

audioXpress

Advancing the Evolution
of Audio Technology

APRIL 2013

US \$9.00/Canada \$10.00

Repurpose Your Tube Amplifiers



Clean and Preserve Treasured LPs



Explore PVDF's Potential



PLUS

- New Revelator Beryllium Tweeter Put to the Test
- An Introduction to Popular Preamp Tubes
- CES 2013: A Detailed Review
- News & Products: A Versatile PA Package, a High-Performance Subwoofer, an Affordable Handheld RF Spectrum Analyzer, and More



audioXpress.com

PARTS CONNEXION



The Authority on Hi-Fi DIY

**Your #1 Source
for
NEW & NOS Vacuum Tubes,
DIY Parts & Components
and
Audiophile Accessories.**

Sales:

order@partsconnexion.com



905-631-5777

www.partsconnexion.com



1-866-681-9602



Inquiries:

info@partsconnexion.com

905-681-9602



5109 Harvester Rd, Unit B2, Burlington, Ontario, Canada L7L 5Y4

Debit, Visa, Mastercard, Amex, PayPal, Money Order & Bank Draft



HAMMOND MANUFACTURING™



USA

Tel: (716) 630-7030
Fax: (716) 630-7042

UK

Tel: 01256 812812
Fax: 01256 332249

Canada

Tel: (519) 822-2960
Fax: (519) 822-0715

Australia

Tel: 8-8240-2244
Fax: 8-8240-2255



Contact us for free catalogs & a list of stocking distributors.

www.hammondmfg.com

Editors' note: Just prior to printing this issue, we learned that Ed Dell, founder of Audio Amateur, had passed away. He was 90 years old. Ed was a remarkable man whose talents ranged from DIY audio to publishing to writing. We'll celebrate Ed's work in the next issue. Our thoughts are with his family and friends.

Improving a Classic

Recently, Patrick Brunner found a pair of Dynaco's ST70s—once known as the best-selling tube power amplifier—in good condition. As an engineer, he couldn't resist adding some tweaks to the old classic. In this issue, learn how he installed a new 6GH8 driver board to the ST70 and updated its relatively weak bias supply (p. 12). You can do the same for \$25 or less.

There is a dizzying array of tubes out there. But if your interest is in audio amplifiers, you need detailed knowledge of only a few models—including critical audio preamplifier tubes. Find out more in Richard Honeycutt's article (p. 22).

Mike Klasco and Steve Tatarunis call high-polymer piezoelectric film "the lost technology." In the first of a two-part article, Klasco and Tatarunis introduce you to the often-overlooked technology and its promises and drawbacks for audio applications (p. 8).

Also in this issue, Vance Dickason reviews Scan-Speak's D2908/714000, the company's second 30-mm beryllium dome tweeter (p. 18).

In another review, Victor Staggs looks at the Spin-Clean Record Washer System MKII. He says the affordable system enables you to expand the lifetime of irreplaceable LPs (p. 25).

Geoff Boyd, co-founder one of the UK's first personal computer companies, relaunched his entrepreneurial career in the Silicon Valley, establishing Coleridge Design Associates to develop innovations in consumer electronics audio and sound reproduction. Check out our interview (p. 28).

Finally, David J. Weinberg provides his full take on the 2013 International CES trade show in Las Vegas (p. 33).

Regards,

Mary Wilson
editor@audioxpress.com

CONTENTS

VOLUME 44 NUMBER 4 APRIL 2013

FEATURES

Construct a Simple LED Bias Meter and Supply

Small PCB combines the bias supply and an LED bias-setting circuit

By Patrick Brunner 12



Testing the Spin-Clean LP Washer Machine

Reviewer recommends cleaning system

By Victor Staggs 25



Entrepreneur Embraces Audio Technology Evolution

An interview with audio professional Geoff Boyd

By Shannon Becker 28

CES 2013

Mostly Ho Hum, with a Few Sparkles
A comprehensive overview of the annual show

By David J. Weinberg 33

COLUMNS

SPEAKERS — "PARTS IS PARTS" High-Polymer Film (Part 1)

The Lost Speaker Technology

An exploration of PVDF's untapped potential

By Mike Klasco and Steve Tatarunis 8



TEST BENCH

Scan-Speak High-Frequency Driver

A beryllium tweeter in a high-end product

By Vance Dickason 18

HOLLOW-STATE ELECTRONICS Popular Preamp Tubes

Use the correct tube for your project

By Richard Honeycutt 22



DEPARTMENTS

From the Editor's Desk	4
Client Index	7
Member Profile	20
Products & News	40-41
Crossword	42
Marketplace	43
Classifieds	44
Contributors	44

WEBSITES

WEBSITES YOU SHOULD KNOW:

audioamateur.com
audioxpress.com
voicecoilmagazine.com
cc-webshop.com

This is what great sourcing in Asia looks like.

Tymphany's team of design, engineering and production experts get your leading-edge products to market on time—and on budget.

- Western leadership
- Innovative engineering & design
- Competitive costs
- Transparent business practices
- Partnership you can trust

TYMPHANY
 We're not your outsource. We're your resource.
www.tymphany.com



This is what great sourcing in Asia looks like.

Tymphany's team of design, engineering and production experts get your leading-edge products to market on time—and on budget.

- Western leadership
- Innovative engineering & design
- Competitive costs
- Transparent business practices
- Partnership you can trust

TYMPHANY
 We're not your outsource. We're your resource.
www.tymphany.com

- 
- This is what great sourcing in Asia looks like.**
- Tymphany's team of design, engineering and production experts get your leading-edge products to market on time—and on budget.
- Western leadership
 - Innovative engineering & design
 - Competitive costs
 - Transparent business practices
 - Partnership you can trust
- TYMPHANY**
 We're not your outsource. We're your resource.
www.tymphany.com



This is what great sourcing in Asia looks like.

Tymphany's team of design, engineering and production experts get your leading-edge products to market on time—and on budget.

- Western leadership
- Innovative engineering & design
- Competitive costs
- Transparent business practices
- Partnership you can trust

TYMPHANY
 We're not your outsource. We're your resource.
www.tymphany.com



This is what great sourcing in Asia looks like.

Tymphany's team of design, engineering and production experts get your leading-edge products to market on time—and on budget.

- Western leadership
- Innovative engineering & design
- Competitive costs
- Transparent business practices
- Partnership you can trust

TYMPHANY
 We're not your outsource. We're your resource.
www.tymphany.com



This is what great sourcing in Asia looks like.

Tymphany's team of design, engineering and production experts get your leading-edge products to market on time—and on budget.

- Western leadership
- Innovative engineering & design
- Competitive costs
- Transparent business practices
- Partnership you can trust

TYMPHANY
 We're not your outsource. We're your resource.
www.tymphany.com

THE TEAM

PUBLISHER:	Hugo Van haecke	ADVERTISING COORDINATOR:	Erica Fienman
EDITOR-IN-CHIEF:	C. J. Abate	TECHNICAL EDITORS:	Jan Didden, David J. Weinberg
MANAGING EDITOR:	Mary Wilson	REGULAR CONTRIBUTORS:	
ASSOCIATE EDITOR:	Shannon Becker		Erno Borbely, Richard Campbell, Dennis Colin, Joseph D'Appolito,
ASSOCIATE PUBLISHER:	Shannon Barraclough		Vance Dickason, Jan Didden, Bill Fitzmaurice, James T. Frane,
CONTROLLER:	Emily Struzik		Gary Galo, Chuck Hansen, Mike Klasco, G. R. Koonce, Tom Lyle,
ART DIRECTOR:	KC Prescott		James Moriyasu, Nelson Pass, Richard Pierce, David A. Rich, Paul
CUSTOMER SERVICE:	Debbie Lavoie		Stamler, David J. Weinberg

THE NETWORKS



OUR INTERNATIONAL TEAMS

	United Kingdom Wisse Hettinga +31 (0)46 4389428 w.hettinga@elektor.com		Spain Eduardo Corral +34 91 101 93 85 e.corral@elektor.es		India Sunil D. Malekar +91 9833168815 ts@elektor.in
	USA Hugo Vanhaecke +1 860-875-2199 h.vanhaecke@elektor.com		Italy Maurizio del Corso +39 2.66504755 m.delcorso@inware.it		Russia Nataliya Melnikova 8 10 7 (965) 395 33 36 nataliya-m-larionova@yandex.ru
	Germany Ferdinand te Walvaart +49 (0)241 88 909-0 f.tewalvaart@elektor.de		Sweden Wisse Hettinga +31 (0)46 4389428 w.hettinga@elektor.com		Turkey Zeynep Köksal +90 532 277 48 26 zköksal@beti.com.tr
	France Denis Meyer +31 (0)46 4389435 d.meyer@elektor.fr		Brazil João Martins +351214131600 joao.martins@editorialbolina.com		South Africa Johan Dijk +27 78 2330 694/ +31 6 109 31 926 J.Dijk@elektor.com
	Netherlands Harry Baggen +31 (0)46 4389429 h.baggen@elektor.nl		Portugal João Martins +351214131600 joao.martins@editorialbolina.com		China Cees Baay +86 (0)21 6445 2811 CeesBaay@gmail.com

April 2013 ISSN 1548-0628

audioXpress (US ISSN 1548-6028) is published monthly, at \$50 per year for the U.S., at \$65 per year for Canada, at \$75 per year Foreign/ROW, by Segment LLC, Hugo Van haecke, publisher, at 111 Founders Plaza, Suite 300, East Hartford, CT 06108, USA Periodical postage paid at Vernon, CT and additional offices.

Head Office:
Segment LLC, 111 Founders Plaza, Suite 300, East Hartford, CT 06108
Phone: (860) 289-0800

Subscriptions:
audioXpress
P.O. Box 462256
Escondido, CA 92046
E-mail: audioxpress@pcspublink.com
Phone: (800) 269-6301, Internet: audioamateur.com,
Address Changes/Problems: audioxpress@pcspublink.com

Postmaster: Send address changes to audioXpress, P.O. Box 462256, Escondido, CA 92046.

US Advertising:
Strategic Media Marketing, Inc.
2 Main St.
Gloucester, MA 01930 USA
Phone: (978) 281-7708
Fax: (978) 281-7706
E-mail: peter@smmarketing.us
Advertising rates and terms available on request.

MEMBERSHIP COUNTER

We
now have

279453

members
in

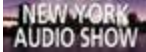
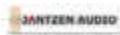
83

countries.

Not a member yet?

go to audioamateur.com

SUPPORTING COMPANIES

	ACO Pacific, Inc. www.acopacific.com 24		Menlo Scientific, Ltd. www.menloscientific.com 17
	Akitika www.akitika.com 43		Mundorf EB GmbH www.mundorf.com 19
	Audience www.audience-av.com 38		New York Audio Show www.theshownewyork.com 9
	Audiyo www.audiyo.com 26		Parts Connexion www.partsconnexion.com 2
	Avel Lindberg, Inc. www.avellindberg.com 36		Parts Express www.partsexpress.com 48
	Dynakit Vacuum Tube Audio Products www.dynakitparts.com 43		Saelig Co., Inc. www.saelig.com 43
	Elektor www.elektor.com 21		Silicon Ray www.siliconray.com 39
	Front Panel Express www.frontpanelexpress.com 29		Solen Electronique, Inc. www.solen.ca 35
	Hammond Manufacturing Co. www.hammondmfg.com 3		SumR www.sumr.com 43
	Jantzen Audio Denmark www.jantzen-audio.com 27		Test Equipment Depot www.testequipmentdepot.com 30
	KAB Electro-Acoustics www.kabusa.com 31		Tympany www.tympany.com 5
	Linear Integrated Systems www.linearsystems.com 23		
		CLASSIFIEDS:	
		All Electronics Corp.	44

Not a supporting company yet?

Contact Peter Wostrel (peter@smmarketing.us), Phone (978) 281-7708, Fax (978) 281-7706
to reserve your own space for the next issue of our member magazine

Editorial Inquiries

Send editorial correspondence and manuscripts to:
audioXpress, Editorial Dept.
111 Founders Plaza, Suite 300, East Hartford, CT 06108
E-mail: sbecker@audioXpress.com

No responsibility is assumed for unsolicited manuscripts. Include a self-addressed envelope with return postage. The staff will not answer technical queries by telephone.

Legal Notice

Each design published in audioXpress is the intellectual property of its author and is offered to readers for their personal use only. Any commercial use of such ideas or designs without prior written permission is an infringement of the copyright protection of the work of each contributing author.

SEGMENT LLC
audioXpress VOICE & COIL
WORLD TUBE DIRECTORY LIS

High-Polymer Film (Part 1)



The Lost Speaker Technology

Exploring the potential of high-polymer piezoelectric film

This month we plan to focus on high-polymer piezoelectric film, a virtually untapped material that could be used in various transducers (e.g., headphones, microphones, and tweeters). The high-polymer element is polyvinylidene fluoride (PVDF) and its application possibilities seem less familiar to speaker hobbyists than the piezoelectric ceramic drivers we explored in last month's article. In fact, it seems that the audio engineering community at-large is either not familiar with PVDF film or misunderstands PVDF piezoelectric-film technology. Hopefully, this month's article will serve as an introduction (or reintroduction) to PVDF piezoelectric-film technology.

In 1985, Jesse Klapholz (a former *Journal of the Audio Engineering Society* editor) presented a paper, “High Polymer Piezoelectric Film in Electroacoustical Transducer Applications,” at the 79th Audio Engineering Society (AES) Convention. Klapholz's introduction stated: “Since the discovery of piezoelectricity by the Curie brothers in 1880, there has been continued research and development because of piezoelectricity's practical and economical applications as well as scientific importance. Piezoelectricity, simply defined, is ‘pressure electricity’ and is a property of certain materials that alter their shapes under the influence of an electrical field, or vice versa. Many different types of piezoelectric transducers have been manufactured over the years, for example: phonograph pickups, microphones, strain gauges, vibration pickups, underwater sound sensors, and tweeters.”

More than 28 years have passed since Klapholz's talk, and while there have been a half-dozen relatively technically successful efforts involving high polymer film transducers for audio (e.g., speakers, microphones, headphones, and even air-motion transformer high polymer tweeters)



Photo 1: Pioneer's HPM-100 tweeter was among the few technically successful efforts involving high-polymer film transducers.

only the first launch—Pioneer Electronics's HPM speakers in the mid-1970s—made much of a commercial impact.

There are several reasons to revisit PVDF film today. Its lighter weight is better for autosound applications. It can be used as an alternative piezoelectric solution, eliminating the lead issues found in most ceramic piezoelectric speakers. The electronics for the high-voltage drive is possible now with projected sound from ultrasonic beam speakers and the potential for direct digital-sound reproduction.

PAST PVDF SPEAKERS

More than a half-dozen PVDF speakers have been commercialized. But, for the most part, these speakers have not made it to the mainstream users, so people might be unfamiliar with all these valiant PVDF designs.

PVDF technology was introduced to the audio world when Pioneer Electronics announced a series of viable products in the mid-1970s. Masahiko Tamura and his co-workers at Pioneer's Acoustical Engineering Research Laboratory in Saitama, Japan produced high-quality PVDF film microphones, phono cartridges, stereo headphones, and tweeters. Their work was a turning point for PVDF piezoelectric film because it showed its commercial viability in audio applications. The Pioneer HPM-100 was a four-way system designed by Bart Locanthi and his team of former-JBL engineers, all of it that is, except the

super tweeter, which came from Pioneer's Japanese research group (see **Photo 1**). HPM stands for “high-polymer molecular,” in reference to Pioneer's then newly developed high-polymer molecular film “PVDF” super tweeter. The film was shaped semi-cylindrically to project 180° sound. This driver's frequency response ranged from 12 to 25 kHz.

Locanthi continued to support Pioneer's high-polymer film speaker development, but he also led its development of the Technical Audio Device (TAD) pro group studio monitors, beryllium-diaphragm compression drivers, and concert-sound speaker systems. Pioneer's Japanese team continued to develop the HPM series. After the initial introduction of the semicircular high-polymer super tweeter, most new implementations were cylindrical and omnidirectional, with at least a horizontal approximation of a pulsating sphere. The HPM-200 was another four-way design, but it boasted high-polymer drivers operating at 2,000 Hz and higher. The HPM-150 used a new version of the PVDF tweeter, which was then horn loaded, but it retained its omnidirectional characteristics (see **Photo 2**).

By 1981, Pioneer had discontinued the HPM series, perhaps due to the high cost of the sophisticated designs and issues with the metallization corroding (attributed to the high levels of air pollution in many US cities 30 years ago). Another issue was extending the response below 2,000 kHz did not lend itself to practical implementations. PVDF film response at the bottom-end tends to require a larger radius, and getting down to the lower midrange proved difficult. Today, the idea of a 2.1 or 5.1 system that uses all PVDF drivers with a common subwoofer is a distant dream. Matsushita (now Panasonic), Mitsubishi Electric, Sony, Samsung, and others also had active PVDF film speaker projects through the 1980s. While some of these efforts yielded technical

"THIS PROMISES TO BE THE BEST AUDIO SHOW THAT NEW YORK HAS SEEN IN A LONG TIME"

This is what our Media Sponsors, Visitors and Exhibitors are saying.



Plus many more audio experiences including...an exclusive screening of the official Record Store Day film for 2013, competitions, home theatre experience, product launches and a huge selection of the best high performance audio & home entertainment from around the world.

QUITE SIMPLY SUPERB AUDIO SYSTEMS SETUP IN INDIVIDUAL LISTENING ROOMS.



SAVER E-TICKETS NOW AVAILABLE ONLINE FROM \$18

A GREAT SELECTION OF TICKETS AVAILABLE INCLUDING 1, 2 and 3 day passes, Student, Society & Club discounts and this year we're offering all visitors the chance to make further savings via twitter & facebook
NEW PAYMENT SYSTEM NOW IN PLACE FOR QUICKER SHOW ACCESS AND ONLINE PAYMENTS

OFFICIAL MEDIA SPONSORS

the absolute sound

stereophile

SOUNDVISION

TONEAudio

ELECTRONIC HOUSE

MEDIA ASSOCIATE

Enjoy the Music.com

US SALES MANAGER

Christina Yuin | christina@chestergroup.org
Office: 845-361-3001 | Mobile: 917-238-0764

UK / INTERNATIONAL SALES

Justin Bird | justin@chestergroup.org
Office: +44 (0) 1244 559033 | Mobile: +44 (0) 7880 884 123

FOR FULL SHOW AND TICKET DETAILS VISIT
CHESTERGROUP.ORG/NEWYORKAUDIOSHOW

@NewYorkAudioAV

facebook.com/NewYorkAudioShow





Photo 2: The Pioneer HPM 150 tweeter, released in the late 1970s, used a new version of the PVDF tweeter, but it retained its omnidirectional characteristics.

papers and patents, the programs never resulted in commercialized products from these brands.

Then, Audax (now Harman France) introduced its half-egg-shaped dome tweeter in its Audax HD3P piezoelectric polymer tweeter. Until this point, most PVDF transducer designs used planar or curved films. However, F. Micheron and C. Lemonon's, "Moulded Piezo Electric Transducers Using Polar Polymers," (*Journal of the Acoustical Society of America*, 1978) introduced a vacuum-molding technique to fabricate 3-D-shaped transducers (e.g., cones, portions of spheres, corrugations, and so forth). They found that these transducers could be designed to meet certain acoustical parameters, which could not have been obtained with planar or curved films. Perhaps inspired by their work, Audax launched the HD-3P elliptical dome tweeter around the late 1990s. It was a both a technical and



Photo 3: Gallo Acoustics's CDT tweeter contains a proprietary design with no voice coil or magnets. (Photo courtesy of Gallo Acoustics)

commercial experiment in PVDF production. Audax priced the tweeter high to keep sales low, just in case the product did not survive in the field. Why the HP-3P was not developed into a family of products was perhaps due to some combination of external business issues at Audax, technical production, and service-life challenges. The PVDF film coating was a vacuum deposit of pure gold, and the diaphragm was clamped to an elliptical ring with a sealed and pressurized chamber behind it. The elliptical dome was formed by the constant, positive force from the pressurized nitrogen gas on the film.

As with other PVDF speakers, an electrical signal is fed to the metal electrodes deposited on both sides of the ceramic film, the diaphragm's surface area responds by elongating and contracting proportionally in size with the signal. Sound waves are generated by the diaphragm's stretching, which converts the vibration into a pulsating motion rather than a piston motion. The transient ability is outstanding because the HD-3P's moving mass is approximately 20 times less than a conventional 20-mm dome tweeter, while the directivity is equivalent. The waterfall plots (i.e., 3-D response graphs showing frequency, amplitude, and time) were impressive. The HD-3P was supplied with its own crossover network, which could be adjusted between 4 to 6 kHz. System sensitivity was in the 86-to-94-dB range.

Early units suffered from Audax's worst fear, a less than perfect gas seal, which caused the nitrogen to gradually leak away. Its first visible sign is that in high-pressure weather, wrinkles or creases appear in the gold dome with a resulting loss of top-end response.

GALLO CDT

More recently, Anthony Gallo Acoustics Europe and FILS have been refining the technology. Anthony Gallo refers to his speaker as "a tweeter without compromise." **Photo 3** shows his proprietary design, which is called the Cylindrical Diaphragm Transducer (CDT). Gallo spent years refining this design, and the company's marketing literature emphasizes the CDT's unique construction. "The CDT uses no voice coil or magnets. Instead, the signal is passed across the conductive surface of the diaphragm, which attempts

to expand while the driver's cylindrical shape supplies the necessary restorative force." The specifications show the CDT has a 3-to-25-kHz range. The diaphragm is made from Kynar and coated in silver. The construction resembles the lines of the Pioneer's early HPM tweeters.

