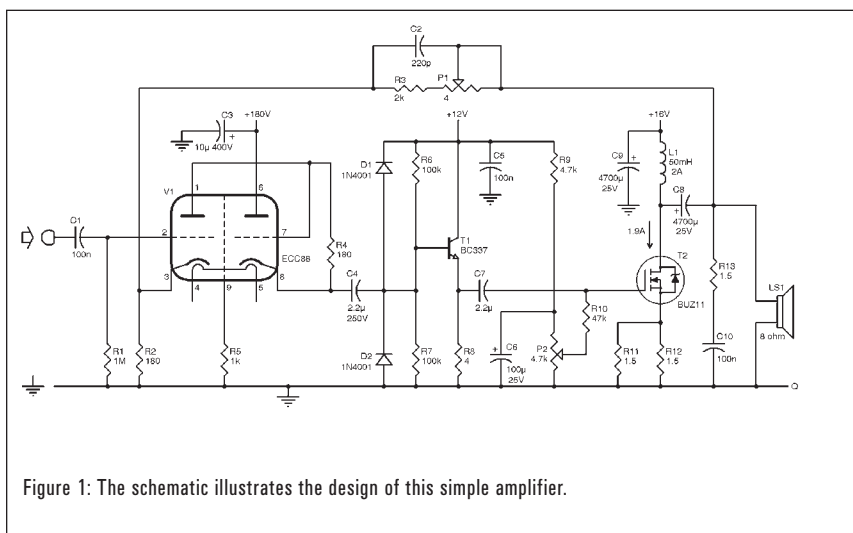


Figure 1: The schematic illustrates the design of this simple amplifier.

than the recommended 50 mH. However, with an output power of 1 W the amplifier had difficulty reproducing signals below 160 Hz. The distortion rose to as much as 9% for a signal of 20 Hz at 100 mW. To properly reproduce low-frequency signals the amplifier needs a much larger coil with an iron core and an air gap. This prevents the core from saturating when a large DC current flows through the coil.

Such a core may be found in obsolete equipment, such as old video recorders. A suitable core consists of welded E and I sections. These transformers can be converted to the required inductor as follows: cut through the welding, remove the windings, add 250 to 300 windings of 0.8-mm enamelled copper wire, firmly fix the E and I sections back together with a piece of paper in between as isolation.

ECC 88

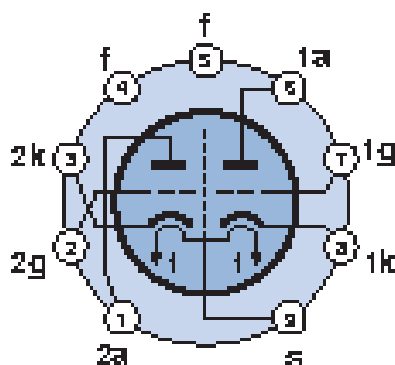


Figure 2: The BUZ11 can be replaced by an IRFZ34N and an ECC83 can be used instead of the ECC88.

The concepts used in this circuit lend themselves very well to some experimentation. However, the number of supply voltages can be a bit of a problem to start. For this reason, we have designed a power supply especially for use with this amplifier (quad power supply for hybrid amp). This can, of course, just as easily be used with other amplifiers.

The supply uses a cascade stage to output an unbalanced voltage of 170 V for the SRPP (single rail push pull) stage (V1). During initial measurements we found that the ripple on this supply was responsible for a severe hum at the output of the amplifier. To get around this problem, we designed a separate voltage regulator (high-voltage regulator with short circuit protection), which can cope with these high voltages.

If you use a separate transformer for the filament supply, you can see if the circuit works without R5. During the testing, we used a DC voltage for the filament supply.

SOUND SUCCESS

Although you may not suspect it from the test measurements (Table 1), this amplifier doesn't sound bad. In fact, it is easily better than many consumer amplifiers. The output power is fairly limited, but it is still enough to let your neighbors enjoy the music as well. It is possible to make the amplifier more powerful, in which case we recommend that you use more than one MOSFET in the output stage. The inductor also needs to be made beefier. Since this is

Table 1: Test measurements

Min. gain	12.3×
Max. gain	31.6×
Input sensitivity	0.64 V at min. gain
Bandwidth	≥200 kHz
LF roll-off	11 Hz
THD+N (1 kHz/1 W/8Ω)	0.09% (BW = 80 kHz)
Supply ripple (100 Hz)	−80 dB (at 1 W output)
P _{max} (1% THD)	7.6 W (1 kHz)
Damping factor	17

Specifications: IRFZ34N, ECC83, 155 V using 064011-1 and 064016-1, $U_{ff} = 12.6 V_{DC}$, 8 Ω load, T2 set to 1.3 A

a Class A amplifier, the supply needs to be able to output the required current, which becomes much greater at higher output powers. The efficiency of the amplifier is a bit over 30%. **ax**

Editor's note: This article was originally published in Elektor July/August 2006. Go to www.elektor.com for more information.

PARTS & COMPONENTS

Capacitors

- C1 = 100 nF 250V MKT, lead pitch 15 mm, dim. 7 × 18 mm max.
- C2 = 220 pF
- C3 = 10 mF 400 V radial, lead pitch 5 mm 13 mm max.
- C4 = 2 mF2 250 V, lead pitch 27.5 mm, dim. 11 × 30 mm max.
- C5, C10 = 100 nF
- C6 = 100 mF 25 V radial
- C7 = 2 mF2, lead pitch 5 or 7.5 mm
- C8, C9 = 4700 mF 25 V radial, lead pitch 7.5 mm, 18 mm max.

Inductors

- L1 = ≥ 50 mH, not on board, see text

Miscellaneous

- V1 = ECC88 with 9-pin valve socket (Chelmer Valve Company)
- Heatsink for T2, ≤ 1 K/W
- PCB, Ref. 050153-1 from The PCBShop

Resistors

- R1 = 1MΩ
- R2, R4 = 180Ω
- R3 = 2kΩ

- R5 = 1kΩ
- R6, R7 = 100kΩ
- R8, R9 = 4kΩ
- R10 = 47kΩ
- R11, R12, R13 = 1Ω 5 W
- P1, P2 = 4kΩ7 preset

Semiconductors

- D1, D2 = 1N4001
- T1 = BC337
- T2 = BUZ11 (or IRFZ34N)

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InfoComm 2011

The Center of IT All

An on-the-ground report from InfoComm 2011

InfoComm International (www.infocomm.org) puts on an interesting conference and exposition, much more directed toward live sound reinforcement and commercial applications than CEDIA or CES, which are aimed at consumer products and residential services. However, there is a lot of overlap as many of the video, audio, networking, and processing products can serve both markets.

Insight Media's Projection Summit and DisplaySearch's Digital Signage Conference are coincident with InfoComm. The "IT" in InfoComm 2011's theme phrase is an obvious reference to the integration of information technology with commercial and live-event audiovisual systems. The extent of wireless

and wired computer-based control and signal distribution systems discussed and exhibited reinforced the theme.

ACADEMICS

Like CEDIA and CES, the InfoComm Academy offers an assortment of more than 115 courses (some as preparatory for certification), seminars, and workshops. Almost all offerings were technical in nature. I attended several.

During the Projection Summit's session "AV and Home Theater 3-D Projection," Jonathan Brawn (Brawn Consulting; www.brawnconsulting.com) advised us that hybrid screens (claimed to be usable for 2-D and 3-D projection) can be "adequate" but do substantially compromise both the 2-D and 3-D dis-

play quality. In particular, he said that to maintain the polarization of the 3-D image off the screen, the 2-D image quality is degraded. He considers the Stewart (www.stewartfilmscreen.com) Silver 5-D screen material (2.8 gain; 30° half-gain angle), which has silver particles embedded in the fabric coating, to be decent for 2-D and 3-D images. (I would think that the addition of the silver particles would add video noise in the form of sparkles). He also likes Mocom Screens' (www.mocomscreens.com) Solstice concave screens (aluminum with an etched silicon coating; 18-23 gain). Although curved screens can focus sound reflections toward the viewer, I proved mathematically, and in my home, that a properly designed and

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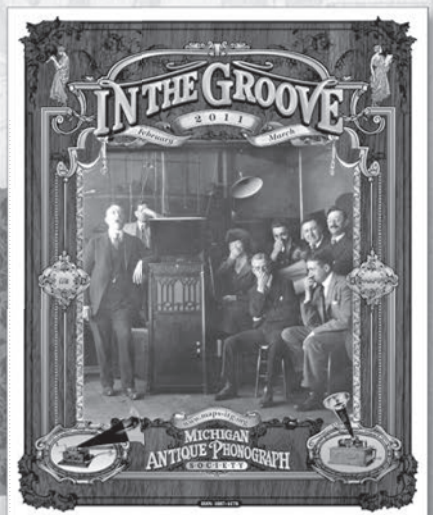


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positioned curved screen can deliver an image with very low hotspotting over a fairly wide viewing angle, although there will be other image-quality issues to contend with; however, a curved high-gain screen is one way to overcome the dramatic light loss from 3-D projection techniques and 3-D glasses.

During the Q&A I raised several issues:

- Today's 3-D glasses tend to exhibit color shift that varies with light level.
- Many silvered screens tend to exhibit color shift with viewing angle.
- While Brawn talked about the playback end of the chain, I asked about the image quality compromises applied during 3-D content creation and mastering, such as filtering (which degrades image detail and resolution) to minimize visual crosstalk.
- More than one of the presenters spoke about viewing 3-D with your head tilted to the side, mentioning the marketing by some companies claiming you can see the images even while lying on your side. Even if the technology (with or without 3-D glasses) enabled viewing the images with your head tilted, I wondered how you could see 3-D when lying on your side, since the 3-D effect is based on sideways displacement of the left- and right-eye images; with your left and right eyes above one another, there is no horizontal displacement, and therefore no perceivable stereoscopic effect.
- Xpand's inclusion of a USB connection in their new 3-D glasses led me to question whether owners of the older Xpand glasses will be offered some form of upgrade. None of the presenters knew the answer, but they did say that some form of glasses-software upgrade was available, but only at the factory.

Peter Putman (Roam Consulting; www.hdtvexpert.com) has data from two reliable research sources (including a USC study) that 15-25% (not the typically reported 7%) is a more realistic percentage of the people who cannot see stereoscopically.

The group of presenters generally agreed that compared with the light level off the screen for 2-D viewing, when using the same projector and

screen for viewing 3-D through 3-D glasses, the off-screen light level is as much as 75% lower!

Putman also said that the most accurate color and gamma image characteristics most projectors are capable of delivering occur at about half the projectors' rated light output.

Putman had his own session: "Soup to Nuts of Digital Video." I thought that his explanation and terminology used when describing MPEG compression was a bit simplistic for this InfoComm audience, finding it incomplete, and, at times, I thought it was inaccurate, even though later in the presentation he filled in some of the details and corrected certain statements. Putman pointed to www.tsreader.com/tsreader/index.html for three versions (free, \$100, \$400) of an MPEG-2 transport stream analysis and recording program, which in addition to analyzing the broadcast bit stream, enables you to record over-the-air (OtA) SD and HD programs directly to your computer's hard drive. The website is quite comprehensive. He recommended

the \$70 Hauppauge WinTV Aero-m (www.hauppauge.com/site/products/data_aero-m.html) USB ATSC mobile and OtA SD/HD broadcast receiver for your PC.

www.3duniversity.net is a (from their brochure) "neutral, non-biased source of information on 3-D products" and technologies.

EXHIBITS AND PRESS EVENTS

Bose (www.bose.com) presented and demonstrated their RoomMatch modular line-array loudspeakers, which were not perfect, but were the first Bose speakers I could stand to listen to. The room was relatively small for a sound reinforcement array, but it was thoroughly damped all around to absorb reflections and keep the reverberation time down. Overall, the female vocalist recording sounded okay, but with a bit of sibilance. On other recordings, there was too much mid-bass and the high end did not sound natural. Playback of Katharine McPhee singing "Somewhere Over the Rainbow" didn't sound bad but accentuated her breathiness. I

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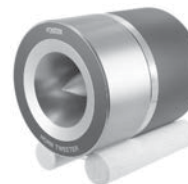
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walked around the room during playback of pink noise, and the high end changed dramatically with distance from the speakers, and as I moved laterally. Bose uses EQ for each module, adjusted to try to balance the sound quality for both close and distant listeners. Each module comprises two cone woofers, a 500 Hz crossover, and six high-frequency compression drivers with custom-designed throats. This speaker model line was designed for fixed installations.

AKG has a free iPhone/iPod-Touch app "to browse, monitor, and control their wireless microphone and in-ear monitor systems." The AKG WMS 40 mini wireless microphone kit (\$100; www.AKG.com/site/products/powerslave,id,1221,pid,1221,nodeid,2,_language,EN,country,ENUS.html) is an analog system that appears to offer good performance at a quite reasonable price.

Sonic Foundry's Mediasite (www.sonicfoundry.com/mediasite/) webcasting package allows you to "record and deliver your online learning, interactive lectures and multimedia presentations automatically." It supports streaming live and on demand, with variable speed playback (but no pitch correction).

Audio Control (www.AudioControl.com) is the exclusive distributor of Studio Six Digital's (www.StudioSixDigital.com) \$400 iAudioInterface2, which has a balanced mike input (switchable 48-VDC phantom power), Toslink digital audio output, analog line input and output, runs off an internal Li-ion battery or external wall wart, and works with the iPhone 4, iPod Touch 4, iPad 1, and iPad 2.

What we old-timers used to call video teleconferencing has a new name—telepresence—which is claimed to offer expanded capabilities, including live visual collaboration and large strategically placed displays that make it appear to each person that they are all in the same room, seated around a conference table.

A PLEASANT MUSICAL EVENING

Extron (www.Extron.com) hosted an evening at the Orlando Hard Rock Live & Cafe. Jumpin Jack Flash—a

Rolling Stones cover band—was loud (I always have my Etymotic Research — www.Etymotic.com—Ety-Plugs ER20s with me), but the sound was good and the singing intelligible. It was a welcome contrast to my unpleasant experiences at concerts associated with other conventions.

STANDARDS DEVELOPMENT ACTIVITIES

Within the past three years, InfoComm became an ANSI-accredited standards developer. The dedicated InfoComm standards group has a staff of five and more than 400 volunteers involved in generation of standards and best practices. They already have produced three ANSI-recognized standards:

- ANSI/InfoComm 1M-2009, "Audio Coverage Uniformity in Enclosed Listener Areas," ACU, provides a procedure to measure the uniformity of spatial coverage, and coverage-uniformity criteria for the design and commissioning of audio systems.
- ANSI/InfoComm 2M-2010, "Standard Guide for Audiovisual Systems Design and Coordination Processes" provides "a description of the methods, procedures, tasks, and deliverables typically recommended or applied by professionals in audiovisual (AV) systems design and integration projects. The standard enables clients and other design and construction team members to confidently assess whether the responsible parties are providing the expected services."
- ANSI/InfoComm 3M-2011, "Projected Image System Contrast Ratio" "defines projected image system contrast ratio and its measurement. It applies to both permanently installed systems and live events. It applies to front and rear projection. This standard defines four contrast ratios based on content viewing requirements. System contrast ratio refers to the image as it is presented to viewers in a space with ambient light. Practical metrics to measure and validate the defined contrast ratios are provided."