FILS SOUND

The most recent PVDF film speaker is from Korean electronics manufacturer FILS Sound. Refinements include surface treatment for enhanced adhesion of metalized coating and leadout wires (see **Photo 4**). FILS Sound uses poly(3,4-ethylenedioxythiophene), otherwise known as PEDOT (a specialized polymer film) with pure carbon nanotubes (CNTs) electrochemically deposited on the electrodes. The PEDOT/CNT-coated microelectrodes have lower impedance than the bare platinum (Pt) microelectrodes, and the PEDOT/CNT film offers excellent stability. The finished film is flexible and this property enables it to be used in unique form factors.

PVDF

Next, we will examine polymer film itself, otherwise known as PVDF or Kynar piezoelectric film. A polymer made of 1,1-difluoroethene, polyvinyliden difluoride (PVDF) is known as piezoelectric, meaning it will produce an electrical current when bent or pressed. The material can be shaped into a long ribbon, bent into almost any shape, or formed into a dome. It can then act as a microphone



Photo 4: FILS Sound produces a flexible PVDF film speaker. (Photo courtesy of FILS Sound)

or a speaker. PVDF films are made from a semi-crystalline, high-molecular resin (e.g., Arkema's Kynar), which is extruded into sheet form. When PVDF is initially extruded for piezoelectric applications, the film must be stretched so the orientation of the polymer chains in the film's plane can achieve enhanced piezoelectric activity. The film stretching is performed uniaxial (usually in the direction of machine travel) or in both machine and transverse directions (biaxial). The film is coated on both sides with a conductive electrode metal, usually by vacuum deposition, to provide intimate electrical contact with the PVDF film during poling and use. The film is then polarized by an intense electric field at an elevated temperature followed by a cooling within the applied field.

KYNAR'S CORPORATE TRAIL

One aspect of PVDF piezoelectric film's spotty commercialization may be that its corporate ownership has traveled a tortuous path. DuPont invented and patented polyvinyl fluoride film in 1948. Pennwalt Chemicals acquired the rights and developed the licensing program that enabled its first widespread commercial use as a pigmented liquid coating and for more obscure PVDF-film applications (e.g., speakers). This coating had been sold under the Kynar 500 trade name since the mid 1960s. In the 1980s, the French chemical conglomerate Elf Atochem (now named Arkema) acquired Pennwalt. Today, Kynar 500 is a registered trademark of Arkema, which continues to offer Kynar resins, foams, and film. However, in the early 1990s, AMP acquired the Piezo Film Sensors Division from what was then Elf Atochem and renamed the division AMP Sensors. In 1998, Measurement Specialties, Inc. (MSI) acquired the Sensors division from AMP. In 2002, MSI relocated the piezo film manufacturing to its head office in Hampton, VA. While still offering piezoelectric film, MSI's focus is on sensors rather than on PVDF film's application to commodity transducers (e.g., speakers).

DESIGN CHALLENGES

A plastic piezoelectric film driver would seem to be mechanically simple: A sheet of PVDF with electrodes attached, held loosely in a frame against a soft polyurethane foam former/damper. For use

in loudspeakers, PVDF's main draw is its ability to flex when an audio voltage capable of driving a speaker is applied, converting electricity directly into sound with good linearity. There are many design rules at play here that are different from those applied to conventional loudspeaker drivers.

There are a number of hidden design challenges with PVDF speakers and a few of them are similar to the challenges found in ribbon planar and electrostatic designs. A larger horizontal radius extends the low-frequency cutoff. Design issues include lead-out wire termination, metallization, and forming the film into the target shape. Speaker system integration is another consideration since PVDF speakers are not "drop-in" replacements for electrodynamic speakers. It takes a couple hundred volts drive signal to makes PVDF speakers sing.

Lead-out wire issues are similar—but different—as with tensioned diaphragm planars (e.g., ribbons and electrostatics). With other film speakers, you can attach the lead-out wires outside the clamped area and the substrate is stable. With PVDF film, the film substrate itself—even at the attach point—is moving with the signal. Soldering lead wires to the film is difficult as the surface "moves" on the microscopic level. However, soldering with very high silver content and rubberized conductive techniques has been successfully used in mass production. The attachment technique must accommodate extended flex life or cracking over time will result. Today, there are robust solutions, but this was not always the case in early PVDF speaker products.

Metallization creates the electrodes and is an inherent requirement for the film's self-polarization. Pioneer's early efforts used nickel, which had a way of "evaporating" over the years. Audax addressed the metallization's corrosion by using a gold-sputtering process. However, Audax also needed a superior seal to prevent the nitrogen gas (used to inflate the elliptical dome to the desired form) from leaking. Wrinkles and worse were common over time with Audax's PVDF tweeters, but the failure modes were often leaky seals rather than loss of positive gas through the film membrane itself. Gallo uses silver metallization in its PVDF tweeter. And, more recent

developments in PVDF metallization techniques suggest that platinum in combination with plasma-treated PVDF film will produce excellent results.

Shape is also an issue. PVDF film is not a high-force drive like PZT ceramics, yet the flexible film's shape must be maintained. Specifically, the film expands and contracts across the "machine direction." Some films were biaxial stretched and moved both sideways and up/down, but most PVDF loudspeakers used uniaxial film. We have mentioned that if held in a curved shape, the larger the radius, the more extended the lower end response. Pioneer managed to extend the response down to 2,000 Hz in its HPM 200. Excursion is limited, so a large radiating area and/or horn loading is needed to increase the maximum acoustic output and extend the midrange response's bottom end. PVDF diaphragms are not particularly stiff or high force, which limits midrange even when horn loaded.

Design rules are not readily or clearly defined by the PVDF film manufacturers or in the technical literature, but attempts to hold the film in shape must not suppress diaphragm movement. Pioneer and others have used foam behind the film. Audax used nitrogen gas with some positive pressure. Dr. Oskar Heil's air-motion self-supporting configurations may have promise for future work, as other diaphragm support solutions suppress output (although foam support backing of the film can provide some strategic damping of undesired resonances). In 1988, Dr. Ivar Veit, of Sennheiser Electronic presented a paper, "The Piezoelectric PVDF Film—Its Properties and Application in Electroacoustic Transducers," at the 84th AES Convention in Paris, France. The paper explored PVDF microphone applications, and it also suggested a PVDF speaker topology for an elongated cone (sort of a Walsh driver, better known as the Ohm Speaker), and another self-supporting approach, air-motion pleated film.

Next month, we'll continue to explore PVDF transducers, from headphones to accelerometers to even present-day variants such as EAP artificial muscles for haptics and bass enhancement. *ax*

Construct a Simple LED Bias Meter and Supply

A design that works for the Dynaco ST70 and other tube amplifiers

Recently, I got bitten by the nostalgia bug and picked up a pair of old factory-wired Dynaco ST70s in pretty nice condition. But, being an engineer, I couldn't leave well enough alone. On one of the Dynaco ST70s, I installed a new 6GH8 driver board instead of dealing with the rare 7199 issue. Next, the comparatively weak and remote bias supply also seemed like it could use an update. So, I designed a small (3" x 3") PCB to combine the bias supply and added the LED bias-setting circuit. Note: This DIY project assumes that your amp is working correctly. The total cost should be \$25 or less, especially if your junk box is well supplied.

BIAS-METERING CIRCUIT

This bias-metering circuit is not new by any means, but it enables quick, simple, and reasonably accurate bias setting without a meter. It is a simple, discrete transistor differential amplifier driving a pair of LEDs. When the two reasonably matched transistors' bases have the same voltage, the LEDs illuminate equally. If the voltages are unequal, one LED will be dim while the other will brighten. Increased voltage divergence will cause one LED to be fully illuminated while the other LED would be completely off. This way, you can see if the bias is out of adjustment with just a quick glance.

Using the comparator circuit, one transistor's base is connected to a reference voltage equal to the voltage you want to set at the cathode resistor(s) of your output tube(s). The other transistor's

base goes to the monitored cathode resistor's high side.

BOARD DESIGN

The board I designed has a pair of comparators since the Dynaco ST70 has only one cathode resistor per channel. Each resistor should have 1.56 VDC, representing 100 mA, across the 15.6- Ω cathode resistors for a pair of output tubes. The reference voltage was generated by dividing the circuit's regulated 15-VDC supply. Keep the lower resistor at 1 k Ω or a little less and select the divider's upper resistor to give the desired reference voltage. The regulator can be a 12- or 15-V part, just adjust the reference divider as needed to produce the desired reference voltage (see **Figure 1**).

Note: Test the regulator's output before installation and calculate the exact divider resistor values since there is some variability in the output of three terminal

regulators (e.g., ± 0.6 V on a 7815) and on the set point precision. Another easy alternative is to pad (i.e., parallel) one of the divider resistors with a high-value resistor to tweak the reference voltage up or down a few millivolts.

The circuit seems tolerant of parts choice. I tried random 2N4401 transistors and matched Diode's high-gain ZTX-694Bs. I received acceptable performances in each case. But, it is best to use a digital multimeter (DMM) with a transistor gain test function to match the transistors. I also found it worthwhile to test the LEDs for uniformity using a battery or bench supply and connecting them in series with a current-limiting resistor. I found that green LEDs vary unacceptably in brightness and color shade (green to yellowish green). I chose blue LEDs since they are much brighter at low currents and more consistent in color and brightness. They also look cool.

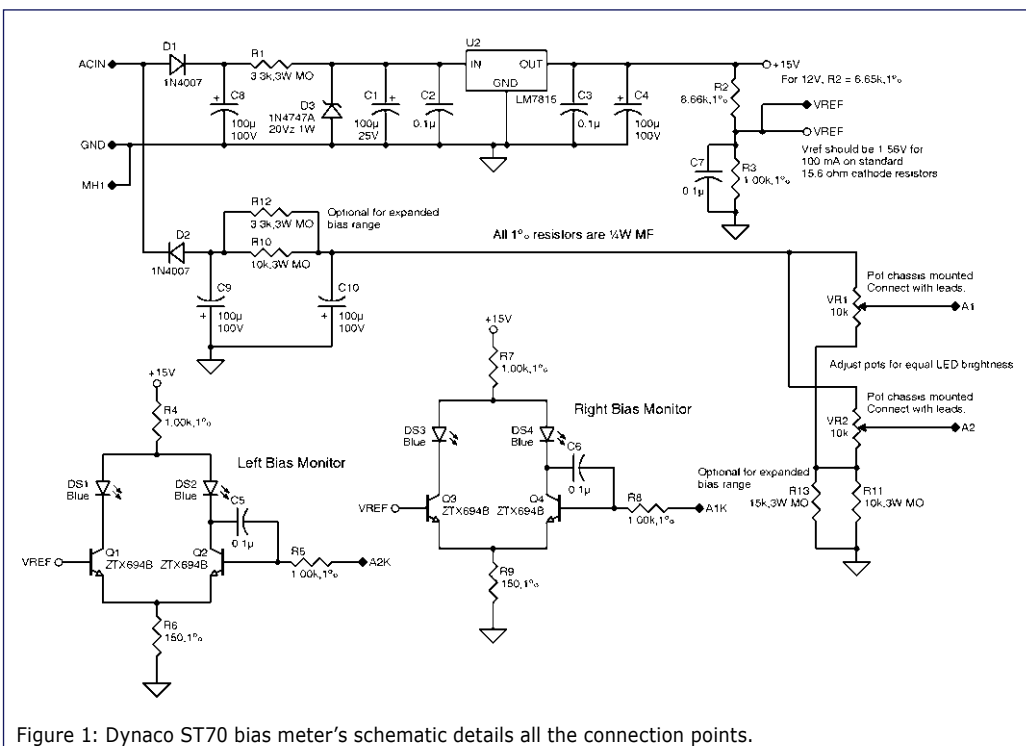


Figure 1: Dynaco ST70 bias meter's schematic details all the connection points.



Have you built
an audio system
that would be the
envy of audiophiles
everywhere?

Everyone has a “dream system.” But only the most ambitious, talented audiophile can actually make his or her audio dream system a reality!

Share Your Finished Audio Dream Systems

Have you built an audio system that would be the envy of audiophiles everywhere? If so, share it with the staff at *audioXpress*. Impress us and we might feature your system in an upcoming issue of *audioXpress*, on our website, or both!

Submit your photos and descriptions

via e-mail to [**sbecker@audioxpress.com**](mailto:sbecker@audioxpress.com)

for a chance to have your design featured in *audioXpress*. Please include **“AX DREAM SYSTEM”** in the subject line.





Photo 1: Mark the bottom of the chassis between the potentiometer's holes and the power transformer.

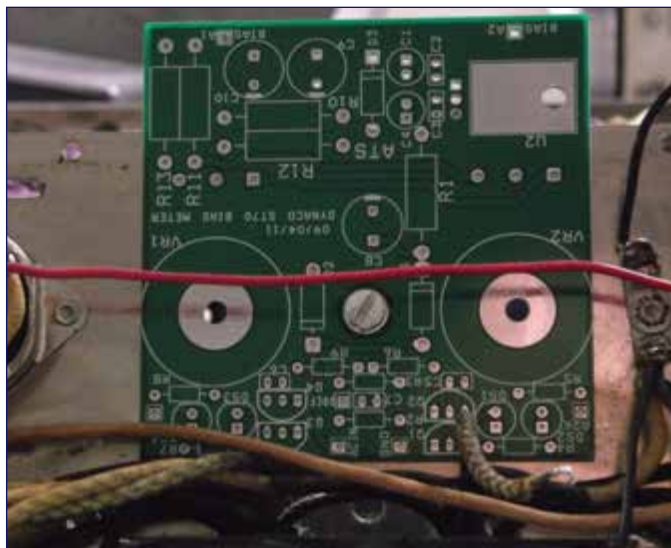


Photo 2: Use the center of the potentiometer's mounting holes as a guide to mount the board to the bottom of the chassis.

If you have an amplifier with one resistor per tube and four tubes, use two boards with four comparators. A 20-V Zener diode protects the regulator and enables the use of lower voltage filter capacitors. I "stiffened" the bias supply with a higher value and voltage capacitors (100 μ F/100 V vs. 50 μ F/75 V).

BOARD ASSEMBLY

This board is designed to fit a ST70 chassis, but it could be fit to other chassis. The first thing to do is to ensure the filter capacitors are fully discharged! If you are using a ST70, remove all the tubes, the two bias potentiometers and their wiring, the selenium rectifier or silicon diode, and the bias supply capacitors.

Use a black marker to blacken the chassis in the area between the potentiometer's holes and the power transformer on the bottom side of the chassis (see **Photo 1**). On the bottom of

the chassis, mount the bare board with 6-32 hardware using the hole that held the selenium rectifier to ensure the board is square with the chassis. Use the two holes in the board that match the potentiometer's mounting holes' centers as a guide (see **Photo 2**).

Use a needle or other sharp instrument to mark the eight LED lead holes so the marks show in the area blackened with the marker. Remove the board then carefully center punch four places exactly centered between each of the marked pairs of lead holes.

Drill four holes for the LED size you want to use (T1 or T1.75). Start with a small pilot drill then enlarge the bit size to the final size or use a tapered hand reamer to get the exact size. Be sure to avoid

damaging the power transformer leads (see **Photo 3**).

Deburr the holes on both sides of the chassis (hand turning a large drill bit works well) to ensure the LEDs fit satisfactorily. Then, clean out any metal chips that might have fallen into the chassis. The marker can be removed with isopropyl alcohol.

I used blue T1.75 LEDs and ground the LEDs' ends flat for a more diffused light. I later mounted them flush with the chassis for cosmetic purposes. Install and solder all the parts on the board but do not solder the LEDs (see **Photo 4**). Insert them and bend their leads a little so they do not fall out of the board. Use a screw

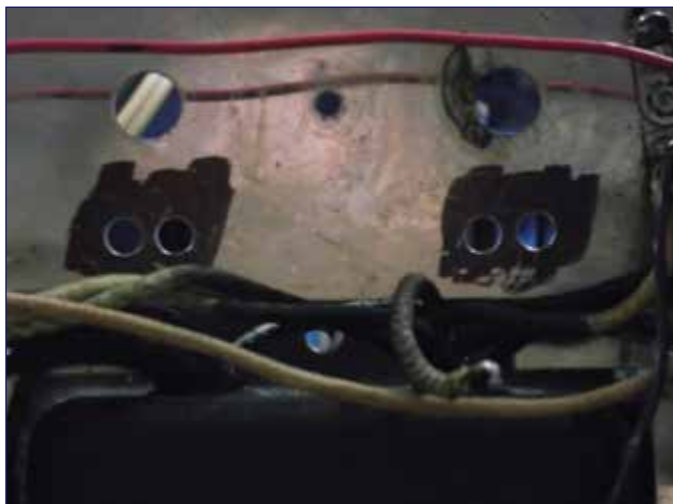


Photo 3: Drill four holes for the LEDs.

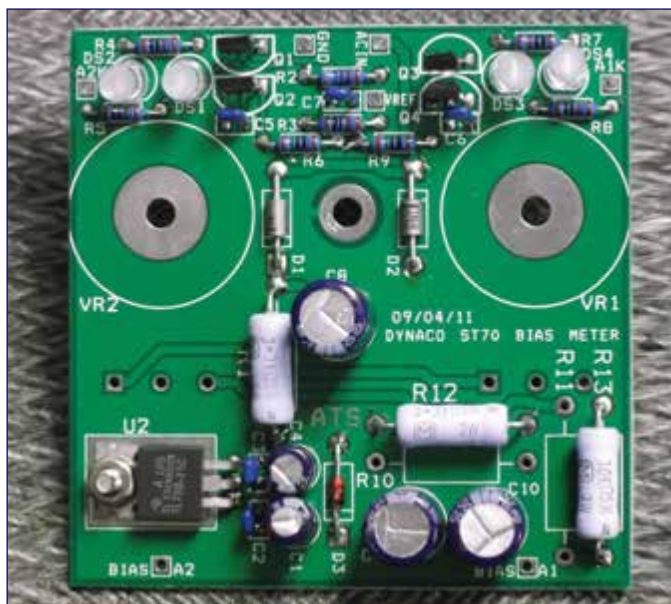


Photo 4: All the parts have been soldered to the board.

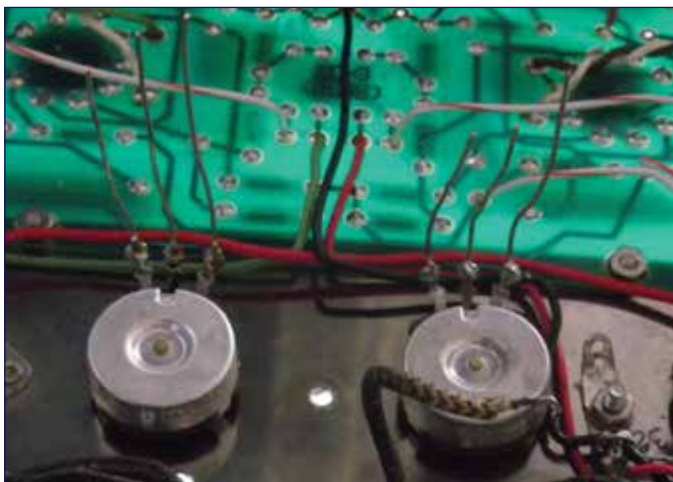


Photo 5: Stagger the length of the leads for the potentiometers.



Photo 6: The LEDs are positioned in place.

and lock washer to install a 7/8" long 6-32 standoff in the center hole of the board's component side.

Solder bare wire leads (1.5", 2", and 2.5") to the two potentiometers staggered in length by about 0.5" (see **Photo 5**). Mount the potentiometers to the chassis.

If any of the power transformer leads are in the way of the LEDs' holes, dress or ty-wrap them out of the way. With the board's component side facing the chassis, tilt the board slightly. Starting with the longest potentiometer lead, thread all six leads into the matching holes in the board (see **Photo 6**). Secure the board's standoff with a 6-32 screw and lock washer through the chassis's top, ensuring that it is square with the chassis. Solder the potentiometers' leads and trim them. Then, position the LEDs in their respective holes. If you ground them flat and want them flush with the chassis, a piece of tape on the top of the

chassis will hold them in place while you solder them (see **Photo 6**).

Refer to **Photo 4** and **Photo 7** for the next few steps. Solder the power transformer bias supply lead to the pad labeled ACIN. Note: All the PCB connections are labeled in white on the component side as well as in copper on the circuit side (see **Photo 4**). Solder a wire from the chassis ground lug to the pad labeled GND. Solder a wire from the pad labeled A1 (BIAS) to driver board pad 21. Solder a wire from the pad labeled A2 (BIAS) to driver board pad 6. Solder a wire from the pad labeled A1K to pin 8 of the output tube on the A1 biased channel where the 15.6- Ω resistor is located. Then, solder a wire from the pad labeled A2K to pin 8 of the output tube on the A2 biased channel where the 15.6- Ω resistor is located.

Power up the unit without any tubes installed. The two center LEDs should be brightly illuminated, indicating low

current (the outer two LEDs indicate high current) as shown in **Photo 8**.

Verify that there is approximately 1.56 VDC (or the reference voltage you selected) at the test point on the boards labeled V_{REF} . Verify that the potentiometers produce approximately -45 VDC on each tube's pin 5 when fully counter clockwise, and decreases to approximately -30 VDC fully clockwise. Note: *Leave the potentiometers in their fully counter clockwise positions.* Failure to do so could cause severe damage to the amplifier.