The ACU standard is the first of five (possibly six) planned for development

as part of the Amplified Audio System Performance Standards Suite. The remaining four (five?) are:

- Equalization Optimization will “describe the performance requirements for audio system equalization for a variety of venues within enclosed areas, and provide a method for achieving equalization of an amplified audio system to optimize the resulting performance in the room environment. Note that this standard will apply to both music reproduction systems, which require a full frequency spectrum, and speech reinforcement and/or emergency notification systems, which have a more limited frequency range.” (I would prefer a title that referred to the resultant tonal balance rather than the technique for its accomplishment.)
- Undesirable Sound “will set an acceptable threshold for unwanted sound elements of amplified audio systems; describe the method for testing of the amplified audio system; and provide the method of documentation to demonstrate that the unwanted sounds are not

evident while the system is operating. The standard would describe the measurement of the audio signal as compared to the noise level of the system. This standard is not intended to measure the acoustics of the space, nor is it intended to compare the performance of the system to the environment.”

- Reproduced Speech and Reproduced Music Quality “proposes to address the minimum acceptable levels of speech quality and reproduced music performance quality for amplified audio systems from the perspective of time-domain acoustical parameters. The standard should incorporate currently accepted methods for acoustical measurement of the system to determine minimal acceptable levels of sound clarity/quality for speech and performance reproduction quality for music.”

- Sound Pressure Level Optimization in Audiovisual Systems proposes to “characterize this ambient noise, recommend a signal-to-noise ratio for different venue types, and provide measurement techniques using common test equipment. The standard may also refer to

maximum sound pressure levels acceptable for audience safety.”

- Room Effects is an optional effort, as yet undefined.

InfoComm’s Standards and Best Practices Program seeks out and works with other relevant standards organizations such as the AES, the ASA, SMPTE, CEDIA, the Society for Information display (SID), and the Illuminating Engineering Society (IES), to minimize conflicts and duplications of effort, plus to help ensure that the standards are in concert with those of the other organizations and serve as many users as possible. Where appropriate, InfoComm’s standards documents reference and direct readers to other organizations’ standards, engineering guidelines and recommended practices.

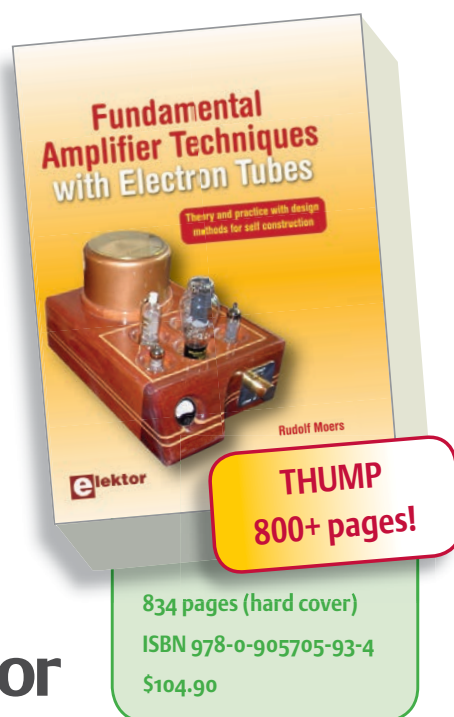
InfoComm has a standard development procedure with a schedule aimed at producing a standard ready for ANSI approval within 18 months of that standard development group’s start date.

Next summer, InfoComm will be held June 9–15, 2012 in Las Vegas. **ax**

Fundamental Amplifier Techniques with Electron Tubes

➔ **The ultimate tube amplifier reference book!**

The aim of this book is to give the reader useful knowledge about electron tube technology in the application of audio amplifiers, including their power supplies, for the design and DIY construction of these electron tube amplifiers. This is much more than just building an electron tube amplifier from a schematic made from the design from someone else: not only academic theory for scientific evidence, but also a theoretical explanation of how the practice works. No modern simulations, but because you first understand the circuit calculations, then you can work with your hands to build the circuit and last, but not least, if you have a multimeter, a signal generator and an oscilloscope, you can measure the circuit parameters yourself to see that theory and practice are very close. That is the aim, and makes this book a unique reference source.



elektor

Munich HIGH END Audio Fair 2011

A report on Europe's largest trade fair for consumer electronics

This year The M.O.C. in Munich hosted the HIGH END, its well-known, popular, and successful specialist trade fair from May 19-22, with 337 exhibitors from 29 countries presenting their high-end consumer electronics. In total, the number of exhibitors increased by 30% in comparison to the previous year. As a result, the range of products was wider than ever and enthusiastically received.

The show has continuously expanded, gaining a reputation as Europe's largest trade fair for consumer electronics, and every year, it is growing more important on international level as well. The proportion of non-German exhibitors reached almost 50%, up from 46% in comparison to the previous year. This year, an increase of almost 14% in trade visitors was recorded as compared to the previous year. The proportion of foreign trade visitors also increased from 60 to 71%. The fair was especially popular with visitors from the United States, Scandinavia, and Switzerland. The strongest European visitor nations after Germany were Switzerland, the United Kingdom, Austria, Russia, Italy, Sweden, France, and Spain. The most overseas exhibitors came from the U.S., India, China, Taiwan, Japan, Israel, Australia, and Japan.

Kurt Hecker, the chairman of the HIGH END SOCIETY, summarized it like this: "Over the past 30 years, the HIGH END has developed into the most important trade fair for high-end consumer electronics in the world."

The HIGH END show has become a central meeting point for members of the industry. Specialists from retail and industry attend HIGH END to obtain insider information on current developments and new technical features, and to see these presented and demonstrated.

I was there also the day before the show when all last minute efforts had

to ensure demonstration capabilities the next day. Believe me when I say that late night work was more rule than exception.

The rooms at exhibition centers are generally not designed with audio demonstrations in mind. So, a lot of work was done to ensure that room acoustics were not blocking the audio demonstrations. It is a shame when you have a room piled with expensive equipment and not be able to demonstrate why a purchase of that equipment is justified.

Room acoustics is often regarded as voodoo science, especially when a solution is expensive.

I didn't know what to think of the acoustic system resonators of Frank Chang (www.franckchang.com): small metal bowls placed on a wooden block. The bowls are available in several kinds of metal. Depending on your solution, you place these acoustic system resonators on the walls of your listening room. The effect? Hmm, let's say that the rooms of distributor Fast Audio (www.fastaudio.com) were definitely among the pleasant listening environments at the show.

A more conventional approach (if anti sound is conventional) was done by Bag-End (www.bagend.com) who offered their E-trap solution for bass absorption below 60 Hz. Wolfgang Krieger from Hörzone (www.hoerzone.de) was very convincing in his lecture at the technology stage.

This technology stage offers a wide variety of lectures on audio technology. Most lectures are easy to understand and draw a lot of attention. These lectures will be available soon for streaming or listening on www.highendsociety.de in MP3 format.

Dr. Arne Färber (www.farber-acoustics.com) was presenting the ins and outs of his huge natural stone (!) spherical horns, with a weight of over 350 kilos per side (including bass units) (Photo 1, Return of the Karlson cou-

pler). It was very interesting to see the use of a Karlson coupler for mid/high frequencies. The main goal was to minimize group delay differences.

Sometimes, depending on the speaker's enthusiasm, a few well-placed questions lead to unexpected remarks. After the presentation, Dr. Färber made the remark that the Karlson coupler was rather easy to develop and easy to implement! Who needs more encouragement to do some experiments with Karlson couplers?



Photo 1: Return of the Karlson coupler



Photo 2: Devialet D-premier

Talk about encouragement: I do not really believe that my last year's remark that the all-digital age had not yet arrived encouraged manufacturers to make an extra effort. But, at this year's show almost everyone offered easy-to-use, high-quality streaming products.

Streaming products are certainly not that easy for small companies who do not have the budget or skills to develop a good streaming product. In a small booth rather invisible for most of the visitors (generally invitation only), StreamUnlimited (www.streamunlimited.com) offered a wide variety of modules, PCBs, and software. StreamUnlimited has its roots in the former Philips Audio Video Innovation Center in Vienna. For small (and larger) companies these products and services might be the solution they are seeking. On their website is a large amount of information available for download.

Not to be overlooked in this field of products is, of course, the Devialet D-premier (www.deviallet.com). The Devialet D-premier (**Photo 2**) is a masterpiece in design, manufacturing qual-

ity, and, soundwise, most pleasing.

But one way or another, the price for good looks, for me, goes to the Naim NDX (www.naimaudio.com). The Naim NDX (**Photo 3**) has a black and green appearance that is very stylish and understated. I have the feeling



Photo 3: The Naim NDX

that this is not a PC in disguise but a real piece of audio equipment. The NDX is not only controllable by remote control, but also

for instance, with an iPod-touch using Naim's n-stream app. I guess this NDX is just the one a lot of people have been seeking.

When I came across the Western Electric 16B loudspeaker 9 (**Photo 4**) in the Silbatone room, the words of Qui-Gon Jinn (Star Wars) came directly to mind: "There is always a bigger fish." This monster single-unit stereo speaker, built in 1928, played very elegantly. The unit has four field coil WE555W drivers, two WE979A tweeters, and four Altec 515B woofers. Silbatone had a large room, and they needed it. The G.I.P. laboratory (www.gip-laboratory.com) 9700A field coil

loudspeaker system was in the same room, and they are big as well. It does not often happen that the floor occupied by speakers equals the space available for the listeners. It was brilliant to see that everyone who entered the room left with big grins on their faces.

Don't get me wrong: others had large systems as well. Or, as the PMC sales manager so eloquently phrased: "This system (the BB5-XBD based 5.0 surround system powered by Bryston) comes with the divorce papers." The PMC/Bryston demo was impressive, overwhelming and dynamic (www.pmc-speakers.com, <http://bryston.com/>). However, that could be said of a lot of other brands as well. A complete contrast in size were the little Kiso speakers (www.kisoacoustic.com) just a few rooms away from PMC. Yes, they were impressive, overwhelming, and dynamic as well, but in a completely different way. It was remarkable how pleasant listening to those very small speakers was. However, with cabinets hand-made by the famous guitar manufacturer Takamine and a very



Photo 4: There are always a bigger fish—like the Western Electric 16B loudspeaker 9.

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PRODUCT
REVIEW

"Audience's Au24e interconnects and speaker cables perform as well as any cables I've heard. What's more, they compare favorably with other reference-quality cables, not only as an overall package of strengths and weaknesses, but line by line, in any sort of audiophile accounting."

Brian Damkroger - June 2010

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subtle tuning, a double pair will bring you into the same price range as the PMC's. Still, it's something to discuss with your partner.

As the show has become more important over the years, the number of attending designers and engineers has grown as well. So you could stumble onto someone like Tim de Paravicini (www.ear-yoshino.com) (**Photo 5**, The Paravicini 312) like I did.

You could have a discussion about the use of HF techniques in audio design, skin effect, or the power grid situation in the UK. Or, you could see Frank Denson (www.welltempered-lab.net) helping someone who had to adjust a turntable which was a bit mangled in transport (always follow the instructions for shipping delicate equipment). The show has also become a focal point for the demonstration of prototypes in long sessions after closing time. I have seen some "spiderweb electronics," which were remarkable: Remarkable that they worked and remarkable in high quality sound.

I am definitely not into tubes, although I believe you can make good amplifiers with them. The reason? I did not grow up designing with them. But if you see someone who is actually developing new tubes, they have my sympathy vote for just trying to do such a thing.

This German manufacturer Elrog (www.elrog.com) does it. With somewhere between 211 and 845 tubes, the ER845 comes with an improved grid, a hundred times better vacuum, and a special graphite anode. Have a look at them, or even better, listen to an amp in which they are used (www.cayin.com).

SB Acoustics (www.sbacoustics.com) presented a large range of loudspeaker chassis, which are simply inviting you to design and build a system. The general impression was one of well-thought out designs and good quality (although their website needs some updating.)

Maybe something to combine with the products of Lead Audio (www.lead-audio.com), who are offering a range of ready to use amplifier modules and DSP boards. Interesting is the software tool, which enables both de-



Photo 5: The Paravicini 312

signing and measuring. For production and service, they also offer an upload-only tool.

Of course, you can also measure with MicW (www.mic-w.com), a measurement microphone for your i-Phone/i-Pad/i-Pod touch. The available apps are covering Signal Scope, Freq Analyzer, SPL meter, SPLNFFTNoise meter etc. etc. Of course, the MicW has its limitations, but with a price tag of €99 (approximately \$142 U.S.), it might be a "handy" tool for everyday use—to avoid carrying around hefty and expensive tools all day.

And now, for something completely different.

There was a company that took a great effort to attend the show. They were there with their flagship product, leaflets, and enthusiastic representatives. However, they spoke a language not widely used among the visitors. I did not understand what kind of product they were offering or what this good-looking piece of equipment was doing. So I read the leaflet, which was more or less in English, and I was still not able to find out what they were offering. An enthusiastic sales rep explained everything to me once again in a language I still did not understand.

Blame me for missing the invention of the year, but I decided it was definitely the right time to go for a beer in one of Munich's beer gardens.

See you at the 2012 fair! **aX**

MIDI USB HOST

Kenton added the “MIDI USB Host” to its range of unique studio solutions. With the introduction of the MIDI USB Host, it’s easy to interface USB-enabled devices directly to those with standard five-pin DIN MIDI connections, either In or Out, without the need for a computer.

The MIDI USB Host provides a simple and straightforward means of connecting any “Class Compliant” USB device. This enables the direct connection of a USB controller or keyboard to another MIDI instrument that has only a five-pin DIN MIDI connection.



The MIDI USB Host

Mains powered, the compact and rugged MIDI USB Host features a USB port (USB A socket) and MIDI In and Out sockets (both on 5-pin DIN). MIDI data received at the MIDI In socket will be sent to the USB device, while MIDI data received from the USB device will be sent to the MIDI Out socket. Additionally, the MIDI USB Host can provide up to 500 mA of USB Buss power to the USB device if required.

For more information, contact Kenton Electronics at www.kentonuk.com.

PROSCENIUM BLACK DIAMOND III TURNTABLE

Walker Audio’s Proscenium Black Diamond III turntable features a modified suspension system that significantly improves the audio quality by adding a separate, isolated air supply that uses lower air pressure in the suspension chambers.