Install all the tubes and power up the unit. Allow 5 to 10 min. for the tubes to stabilize. Then slowly turn each bias potentiometer clockwise until the LEDs are equally bright. Note: There will be some interaction since the bias supply is not regulated. Set one side, then the other, and then readjust the first one. Repeat as needed until both pairs of LEDs are equally bright. Initially, as an added precaution,

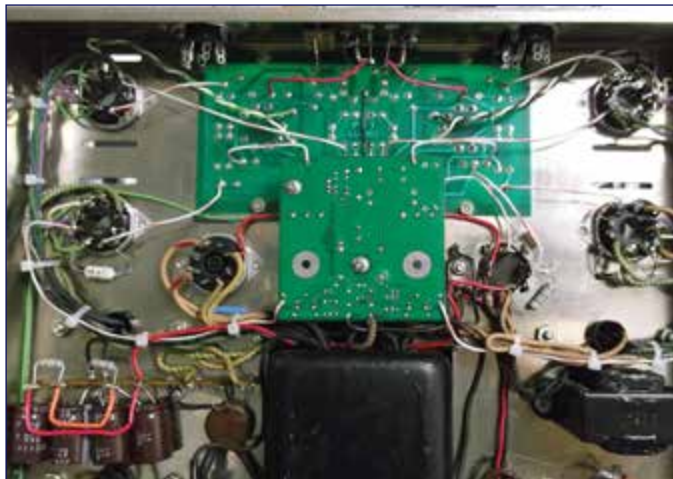


Photo 7: The completed board is wired and mounted.

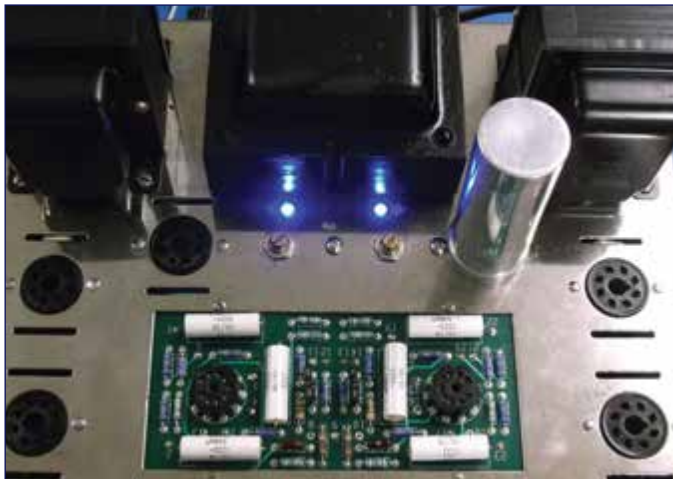


Photo 8: The LEDs indicate that the proper voltage is attained.



Photo 9: The entire setup is shown with the tubes in place.



Photo 10: The alternate project calls for balanced potentiometers installed on a new driver board.

you can monitor the bias voltage (1.56 V) with a digital volt meter (DVM) at the octal socket on the front of the chassis. After the tubes are stable and the bias current has been confirmed, just watch for equally bright LEDs (with no signal of course), or adjust the potentiometers as desired—no meter needed (see **Photo 9**).

DETAILS

It may take the amplifier 5 to 10 min. to stabilize, so initially the low current (center) LEDs will be illuminated. Amplifying a signal will, naturally, indicate higher current and then the outer LEDs will be brightest. Line voltage fluctuations will affect the bias as well.

ADDED OPTIONS

With the corner of the chassis previously occupied by the bias supply now vacant, I added four 82- μ F/350-VDC capacitors in series and parallel with two 220-k Ω , 2-W

voltage balancing resistors to “stiffen” the output plate supply. I used the existing terminal strip to mount these components (see lower left corner of **Photo 7**). This effectively adds an additional 82 μ F/700 VDC to the B+ supply. Connect the negative side to the chassis ground lug and the positive side to the can filter capacitor’s #1 tab. This should help with low-end and transient response.

There are also spaces for two resistors (R12 and R13) to be placed in parallel with R10 and R11, respectively, if you want to widen the bias supply range. I found this unnecessary with the tubes I used. If you determine another optimum idle current, using a good signal generator and distortion analyzer, adjust the reference divider to get the desired voltage.

IN RETROSPECT

What would I have done differently? I probably would use Zener diodes to stabilize the voltages at the top and bottom of the bias potentiometers and add an emitter follower at each of the bias potentiometers’ wipers to add stability and eliminate the slight interaction between the potentiometers. This might slightly improve inter-channel isolation or crosstalk. But, it’s probably overkill.

If you have an amplifier with one resistor per tube and four tubes (e.g., a PP parallel mono amp or stereo PP amp) you would need two boards with four comparators. Select cathode resistors that would yield about 1.56 V at the desired current level of each tube. This should not cause problems when you have individual bias and balanced potentiometers. Mechanical placement would depend on your particular amplifier.

I thought this would look cool and tried such an installation on the second S70 I modified. I used the PCB’s original mounting hole plus the voltage regulator hole so the boards would be secure and would not rotate. I added balance potentiometers on the new driver board (by KTA) that are visible if you look closely (see **Photo 10**). I also added a new power supply PCB (Classic Valve Designs). I used the original chassis mounted bias potentiometers for bias level instead of the hard to access ones on the Classic Valve Designs’ power supply PCB. **Photo 11** shows the trim potentiometers I added to the two comparator boards to make the bias set point reference voltage easily adjustable in order to try different current settings.

Sorry, no warranties expressed or implied. Best of luck to you and always ensure the filter capacitors are fully discharged before you begin. *aX*

Author’s note: I have a few (14) extra boards. If anyone wants one for \$12.50 including postage, payable via PayPal, e-mail me at BRUNNER@ieee.org.



Photo 11: An alternate project shows trim potentiometers added to the two comparator boards.

Engineering Consulting for the Audio Community

Celebrating
30 YEARS
1983-2013

MENLO SCIENTIFIC



- Liaison Between Materials, Suppliers, & Audio Manufacturers
- Technical Support for Headset, Mic, Speaker & Manufacturers
- Product Development
- Test & Measurement Instrumentation
- Sourcing Guidance

sponsors of "The Loudspeaker University" seminars

MENLO
SCIENTIFIC

USA • tel 510.758.9014 • Michael Klasco • info@menloscientific.com • www.menloscientific.com

Scan-Speak High-Frequency Driver

A 30-mm beryllium dome tweeter

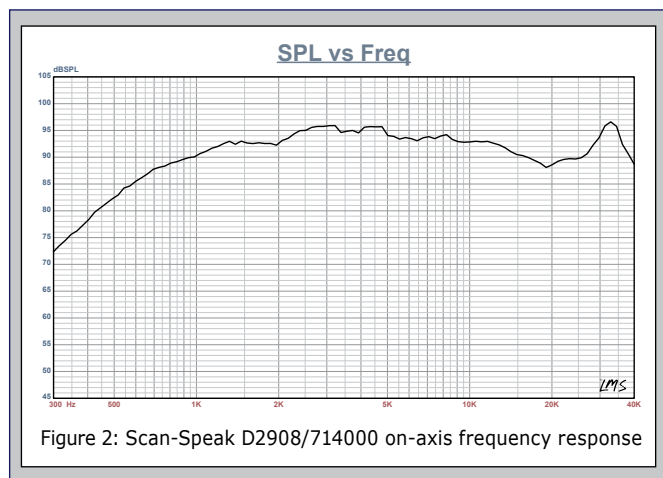


Photo 1: Scan-Speak recently released the D2908/714000, a 30-mm beryllium dome tweeter.

Scan-Speak, founded in 1970, remains at its original address in Videbaek, Denmark, and offers the same “no compromise” philosophy that has always been a part of the Scan-Speak mission. Perhaps that is one reason Scan-Speak is still the OEM driver darling of high-end loudspeaker manufacturers worldwide. (Scan-Speak exports 95% of its production.)

This month, Scan-Speak sent me its recently released D2908/714000, which is the company's second 30-mm beryllium dome tweeter (see **Photo 1**). Scan-Speak's first beryllium dome tweeter was the R3004 Air-Circ Illuminator, which was featured in *Voice Coil*'s January 2010 issue.

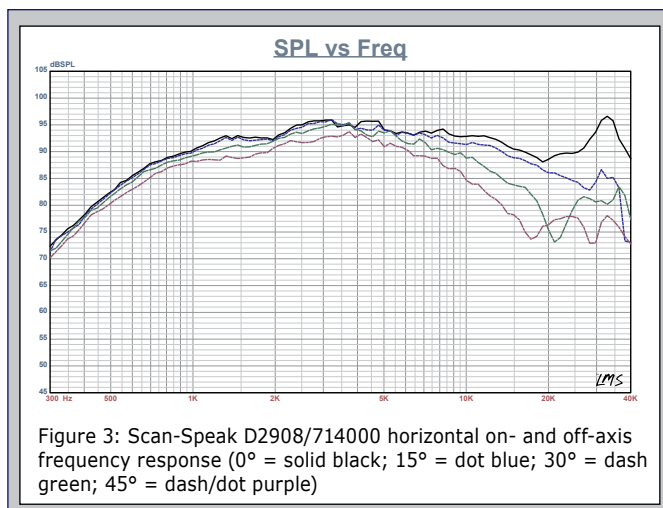
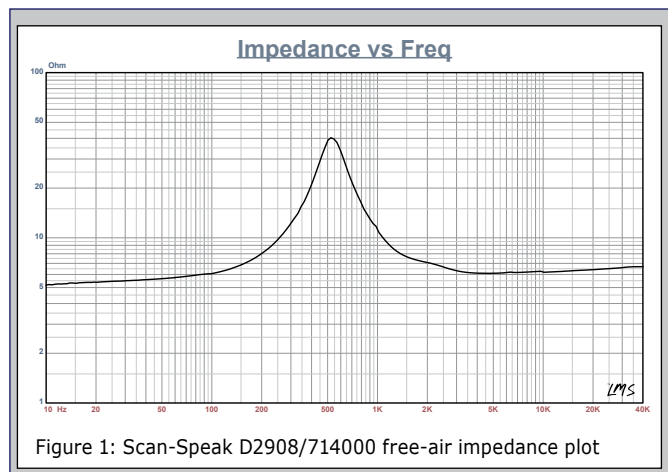
Basically, the new D2908 utilizes the Revelator D29 dome's wide surround concept, but the actual dome (sourced from Truextent) is 99% pure beryllium coupled to the highly effective and patented Symmetrical Drive (SD-2) neodymium motor



system. Scan-Speak's SD-2 motor is composed of a shaped gap area in conjunction with a copper shorting ring (i.e., copper pole cap). Other features include a black anodized aluminum faceplate with a protective grill, [You don't want your customer's child jamming his fingers into a \$590 (retail not OEM!) tweeter!], a titanium voice coil former, a nonresonant aluminum rear chamber, and gold-plated terminals.

I used the LinearX LMS analyzer to begin testing the D2908 beryllium dome by generating a stepped sine wave impedance plot. **Figure 1** shows the result of the LMS 300-point impedance sine wave sweep. The tweeter resonance is 525 Hz. Minimum impedance for this tweeter is 6.1Ω at 4.8 kHz with a measured RE equal to 5.69Ω . The factory specification for the motor Q_{TS} is 0.47.

After completing the impedance measurements, I recess mounted the Scan-Speak tweeter in a small enclosure with a 7" $\times$ 12" baffle area and measured the on- and off-axis frequency response at 2.83 V/1 m. **Figure 2** shows the on-axis response.



EVOLUTION through INNOVATION

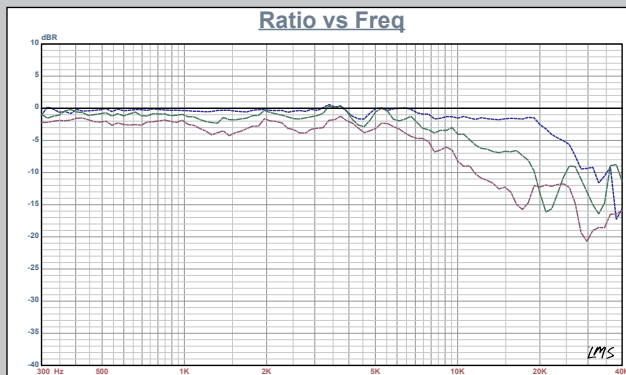


Figure 4: Scan-Speak D2908/714000 normalized on- and off-axis frequency response (0° = solid black; 15° = dot blue; 30° = dash green; 45° = dash/dot purple)

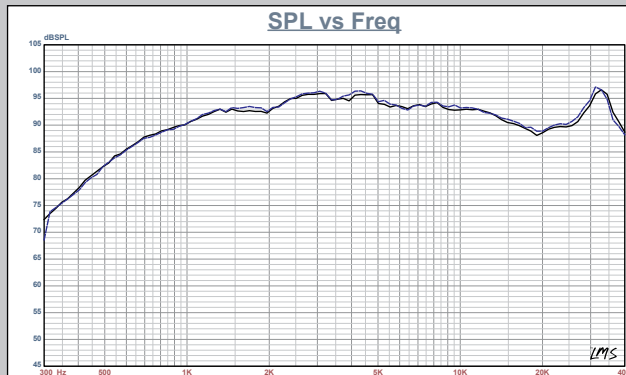


Figure 5: Scan-Speak D2908/714000 two-sample SPL comparison

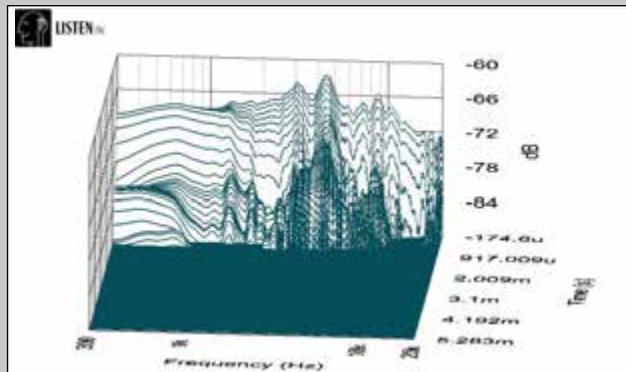


Figure 6: Scan-Speak D2908/714000 SoundCheck CSD waterfall plot

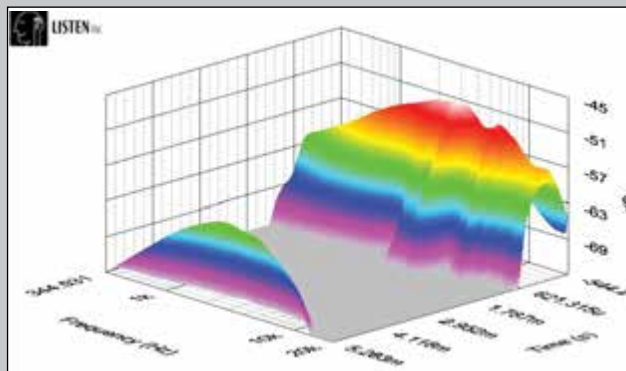
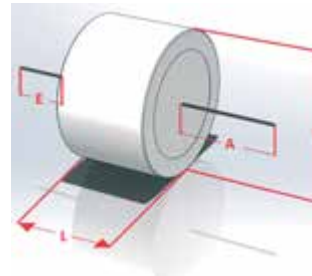


Figure 7: Scan-Speak D2908/714000 SoundCheck STFT surface-intensity plot



The main feature of the EVO winding technology comes with its unusually narrow but high capacitor reel. This geometry results in two, acoustically clearly perceptible benefits: A much shorter

and utmost little loss signal path between huge contact areas is granted, thus an extremely low equivalent series resistance/ESR. Secondly, in order to meet capacitance the number of paralleled windings is larger than with regular caps, thus an effectively minimized equivalent series inductivity/ESL.

After the utterly precise EVO winding process, these reels are spilt by hand in especially developed MCap* housings. By that, vibrations and microphonic effects on the reel are most effectively avoided. Furthermore, we only employ purest Polypropylene foil vaporized with thickest metal layer possible. Plus the unusual asymmetric wire lengths allow both mounting directions on PC boards, horizontal and vertical.

Now available: MCap®EVO • MCap®EVOAlu.Oil
MCap®EVO SilverGold.Oil



Mundorf EB GmbH
Liebigstr. 110
50823 Köln • Germany

+49 221 977705-0
info@mundorf.com
www.mundorf.com

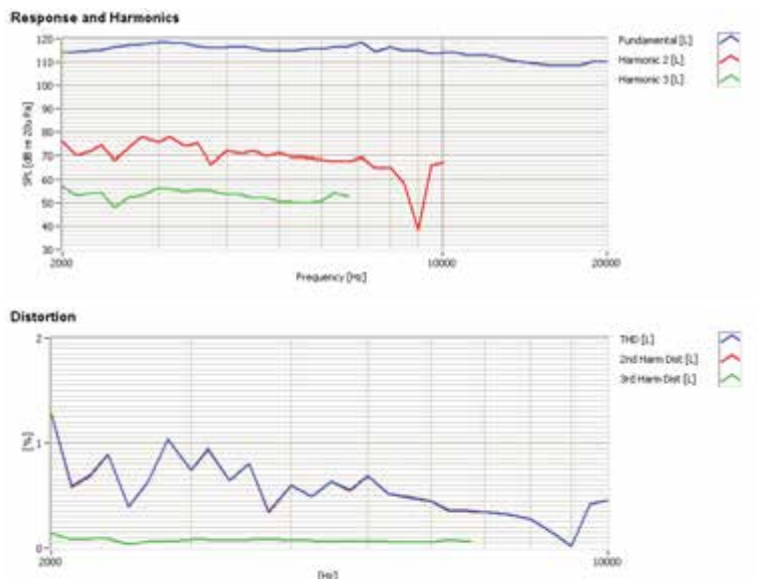


Figure 8: D2908/714000 SoundCheck distortion plots

The D2908's frequency response is a very flat ± 1.8 from 2 to 12.8 kHz, with the beryllium breakup mode located at 32.8 kHz. **Figure 3** shows the Scan-Speak Revelator beryllium dome tweeter's on- and off-axis response. Off-axis, the device is -4.0 dB down at 10 kHz from the on-axis response

with respect to the 30° off-axis curve and -8.2 dB at 45° off-axis, again with respect to the on-axis response. **Figure 4** shows the normalized version of **Figure 3**. In terms of production consistency, the two-sample SPL comparison is shown in **Figure 5**, indicating the two samples were well matched with some minor variation in the 3.5-to-10-kHz region.

Next, I recess mounted the tweeter and used Listen's SoundCheck analyzer and the 0.25" SCM microphone to measure the impulse response. Importing this data into Listen's SoundMap software produced the waterfall plot shown in **Figure 6**. **Figure 7** provides the STFT displayed as a surface plot. Last, I used the SoundCheck noise generator and SLM utilities to set the 1-m SPL to 94 dB (3.5 V) and the sweep range to 2 to 20 kHz and measured the second- and third-harmonic distortion at 10 cm (see **Figure 8**). This shows the relationship between the second- and third-harmonic distortion; however, the correlation to subjective preference based on the THD is not well

established. For manufacturers that have wanted to field a beryllium tweeter in a no-compromise high-end product, Scan-Speak has come up with another best of all possible worlds, the Revelator SD-2 motor and a beryllium dome. For more information, visit www.scan-speak.dk. *ax*

MEMBER PROFILE

Member Name: Howard Ferstler

Location: Tallahassee, FL

Education: BA in history and philosophy; electronics (bomb-navigation systems technician) training in the United States Air Force

Occupation: Howard is now retired. He worked for 35 years as a library technical assistant.

Member Status: Howard said he has been a longtime subscriber to both *audioXpress* and *Voice Coil*.

Audio Interests: Howard is intrigued by all traditional aspects of audio including speakers, amps, receivers, and players.

Most Recent Purchase: He listed two Crown XLS1000 stereo power amps, a Pioneer VSX-1122-K receiver, and several Dayton subwoofer drivers among his recent purchases.

Current Audio Projects: For years, Howard fiddled with audio gear, reviewed products, and wrote articles and books. However, he said he finally has systems

he appreciates and has no desire to upgrade. However, he is layering redwood over one final speaker to cosmetically match it with the others.

Dream System: Howard has two dream systems, both of which are in operation. He is an "amps are amps" kind of guy. With speakers, he is considerably more critical. He uses several Allison speakers, and he has been friends with Roy Allison for decades.

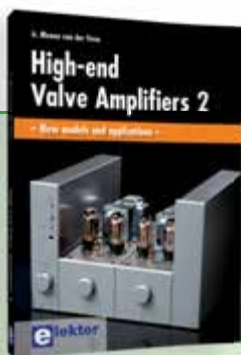
Howard's main system (music only), features Allison IC-20 loudspeakers as his left and right channel speakers. His center speaker (in a custom-built solid-cedar cabinet) has Allison drivers and a crossover based on Allison designs. The surround channels are four refurbished Allison Model Four loudspeakers, and he has dual cylinder subwoofers, with Dayton Reference Series 12" drivers (home designed and built, with a smooth extension to 18 Hz) a Yamaha DSP-A1 integrated surround amplifier, a Crown XLS1000



This is a reclad left speaker for one of Howard's dream systems. The speaker is shown here without its grill.

power amplifier, a Rane THX-44 equalizer #383038 that handles the three front channels, plus the subwoofers, and an Onkyo DV-S939 DVD player, used only for CD playback.