New coupling material was also added to isolate the air chambers from the equipment rack. The state-of-the-art, all air-bearing, linear tracking turntable is hand-built to exacting specifications.

For more information, contact Walker Audio at www.WalkerAudio.com.

MONITOR SERIES 7 LOUDSPEAKERS

Paradigm’s Monitor Series 7 represents a complete redesign of the lineup, technologically and aesthetically. While faithfully preserving the natural acoustic signature of Monitor Series speakers, this generation offers critical sonic refinements through the introduction of Paradigm Reference design and technology in spades. A cleaner, more linear aesthetic rounds out the new package.

Monitor Series 7 design has several new features. It has self-aligning magnetic grille design. Honeycomb interior corner architecture ensures a more spacious and transparent sound since the new architecture prevents sound capture in grille corners. Acoustic integrity remains intact whether speakers are played with grilles on or grilles off.

It has a complete baffle redesign, with 0.75" MDF baffles across the board for further increased solidity and cabinet resonance reduction. The baffle has been FEA-optimized to remove resonances and vibrations and critically tuned to the rest of the cabinet. An elegant plinth (base) provides stability for the narrower floor standing footprints and a stylistically cleaner, less intrusive alternative to outrigger feet.

The design represents a 20% overall reduction in model footprints (floor standers and center channels). The Monitor 7 is a

new size and it’s a three-driver model (vs. four drivers in previous iterations) covering the spectrum through a tweeter, mid/bass and bass driver with audible improvements in sensitivity and extension.

Monitor Series 7 is available in Black Ash and a new Heritage Cherry finish. Surrounds are in Black. For more information, visit Paradigm Electronics at www.paradigm.com.

N7 NETWORK MUSIC SYSTEM IN BLACK

Denon Electronics has announced its well-known N7 Networked CD Receiver and 2.0 Channel Speaker System—consisting of the RCD-N7 CD Receiver and SC-N7 Stereo Loudspeakers—is now available with a sleek black cosmetic, as well as the original white “mod style.” This enables you to match and integrate the N7 into virtually any interior décor. In addition, all new N7 systems now come with a free AirPlay upgrade (regular price \$49.99). AirPlay enables you to stream from iTunes music libraries on Mac or PC, as well as music stored on your iPad, iPhone, or iPod touch (through Wi-Fi-enabled networks).

The N7 system expands your music experience by enabling you to enjoy your favorite music, from multiple content sources, in high-quality two-channel audio. The RCD-N7 receiver and high-performance SC-N7 speakers are designed to integrate smoothly in a full-functioning music system. With its iPhone/iPod dock, stereo loudspeakers and trendsetting profile, the N7 system is ideal for bringing powerful, great sounding music to any room.

Additionally, by



Paradigm's Monitor Series 7

combining Denon's RCD-N7 CD Receiver and SC-N7 Stereo Loudspeakers, the N7 system offers users a straightforward, simple, and efficient way to create a networked system throughout the home. For instance, Denon's special "Party Mode Plus" multi-zone network streaming management system for use with new Denon A/V receivers lets you control and play music simultaneously on up to five Denon devices on their network. In addition to full iPod/iPhone connectivity, the RCD-N7 allows you to listen to today's popular online music services such as Rhapsody, Napster and Pandora, as well as stream music wirelessly from a PC. The RCD-N7 also provides you with the capability to playback CD, enjoy AM/FM radio, and more. Most importantly, the receiver features full digital processing, which provides a pure signal transfer and optimum audio performance from all sources. For more information, contact Denon Electronics at www.usa.denon.com.

CLASS D AUDIO AMP

ON Semiconductor's NCS8353 stereo audio amplifier is a Class D device with high efficiency levels (greater than 87%) that climates the need for the inclusion of a heatsink in the system design. Aimed at the flat panel TV market the device can be powered from the existing 24-V backlight rail in the TV system and is capable of delivering a continuous output power of up to 20 W per channel into an 8- Ω bridge tied load (BTL).

The pulse-width modulation (PWM) technique utilized within the Class-D architecture permits filter-less operation in certain circumstances by using the speakers themselves as an LC filter. This can significantly improve total bill of material costs as the additional components typically required to filter Electro-Magnetic Interference (EMI) can be omitted.

Four selectable gain ranges are supported: 20 dB, 26 dB, 32 dB, and 36 dB. An integrated digital power limiter can be set, using two external bits, to deliver a specific output (10 W, 12 W, 15 W, or 20 W). This protects the TV



ON Semiconductor's NCS8353 stereo audio amplifier

speakers from high amplitude input spikes. A shutdown function reduces the quiescent current drawn by the amplifier to 100 μ A typical, while the mute feature ensures that audio is not present at the output during audio source switching.

In order to permit uninterrupted audio operation at lower output powers, should the internal temperature rise above the junction threshold of 150°C, the internal gain of the device is slowly reduced. The combination of gain reduction and internal power dissipation results in a stable maximum junction temperature of approximately 140°C. The output stage will completely shut down if the junction temperature rises above 160°C. The power stage is re-enabled once the device junction temperature cools to below 130°C.

If a short circuit event is detected, the output stage of the devices is completely disabled and an internal counter activated. After a 100-ms period

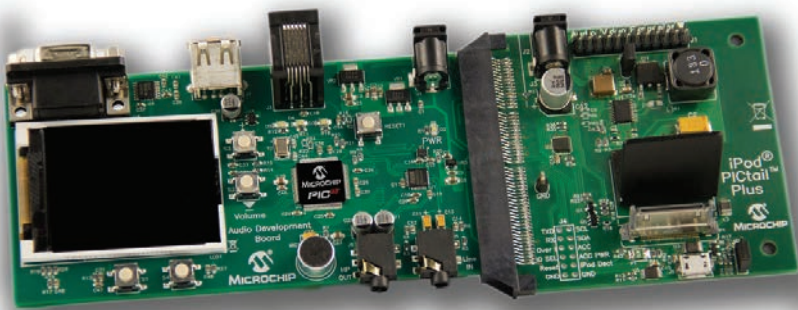
the output stage will attempt to reactivate, with the cycle continuing until the short is removed.

The NCS8353 is housed in a compact 5 mm $\times$ 5 mm, Pb-Free, 32-pin QFN package. For more information, go to ON Semiconductor at www.onsemi.com.

DEV KIT FOR HIGH-QUALITY AUDIO APPS

Microchip Technology's Audio Development Board for PIC32 MCUs is a complete solution for the development of 24-bit audio and speech applications with record, playback, and mixing capabilities. It features an 80-MIPS PIC32 MCU, a 24-bit Wolfson audio codec, a 2" color LCD, a USB interface, and an on-board microphone. Supported by Microchip's free software libraries, the kit provides a perfect solution for the development of speech and audio recording and playback designs.

The 80-MIPS PIC32MX795F512L MCU on the audio development board features 512-KB flash and 128-KB



Digital Audio Development Kit for PIC32 (Part# DM320411)

RAM, providing plenty of processing power and memory to decode, analyze, and play back audio and speech. Libraries are available for speech recording and playback, as well as MP3 music decoding applications. Additionally, an audio Sample Rate Conversion (SRC) library for 33 kHz, 44.1 kHz, and 48 kHz is also supported, which enables developers to reduce component costs for playback solutions. There are also libraries available for managing the USB interface and driving the on-board color LCD, which features 16-bit color images. For more information, contact Microchip Technology at www.microchip.com.