His second system, which features almost as many components, is used mainly as his home theater. This system includes a Samsung 56" DLP TV (down the line he hopes to upgrade to a 70" LED set), and a home-built speakers with Allison, Tang Band, RadioShack, Dayton Audio, and NHT drivers. The three front systems use vertical MTM mid/tweeter arrays, with dual woofers at the bottom, a Pioneer VSX-1122-K receiver, dual cylinder subwoofers, with Dayton Titanic Series 12" drivers (home designed and built, with redwood top and bottom panels), a Crown XLS1000 power amplifier, an ART EQ351 mono equalizer for the subwoofers, and a Panasonic DVD/VHS recorder, a Sony BluRay player, and a RadioShack mini TV (used to program the recorder).

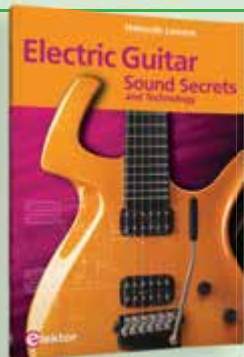


New models and applications

High-End Valve Amplifiers 2

Valve amplifiers have a lively, deep, clear, expressive and dynamically sound and they do not appear to have any limitations. Menno van der Veen investigates in a systematic theoretical approach, the reasons for these beautiful properties. He develops new models for power valves and transformers, thus enabling the designer to determine the properties of the amplifier during the design process. You will notice in this book that the author not only writes about amplifier technique, but tells about the way the development of valve amplifiers can have an influence on your daily life.

420 pages • ISBN 978-0-905705-90-3 • \$59.70



Sound Secrets and Technology

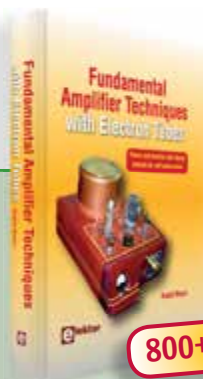
Electric Guitar

The underlying sound of electric lead and bass guitars is determined largely by their electrical components. But, how do they actually work? For the interested musician (and others), this book unveils, in a simple and well-grounded way, what have, until now, been regarded as manufacturer secrets. The examination explores deep within the guitar, including pickups and electrical environment, so that guitar electronics are no longer considered highly secret. With a few deft interventions, many instruments can be rendered more versatile and made to sound a lot better – in the most cost-effective manner.

287 pages • ISBN 978-1-907920-13-4 • \$47.60

100% Audio

Must-haves for audio lovers
and DIY enthusiasts



800+ pages!

The ultimate tube amplifier reference book

Fundamental Amplifier Techniques

This book is a must-have for all tube fans and the growing circle of RAFs (retro-audio-aficionado's). In a mind blowing 834 pages Rudolf Moers covers just about everything you need to know about the fundamentals of electron tubes and the way these wonderful devices were designed to function at their best in their best known application: the (now vintage) tube audio amplifier. The aim of the 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.

834 pages • ISBN 978-0-905705-93-4 • \$104.90

Further information
and ordering at

www.elektor.com/store



Elektor US

111 Founders Plaza, Suite 300
East Hartford, CT 06108 | USA

Phone: 860.289.0800

Fax: 860.461.0450

E-mail: order@elektor.com



3.5 Hours of video material

DVD Masterclass High-End Valve Amplifiers

In this Masterclass Menno van der Veen will examine the predictability and perceptibility of the specifications of valve amplifiers. The DVD represents 3.5 hours of footage filmed in the grand meeting room of Elektor House. Bonus elements on the DVD include the complete PowerPoint presentation (74 slides), scanned overhead sheets (22 pcs), AES Publications mentioned during the Masterclass. Not forgetting the bombshell: 25 Elektor publications about valves.

ISBN 978-0-905705-86-6 • \$40.20



140 Minutes video presentation and more

DVD Feedback in Audio Amplifiers

In this Masterclass we address several aspects of feedback in audio amplifiers. The focus of this Masterclass, although not entirely math-free, is on providing insight and understanding of the issues involved. Presenter Jan Didden provides a clear overview of the benefits that can be obtained by feedback and its sibling, error correction; but also of its limitations and disadvantages. Recommended to audio designers and serious audio hobbyists!

ISBN 978-907920-16-5 • \$40.20

Popular Preamp Tubes

Familiarity simplifies tube selection



The first hollow-state component was one of Thomas Edison's light bulbs with an extra metal support structure inside. Edison noticed that a small current flowed from the filament to this structure. John Ambrose Fleming saw the potential usefulness of the "Edison effect," and created the "Fleming valve," the first hollow-state diode, which was used to detect radio signals. Whether Fleming went on to develop a triode or whether Lee De Forest did that is a matter for debate. Certainly, De Forest was responsible for the early commercialization of the "Audion" triode. This device, which resembled a light bulb with what was later called a "grid cap," was used to detect radio signals. It was much more sensitive than the Fleming valve for that application.

By the 1920s, De Forest had sold his patent for the Audion to AT&T, and vacuum triodes were being manufactured by several companies. The earliest model, and one of the most popular, was the model 01. This low- μ tube (with an amplification factor, or μ , of about 10) had a 5-V filament that drew 250 mA. By this time, the tube's envelope had been standardized as a glass envelope with no grid cap and with a four-pin base providing two pins for the filament/cathode, one for the plate, and one for the control grid (see **Photo 1**).

EARLY TUBE DEVELOPMENT

The early market for vacuum tubes included broadcast, commercial, and military radio receivers. AT&T and other companies also used them for amplifiers in transcontinental telephone cable service. Also, RCA and Western Electric used them in



Photo 1: This is a "01" triode with a four-pin base.

motion-picture theaters. Over the years, the tubes gradually became smaller and other base designs appeared. **Photo 2** shows the interior of a 1924 Atwater Kent AM radio receiver. **Photo 3** shows a 1939 Philco table radio. Note that as radio design developed, the size of the sets decreased.

By the late 1940s and early 1950s, AM radio receivers had standardized to a five-tube design, often called the "All American Five." This design used a hollow-state rectifier (e.g., a 35W4) and an oscillator/mixer (called a "converter"—perhaps a 12BE6) to convert the modulated radio frequency

signal to an intermediate frequency (IF)—usually 455 kHz. It also used an IF amplifier (usually a pentode, e.g., a 12BA6), a detector/amplifier such as a 12AV6 that contained both a diode and a triode, and a single-ended power amplifier that was usually a power pentode or beam power tube such as a 50C5. These sets abandoned the earlier quest for quality sound in favor of low manufacturing costs. In fact, Arthur Atwater Kent, one of the foremost radio manufacturers of the 1920s, chose to go out of business rather than try to compete with these "midget" designs.

Since the "All American Five" sets didn't use a power transformer, they could be powered from either AC or DC mains, a convenient feature in those days because some locations used a DC power grid. The disadvantage was that when they were powered from AC lines, the chassis could be "hot" at 115 VAC, presenting an electrocution hazard. Because of the ubiquitous hot chassis designs, tube manufacturers created many tubes with odd filament voltages (e.g., 21, 26, 33, 38 ... up to 117 V).

The commercialization of television in the 1950s led to a proliferation of new tube types, since a typical



Photo 2: Here are the innards of a 1924 Atwater-Kent radio.



Photo 3: The circuitry of this 1939 Philco radio is a bit more compact.

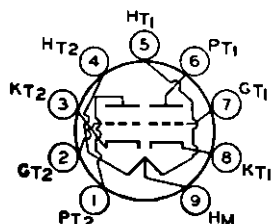


Figure 1: This is the pinout for the 12A*7 family of dual triodes.

TV could contain upward of 20 tubes. The 1973 *RCA Receiving Tube Manual* contained 45 pages of then-current tube data—with an average of one tube's data per page—plus a seven-page chart of abbreviated data containing approximately 30 discontinued types of tubes per page. When I purchased my first tube manual in 1966 and started looking inside, it was like drinking from a fire hydrant. I eventually discovered that most of the listed tubes were only used for televisions, and therefore were of interest to me only when I needed data during a repair adventure. I was more interested in old AM radios, partially because of their beautifully crafted furniture cabinets, and partially because of their superior audio quality when compared to what was available from the 1960s consumer-grade receivers. (Measurements I took in the 1980s revealed that my 1939 Philco AM receiver had far better frequency response than a 1970s-vintage home-stereo receiver's AM section!) But mostly I was interested in audio amplifiers.

AUDIO AMPLIFIER TUBES

Thus, my specific interest greatly reduced the number of tubes with which I needed any real familiarity. Today, a hollow-state circuits aficionado usually finds relatively few models of tubes to be of importance. For example, let's first look at audio preamplifier tubes. These can be segregated into triodes and pentodes. By far the most popular of the triodes is the 12A*7 family, including the 12AT7 and 12AX7 high- μ dual triodes and the 12AU7 and 12AY7 medium- μ factor dual triodes. (There was also a 12AZ7 high- μ dual triode, but that one is little-used today.) All these tubes have a nine-pin miniature envelope

and the same pinout (see **Figure 1**). They have 12.6-V filaments and draw 0.15 A. The filaments are center-tapped and the two sections can be fed in parallel, running on 6.3 V at 0.3 A. The tubes of the 12A*7 family differ primarily in their amplification factor or μ .

The most common of these dual triodes is the 12AX7, which has an μ of 100. This tube is also known by its European model number, ECC83. The 7025 tube is a 12AX7 with a controlled noise and hum characteristic. Since there is some normal manufacturing variation in the μ of tubes of the same model, some vendors separate them into groups according to the "sound" they will produce in an amplifier. Mostly these vendors target guitar amplifier users describing the tubes in terms such as "hot," "aggressive," "smooth," and so forth. Naturally, a higher-gain tube will be easier to drive into distortion than a lower-gain tube. And some models are described as having lower noise and microphonics (i.e., the tendency for tubes to produce a "ping" sound

in an amplifier's output when tapped or bumped). One well-known supplier offers a 7025 plus six different models of the 12AX7. This tube is pretty much the standard audio preamplifier tube of the dual-triode class.

The 12AT7 (ECC81) is similar to the 12AX7 in that it has a high μ . In this case though, "high" is 60, not 100. The 12AT7 has a maximum plate dissipation of 2.5 W, compared to 1.2 W for the 12AX7. This makes it useful for applications in which the tube must supply more current to the load (e.g., drivers for spring reverb units).

The 12AU7 was the standard dual-triode amplifier in electronic measuring instruments (e.g., vacuum tube voltmeters and oscilloscopes). It has a medium μ of about 20. The 12AY7 also has a medium μ , but in its case, "medium" is 40. The 12AY7 is not commonly used today.

INDUSTRIAL TUBES

A variety of military/industrial tube models were developed for use in mission-critical applications or applications

1nV Low Noise Dual JFET

Low Noise < 1nV
Monolithic Dual
Tighter Idss Matching
Narrow Idss Grades
Low Capacitance: 20pf
Functional Replacement for 2SK389

www.linearsystems.com 800-359-4023

7052PH

PHANTOM Powered
Measurement Mic System

NOW 4Hz to 25+kHz

<16dBA >135dB SPL

IEC61094-4

Compliant

1dB/div

30 kHz

Anechoic
Free Field
Response
Included

Rugged
STAINLESS
Body
Operational
<-20 to >70C
Storage
<-30 to >85C

PHANTOM
<18Vdc
to
>56Vdc

Removable
Capsule
Titanium
Diaphragm

www.acopacific.com

Consumer Type	Industrial Type
12AT7	12AT7WA, 6201, 6679
12AU7	12AU7WA, 6189, 5814, 7730, 6680, ECC802, 7316
12AX7	7025, 6681
12AY7	6072

Table 1: This table lists industrial replacements for some consumer dual triodes.

in which the tubes are subject to vibration. These can be substituted for the standard consumer models, and will operate properly in the circuit. They may or may not perform better or outlast the consumer model tube. See **Table 1** for examples of industrial replacements for the 12A*7 group.

In addition to these exact-replacement industrial tubes, there are many "close-but-not-exact" replacements. For the 12AT7, there are the 5965, 6211, and 6829, all of which have an μ of 47, but are otherwise similar to the 12AT7. For the 12AU7, there is the 5963, which has a maximum plate voltage of 250 V vs. 330 V for the 12AU7. The 5751 is an industrial high- μ dual triode similar to the 12AX7, but with an μ of 70. The 6EU7 is a low-hum, nine-pin, high- μ (100) dual triode with a different pinout than that of the 12AX7.

Octal-type dual triodes are available that perform similarly to the 12AX7 and the 12AU7. These are the 6SN7 and the 6SL7, respectively, plus their 12-V cousins, the 12SN7 and the 12SL7. The octal tubes have been manufactured in glass and metal envelopes (see **Photo 4**), the latter providing the advantage of internal shielding against hum induced from outside the tube.



Photo 4: These two 12SN7 dual triodes have octal envelopes. One is glass. The other is metal.

PREAMPLIFIER TUBES

In amplifiers using a lot of negative feedback to reduce distortion, pentode preamp tubes are often preferred. Pentode preamps are also found in capacitor microphones. For audio amplifier service, "sharp-cutoff" pentodes are used. These are more linear in their operation than the "remote-cutoff" pentodes found in radio frequency (RF) circuits having automatic gain control (AGC).

An excellent old-timer for audio preamps is the 6AU6 and its 3-, 4-, and 12-V cousins the 3AU6, the 4AU6, and the 12AU6. The 6AU6 is a seven-pin miniature tube having a transconductance of 5,200 microsiemens (μ S) when used with a 150-V plate supply. The 7543 is an identical tube except that it has a controlled hum characteristic. The 6HS6 is another seven-pin miniature pentode that matches the pinout of a 6AU6, but it has a 9,500- μ S transconductance with a 150-V plate supply. The 5879 is a nine-pin miniature pentode with a lower transconductance (1,000 μ S with a 250-V plate supply).

One other preamplifier tube was popular in home-audio amplifiers of the late pre-solid-state era: the 7199 combination medium- μ triode/sharp-cutoff pentode. This nine-pin tube contained a triode with a μ of 17 and a pentode with a transconductance of 7,000 μ S when used with a 220-V plate supply. A typical application of the 7199 used the pentode section as the preamp, and the triode section as the phase splitter of a push-pull audio power amplifier. It was also used as the first stage (triode) and second stage (pentode) of some models of Kay guitar amplifiers.

If you decide to swap preamp tubes around in some of your equipment, the 12A*7 family is mostly interchangeable except that you should remember the 12AT7's higher plate dissipation rating, and not replace it with any of the other 12A*7 family in positions where you may require higher output current. Also, remember that a lower-gain tube will sound quieter at the same volume-control setting, and it will produce a cleaner sound in a guitar amplifier than will a high-gain tube.

Next month, I'll look at some of the better power-amplifier tubes. *aX*

Testing the Spin-Clean LP Washer Machine

A handy system for cleaning vinyl records

Spin-Clean International
P.O. Box 15200
Pittsburgh, PA 15237
(800) 931-5850
www.spincleanrecordwasher.com

First, a little history is necessary. Many record-cleaning devices have appeared over the years, especially since the advent of the microgroove LP, with which almost any dust is audible. I have not tried them all, but I have experimented with a few of them. My first gadget was the Dust Bug, made by Cecil E. Watts. It was a Plexiglass, tonearm-like device that had a cylindrical brush instead of a stylus. The Dust Bug would capture the larger pieces of dust that were attracted to the LP. I also recall a simpler device—a soft pad covered in blue velvet—that attempted to get down into the grooves and brush out the dust, but it just pushed the dust around on the LP.

RECORD PRESERVATION

In the mid-1970s, I attended a San Diego Audio Society meeting in San Diego, CA. The society hosted a talk by Dr. Bruce Maier, a chemist and the inventor of the Discwasher record-cleaning tools. The Discwasher consisted of a D3 (now D4) vinyl cleaning fluid and a walnut brush handle covered on one side by directed-pile velvet cloth. Mechanically, the velvet fibers would get into the LP grooves as long as the brush was properly oriented. When moistened with D3 fluid, the brush would pick up dust in spite of the electrostatic attraction, and the record would sound much cleaner.

Because drying strokes by the brush would recharge the static electricity on the LP, you could follow the cleaning by using a Zerostat antistatic gun to



Photo 1: Spin-Clean's record washing system enables you to clean both sides of your LP at once.

discharge the static. Both of these cleaning appliances still exist in one form or another. The Discwasher brand is now owned by another company, and reports of its brush quality on the Web are not flattering. I still use the Discwasher fluid.

During his talk, Maier discussed earlier products' failure to properly clean records and he explained how he came up with his system, detailing his development of the cleaning formula. Of course, it is mostly water, but he added a detergent that removed dust and oily fingerprints from the record without "pulling" the lubricant component from the vinyl formulation. Eventually, he found a detergent that could do this, which he confirmed by testing the used cleaning solution for the presence of vinyl lubricants.

Because it really works, I have used the D4/Zerostat routine religiously when playing LPs, especially prior to transferring my best LPs to my computer for remastering in the digital domain. This is adequate for records I have purchased new and kept in good shape, but it is not trustworthy when I

buy used records at shops or at library benefit sales. Here, you are taking your chances, and you might want to give your used finds a good cleaning before trusting them to an expensive stylus.

TIMES HAVE CHANGED

When I lived in San Diego, I would occasionally take a handful of used LPs to the local super-fi emporium, which would let me clean them myself on a Keith Monks record-cleaning machine for \$0.50 per LP. This always made an audible difference in the LPs' playback quality. However, I no longer live in San Diego, and it is a bit far out of my way to travel that distance simply to clean a new batch of old LPs. And I have a box of used library-sale LPs awaiting transfer to my hard drive. Serious collectors might spring for their own Keith Monks machine, or some other brand, but they are expensive and take up a lot of space.

THE SPIN-CLEAN SYSTEM

Ed Dell lent me the Spin-Clean Record Washer System MKII for review. This cleaner consists of a cleaning-fluid tank containing rollers and a pair of brushes (see **Photo 1**). You plunge your LP into the narrow space between the brushes, which are submerged by the cleaning fluid, and you rotate the disk by hand. The disk turns on rollers inserted into the tank (see **Photo 2**).

You can adjust this unit to clean 12" disks, 78-rpm disks, and 45-rpm disks, simply by moving the rollers into corresponding slots in the tank. The disk will be supported with its label out of the fluid.

When you receive this device in its shipping box and read the instructions, you will need to accomplish some



Supreme® Silver/Gold/Oil



MCap® EVO Silver/Gold/Oil



MCap® EVO Oil



MCap® EVO



MLHC+® High Current Cap

Distributed By
WWW.AUDIYO.COM
(416) 704-0105



Photo 2: The Spin-Clean unit features adjustable rollers.

preliminary steps before the machine is ready for use. It comes with drying cloths that you must pre-laundry before use. In addition, because most of the cleaning fluid consists of water, you will need to buy your own gallon of distilled water for filling the tank. After all, this is less expensive than shipping gallon jugs of water around the country.

To change the water into cleaning fluid, you add measured amounts of cleaner concentrate to it. A table explains how to do this, but it needs a bit of interpretation. The 4-oz. bottle of concentrate has a small cap, so you need to add three capfuls to a full cleaning tank. The larger size bottles have a larger cap, so you need to add only one capful to a full cleaning tank.

The included instructions are explicit about how many turns to rotate the disk, and in which direction. They are equally explicit about which direction to wipe the disk with the drying cloth.

PRACTICAL EXPERIENCE

When I cleaned a few test LPs for review, I worried that the drying cloths were not nappy enough to reach down into the grooves and pick up the liquid. But after I ran the cloth around the disk a few times, the record seemed to dry out in good shape. I expected to get a lot of fluid on my T-shirt and on the record label, but they both stayed dry with careful handling, which surprised me.

I used this machine to clean several LPs. For one LP, I did careful tests to see whether there was some objective

measurement of cleaning effectiveness. One LP was a Musical Heritage Society recording of *12 Sonatas for Harpsichord* by Domenico Scarlatti, MHS 555. These sonatas are quite lively, and the sound does not reveal any dust that might be present on the record, so I enlisted the aid of ClickRepair software by Dr. Brian Davies (www.clickrepair.net).

The first time I transferred Side 1 to my hard drive, I used only the Discwasher brush and Zerostat pistol as usual. (I did not want to risk my stylus with an untouched used LP.) Then I ran ClickRepair and wrote down the number of repaired samples divided by the total number of samples.

Next, I used the Spin-Clean system to clean and dry the LP. I let the LP air-dry after using the drying cloth, just to be sure. I transferred Side 1 again after a quick touch-up with the Discwasher routine. Finally, I ran ClickRepair again to see whether the number of repaired samples had decreased, due, I hoped, to removal of dirt that would cause audible ticks. The final score was 1 out of every 326 samples repaired before cleaning, and 1 out of every 347 samples repaired after cleaning—both in the left channel. The right channel went from 1 out of every 305 to 1 out of every 318. This was a measurable improvement in both channels.

I am pretty sure the cleaning fluid removed dust the stylus would normally push out of the way in the groove during playback, and this would not register in ClickRepair. But this dust is

abrasive to your stylus and to the vinyl grooves, so it is better to remove it. I have also cleaned some LPs using the Keith Monks' machine to remove some sticky substance in the grooves, and I am sure the Spin-Clean machine would work as effectively.

If you were to engage in a mass record-cleaning effort, you would need a big supply of the drying cloths on hand, and you would want to hang them up to dry. They dry pretty fast on a coat hanger. Also, if you follow the drying cloth with air drying, you will need a

rack or some support for your LPs. If you don't have space for a bunch of air-drying LPs, this may limit the number of LPs you can treat at one time.

GIVE IT A SPIN

The Spin-Clean system works as advertised. It is an unpretentious, affordable product. It can be used to get more pleasure and lifetime out of your LPs, including some disks that may be irreplaceable. It is a little bit tricky to set up and you do all of the cleaning yourself, but there is no electric motor

or other mechanism to fail. It won't remove particles that are molded into the record as part of the vinyl formulation (which may contain label material from reground records), but it will remove loose particles that would otherwise cause wear.

The manufacturer does not make any claims one way or the other regarding whether the cleaning fluid is designed to discriminate between fingerprint oil and the vinyl lubricants. However, the fluid doesn't have any obvious odor, particularly that of alcohol. *aX*

MANUFACTURER'S RESPONSE

Thank you for the excellent review of the Spin-Clean Record Washer MKII. We have been manufacturing and hand-assembling the Spin-Clean in Pittsburgh, PA, since 1975, and we have been very pleased with the international success of the new MKII. Our package deal includes seven drying cloths and enough washer fluid to clean almost 6,000 records. If you are planning on cleaning a lot of

records at once, it is handy to have the extra supplies the package offers.

Our cleaning solution is a non-alcohol-based cleaning solution that does not leave a residue and, due to the design, it encapsulates the dirt and makes it sink to the bottom of the bath unit so it is not redeposited on your records. Because it contains no alcohol, it is perfectly safe to use for cleaning 78s as well as 45s and LPs. Our fluid is great

for removing dirt, dust, and oily fingerprints from records without harming any of the vinyl's properties. Our solution even works well with moldy records.

Once again, we thank you for your time and effort on an outstanding review.

Mark Mawhinney
Owner

Spin-Clean International

JANTZEN AUDIO DENMARK



C-COIL POWER INDUCTOR with up to 2.000 W capacity. Where other coils get overheated, you just order Jantzen C-Coils. Designed for bass, subwoofers and amplifiers.



Superior Cap Even the finest nuances can be heard. The sound never gets over-edged, really superb naturalness with a somewhat bright top-end.

Silver Cap Super smooth cap without any harsh additions to the sound. Absolutely neutral tonal balance. A truly outstanding audio part.

Silver Gold Cap More resolution, more sound stage. Lots of dynamics. Fast reaction, life feeling and natural sound.



CROSS COIL high-end induction coil. Absolutely the closest to the ideal inductor in the World.



1.6 & 1.8 mm baked wire coil
Long expected & wanted!
New round wire coil made of 1.6 & 1.8 mm baked wire. Available as air cored coil and with non-ferrite core.



WAX COIL wound of copper foil and paper insulation. Wax impregnated. Hard as a rock. Second to none.



JA-8008 Jantzen Audio 8" driver
8 ohm, 95 dB designed by Troels Gravesen and made by SEAS, Norway. Ideally mated with high efficiency, 34 mm dome Audax tweeter with JA-waveguide.

For more info: www.jantzen-audio.com

Parts available at www.parts-express.com & other Jantzen Audio dealers

Entrepreneur Embraces Audio Technology Evolution

DIYers are encouraged to learn through practical experience

SHANNON BECKER: Tell us a little about your background and where you live.

GEOFF BOYD: I have lived in San Jose, CA, since 2006. But, I hail from the Caribbean and spent most of my life living in UK. I am a 1970 Commonwealth Scholar and Physics and Chemistry graduate of the University of Leeds, West Yorkshire, England, with post-graduate and post-doctoral research experience in Material Science at the Oxford University, Oxford, England. Leaving academia in the early 1980s I co-founded Memotech, one of the UK's leading first-generation PC companies. I then led NXT, the company that introduced the world's first computer interactive Videowall display systems, which included marketing and selling these high technology display systems into Japan.

In 2010, after more than 10 years at NXT specializing in new business development, technology innovation, and intellectual property licensing, I rekindled my entrepreneurial activities and founded Silicon Valley-based Coleridge Design Associates, which has the objective of building a team of designers, scientists, and engineers who specialize in creating intellectual property (IP) by invention and innovation aimed primarily at the consumer electronics (CE) and green energy (GE) markets. At its core is "Invention by Design" rather than "Invention by Serendipity" with the skill and experience to recognize the difference between a trip to Brighton (the seaside) and a trip to Mars.

SHANNON: What was your first personal project? Why did you build it? Is it still in use?

GEOFF: My exposure to electronics was as a postgraduate student in the



Geoff Boyd is the managing director of Coleridge Design Associates.

Department of Metallurgy, Oxford University, where those so inclined built their own electronics equipment for lab experiments. I took to this like a duck to water and became quite proficient at electronics design and construction as well as sheet metal work for enclosures. My first personal project was to build a functioning version of Peter Walker's Quad 405 current dumping amplifier. The design with full schematics was published in a December 1975 issue of *Wireless World*. I was fascinated with the concept of the reactive bridge balancing technique used in the design. In fact, I remember doing a second-order calculation to fine tune the inductor's resistance of the bridge. I added Douglas Self's advanced pre-amplifier with discrete LED-biased op-amps, which was also published in *Wireless World* in 1976 as well as a discrete Class A headphone amplifier also published at the time. I laid out the PCBs using the "pen and tape" method and etched it in the lab. No purchased kits here! I fabricated the sheet metal enclosure under the expert tutelage of John Short, who ran the student workshop in the Department of Metallurgy at Oxford for many years. This integrated amplifier had a pride of place in my

living room for many years. It eventually gave way to a Yamaha AV receiver over 10 years later.

SHANNON: You have more than 30 years of experience in technology and audio visual innovation. How did you get started?

GEOFF: In 1978 I moved from the Department of Metallurgy to the Engineering Department at Oxford University as a post doctorate researcher in mechanical properties of materials at elevated strain rates. This required recording data for tests lasting a few milliseconds with data rates at tens of MHz. Though my passion for music and interest in audio electronics remained, my electronics interest and expertise shifted to computer and memory electronics design.

SHANNON: What made you venture out on your own and start Coleridge Design?

GEOFF: I started as an entrepreneur during those heady days of the first personal computers in 1979. I plotted to start a hardware and software business with another researcher at Oxford, Robert Branton, who worked with the programming research group at Oxford. It wasn't a difficult decision to branch out because at the time Margaret Thatcher had just become prime minister and the cushy jobs at the universities were disappearing fast. By 1981, the writing was on the wall and tenure was going to end, so I decided to forget about an academic career and start my own tech business. Our first business, Memotech, was making add-on memory packs for the Sinclair ZX81. Initially, I designed the products while still at the Engineering Department and then I jumped ship as soon as the

business roared to a massive success.

The story of Memotech is interesting. The ZX81 came with 1 KB of memory, and the first thing the user needed was a 16-KB memory pack. When dynamic random access memory (DRAM) ICs were purchased, they needed to be fully tested in circuits with demanding tests, which typically lasted 3 to 4 min. In the UK, there were two contract manufacturers who made Sinclair's add-on packs—Thorn EMI and AB Electronics. They used GenRad testing machines that cost over \$1 million each. You couldn't speed up the test, so the throughput of these machines was limited. Memotech couldn't afford these machines to test its MemoPaks, as they were called, so we built our own testing rigs using Intel 8048 8-bit microcontrollers with a complete memory test system that cost us less than \$500! The MemoPaks were housed in black anodized extrusion enclosures and had a reputation for quality. Needless to say, Memotech cornered the market on Sinclair ZX81 memory add-ons, and we were able to build a multi-million-pound business within one year. I remember that we had UK retailers WH Smith, Boots, and others on allocation, and we could sell everything that we could make. In the US, the ZX81 was launched as the Timex 1000, and we experienced explosive growth and success. I hastily left the university and never had the time to submit my D-Phil thesis from the work in the Metallurgy Department at Oxford, although my research was peer reviewed and published at the time.

At Memotech, we thought all we had to do was produce a first-class product with a great design and specifications, and the buyers we had on allocation would come to us. So, we designed and manufactured the Memotech MTX 512 home computer, which was launched in 1983. We were competing against BBC Microcomputer System and never stood a chance in the UK. The buyers never came and the level of marketing required was beyond our resources, so our backers eventually pulled the plug in 1986. That was a huge lesson. I bought what was left of the business and relaunched Memotech Computers using high-resolution digital

video technology that had been developed at Memotech to a new market of videowall technology. We dominated the supply of videowall controllers for nearly 10 years, from 1986 to 1995.

Another lesson I learned from 1995 to 1999 was that "things change." We miscalculated, thinking that to have large LCD-TVs one would need to "tile" smaller displays. In 1995, it was generally accepted in the display industry that one could never manufacture LCDs larger than approximately 23" diagonal because of glass-handling issues. Another bit of wisdom at the time was that LCDs would quickly transition from amorphous silicon active matrix LCD (AMLCD) to low-temperature polysilicon technology (LTPS), which would mean the driver electronics used with AMLCD would be eliminated. And a further bit of wisdom at the time was that the yield of LCDs would never exceed about 70%. I launched Coleridge Design in 1996 to create a business to tile partially defective LTPS 23" to 25" LCD panels into 100" very large screen flat panel displays (VLS-FPDs) based on these false assumptions.

Needless to say, the business never took off as technology changed making all three assumptions on which the business was based wrong. And in 1999, I joined NXT, the UK flat-panel speaker IP company, as a display consultant to launch SoundVu where "the screen is the speaker." For 10 years, I worked at NXT with a fabulous team of colleagues all passionate about music and sound reproduction. I worked primarily in IP business development and sales. It was a valuable experience that brought me in contact with all the great audio and consumer electronic companies of the world. I did contribute on the technology side and have a number of NXT patents to my name, but it wasn't my day job. In 2006, the bulk of the NXT business moved to Hong Kong to be closer to its licensees and I moved to Silicon Valley to be closer to the OEMs that were licensee targets. By 2010, NXT was retrenching, having failed to make a lasting impact with its IP licensing business model, and started moving back to UK. This was my cue to relaunch my entrepreneurial career in Silicon Valley.

The Convenient All-in-One Solution

for Custom-Designed Front Panels & Enclosures



You design it
to your specifications using
our FREE CAD software,
Front Panel Designer



We machine it
and ship to you a
professionally finished product,
no minimum quantity required

- Cost effective prototypes and production runs with no setup charges
- Powder-coated and anodized finishes in various colors
- Select from aluminum, acrylic or provide your own material
- Standard lead time in 5 days or express manufacturing in 3 or 1 days

**FRONT PANEL
EXPRESS**

FrontPanelExpress.com
1(800)FPE-9060

Coleridge Design in San Jose, CA, was launched at the beginning of 2010.

SHANNON: Tell us about your work. Do the models you used 30 or even 20 years ago still function today?

GEOFF: The Coleridge Design plan is to develop IP mainly in consumer electronics audio and sound reproduction as well as in printed electronics and green energy with the "user experience" as the guiding force. I call it "inventing by design," where I call on my extensive experience in science, technology, engineering, and mathematics (STEM) to lead a team charged with addressing neglected technology needs.

The entrepreneurial model we used in the past was based on gut feelings. We make a design and a product then put it out there to see how it sells. If the product *and* price was great then it would sell with moderate PR and marketing. The marketing was entirely business-to-business (B2B) or business-to-consumer (B2C), depending on the product and the target market. The

Internet changed the model slightly in the last 20 years but not significantly. Today, we have a fundamental shift with the advent of social media, which in effect means that our marketing effort is dominated by consumer-to-consumer (C2C). Another significant change is the advent of Kickstarter and crowdfunding. In the context of making and taking products to market, I view it as an extension of C2C where you can test the market before you build your product. Our case with Coleridge Design and the aCUBE is a classic case of using Kickstarter to test the market and fail early.

SHANNON: Your most recent innovation is the aCUBE. How did this design come to be? What makes it so unique?

GEOFF: In about 2004, Dr. Graham Bank, a colleague at NXT, made a breakthrough in loudspeaker technology inventing the balance mode radiator (BMR) loudspeaker. The BMR is a full-range loudspeaker driver, which



The aCUBE uses 4.5" BMR full-range loudspeaker drivers, beautiful handmade clear cast acrylic 6.5" cube enclosures and the latest Class-D amplifier technology from Maxim Integrated.

provides outstanding performance. My personal view is that this is the most significant advance in loudspeaker technology since 1925 when Rice & Kellogg invented the loudspeaker as we know it today.

BMR technology has appeared in many stand-alone loudspeaker products. However, these have largely been in either expensive Hi-Fi or in performance compromised speaker systems. The advantages of BMR speaker technology are many, but primarily relate to its pinpoint accuracy yet wide dispersion and extended frequency range. Together this allows the design realization of a high-performance, single-drive system such as the aCUBE.

This project takes the 4.5" BMR full-range loudspeaker drivers from CSS, a company owned by my former NXT colleagues, Dr. Graham Bank and Jon Vizor, and marries these drivers with beautiful handmade clear-cast acrylic 6.5" cube enclosures and the latest Class-D amplifier technology from Maxim Integrated. The result: The best in-class performance speakers optimized as near-field active loudspeakers that are stylish, exceptional quality, affordable, and convenient.

The use of acrylic is quite by accident. I have tended to use aluminum extrusions in most of my designs. The MemoPak 64K, the Memotech MTX 512 computer, and the Memotech DDFS videowall controllers were all made with black anodized aluminum preferably brushed. So we designed and prototyped a range of BMR



Test Equipment Depot

800.517.8431





- Oscilloscopes
- Power Supplies
- Spectrum Analyzers
- Digital Multimeters
- Network Analyzers
- Function Generators
- Impedance Analyzers
- Frequency Counters
- Audio Analyzers
- Soldering Equipment
- Assembly Hand Tools
- Tool Kits
- **And Many More...**



www.TestEquipmentDepot.com

Sales • Repair & Calibration • Rental • Leases

speakers in anodized aluminum enclosures. However, before we made the prototypes, we built some acrylic enclosures as proofs of concept to test the BMR drivers from Cotswold Sound Systems. They sounded fabulous. However, when we used the aluminum prototypes, the enclosures rang like a bell and we had to take drastic measures to dampen the sound. Due to my materials science background, I realized that the acrylic sounded fabulous because of the material's high internal damping over the entire audio bandwidth due to viscoelasticity. That was the reason the relatively thin walled enclosures sounded so well. Once we decided to make the aCUBE out of acrylic sheet, we had to find a supplier who could make perfect cubes using CNC and the latest techniques in bonding and polishing. The beauty in cast acrylic sheet is how it renders the light through perfect edges.

I have to confess, the aCUBE Kickstarter project was a bit of a Trojan horse in an attempt to gauge whether the consumer electronics market has an appetite for a new audio brand in quality sound reproduction and whether crowdfunding is a viable route to launching such a brand. It didn't take long to see that in its present form, the Coleridge Design brand will not be a viable vehicle for launching the groundbreaking, disruptive audio technologies as I envisaged. Another valuable lesson learned from this early failure is that very little has changed and launching a new brand is still all about marketing, albeit nowadays C2C social media marketing.

SHANNON: Describe your touchpen technology and how it works.

GEOFF: A couple of weeks after I got my first iPhone in 2007, I designed and built a capacitive-touch pen using conductive silicone rubber to emulate the finger. There are two requirements for a capacitive touch pen. The first is that it must form a flat conductive area of about 0.5 to 1 cm² on the touch glass surface. The second is that this conductive area must be electrically connected to an electrical "sink" such as the human body or "large" lump of metal. The first touch pen that we built



The Lunatik Touch Pen, available in several different colors, is currently in prototype development. The accessory can be used both as a regular ink pen and as an implement for your tablet.

had a mild steel core of about 100-mm long × 3-mm diameter embedded in a silicone rubber "pen" about 110-mm × 8-mm diameter. We built a few hundred prototypes, but it wasn't viable because there was no IP protection.

So we came up with a design in which the rubber grip of a gel pen was made out of conductive silicone rubber and modified so that when the pen refill was retracted the silicone rubber tip would collapse and could be used as a touch pen even when the pen body was plastic because the grip would conduct through the fingers.

Coleridge Design licensed the technology exclusively to Scott Wilson at Lunatik.com who launched it on Kickstarter, his second project after his very successful TikTok project that created the Lunatik Brand. (For more information, visit www.kickstarter.com/projects/1104350651/lunatik-touchpen-the-evolution-of-thestyus.)

This is the licensing business model that we generally want to use for the IP we develop. The key is to make a whole product that is ready for market. Most of the time it is not that easy because the technology is not a "whole product" and needs one or more entities in the supply chain to complete the product. In many cases, it might be an OEM or brand to take the product to market as well as suppliers to change the way they make products. That is very hard and needs to be driven by the OEM. That was

the reasoning behind trying to make Coleridge Design an audio brand. If one cannot take it to market then one has to make it worth the while of the OEM or brand to get on board. That generally means some degree of exclusivity. Say a time-limited exclusivity or even an outright sale or fully paid up license.

SHANNON: What do you see as some of the greatest audio innovations of your time?

GEOFF: In the last 40 years, we have come a long way in improving the user experience but only if we use convenience as the main metric. To speak to that, I would say three of the great innovations of "my time" include: The Digital Audio revolution, which has led to surround sound and iTunes; the Class-D filterless audio amplifier; and distributed mode loudspeaker (DML) culminating in Dr. Graham Bank's BMR. However, in so many ways, we have gone backward in the user experience of audio, mostly in the name of convenience. I recall valve amplifier systems

The Invisible Switch



The Switch Is Connected With The Shortest Possible Leads. The Wired, Battery Driven Selector Is Placed Anywhere.



KAB
Preserving The Sounds Of A Lifetime
www.kabusa.com

from the 1960s and 1970s with very large speakers, some of them built into the users' homes, which outperform most systems I have heard in the last 20 years.

How do we get great-sounding audio out of relatively "small" enclosures? I clearly remember an encounter I had with Michael Gerzon, who it would be reasonable to say invented surround sound. It was sometime in 1975, just after he had published his work on surround sound in *Wireless World* in December 1974. I was invigilating as a student's part-time job on Friday evenings at the Radcliffe Science Library in Oxford and Michael, who was at the Oxford Mathematics Institute, had reserved some books on Matrix theory. I spotted his name on the ticket and when he came to collect his books I pumped him with questions on surround sound. I came away with two pieces of information, which I clearly remember to this day. The first was that the minimum number of speakers required for full surround sound would be six at the corners of an octahedral arrangement. Two at the top front, one at the bottom center, two at the bottom back, and one at the top center. But the bad news, he said, was that for the equations to work they *all* had to be full-range speakers (i.e., including bass). This has remained with me for 40 years.

SHANNON: Are you currently working on or planning any other speaker-related projects?

GEOFF: Coleridge Design has been developing IP on three audio related projects:

A personal surround-sound headphone system (PX3) based on design work we did on motorcycle helmet audio (www.youtube.com/watch?v=ilfSA_FoiaU). The new development seeks to achieve the same Helmet-Blaster unbelievable surround-sound performance in similar form factor and power requirements as conventional headphones.

The magnetless voice coil actuator (M-LVCA), which is a green initiative to eliminate rare earth magnets in loudspeaker motors at reduced cost

without loss in performance and increase in weight. This is based on recent advances in insulated iron soft magnetic composites (SMCs) coupled to audio digital signal processing. It is scalable to all sizes of loudspeaker motor. There are possible spin off applications in electric vehicle technology

The extended range flat-panel bass (flatBASS) loudspeaker with active shallow enclosure technology. My 1975 encounter with Michael Gerzon makes this what I consider the holy grail of loudspeaker technology!

SHANNON: Can you recommend any useful new parts or promising technologies to *audioXpress* readers? Anything you're using now that you think readers should know about?

GEOFF: I would recommend Graham Bank's BMR loudspeaker drivers from Cotswold Sound Systems mounted in naturally damped "thin-walled" acrylic enclosures. Thin-walled clear cast acrylic sheet typically 4-mm thick for 3" to 4" cubes, say 6-mm thick up to 6" to 8" cubes and say 10-mm thick up to 12" to 15" cubes.

There has been rapid improvement in lowering the cost and increasing the performance of the latest filterless class-D amplifiers from Maxim Integrated and Texas Instruments (TI). They are very efficient and worth evaluating in new designs but good quality power supply design is critical. Also the bridge tied load (BTL) output configuration of modern Class-D is pretty much mandatory but care must be taken to switch both ends when using speaker switch boxes.

Another new technology worth considering in modern audio designs is the use of supercapacitors from, say, Maxwell and PowerStor, particularly for battery designs, which are now really viable with the new super-efficient filterless Class-D amplifiers. Audiophiles love the concept of a battery-powered audio amplifier! Quiescent current of these amplifiers is the key efficiency metric. Supercapacitors have drawn much attention in recent years due to their high power density,

reversibility, and long cycle life. They are found in a wide range of applications from smart phones to electric vehicles and the rapid price reduction in recent years has made them affordable in applications like this.

These low-cost supercapacitor devices are typically 2.5 to 3 V maximum so one needs to incorporate active balancing when these devices are used in series. For example, AA batteries would be configured in series for relatively high peak powers into 4-Ω loads from typically 15 or 12 V (primary or rechargeable respectively). However, particularly when partially discharged, these battery stacks are very poor at delivering the intermittent heavy-power transients required for high quality audio. A series bank of active balanced supercapacitors can supplement the battery pack and completely counteract this.

SHANNON: Do you have any advice for *audioXpress* readers who want to build their own sound systems?