NEW NETWORK RECEIVERS

Onkyo has released of two high-end network 9.2-channel THX Ultra2 Plus-certified A/V receivers—the TX-NR5009 and the TX-NR3009. The receivers deliver the power, performance, sophisticated processing, exceptional connectivity, and quality that serious audio-video enthusiasts have come to expect.

Both receiver models include major upgrades from last year, including the

use of the latest HQV-Vida and Marvel Qdeo video processors, new DTS Neo:X dimensional surround processing, Dolby Volume, and new streaming internet radio channels.

When it comes to input options, the TX-NR5009 and TX-NR3009 are extremely versatile, sporting eight HDMI inputs and two outputs, plus a full range of legacy analog and digital AV connections. New media connections include an Ethernet port, two USB ports, a Universal Port for Onkyo peripheral devices, and an RGB input for video content from a connected PC. Onkyo also offers an optional UWF-1 wireless LAN adaptor that turns the front panel USB port into a home internet access point. Users can also download and install free applications that turn their Android or iPod touch/iPhone into a full-function remote control to control the receiver.

Both receivers are designed to connect to the new generation of user-customized Internet radio stations and streaming music services, including those from Spotify, AUPEO!, Pandora, Last.fm, Rhapsody, Napster, Mediafly, Slacker, Sirius XM, and vTuner. The re-

ceiver is also DLNA 1.5 certified; it can interface with USB-compatible portable music devices, such as iPods, and play music straight off a USB thumb drive. The unit can handle a wide variety of audio formats, including FLAC, WMA Lossless, WAV, AAC, Ogg, MP3, and, for audiophiles, Super Audio CD.

With terminals for 11 speakers, the nine amplifier channels can be tasked to power a wide variety of front, surround, height, bi-amped, or remote-zone loudspeakers depending on the users needs. Onkyo makes it easy to fine-tune all these speakers by providing the latest Audyssey MultEQ XT32 room-correction and equalization technology, which perfects audio performance regardless of a room's shape or acoustics.

The receivers have backlit remote controls and an overlaid graphical OSD for swift, seamless, and simple adjustment of settings during a program, game, or movie. Plus, both receivers use Onkyo's proven wide range amplifier technology (WRAT) power stages and three-stage inverted Darlington topology to deliver high power with low distortion and exceptional high current capability. Audio signals on are refined by PLL jitter-cleaning technology and Onkyo's VLSC contributes to an extremely crisp digital-to-analog signal conversion. Separate aluminum panels encase the low-resonance chassis to help eliminate vibration and microphonics.

Onkyo's TX-NR3009 uses 24-bit TI Burr-Brown DACs for each channel and a high-current power supply with large 18,000- μ F capacitors and a large EI transformer.

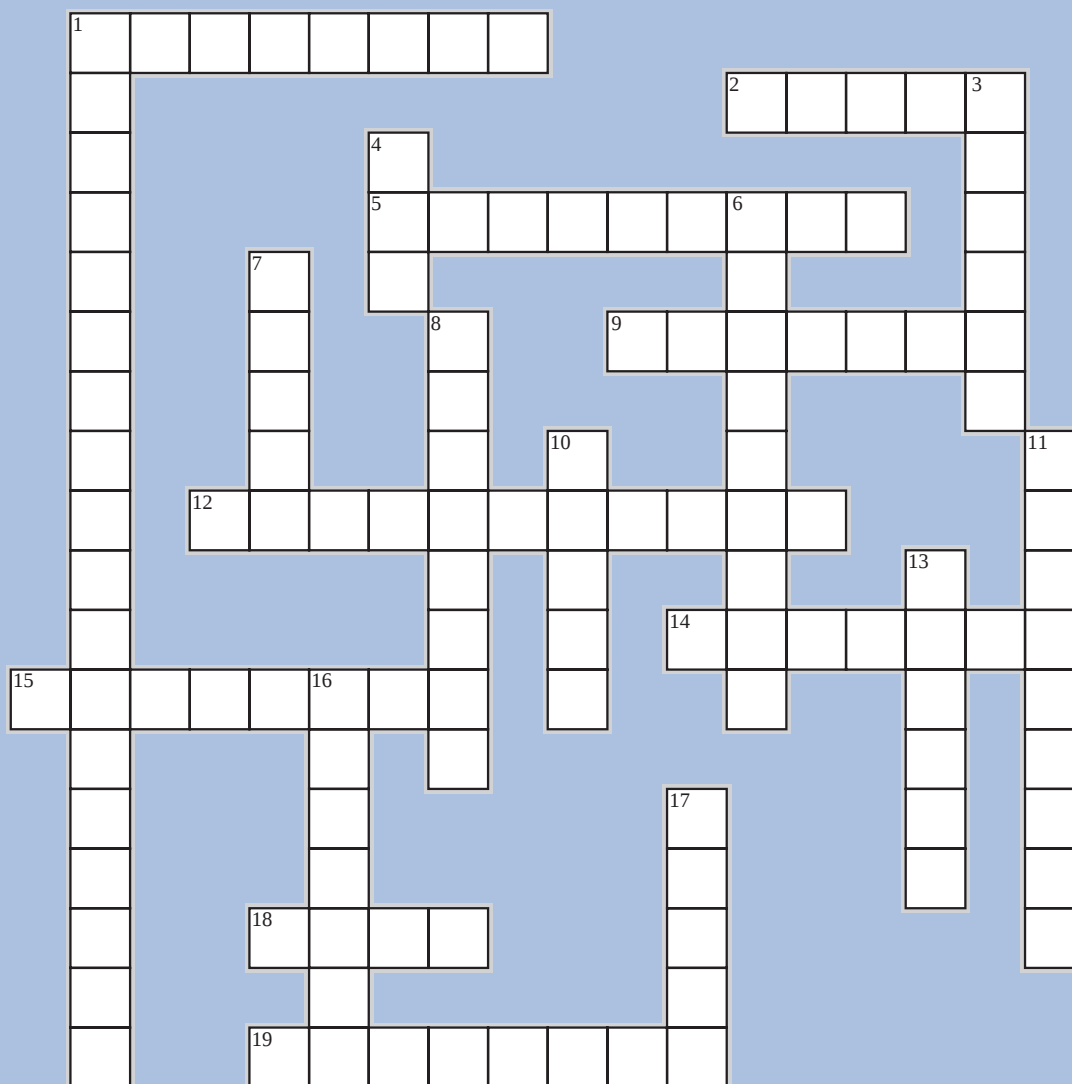
The TX-NR5009's amplifier takes the whole issue of amplifier and power supply performance up a notch. Power flows efficiently from a massive high-current toroidal transformer through two 22,000- μ F capacitors, with dedicated transformers for audio and video. The digital audio section employs Powerful 192-kHz/32-bit TI Burr-Brown DACs on all channels, coupled to a 32-bit DSP chip. These contribute to the receiver achieving THX Ultra2 Plus certification and a level of sound quality that rivals that of many separate component amplifiers. Go to www.onkyousa.com for more information.



Front view of the TX-NR5009



Front view of the TX-NR3009

**ACROSS**

1. < 15 Hz
2. An “audiotrope” is a type of what that searches for the sources of sounds
5. AUX
9. Speaker for high-frequency sounds
12. Wave transmission
14. Output point on a preamp [two words]
15. Tx
18. Drop in decibels
19. FI

DOWN

1. SPL [three words]
3. Sound quality
4. Wavform file extension
6. Irregular intervals
7. A method using sound waves to detect objects, especially those under water
8. 1,000 MB
10. He founded the amateur radio association in 1914
11. To transmit two or more signals at the same time over one channel.
13. Cu in voice coil
16. The gentleman who connected U.S. President Roosevelt and Britain’s King Edward VII with a transmitter
17. American inventor (b. 1933) whose noise reduction technology has revolutionized the audio and film industries

Editor’s Note: Answers to this puzzle will appear in the next issue.