GEOFF: In the words of Nike, "Just do it." I don't mean to be flippant, but I firmly believe that you really learn when you make stuff. I include circuit simulations in "making stuff." I tend use TI's TINA-TI and other free tools for analog simulation. I don't breadboard until I have it working in simulation. But, in the end, it has to be prototyped and tested. In analog audio electronics, this is getting really hard as we move to smaller fine-pitch ICs. My advice is to make use of manufacturer's reference board designs and take a stab at laying out your designs using the many free tools available from PCB fabricators. I tend to use old fashioned axial and radial devices for breadboarding small sections, but more often than not, the working simulations allows one to go straight to SMD PCBs, typically 0603 passive devices for prototypes and preproduction only moving to 0402 if board space is an issue. Another golden rule I have for analog audio is to always use full differential designs, particularly when interfacing to digital ICs with analog outputs. *aX*

CES 2013

Mostly Ho Hum, with a Few Sparkles

A fresh take on CES 2013

In January, I found myself at another CES—so many toys, so little time: HDTVs (smart, or maybe not so smart), home devices and appliances, acres of “i” and Android (sorry, Android, you don’t have as catchy a letter) peripherals and accessories, press conferences, taxi lines, crowds, and not-quite-painful noise levels—hectic!

The \$200 billion US consumer electronics industry was represented by more than 3,200 exhibitors spread out over almost 2 million square feet at CES (www.CESweb.org) in Las Vegas, NV. The Consumer Electronics Association (CEA, www.CE.org), the trade organization that produces CES and serves as a legislative advocate and lobbyist for the US consumer electronics industry, has informed the press that the show is no longer to be identified as the “Consumer Electronics Show.” It is now known as the “International CES” or “CES.”

PERCEPTION—THIS SHOW VS. LAST YEAR’S SHOW

The CEA claimed approximately 150,000 attendees (more than 35,000 of whom were from the more than 170 countries outside the US), similar to last year’s numbers. They also declared that 20,000 new products were launched, most of which appeared to be tablet computers, smartphones, related accessories, and apps.

The Eureka Park section of the show floor, presented in partnership with the National Science Foundation (www.NSF.gov) and Startup America (www.SBA.gov/startupamerica), showcased approximately 140 entrepreneurs and innovative startup companies trying to break into the consumer electronics marketplace.

There was a substantially increased Chinese-brand presence, as Chinese manufacturers attempt to become major players in consumer electronics, trying to replace the Japanese and Korean companies, many of which have been

using Chinese manufacturing.

There was an increase in the presence of LED light bulb companies and the variety of bulb styles. Among the eight automakers exhibiting, Audi and Lexus showed, but did not demonstrate, self-driving vehicle technologies. There were also more products related to health and fitness.

The most exciting technology I saw was 3-D printing, as two companies—**MakerBot** (www.MakerBot.com), which offers the Replicator 2x 3D Printer, and **Sculpteo** (www.Sculpteo.com), which provides a 3-D-printing service—showed statues and 3-D-printed items with interlocking moving parts. This technology has been used by the government for years, and used in recent times by major companies. It is helping small manufacturers quickly make less-costly prototypes of complicated assemblies and parts with complex shapes. Once it generates a 3-D CAD drawing, and select the right “printing material,” the 3-D printer can produce it in hours, shaving days or even weeks off the prototyping process. This greatly reduces product design and testing time, and gets the final product to market more rapidly.

For those who found time, the 2013 CES conference program featured 300 sessions, including several keynotes.

Press conferences included many more celebrity tie-ins than I recall from past years, and emphasized services and apps for Internet-connected HDTVs. Integration and “simplicity of operation” were the primary themes, but how well they are realized remains to be demonstrated.

Wireless connectivity is integrated into more consumer devices, with user interfaces that appeared to exhibit improved ergonomics.

Some surveys have shown that consumers aren’t interested in using their TVs as PCs, other than to access audio/video programming. User interfaces for accessing content, including voice and

gesture control, looked more polished than they did last year, although they are not as easy to use as an FM radio. HDTV connectivity functions are making it easier for consumers to cancel cable TV and DBS contracts, maintaining only high-bandwidth (high-speed) Internet connections, even though the image and sound quality will not be as high and nowhere near what DVDs and Blu-ray discs deliver.

Despite rumors of plasma’s rapid disappearance from the consumer HDTV market, several manufacturers introduced new models. As for 3-D technology, it was no longer “central” to the display category. Large OLED HDTVs and UHD TVs (formerly known as 4K) occupied the “left and right channels” of image presentation, although neither appears readily available in quantity.

UHD TV

Ultra HD and UHD are the newly chosen terms for consumer 4K displays, which have a 3840 × 2160 pixel count (twice the horizontal and vertical pixel counts of HDTV, but lower than the 4096 × 2160 digital-cinema maximum). UHD-standardized characteristics also include 10-bit color and a 60-Hz progressively scanned video-frame refresh rate—compared with over-the-air (Ota) US DTV broadcasting, DVDs, and Blu-ray discs, which use 8-bit color plus 30-Hz interlace-scanned and 24- or 60-Hz progressively scanned video refresh rates.

UHD content file size is so large that streaming is essentially impossible without huge image-quality loss, and even with high-speed Internet connections, the download time will be longer than many (generally impatient) consumers will accept. Blu-ray has the potential to deliver 4K video content, but a standard is needed. High-efficiency video coding (HEVC, www.HEVC.info) is considered a successor to H.264/MPEG-4AVC and it

is under development by the Joint Collaborative Team on Video Coding (JCT-VC, www.itu.int/en/ITU-T/studygroups/com16/video/Pages/jctvc.aspx, including MPEG and VCEG experts). HEVC has the potential to improve compression video quality at bitrates as low as half those needed for H.264/MPEG-4AVC, which itself provides video quality similar to MPEG-2-compressed video (used for Ota US digital TV broadcasting) at a 30% to 35% lower bitrate.

UHDTVs and UHD sources will need two DVI or one DisplayPort connections because HDMI can't deliver the bitrate necessary without considerable lossy data compression. To achieve substantial visual benefit from Ultra HD, a screen substantially larger than 60" is needed, given the distance from which most people view their HDTVs.

There are still questions regarding source material availability, up-conversion quality, and true video bandwidth (modulation transfer function, which is a real measure of image detail capability). Pixel count doesn't mean much if these and other characteristics aren't up to snuff.

Several manufacturers exhibited UHDTVs. While some companies showed a UHDTV next to an HDTV, with HDTV content up-converted for the UHDTV, no one showed the complement: 4K content on the UHDTV, down-converted for the adjacent HDTV. Naturally, content was selected to be visually impressive and of a nature to make it difficult to evaluate display performance. Up-conversions varied widely in quality.

EXHIBITS (MOSTLY VIDEO)

JVC Pro (<http://USJVC.com>) exhibited its PS840UD and RS-840UD 84" UHD monitors (each less than \$20,000 srp) featuring 3840 × 2160 pixels, 10-bit color, and a 120-Hz image refresh rate.

LG Electronics (www.LG.com) unveiled UHDTVs of 84" (\$20,000 srp), 65", and 55"; the images were "pretty" but not accurate renditions of the source content. The video on its UHDTV looked cartoonish. Its new smart-TV BP730 Blu-ray player includes direct-from-Internet streaming apps (including Hulu Plus, Pandora, Netflix, and YouTube) plus 4K up-scaling and 2-D-to-3-D conversion. LG's 55" OLED HDTV (planned for release later in 2013) is based on four-subpixel OLEDs

per pixel: All four are white OLEDs, three with R, G, or B optical filters. It uses passive technology to display 3-D in half-resolution. New plasma HDTVs were also introduced.

Panasonic (www.Panasonic.com) is still a source for plasma HDTVs. The company wants you to have "Your TV ... Your Way," focusing on personalization and ease of access to content. Some of its models support "My Home Screen," where each person can set up his own TV homepage (as if any more proof was needed that TVs are driven by embedded computers). "Swipe and Share 2.0" enables swipe transfer of video (including YouTube) and images from mobile devices to the HDTV. There are 32 new Smart-Viera models (16 plasmas and 16 LED-lit LCDs). Panasonic Vieras include Home Shopping Network (HSN) onscreen-shopping via the TV's remote. Panasonic was another company with an UHDTV: a prototype 56" OLED manufactured using printing technology. Press conference focus veered away from traditional TV use toward increased PC-Web functionality—Internet-sourced video and local image/file sharing. Also highlighted was a 20" 3840 × 2560 Windows 8 tablet. Ecological commitment was casually touched on. And, mention of its Blu-ray players seemed an afterthought.

Samsung (www.Samsung.com), another maker of new plasma HDTV models, wants us to "discover the world of possibilities" with "more choices and better access." This company wants you to own "appliances that get [as in understand] you and your home," ... "connecting people and their devices." Samsung's new HDTVs include a "Smart Hub feature with five-screen interface," claiming that voice control and smart-search simplify access to user content plus broadcasts, video on demand (VOD), apps, and the Internet. A Samsung Evolution Kit attaches to the back of older Samsung smart TVs, adding the latest features. Samsung's 56" OLED UHDTV (each of the three subpixels generates red, green, or blue light, so the subpixels don't need optical color filters) with MultiView can simultaneously show two independent HD programs—select the video and audio with a switch on the 3-D glasses with earbuds (e.g., you play video games while your parents watch that old movie). For 3-D viewing, the active-shutter glasses

deliver full-resolution images to each eye through switching, alternating left- then right-eye video frames.

Sharp Electronics's (www.SharpUSA.com) ICC Purios is a UHD panel with special processing that claims to generate a more lifelike 3-D-ish 2-D image and has "earned" THX certification. I saw more jaggies in the upconverted 4K image, and slight color-shift in parts of some image frames. Sharp also announced Aquos UHDTVs, showing 4K and 8K prototypes.

Sony's (<http://Store.Sony.com>) UHDTV—LCD with LED edge lighting—appeared to have a good black level (showing clips from the latest *Spiderman* movie). Sony's 56" OLED UHDTV image looked pretty, but it was difficult to judge black levels because of the content shown.

Toshiba's (www.Toshiba.com) prototype LED-edge-lit UHDTV was demonstrated beside an HDTV, upconverting HD content and showing unacceptable amounts of mosquito noise around object edges within the upconverted image. From far enough away, the upconverted content on the UHDTV looked somewhat sharper than the same HD content on the HDTV, although there is no way to know if the setup was correct or if edge enhancement was added to the UHDTV image.

Other companies touting their UHDTVs were **Changhong** (www.ChangHongMe.com/), **Haier** (www.HaierAmerica.com/), **Hisense** (<http://Hisense-USA.com/>), **Konka** (www.Konka.co.nz), **Skyworth** (84" 4K × 2K: www.Skyworth.com.hk/usa/), **TCL** (www.TCL.com/en.php), **Viewsonic** (www.Viewsonic.com), **Vizio** (www.Vizio.com), and **Westinghouse Digital** (www.WestinghouseDigital.com)—most have models around 50" to 65", with some approximately 84" and up to 110" diagonal.

Red (www.Red.com), best known for its somewhat-reasonably priced professional 4K digital-cinema cameras, announced plans for the Redray 4K cinema player (\$1,450 srp)—a server that is able to play 4K files and can upscale HD content to a 4K DCI 4096 × 2160 resolution (note the digital cinema pixel count). Redray video is YCbCr 12-bit 4:2:2-sampled or RGB 8-bit 4:4:4-sampled (manually chosen), using ITU-R BT.709 colorimetry (same as HDTV). Files stored on the internal 1-TB HDD are encoded using the Red-proprietary lossy codec at a server-internal bitrate of approximately 20 Mbps

and a *.RED file format—a 2 h movie occupies approximately 18 GB on the internal HDD. According to my calculations, the Redray UHD video format generates approximately 5.1 Gbps; thus the server-internal codec bitrate represents approximately 255:1 data compression. Red claims that the delivered image appears lossless. Delivery of a single 4K DCI or UHD 2-D 24-fps video to a UHD display is via a single HDMI 1.4 output (less than or equal to 10.2 Gbps). The Redray can simultaneously feed two different 4K DCI or UHD 2-D 24-fps videos to two different UHD displays. If the UHD-video frame rate is greater than 24 fps, or if UHD 3-D video is chosen, up to four HDMI 1.4 outputs will be required to get the video to a single display. Alternatively, the HDMI 1.4 outputs can be used to simultaneously send up to four different 1080-p videos to up to four HD displays (e.g., to a video wall). The Redray also has two HDMI 1.3 outputs (also less than or equal to 10.2 Gbps): one is for “1080-p-preview” video plus audio, the other can be used for less than or equal to 7.1-channel 24-bit/48-kbps audio. Content can be input to the Redray via Internet download, USB-2 flash media, or an SD card. Red has partnered with Odemax (www.Odemax.com) for network distribution of UHD content to the Redray. The Redray can be used in commercial 4K theaters, but Odemax must handle all billing, with Odemax and Red taking a cut. Another option is to use Red’s Redcine X Pro software with a Redray encode plugin to encode your own 4K content.

PRIMA Cinema (www.PrimaCinema.com) will soon arrive for the wealthy, committed movie devotee with a high-end dedicated home theater. The PRIMA Cinema service makes each rented movie (\$500 per viewing) available to the home only while it is showing in theaters, focusing on opening-weekend 2-D and 3-D theatrical releases. Once playback has begun, the viewer has 24 h to finish a viewing. Currently there are no DVR-type functions (such as rewind, slow motion, etc). “PRIMA Cinema is intended for private residential, non-commercial use only and must be installed by a PRIMA Cinema authorized dealer into an authorized professionally installed home theater.” Pre-approval is required, and it is less likely to approve home theaters with more than 25 seats,

considering them possibly to be for commercial use.

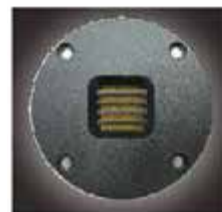
PRIMA Cinema’s H.264-compressed file, delivered as an Internet download, is a modified version of the digital cinema package (DCP) that is delivered to the movie theater for digital cinema presentation. Although the degree of file compression was not revealed, company representatives said that in verification tests, movie studios have approved the security and the video’s image/sound quality and audio PRIMA Cinema delivers. Each movie file is automatically delivered (typical download time is estimated at 4 h) in time to be viewed on movie-theater opening day, but it is coded to prevent prior viewing. The list of titles is limited because agreements have not yet been established with all studios.

The PRIMA Cinema player (\$35,000), which requires a preset static IP address (so it can’t be used elsewhere), delivers 1080p24 HD-video (YUV 4:2:2 video sampling, 10-bit color, ITU-R BT.709 color space, original cinematic-master aspect ratio) with 5.1-/7.1-channel soundtracks in Dolby TrueHD or LPCM. [YUV 4:2:2 samples color twice as often as the YUV 4:2:0 used for OtA, Blu-ray and DVD, delivering twice as much color detail. 10-bit color delivers smoother gray-scale and hue/tint shading changes than the 8-bit color delivered via OtA, Blu-ray and DVD.] The company will consider supporting 4K video and a larger color space once the product and service have been established in the marketplace. The player’s only video and audio outputs are through HDMI connections, preventing simple use of the HD-SDI video input on professional digital cinema projectors. Naturally, the player requires a high-speed Internet connection (greater than 10-Mbps Internet connection to the home is recommended). As yet, no video test patterns or audio calibration signals are stored in the player, but they are under development and expected to be included at the formal product rollout during the second-quarter of 2013.

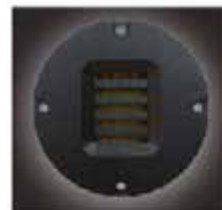
The player, which can store up to 50 movies on its internal 2TB RAID-5 encrypted “movie vault,” is protected from hacking and copying/stealing movie files by several methods including a finger-swipe biometric reader (which includes a “liveness” detector to prevent using an excised finger for



Airborne is proud to introduce a new line of Air Motion Transducers and Ribbon Tweeter. Including the smallest AMT in the world and an open back type Planar Ribbon. AMT are known for their fast transient speed and very good dispersion. The models we propose are closed back type for ease of usage. The Planar Ribbon is very small and is an open back type, which is very good for line arrays and open baffle applications.



RT-20021 3KHz to 40KHz, 88db.



RT-4001 2KHz to 27KHz, 89db.



RT-5002 3KHz to 30KHz, 95db.



RT-4101 4KHz to 40KHz, 86db.



SOLEN Électronique Inc.
4470 Av. Thibault
St-Hubert, QC J3Y 7T9
Canada
Tel.: 450-655-2766
Fax: 450-443-4948
Email: solen@odemax.ca
http://www.solen.ca

access) that can be located at the prime-viewing seat.

TiVo's (www.TiVo.com) DVRs have all the features I would want, but would require too many years to amortize their cost plus lifetime-service fee for me to replace my rented Verizon FiOS set-top box, especially since Verizon charges several dollars per month for the multistream CableCard needed for third-party STBs.

CABLES AND CONNECTIVITY

Accell (www.AccellCables.com), which has been known for high-quality HDMI and other cables (I use several in my home theater system, including a 50' HDMI cable from my DVDO iScan Duo to my Samsung SP-A900B projector, and a 10-m Toslink cable from my Verizon HD STB audio output to my Lexicon MC12), has expanded into the powerline surge-conditioner transient-suppressor market with multi-outlet extension cords (Power Squid, with an internal powerline transient suppressor and noise filter) and a \$20 wall-outlet plug-in module (Accell PowerStation, with three transient suppressed power outlets and two USB

high-speed charging ports) that is useful at home and when traveling.

Monster's theme was "Always Lead. Never Follow" [no matter where they are trying to take us]. Monster is marketing a fusion of fashion, technology, and entertainment/sports. The press conference stressed fashion and appearance of its many headphone models—clearly marketing to the young, leaving sound quality to be assumed. The sound at Monster's press conference (at my seat: several rows in front of the soundboard that was located at the back of the room) was bass-heavy and marginally intelligible. Monster also announced three active HDMI cables for long cable runs.

WiSA (Wireless Speaker & Audio) Association (www.WiSAAssociation.org) is an industry group encouraging adoption of WiSA technology to feed audio over a digital wireless link to a home entertainment system's loudspeakers (obviously requiring an amplifier at, or in, each speaker, and a nearby power outlet). WiSA-compliant components are tested to ensure clean communications within a 30' × 30' area. WiSA developed a compliance test specification to determine interoperability of various manufacturers' products. WiSA technology (which includes forward error correction, error concealment, and a playout buffer) operates in the 5.2-to-5.8-GHz U-NII radio frequency spectrum, transmitting fewer or equal to 7.1-channels of uncompressed less than or equal to 24-bit/96-kbps audio, plus system configuration and calibration data, with fixed 5-ms latency. Inter-speaker audio-delivery time differentials are less than 160 ns.

The **Wireless Gigabit Alliance** (WiGig, www.WirelessGigabitAlliance.org) is an industry consortium generating specifications for a relatively secure, high-bandwidth wireless protocol that can serve as an in-home local area network (LAN). It claims that the technology, which uses the unlicensed 60-GHz band, supports data transfer rates up to 7 Gbps over a maximum range of several hundred feet (depending on intervening structures). This technology competes with Wi-Fi and WirelessHD to become the preferred way to wirelessly distribute high-definition video and other high-bitrate data around the house. WiGig technology is compatible with the IEEE 802.11ad standard. A July 2010 WiGig white paper

is available for download from the website. Based on the website and the white paper, there appears to be nothing in the specification precluding lossy or lossless data rate reduction being applied to the wireless data transfer, although the specification defines permitted codecs and profiles.

MOSTLY AUDIO

dbx-tv (www.dbx-tv.com), designed for inclusion in an HDTV, is a technology to produce the best sound quality from an HDTV's existing processing, amps, and speakers, while incorporating volume leveling, dynamic EQ, clipping prevention, and other algorithms that have been improved over last year's impressive demonstration. In practice, a manufacturer uses **That Corp's** (www.ThatCorp.com) Total Cal system to determine the optimum settings for more than 100 parameters for the amps and speakers in a given HDTV model, then encodes those values into that model's firmware. Thereafter, all of that model are optimized. While it can't make a silk purse out of a sow's ear, it goes a long way toward getting the most out of an HDTV's audio section. This technology will appear in certain models later this year.

DTS (www.DTS.com) has developed DTS Sound and DTS Studio Sound—based on SRS technology—that manipulate TV sound. Listening to its demo, activating the system kicked in EQ that made the sound seem louder, and louder again when turning on the surround virtualization, which slightly increased a sense of stage depth but there was no sense of sound behind me. In a separate demonstration, the DTS theater held an 11.1-channel sound system (left/center/right front, left/right front-height, left/right side, left/right rear, left/right rear-height, and a single channel feeding three subwoofers). First, the speaker-array was played, then we listened to DTS Headphone:X, a virtualized version of the 11.1-channels over Sennheiser headphones (less than \$100 srp). The virtualized height effect did not work well, as I heard only a very slight height effect compared with the speakers (perhaps it worked better for others; standardized pinnae filters vary in their effectiveness for each individual). In addition, the virtualized headphone soundfield was constrained

*Ready, willing
and
AVEL*



*offering an extensive
range of ready-to-go
toroidal transformers
to please the ear, but won't
take you for a ride.*

 **Avel Lindberg Inc.**
47 South End Plaza
New Milford, CT 06776
tel: 860-355-4711
fax: 860-354-8597
sales@avellindberg.com
www.avellindberg.com

to inside my head. DTS claims its technology, which is to be OEM-sourced to equipment manufacturers, works with any headphones. From the brochure: "The DTS Headphone:X experience first requires surround content to be encoded as a DTS-HD bitstream with the room information embedded in the stream. Next, the DTS Headphone:X solution embedded on a PC, tablet, or phone calibrates to the headphones in use. Finally, the reference data is decoded and post-processing enhancement techniques are employed to deliver a truly amazing, home-theater quality surround sound experience over headphones."

Sonic Emotion (www.SonicEmotion.com) is basically a technology for generating a more spacious front soundfield using wave synthesis—claiming to deliver a relatively constant perceived frontal soundfield over a larger listening area (i.e., creating a larger sweet spot).

GoldenEar (www.GoldenEar.com) has two new products. The SC3DA Super-Cinema 3D Array soundbar (\$1,000 srp), which was demonstrated with a single ForceField 5 subwoofer (\$1,000 srp), sounded musical and clear. GoldenEar founder and chief designer Sandy Gross designs these speakers to be flat on-axis and to be positioned toed in (putting the listener closer to being on-axis). The Triton 7 (\$1,400 per pair) sounded especially good on a music excerpt comprising a male chorus, bass drum, and orchestra, even delivering a sense of the chorus being behind the orchestra. Also through the Triton 7s, "The Great Gate at Kiev" from Modest Mussorgsky's *Pictures at an Exhibition* was eminently listenable with no sense of system strain. The male voice singing Frank Loesser's "Once in Love with Amy," accompanied by string bass, sounded quite natural with no exaggeration in the lower vocal register. I continue to find that all of GoldenEar's speakers sound natural and mellifluous—speakers that can be listened to for lengthy periods without fatigue.

For the non-audiophile who wants to play LPs without a turntable, **Stokyo World** (www.StokyoWorld.com) has the Soundwagon (approximately \$100), an officially licensed 1970s-style Volkswagen bus that fits in the palm of your hand. In it are a battery-powered cartridge, a phono preamp, an amp, and a speaker.

It drives itself around the LP, tracking the groove and playing the music. You just need an LP and a flat surface.

NoiseHush's (www.NoiseHush.com) i7 Active Noise Canceling headphones (\$100 srp; available soon) claim to offer the performance of the Bose noise-canceling headphones at a lower price.

MISCELLANEOUS

Finally, a device I have sought for two decades: Thirty-year-old Taiwan company Genius ("Live With Ideas," <http://Genius-Net.com>). The website is rudimentary and a little difficult to navigate; however, I was able to get more information by calling the company's tech support) has the Ring Mouse 2 (\$30 srp), a ring that fits on an index finger with a trackball and two buttons, replacing the mouse. Battery-powered, it connects wirelessly to a very short USB receiver. It enables me to perform all mouse functions without removing my hand from the keyboard as I type. The Ring Air is a similar model, but for reasons not given, it is unable to be sold in the US.

Netgear (www.Netgear.com) is on a mission to simplify and ease everyone's connection to high-speed broadband Internet. The company is a strong proponent of the smart-home, IP-connecting everything that is AC-powered, with all smart-home technology user-installable. The theme was "mobility and cloud integration." Netgear's VueZone wireless video system enables cloud-storage plus Internet monitoring of wireless IP-connected cameras, using any iOS/Android device or web browser [of course, with no mention of security issues or video encryption]. Netgear's Genie ("home networking simplified") is an app for your PC/Mac and Android/iOS device that enables "monitoring, management, and repair" of the home network. [How to wirelessly repair a network you can't connect to is not explained.] Genie's EZ Mobile Connect says it makes smartphone/tablet home-network connections secure. Netgear claims that its NeoTV streaming player is "Google TV done right" and is "seamless and simple."

High-resolution "power" tablets appear to supplant the need for ultrabooks and other small laptops. Panasonic has a 20" 4K tablet. Vizio announced a 12" tablet. Some tablets have

resolutions up to 1920 × 1080 and pixel densities up to approximately 250 pixels/inch (compared with high-resolution full-size computer monitors at 75-100 pixels/inch and HDTVs—42" 1920 × 1080 HDTV at 52 pixels/inch). Users sit closer to the optimum viewing distance from a tablet (9"-tablet optimum is 14") than from their HDTV (42"-HDTV optimum is 5'), thus they can see more detail in the tablet image and it will appear sharper than the 42" HDTV. Video bandwidth questions still arise for movie viewing on tablets, as Internet sources and wireless streaming use lossy data compression that makes concern about image detail moot. This is not an issue for webpage or text viewing.

Crimson Mounts's (www.CrimsonAV.com) pocket-eAzt (\$40 srp) folding iPad/tablet/e-reader alloy stand is stable, slip-free, light-weight, and folds up to a compact rectangle of less than 4" × less than 2" × 1".

Hangman (www.HangmanProducts.com) has expanded its catalog of cleverly designed, inexpensive, simple wall mounts for HDTVs, pictures, mirrors, and speakers. Several of the wall mounts are rated for up to 100 to 200 lbs, depending on the model. Hangman also has two anti-tip kits (\$10 srp and \$30 srp) to prevent table-stand HDTVs and other tall thin items from being pulled over. Hangman offers an wide assortment of hanging solutions for everything but cattle rustlers.

OmniMount (www.OmniMount.com) unveiled a new series of wall mounts using "gravity tilt" technology, which is claimed to offer smoother display positioning and freedom from manual tension adjustment.

Striker Hand Tools (www.Striker1.com) creates an assortment of clever and unusual consumer products, such as the Simple Sucker (\$7 srp): a double-ended 2" × 1.5"-diameter suction cup mount with a flexible stem, for small devices (e.g., smartphones). The website offers a wide assortment of gadgets and tools.

Lockitron (<http://Lockitron.com>), whose technology enables keyless home entry via a smartphone, must have been joking when it distributed the press kit on a 3.5" floppy disk, with the URL on the disk's label. The Lockitron mechanism, in a small battery-powered Wi-Fi package, will fit over the deadbolt lever on the

inside of many doors, making it useful to renters as well as owners.

MPowerD (Micro Power Design; www.MPowerD.com) announced Luci (\$25 srp), a solar- and incandescent-rechargeable 10-white-LED 4.5-oz waterproof inflatable light, 4"-high by 5"-diameter that collapses to a 1"-thick disc for compact storage and transport.

Valencell's (www.ValenCell.com) licensable PerformTek sensor technology is an earbud-based real-time fitness monitoring system collecting biometric and physiologic data including heart rate, speed, distance, calories burned, and more, depending on the implementation, which can include armbands and wrist devices. The release date of products using this technology is expected to be sometime during 2013.

Voxx (www.VoxxIntl.com) owns many readily recognized brand names, claiming each offers more [but not necessarily more advanced] products that deliver convenience features: powered sound docks, wireless accessories (many battery-powered), RCA plug-in USB charger with a LED nightlight, Jensen clock radio

with a nightlight, chargers, Tagg (the pet tracker), and so forth.

MORE TO SEE THAN CES

Due to the presence and size of CES, other organizations hold events in Las Vegas around the same time: ALMA International's Winter Symposium, Storage Visions, T.H.E. Show, plus two press-only events: Showstoppers and Digital Experience. In addition, some manufacturers choose to exhibit in Las Vegas during, but independent of, CES.

Association of Loudspeaker Manufacturing & Acoustics (ALMA) International (www.ALMAInternational.org) is a trade association "dedicated to improving the design and manufacture of loudspeakers." Its 2013 Winter Symposium was a relatively small event of less than 20 exhibitors (including Earthworks, Ferrotec, and *Voice Coil*) plus training seminars, technical paper presentations, tutorials, and panel discussions covering various aspects of headphone, loudspeaker, full-size- and miniature-driver design, modeling, manufacturing, and measurement in today's multi-national cooperative environment. Among them were:

- **Atlantic Technology's** CTO Boaz Shalev delivered the tutorial "A Modern Approach to Bass Response Extension in Conventionally Sized Loudspeakers" that explained the principles behind the H-PAS technology in some of the company's models.
- **CJS Labs's** CEO and Chief Scientist Chris Struck held the workshop "An Introduction to Headphone and Headset Acoustics." Harman's Director of Acoustic Research Sean Olive delivered his paper "The Relationship Between the Perceived Sound Quality of Headphones and Their Acoustical Performance."
- The keynote presentation was "**The Life & Times of Paul Klipsch,**" presented by 34-year Klipsch employee Jim Hunter, Klipsch program manager and historian. His address focused on newly discovered (re-discovered?) engineering aspects of Klipsch's life and work.

The following comments are excerpts from and based on Hunter's material:

Klipsch's files are "mammoth" and his "correspondence with end users (that we still have) would stack up to over 20."

As a youth, Paul Wilbur Klipsch was interested in astronomy, earned his Ham radio license, built his first radio receiver, and joined the Boy Scouts, playing the cornet in a Boy Scout band (and later in his college band).

He used his scientific and engineering background, a facility with electromechanical devices, and math skills that were greater than he would admit, in service of his love of music, leading him to develop the Klipschorn and its siblings. Klipsch believed that high efficiency and low distortion, which he felt could be achieved only with a fully horn-loaded speaker system design, was critical to delivering a "sense of realism" from the playback of music recordings.

Toward the end of World War II, Major Klipsch received support from Sherman Fairchild (owner of the Fairchild Engine and Airplane Corp., which became Fairchild Semiconductor), who provided the needed plywood to build an early version of what would become the K-5 high-frequency horn, to be used with the K-3 corner woofer, comprising the Klipschorn (Klipsch recommended a 500-Hz crossover frequency).

As a part of Klipsch's research, he found a number of technical errors in RCA's Harry F. Olson's book *Elements of Acoustical Engineering* and communicated these to Olson, who, in responding pointed to a March 1936 "Technical Bulletin of the Research Council of the Academy of Motion Picture Arts and Sciences" authored by J. K. Hilliard, which was reprinted in the July 1936 (v27p45) *Journal of the Society of Motion Picture Engineers* (later SMPTE).

In July 1947, Edwin Armstrong, inventor of circuits that led to FM radio, wrote to Klipsch that the Klipschorn, which he had used in a recent demonstration, was "the best thing that I have seen yet. ... It is in a class by itself." Armstrong became an owner and strong proponent of the Klipschorn.

In 1953, Klipsch traded a Klipschorn to Arthur Fiedler for permission to use Fiedler's name in Klipschorn advertising. Klipsch and Fiedler maintained a



audience

Auricap XO
high resolution performance
made by audience USA

**NEW IMPROVED
HIGH RESOLUTION CAPACITOR**

- reduced parasitic losses
- extended effective bandwidth
- improved retrieval of low level information

"I wasn't sure how you can improve upon something that is so good already - the original Auricap. Was I in for a nice surprise! WOW!"

Alex Peychev, APL HiFi

info@audience-av.com 760-471-0202
audience-av.com

long-term relationship as friendly associates, as evidenced by Fiedler's letter to Klipsch in July 1960 that "it sounds terrific," sending his "kindest regards to you and Mrs. Klipschorn."

In 1956, Klipsch hired John Eargle, who was being released from the Army, to create demonstration material and form the Klipsch prerecorded tape division [Some of the resulting recordings recently have been made available again. See "High Definition Tape Transfers" in the Open Forum of this issue. DJW].

Two Klipschorns and a Heresy, reproducing Klipsch's three-channel playback from two-channel recordings, represented the US hi-fi loudspeaker industry in demonstrations at the 1958 Brussels World Fair. The next year, Klipschorns were part of the American National Exhibition in Moscow.

In the July 6, 1971, "Dope From Hope" newsletter is Klipsch and Eargle's suggested Pentaphonic speaker array (three across the front, plus left and right rear speakers playing an attenuated left-right and right-left difference signal, respectively).

Klipsch's sense of humor is clear in a 1980 letter to Dick Heyser stating that "Your patents on TDS [Time-Delay Spectrometry] are invalid, having been anticipated by bats untold centuries ago. Enclosed copy from *Physics Today* tells it like it was."

On May 28, 1953, Klipsch said, "To try to judge the real from the false will always be hard. In this fast-growing art of 'high fidelity' the quackery will bear a solid gilt edge that will fool many people." [Klipsch's pin (currently available from Jensen Transformers) represents a philosophy as important today as it was to Klipsch throughout his life and work. DJW]

Storage Visions 2013 (www.StorageVisions.com) was themed "Petabytes are the new Terabytes," subthemed "All the storage where you need it." One panel discussion addressed a continuing problem: "Safe at Last: Protecting, Storing and Recovering Personal and Commercial Content." Another brought discussion about the file sizes and multi-petabyte storage requirements for 4K, 8K, and 3-D cinema projects. Other sessions examined what venture capitalists and industry analysts think will become the balance between cloud and local storage

for multimedia content; new storage devices, interfaces, and system architectures for individuals and corporate enterprises; storage devices (e.g., SSDs, HDDs, etc) for smartphones, tablets, and ultrabooks; plus content archiving problems and possible solutions. Even the keynote centered on video content: Yoshiaki Shishikui (Head, Advanced Television Systems Research Division, Science and Technology Research Labs, NHK) spoke on "Big Data Indeed: SUPER H-VISION at the 2012 Summer Olympics and Beyond," about NHK's Ultra-HDTV 8K x 4K (33 megapixel, actually 7680 x 4320) system with "22.2-multichannel 3-D sound." He talked about the image size and shape needed for a sense of "realness" and being there, the required raw-video data rates of up to 144 Gbps, the Olympics production system, local and international transmission paths, post-production workflow, and NHK's roadmap for standardization and equipment development. Storage Visions's exhibits emphasized fusion drives (e.g., combination flash memory and HDD), solid-state drives, and data archiving.

A NEW TRAVEL SERVICE

Prior to CES, I learned of a travel service that began in early 2012: **BagsVIP** (www.MakeTravelEasier.com), for air-line-checked bags. It is available at almost 300 US airports, with more being added. Outgoing, go to the website and enter the data it requires. (It wants you to have your boarding pass prior to booking.) Check your bags at the airport as normal. The next time you see your bags is when a bellman brings them to your hotel room. Returning home, you will have to make two bookings through the same site: At hotels in the cities where BagsVIP is available, bring your bags to the bell captain's desk. They will "check" the bags and give you the appropriate receipts. The next time you see your bags is when they are delivered to your home! The fees are reasonable, and my experience was excellent. There are a few bugs, but my bags arrived at each end as promised, and I only had to carry them from my house to the airport on the way out. If you can't find answers on the website, call—they were helpful. I plan to use this service again next January, when I do it all again. *ax*

The advertisement features a dark background with a glowing green laser beam hitting a black rectangular enclosure. The text "Laser Engrave For Free!" is prominently displayed in a large, metallic, 3D font. Below this, a smaller text block states: "Our laser technology can engrave any photo on the front panel (or any other side) of the enclosure. Your amplifier can have a unique looking now." At the bottom, there is a list of products: "IC Kits - Parts - Enclosure - Amplifier - Chassis - Tube - DACs" and "For Companies - Engineers - Professionals - Students - Amateurs". The website "http://www.siliconray.com" and email "sales@siliconray.com" are also provided. The SiliconRay logo is in the top left corner.

SiliconRay
Online Electronics Store
Simplify your electronics projects

Laser Engrave For Free!

Our laser technology can engrave any photo on the front panel (or any other side) of the enclosure. Your amplifier can have a unique looking now.

IC Kits - Parts - Enclosure - Amplifier - Chassis - Tube - DACs
For Companies - Engineers - Professionals - Students - Amateurs

Website: <http://www.siliconray.com> Email: sales@siliconray.com

AMPLIVOX WIRELESS PA SUPPORTS MANY MEDIA DEVICES

AmpliVox Sound Systems has unveiled its newly updated SW720 Wireless PA system, a versatile PA package that supports all types of external media. The SW720 PA enables audio or video to be played from MP3s, CDs, DVDs, or any iDevice from Apple (e.g., iPhones, iPads, or iPods), complemented by a wireless handheld mic for voice amplification. For audiences of up to 500 people and rooms as large as 2,500 ft², the SW720 is an all-in-one solution for multimedia presentations.

The revamped SW720 Wireless PA system with a remote-controlled DVD player now includes AmpliVox's S1732 cable and adapter, enabling iPads and other Apple devices to be simultaneously played and charged. The unit also contains an integrated DVD/CD/MP3 disc player with a USB/SD card reader and video output that enables DVDs to be viewed with a projector or other video display. For voice amplification, the SW720 features a built-in UHF selectable 16-channel wireless receiver with a 300' range wireless handheld microphone.

The SW720's straightforward controls customize presentations. A voice priority switch mutes music when the mic is in use, and separate bass/treble controls enable easy sound adjustments. Weighing 11.5 lb, the molded plastic enclosure is durable

and portable. A protective cover offers many pockets for accessory storage. The SW720 can run for up to 6 h on its built-in rechargeable battery, or it can be powered with the included AC power cord.

For more information, visit www.ampli.com/ipod-pa-system.

DAYTON AUDIO'S DVC SUBWOOFER

Dayton Audio's Ultimax Series DVC subwoofers are purpose-built to move air and create clean, articulate, and fast bass. To improve power handling, increase thermal management, and reduce power compression, Dayton Audio designed the Ultimax Series with large black anodized formers and vented pole pieces, under-spider ventilation,



Dayton Audio's DVC subwoofers are designed to improve power handling and reduce power compression.

and two-layer copper voice coils.

The Ultimax's "Tall-Boy" rubber surround is intended for extra-long linear excursion without reducing the Nomex honeycomb/woven glass-fiber laminated cone's surface area. Copper shorting rings and a pole piece cap reduce inductance and distortion, while the Ultimax's dual spiders maintain linearity at high drive levels.

Dayton Audio's Ultimax Series dual voice coil subwoofers are engineered and built using the latest in subwoofer technology. They are now available in 10", 12", and 15" sizes. Dayton Audio products can be purchased in the US through Parts Express (www.parts-express.com).

For more information, visit www.daytonaudio.com.

DANLEY IMPROVES SYNERGY HORNS SH SERIES

Danley Sound Labs recently announced improvements to many of its already highly-regarded SH Series full-range loudspeakers. The new versions are identified by the suffix "HO," which stands for "high output." For example, if someone wants to get the most performance out of the Danley SH-96, order the Danley SH-96 HO.



Danley raises the sound pressure level (SPL) on its Synergy Horns SH Series.

The new designs use a more powerful two-way high frequency. As a result, the low- and mid-frequency drivers can be used to their full potential yet maintain Danley's characteristic frequency response, phase response, and fidelity. In conjunction, the HO designs use a new crossover and have additional options for bi-amping and for changing the low-frequency impedance. Because the cabinets themselves haven't changed, the new versions retain the coverage and frequency loss patterns of the originals. The new models include the SH-95 HO, the SH-96 HO, and the SH-64 HO.

Because the new switch panel cannot operate reliably if left exposed to the elements, weatherized versions of the new high-output loudspeakers must be pre-ordered with specified bi-amping and impedance settings.

For more information, visit www.danleysoundlabs.com.

B&K PRECISION LAUNCHES "pwrApp" FOR APPLE PRODUCTS

B&K Precision launched its new "pwrApp" for iPad, iPhone, and iPod touch. Adding greater value to its DC power solutions, B&K Precision's



The updated SW720 Wireless PA system includes several practical accessories.



B&K Precision's new "pwrApp" can be used on an iPad, an iPhone, and an iPod touch.

pwrApp enables full monitoring and control of a network-connected (via WLAN) XLN-GL series of power supplies over local wireless networks.

The pwrApp's primary function is remote operation of all XLN-GL power supplies' functions. The pwrApp's features include live visual monitoring and interactive power supply control, visual data graphing, audible trigger alarms within the app, and data export.

Fully functional in-app demos of devices, monitoring, and programs are available with or without a connected XLN power supply. B&K Precision's pwrApp for iPad and iPhone offers full interface control in English, French, German, Portuguese, Spanish, and traditional Chinese via a simple selection menu. Future versions of pwrApp will offer control of additional select WLAN-enabled B&K Precision power supplies. Available for immediate download via iTunes, pwrApp is free of charge to all users.

For pwrApp and XLN information, as well as hardware/software requirements, visit www.bkprecision.com/pwrapp.

NUGEN AUDIO OFFERS STAND-ALONE LM-CORRECT LOUDNESS TOOL

NUGEN Audio, a creator of intuitive tools for audio professionals, has released a new stand-alone version of its LM-Correct loudness analysis and correction tool, which was originally only available as an AudioSuite plug-in. For the first time, LM-Correct is available as a file-based program, taking its speed and simplicity beyond the Avid digital audio workstation (DAW)

environment. LM-Correct provides EBU R128/ATSC A/85 (CALM Act)-compliant loudness correction with unmatched simplicity, providing users with a rapid two-click solution for loudness normalization and conformance.

Part of NUGEN Audio's range of innovative and easy-to-use loudness correction tools, LM-Correct is a faster-than-real-time tool that calculates and corrects for integrated program loudness and short-term maximum loudness. LM-Correct includes an internal true-peak limiter that transparently handles any intersample peaks.

LM-Correct's settings include presets for current loudness standards, short-term loudness, overall integrated program loudness measurement and correction, maximum true-peak level targeting, and "EBU Mode." The software also supports mono through 5.1 audio.

LM-Correct is available immediately for OS X and Windows operating systems. For more information about LM-Correct and other NUGEN Audio products, visit www.nugenaudio.com.



NUGEN Audio now offers a new stand-alone version of its LM-Correct loudness analysis and correction tool.