Audio Marketplace

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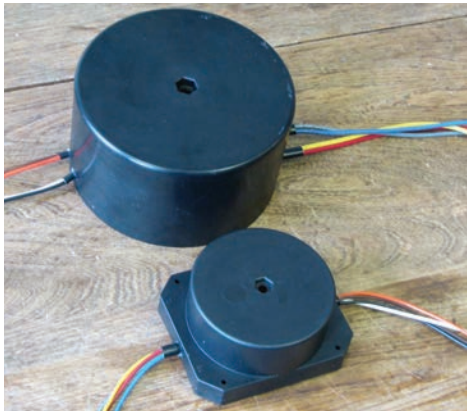
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AN INTERESTING SOLUTION

I read with interest Jeff Macaulay's article, "Efficient 100 W Class A Amplifier," in the August 2011 *audioXpress* issue. Again, Jeff has come up with an interesting solution to a technical problem. But before addressing the article, let me take this opportunity to congratulate you and your editorial team with the acquisition of *AudioXpress* and its sister publications. *AudioXpress*, and before that *Audio Amateur*, *Glass Audio* and *Speaker Builder* have built a fine reputation for technical and editorial excellence, thanks to the decades' long efforts of Ed Dell and his staff. I wish you all great success in expanding the reach and spreading the word of how great this audio hobby of ours is!

But, back to audio. In Figure 2A, Jeff shows his solution for making sure that T1 (the upper output device) doesn't turn off during the time that T2 is sinking the load current. From the point of view of T1, it is working in class A, as it never turns off, but without the usual penalty of high-idle dissipation.

However, if you look at the situation when T1 is sourcing load current, there will be an additional voltage drop across resistor Z which will cause T2 to turn off. So, T2 will not work in class A. It is not clear how an amplifier that works half in class A and half in class (A)B could be characterized, or for that matter how it would sound, but I believe it should not really be called a class A amplifier.

Further in the article, Macaulay introduces a diode in parallel with impedance Z (D1, Figure 3) with the aim to limit the voltage drop across Z and thus to limit the dissipation in Z. That diode will somewhat ameliorate the cutoff of T2 as noted above, but not totally. The increase in V_{be} required to sustain a 5 A load current is about 200 mV (Jeff's numbers), yet the voltage across Z will rise to some 600 mV before the diode starts to conduct in earnest and limit the Z voltage.

One further practical point: if the wiper of trimpot RV1 (Figure 3 again) ever loses contact with the track, several components will release the smoke

they contain. Connecting the top end of the trimmer to the wiper will make that somewhat less catastrophic.

Jan Didden
Hoensbroek, Netherlands

Jeff Macaulay responds:

I have read with interest Mr. Didden's letter regarding my 100-W Class A amplifier design. As I discussed in the article, the circuit is that of a Single-Ended Class A amplifier, not a push pull type, although I can see where the confusion comes from. Except for the unbalancing impedance, the circuit appears, at first glance, to be a push pull stage.

I don't wish to labor the point, but a Class A amplifier is characterized by conduction throughout the entire signal cycle. T1, as Mr. Didden rightly points out, does just that, but what of T2, the lower device? At the signal zero crossing point T2 conducts the same current as T1. They are after all in series. As the signal goes negative T2 provides the necessary current for the load, but the output voltage is always under the control of T1 via the overall feedback loop. As the output signal comes directly from the collector of T2 Z has no part to play in its operation. On positive signal excursions T2 switches off but T1 stays on. Just what's required in a single-ended circuit.

An analogy comes to mind. T2 acts in the same manner as a constant current load in a conventional Class A amp with T1 as the output stage. T2 simply provides the required current on negative excursions. What it does on positive excursions is irrelevant since T1 again provides the required output drive. At all times during the signal cycle, the output is controlled via T1, which acts in single-ended Class A.

SE Class A amps, paradoxically, have more distortion than push pull types since the latter cancel out even order distortions, the hallmarks of a SE device.

Now, despite some views to the contrary, a Class A stage is defined as one in which the device(s) conduct for the whole signal cycle. Nowhere is it written in stone that they need to dissipate huge amounts of heat or consume co-

pious amounts of current. This occurs only because the conventional Class A output stage is biased to cater for maximum output. If the bias current is varied in sympathy with the incoming music signal, a much more efficient Class A stage results. Also, the signal in such an output stage never "crosses over"; hence, no crossover distortion is generated.

Suppose I were to use conventional wisdom to produce 100-W SE Class A into an 8 Ω load. The RMS voltage required would be 28.3 V, a peak of 40 V and a quiescent current of 5 A. The power supply would have to be ± 50 VDC to cater for peak to peak and transistor saturation voltages, etc. The resulting power requirement—a whopping 500 W. In comparison, my output stage uses a quiescent current of 60 mA and a quiescent power dissipation of 6 W for the same output.

Mr. Didden wonders what the output stage sounds like. I can only say to my ears it sounds just like a conventional SE stage. As to a separate classification, how about SEe. The little e standing for efficient?

VACUUM TUBE DEEMED UNNECESSARY

In the August 2011 *audioXpress*, Atto Rinaldo describes his Michele moving-coil cartridge preamp, a hybrid that uses a bipolar junction transistor TR1 (2N3904) as its principal gain stage. The key feature of this design is its cascode dual triode follower—very good bandwidth, little added noise, unit current gain from the common grid stage V1, and nearly unit voltage gain from the common anode stage V2.

Since TR1 is doing all the work, why use a vacuum tube follower? Surely ordinary junction field effect transistors (JFETs) have the same advantages in cascode amplifier and follower service: unit current gain in common gate connection, nearly unit voltage gain in source follower connection, low noise, huge bandwidth, and the 2N3819 sells for a dime apiece worldwide. No heater power required either.

Mike Lampton
Berkeley, CA

Atto E. Rinaldo responds:

Mike, thanks for commenting on my project. Certainly, An alternative solution using JFET instead of a bipolar, could have been implemented and in fact there are designs that consider that.

This is my solution which was aimed to make use of vacuum tube as much as possible, as opposed to solid state.

If I understand your question properly, the Totem pole V1-V2 (in series with TR1) however, cannot be seen as a cathode follower since it has an additional voltage gain of about 21 db while Tr1 gains about 35 db.

The overall stage gain (TR1 -V1) is around 56 db (650 times) necessary to bring a low output MC cartridge level from, say 500 mV, to around 0.3 - 0.4 V needed to drive a good Line Pre. (ideally the MC gain requirements would be around 60db gain—1000 times—but with a low-battery operated tubes this is hardly achievable.) More specifically, with 1 mV at the base of TR1 you can get 45 mV at TR1 collector and 0.65 V at V1 plate. Besides, Mc cartridge has a low low impedance and interfaces perfectly with a bipolar transistor.

CASTLE DESIGN INSPIRES HISTORY LESSON

I enjoyed your interesting, and gratifyingly musically based, article on the "Castle" omni design (September 2011 *audioXpress*). While it probably has some serious lobing and interference problems, it certainly must be true that a pair sound "definitely different," as you put it—airy, transparent, wide, rich, clear, and all that.