SAELIG INTRODUCES HANDHELD RF SPECTRUM ANALYZER

Saelig Company has introduced the PSA Series II RF spectrum analyzers. Available in 1.3- and 2.7-GHz versions, these new instruments are smaller, lighter, and have a longer battery life than other more expensive handheld RF products. PSA Series II analyzers incorporate a 4.3" (11 cm) backlit thin-film transistor (TFT) color touchscreen display, with a high-capacity rechargeable Lithium-ion battery to produce more than 8-h operation per charge. The PSA Series II



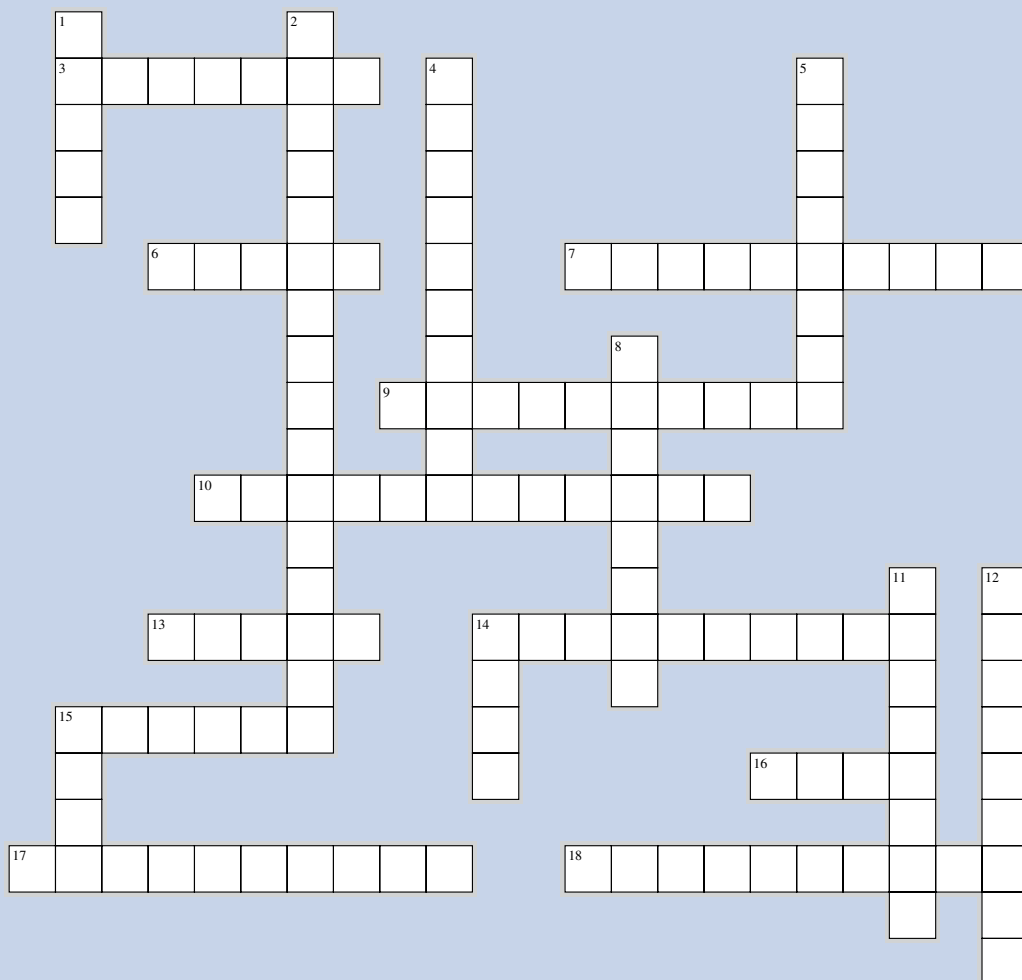
Saelig's PSA Series II RF spectrum analyzers feature long, rechargeable battery life.

PSA1302 has a 1-to-1,300-MHz frequency range, while the PSA Series II PSA2702 operates up to 2,700 MHz. Dynamic range is 80 dB with a noise floor at -100 dBm. Resolution bandwidth is selectable down to 15 kHz.

The PSA Series II's features include sweep modes (e.g., continuous, single, peak hold, and sweep average), AM/FM audio demodulation with built-in speaker, and data logging for traces, data points, or screen images (with storage for 10,000 entries per file triggered from a key press, internal timer, external trigger, or the limits comparator). Traces or complete screen images can be saved to file and compensation tables for antennae or other external transducers can be created and loaded. USB host and device connectors enable the use of USB flash drives or direct connection to a PC.

PSA Series II analyzers are controlled via finger-operated touchscreen soft keys in a hierarchical menu system that provides rapid access to menu functions. All functions can also be operated using just the hard keys.

The ruggedized casing incorporates a rubber protection buffer, a bench stand, and screen protection. For bench-top use, the instrument can be operated from its AC charger. For portable use, its 8-h battery life can be further extended by selecting auto-off, which turns the instrument off (retaining all data) after a selectable delay of 5 to 60 min. from the last key press. The compact, handheld PSA Series II RF Spectrum analyzers weigh 20 oz, making them suitable for any portable RF service kit. For more information, visit www.saelig.com. *aX*



Editor's Note: Answers to this puzzle are posted at audioxpress.com/crossword and will be available in the next issue.

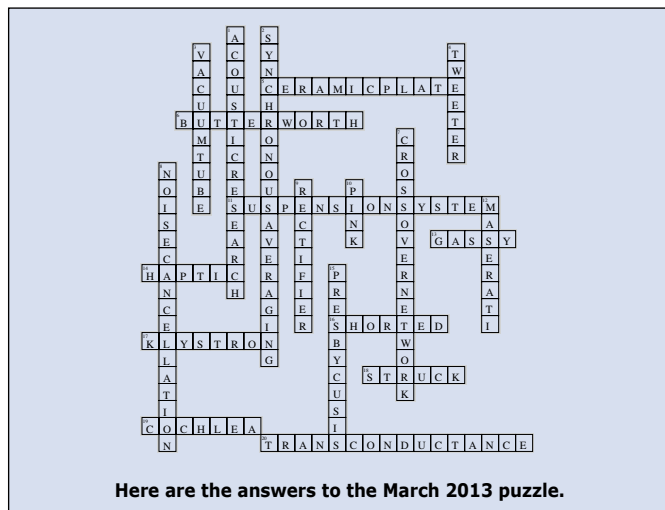
ACROSS

3. Centimeter
6. Unwanted capacitance
7. Single-ended
9. A nonexistent metal that has every physical property needed for a specific application
10. Electron tube or transistor [two words]
13. Specifies one of four values
14. A unit of current equal to 10^{-12} A
15. Mounting plate
16. Radar jamming transmitter that operates in the 92- to 210-MHz band
17. Nickname for Alaskan network of radio stations that link early-warning radar stations [two words]
18. Proof that electric currents in metals are carried by moving electrons [two words]

DOWN

1. A British tube
2. Semiconductor diode [two words]
4. L is its symbol
5. The eardrum

8. Often used to suppress AC-line spikes
11. A remote indicator
12. Includes semitones and whole notes
14. 1,1-difluorethene, polyvinyliden
15. Garbage or gibberish



Here are the answers to the March 2013 puzzle.

Audio Marketplace



dynakit
THE LEGEND LIVES ON!

NEW!
Stainless Steel Chassis
120 VAC or 240 VAC

Kits, Parts
& More!

Visit us at:
www.dynakitparts.com
973-340-1695 • CLIFTON, NJ USA

Sum R Design
www.sumr.com
Encapsulated, shielded toroidal
Transformers



Designed and manufactured in CANADA
tel: 1 416 251 2523 sales@sumr.com

Better Sound Because You Build It

Visit
www.akitika.com
to order your kit



Akitika

AMAZING SCOPES AT AMAZING PRICES!



We have the widest, unique selection of scopes to suit any budget & application: low-end PC oscilloscope adapters for less than \$180 up to high-end 16-bit 12GHz units. Standalone, economical LCD scopes, memory-stick-sized scope adapters and scope-in-a-probe models, 7-in-1 toolbox essentials, up to bargain-priced 4-channel benchtop work horses with FFT and auto-test capabilities. See our website for a great selection of spectrum analyzers, RF signal sources, and waveform gens you won't find anywhere else! www.saelig.com



Saelig



Electronic and Electro-mechanical Devices,
Parts and Supplies. Many unique items.

www.allelectronics.com

Free 96 page catalog
1-800-826-5432



@audioXP_editor

#acoustics#amps#analog#audio#audioXpress
#bass#decibels#digital#disc#drivers#glassaudio
#headphones#hometheater#loudspeakers
#potentiometer#preamps#sound#treble#tubes
#turntable#voicecoil

- **Interact** with the *audioXpress* editorial department
- Keep **updated** on new audio products
- Stay **informed** on audio industry news
- Learn about **upcoming** events, conferences, and more



COVER: SIEGFRIED LINKWITZ
audioXpress
BUILD THE A100 POWER AMP

twitter
Follow us on Twitter



SUBSCRIBE
to audioXpress today!

Tubes
Driver testing
Audio engineering
Vintage audio
and more...

www.audioamateur.com



CONTRIBUTORS

Patrick Brunner ("Construct a Simple LED Bias Meter and Supply Design," p. 12) is an independent design consultant. He started Applied Technical Services in 1982, designing primarily in the medical electronics field. Prior to 1982, he worked at various military, industrial, and medical electronics companies. Patrick resides in Florida. The electronics bug first bit him at age 8 with a crystal radio and a CK722 for an amplifier. The bug was later exacerbated after hearing a Heath kit W9 driving a homemade 15" JBL-baslater ed speaker system. Hi-Fi has remained a hobby since that time.

Vance Dickason ("Scan-Speak High-Frequency Driver," p. 18) has been working as a professional in the loudspeaker industry since 1974. He is the author of *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 the editor of *Voice Coil: The Periodical for the Loudspeaker Industry*, a monthly publication. Although he has been involved with publishing throughout his career, including receiving an AES Citation Award for his ongoing contribution to audio education, he still has a "day job" as an engineering consultant to a number of loudspeaker manufacturers. This currently includes Samsung, The AVC Group (Niles and Sunfire), Artison, and Emotiva.

Dr. Richard Honeycutt ("Get Familiar with Popular Preamp Tubes," p. 22) has been an audio enthusiast, musician, recording engineer, broadcast radio engineer (First Class Commercial licensee since 1969), radio announcer, electronics repairman, tube guitar amplifier designer, speaker system designer, pro-sound/video designer, and college electronics teacher. He is now a consultant in acoustics and electroacoustics. He earned a PhD in Electroacoustics from the Union Institute, and lives in Lexington, NC, with his wife, Betty Jane, near his daughter Alyson, her husband, and two of his three grandchildren.

Mike Klasco ("High-Polymer Film (Part 1): The Lost Speaker Technology," p. 8) is the president of Menlo Scientific, a consulting firm for the loudspeaker industry, located in Richmond, CA. He is the organizer of the Loudspeaker University seminars for speaker engineers. Mike specializes in materials and fabrication techniques to enhance speaker performance.

Dr. Victor Staggs ("Testing the Spin-Clean LP Washer Machine," p. 25) is currently retired and living in Eugene, OR. He holds a BS in Engineering Physics from U.C. Berkeley, an MA in Mathematics from U.C. San Diego, and an MS and PhD in Electrical Engineering from U.C. San Diego, with a thesis on the subject of optical communication. Most of his career was spent in the defense industry in California, doing applied mathematical physics. His current interests are home and Ford Mustang maintenance, jogging (still), loudspeaker system design, and digital signal processing for audio restoration.

Steve Tatarunis ("High-Polymer Film (Part 1): The Lost Speaker Technology," p. 8) has been active in the loudspeaker industry since the late 1970s. His areas of interest include product development and test engineering. He is currently a Support Engineer at Listen, Inc., in Boston, MA, where he provides front-line technical support to the SoundCheck test system's global user base.

David J. Weinberg ("CES 2013: Mostly Ho Hum, with a Few Sparkles," p. 33) is an engineering consultant and technology journalist on audio, video and film technology. He provides audio and home theater engineering consultation and professional location digital audio recording services to companies, radio stations and individuals. He has an MSEE, a First Class Radiotelephone license, and five decades of continued study and active involvement in the audio, video and computer industries. He is chair of the Audio Engineering Society's DC section, and a manager in the Society of Motion Picture and Television Engineers' DC section. Weinberg has authored several articles, is a technical editor for *audioXpress* (www.audioXpress.com), and serves as membership officer for the Boston Audio Society (www.BostonAudioSociety.org) and Editor of its journal, *The BAS Speaker*.

Description	Price Each	Qty.	Sub-Total
Fundamental Amplifier Techniques with Electron Tubes*	\$104.90		
High-end Valve Amplifiers 2*	\$59.70		
Speaker Building 201	\$34.95		
Testing Loudspeakers	\$34.95		
Ribbon Loudspeakers (NEW REPRINT)	\$24.95		
The Joy of Audio Electronics	\$19.95		
Speaker Builder's Loudspeaker for Musicians	\$9.95		
The LP is Back	\$7.95		
Shipping & Handling (Limited-time Rate)	\$5		
* indicates Elektor book.			
TOTAL PAID			

CONTACT INFO (required)

Name

Mailing Address

City/State/Postal Code

Country

Email

Phone

Date

Signature

AX32012

Cut along this line

Yes, I want to subscribe to *audioXpress* for 1 year and receive 12 audio-packed issues!

AX Combo: Print & PDF Download	1 year U.S.	\$85
	1 Year Canada	\$100
	1 Year Foreign	\$110
AX Print	1 year U.S.	\$50
	1 year Canada	\$65
	1 year Foreign	\$75
TOTAL PAID		

CONTACT INFO (required)

Name

Mailing Address

City/State/Postal Code

Country

Email (required for Combo sub)

Phone

Date

Signature

audioamateur.com

AX32012



For complete product descriptions or to place your order online, visit **www.cc-webshop.com**. See the following page for order information.

Prices and item descriptions are subject to change. The publisher reserves the right to change prices without prior notification.

PAYMENT

☐ Check enclosed (Payable to Segment LLC)

☐ Charge my credit/debit card

Card # _____

Expiration date _____

CVC # _____

(Remit in U.S. dollars drawn on U.S. bank.)

Send product order form to:

AUDIO AMATEUR (Segment LLC)

111 Founders Plaza, Suite 300

East Hartford, CT 06108

P: 860.289.0800 x 206

F: 860.461.0450

custserv@audioexpress.com



PAYMENT

☐ Check enclosed (Payable to Segment LLC)

☐ Charge my credit/debit card

Card # _____

Expiration date _____

CVC # _____

(Remit in U.S. dollars drawn on U.S. bank.)

Send subscription order form to:

audioXpress

PO Box 462247

Escondido, CA 92046

P: 800.269.6301

audioexpress@pcspublink.com

PRODUCT ORDERING INFORMATION

To order, contact customer service:

Mail to: Audio Amateur/Segment LLC
111 Founders Plaza, Suite 300
East Hartford, CT 06108

Phone: 860.289.0800 x 206

Fax: 860.461.0450

Online: www.cc-webshop.com

Email: custserv@audioxpress.com

Customer service hours: *Monday – Friday, 8 A.M. – 4:30 P.M.*

Voice mail available at all times.

Please be sure to leave your name and a phone number where you can be reached.

PAYMENT

Orders must be prepaid. We accept check or money orders (in U.S. dollars drawn on U.S. bank only), credit card, and wire transfers. (Wire transfers subject to additional \$20 transfer fee.)



SUBSCRIPTIONS

All subscriptions begin with the current issue. Expect 3 to 4 weeks for receipt of the first issue. Subscriptions, renewals, and change of address should be processed at www.audioamateur.com or sent to:

Subscription Department:

audioXpress

PO Box 462247

Escondido, CA 92046

P: 800.269.6301

audioxpress@pcspublink.com

Subscriptions may be paid with check or money orders (in U.S. dollars drawn on U.S. bank only), credit card, and wire transfers. (Wire transfers subject to additional \$20 transfer fee. PayPal payment available through www.cc-webshop.com.)



For gift subscriptions, please include gift recipient's name and address as well as your own, with remittance. Subscriptions may be cancelled at any time for a refund on all unmailed issues.

Does your subscription expire soon? Renew it online at audioamateur.com.

TERMS OF BUSINESS

Shipping: Please allow 2-3 weeks for delivery. Elektor books may take up to 4 weeks for delivery.

Returns: Damaged or miss-shipped goods may be returned for replacement or refund. Please save shipping material for possible carrier inspection.

Patents: Patent protection may exist with respect to circuits, devices, components, and items described in our books and magazines. Segment LLC accepts no responsibility or liability for failing to identify such patent or other protection.

Copyright: All drawings, photographs, articles, printed circuit boards, programmed integrated circuits, diskettes, and software carriers published in our books and magazines (other than third party advertisements) are copyrighted and may not be reproduced (or stored in any sort of retrieval system) without written permission from Segment LLC.

Limitation of liability: Segment LLC shall not be liable in contract, tort, or otherwise, for any loss or damage suffered by the purchaser whatsoever or howsoever arising out of, or in connection with, the supply of goods or services by Segment LLC other than to supply goods as described or, at the option of Segment LLC, to refund the purchaser any money paid with respect to the goods.

Order Form 2013 Books

Order Form 2013 Subscription

The "Must Have" reference for
loudspeaker engineering professionals.

Home, Car, or Home Theater!

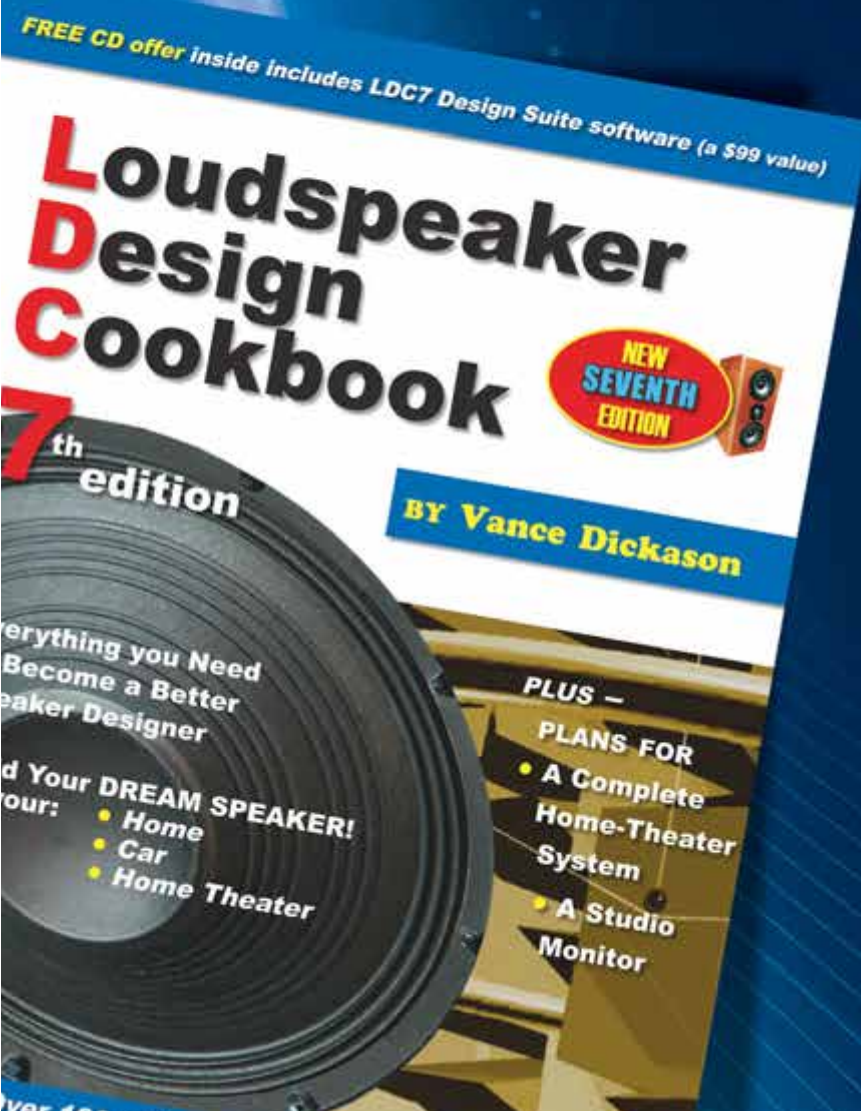
Back and better than ever, this 7th edition provides everything you need to become a better speaker designer. If you still have a 3rd, 4th, 5th or even the 6th edition of the *Loudspeaker Design Cookbook*, you are missing out on a tremendous amount of new and important information!

Now including: Klippel analysis of drivers, a chapter on loudspeaker voicing, advice on testing and crossover changes, and so much more! Ships complete with bonus CD containing over 100 additional figures and a full set of loudspeaker design tools.

A \$99 value!

Yours today for just \$39.95.

Shop for this book, and many other Audio Amateur products, at **www.cc-webshop.com**.





D250 Series 1"
Horn Driver



Sub-Link™ Wireless
Audio System



DA30 Class D
Mini Amplifier



OmniMic V2 Precision
Measurement System



HDN Audio
Transducer



Micro-Edge™ Series
In-wall/In-ceiling Speakers

INNOVATION VALUE QUALITY



Ultimax Series
Subwoofer Drivers



Committed to **innovation**, Dayton Audio strives to design and produce common-sense products of exceptional utility. Although these features benefit users in ways that are difficult to tally, the performance is always best-in-class when it comes to **value**. Years of experience combined with heads-up production techniques ensure that **quality** is never compromised in the quest for affordable pricing.

For additional innovative products visit daytonaudio.com/axm