Some historical comments about your research may be of interest to readers:

1. The catchy rhyming knock on the Bose 901 has more to do with its appearance (all mids) than with its sound. That design has plenty of highs and lows. Whether one cares for their quality and that particular radiation pattern is a different issue.

2. Ohm loudspeakers have always been near-omni, and some have achieved the playback qualities you described.

3. The three early Roy Allison designs and the later IC20 were all half- or

quarter-omni (and effectively full omni within a room), being multidriver and designed for placement against a wall or in a corner. The Allison midrange and tweeter, whose unequaled dispersion performance and design innovations would be worth an article, put out as much sound sideways as forward. Of course, Allison learned about tweeter dispersion performance (and much else) from working with Edgar Villchur and his groundbreaking small domes at the original Acoustic Research.

4. Mark Davis's dbx Soundfield Imaging line of speakers (multidriver phased arrays) were all omni, but shaped broadband omni, above 100 Hz or so; below it is like all bass, equi-omni, to coin a term. (The mid and treble uniform shaping was designed to achieve centered sound when listening off-center.) Later models were forward-facing and designed for closer placement to the front wall, but still omnidirectional playback.

5. David Moulton's sophisticated Beolab V is the latest (and to my mind

about the best) initiative into omni loudspeaker design.

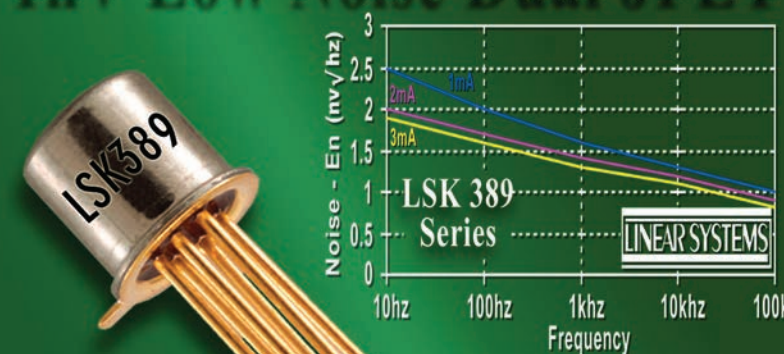
Doubtless, I have left out some designs in this hasty history. For example, the Boston Acoustics short-lived E100, a thin tower (with extra tweeter on the back), was very close to broadband-omni. Don Keele's multidriver CBT is an interesting approach to omni sound. And an authentic ancestor was Bose's 1/8-sphere multidriver 2201, from 45 years ago.

Finally, all conventional forward-facing dynamic speakers are omni below a certain, fairly high midrange frequency. This is not widely appreciated. So when we talk about omni playback, in general we are actually talking about the treble only.

But as you rightly note, the difference that having a lot of treble widely distributed into the reverberant field makes is most striking and musical.

David Moran
Wayland, MA

1nV Low Noise Dual JFET



The graph shows Noise - En (nV/√Hz) on the y-axis (0 to 3) versus Frequency (Hz) on the x-axis (10Hz to 100kHz). Three curves are plotted for bias currents of 1mA (blue), 2mA (red), and 3mA (green). All curves show a decreasing trend in noise as frequency increases. The 1mA curve is the highest, followed by 2mA, then 3mA. The LSK389 Series is identified in the graph area.

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Contributors

Patrick Brunner ("Upgrading the Phase Linear 200 Amplifier," p. 26) is an independent electronic design consultant. He started Applied Technical Services in 1982, designing primarily in the field of medical electronics. Prior to 1982 he worked at various military, industrial, and medical electronics companies. Pat resides in Florida. The electronics bug first bit at age 8 with a crystal radio and a CK722 for an amplifier. The bug was exacerbated later after hearing a Heath kit W9 driving a homemade 15" JBL-based speaker system. Hi-Fi has remained a hobby since that time.

Vance Dickason ("Full-Range Driver Test," p. 8) has been working as a professional in the loudspeaker industry since 1974. He is the author of the *Loudspeaker Design Cookbook*—which is now in its seventh edition and published in English, French, German, Dutch, Italian, Spanish, and Portuguese—and *The Loudspeaker Recipes*. Vance is currently the editor of *Voice Coil: The Periodical for the Loudspeaker Industry*, which is published on a monthly basis. For several years, Vance has been working as an engineering design consultant for various speaker manufacturers and is responsible for numerous award-winning designs, including 20 THX home theater certifications. Speakers that Vance designed that have won magazine and industry design awards include the Artison Portrait, Atlantic 170, 270, 370, 450 and 8200, and the coNEXTion Sonoma 10 and z600c.

Jan Didden ("Spreading the Word: The Joy of Making Things," p. 17) has been writing for *audioXpress* since the 1970s. He is now retired after a career with The Netherlands Air Force and NATO, working in logistics, air defense, and information technology. His retirement finally gave him time to finish all those audio projects that had piled up for decades. He writes about them on linearaudio.nl. His main interests are power amplifiers and audio test equipment. Jan is also the editor/publisher of *Linear Audio*.

Frans Janssens ("Simple Hybrid Amp," p. 30) first contributed his article, "Simple Hybrid Amp," to *Elekter*. It appeared in the July/August 2006 issue of *Elekter* and turned out to be very popular at the time. Frans is one of countless people who have contributed a project to *Elekter's* Summer Circuits edition.

Ward Maas ("The Munich High-End Audio Fair 2011," p. 36) is the owner of Pilgham Audio. He studied electronics, marketing, and amplifier design. During his long career in the field of consumer electronics, Ward has been working in areas ranging from compact disc standardization to radio and television to personal (GPS) navigation. At this moment, Ward is working on an extreme low-noise MC preamp and several special amplifier products. He lives in Almere, Netherlands, with his wife and son.

David J. Weinberg ("InfoComm 2011: The Center of IT All," p. 32) is an engineer, manager, and editor who holds an MS in Administration from Johns Hopkins University, an MS Biomedical and Electronics Engineering from the University of Maryland, and a BS Electronics Engineering from Worcester Polytechnic Institute. He currently edits *The BAS Speaker*, which is the journal of the Boston Audio Society. David's background includes 40 years of determining and implementing cost-effective solutions to complex systems engineering problems, 25 years of location audio concert recording, digital audio system beta testing, engineering consultation, and much more.

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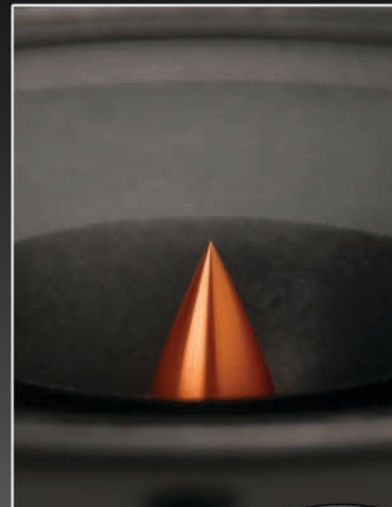
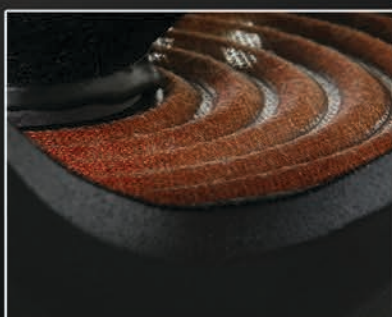
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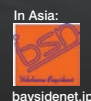


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