AUDIO

THE EQUIPMENT AUTHORITY

MARCH 1993

EXCLUSIVE INTERVIEW
BRIAN ENO

THE HOT ONE!
MARANTZ DCC

REFLECTIONS AND LISTENING ROOMS

TESTED
CELESTION 300 SPEAKER

AUDIO RESEARCH LS3 B PREAMP

more

Admittedly, it's a pretty tall order to apply the moniker of "more amazing" to Carver's new AL-III speakers, considering that their predecessors are the Carver Amazing Loudspeakers themselves.

Recall the critical acclaim:

"I have never heard better sound. Period."

"Their imaging is truly amazing... I am loathe to let them out of my listening room."

"...absolutely majestic... a boon for audiophiles."

"...clean percussion, authoritative bass and a general sense of ease and openness that I cannot quite get from other fine speakers."

We could go on. And we will.

"The image on these speakers is deep, wide, coherent, and precise."

"These are great speakers and I cannot be dispassionate about them for they have affected me deeply... my eyes turn to the ceiling in audiophile ecstasy."

Except now the "majestic" sound emanates from a more compact, more versatile, more efficient design.

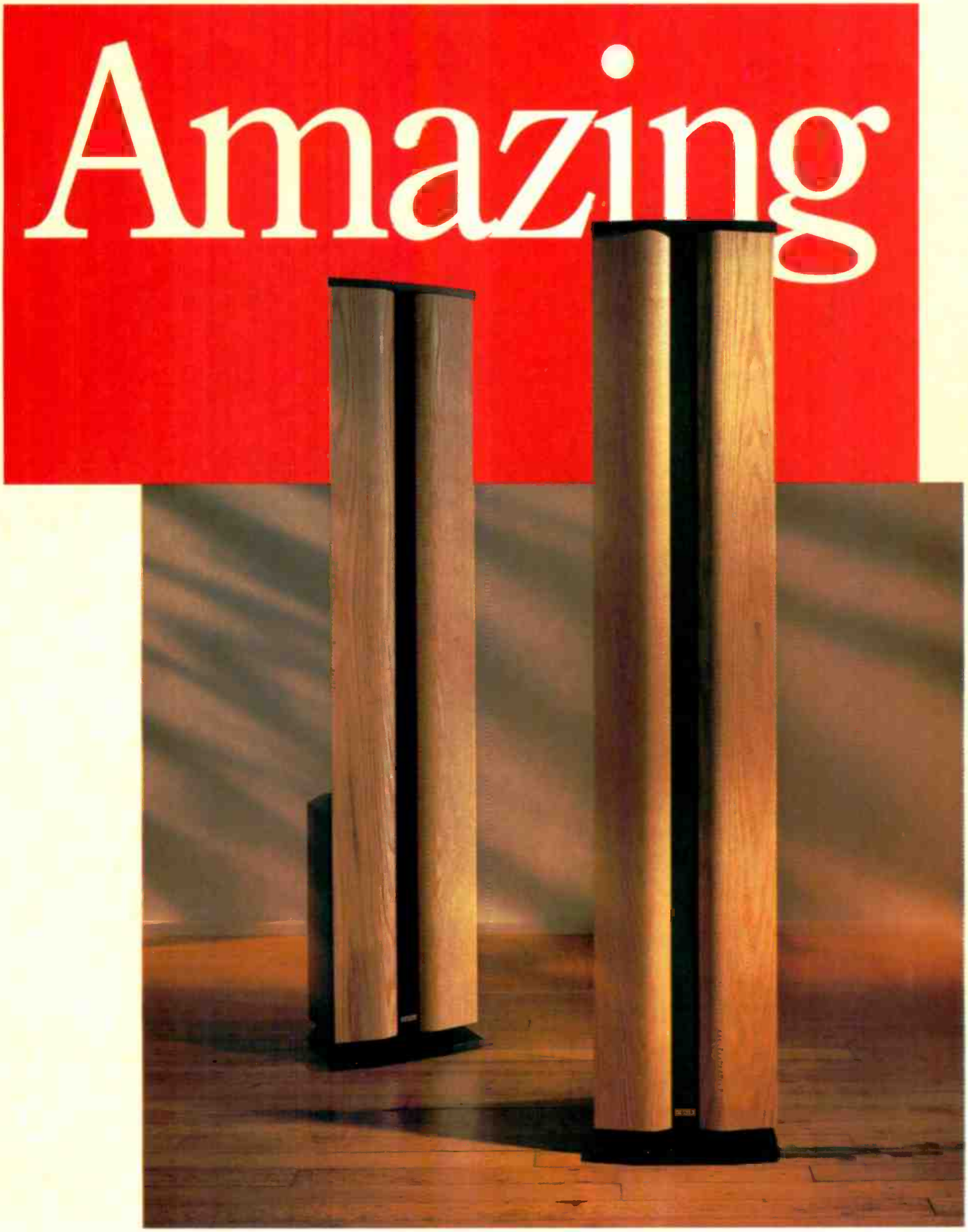
For example: the AL-III's 10 inch woofers are housed in a vented enclosure so they can be placed anywhere; adjustable frequency controls let you compensate for variations in listening environment; and these gorgeous loudspeakers can easily handle a good 400 watts (with pleasure).

Yet, they'll perform with as little as 35 watts per channel. Like we said – efficient.

Not least, the Carver AL-III's are a rare and extraordinary value. Audiophile-heaven for a comparatively earthly price.

Contact us today for more AL-III info, or amaze yourself at your Carver dealer.

Carver AL-III's are beautiful, with hand matched solid oak panels. And a nice fit. 48" full-range dipole driver ribbons and new 10" woofers are only 14.5" W x 72.5" H x 16.5" D. (Hot tip: Pair the AL-III's with Carver's TFM-35 Power Amp and CT-3 Preamp/Tuner for an awfully sweet package!)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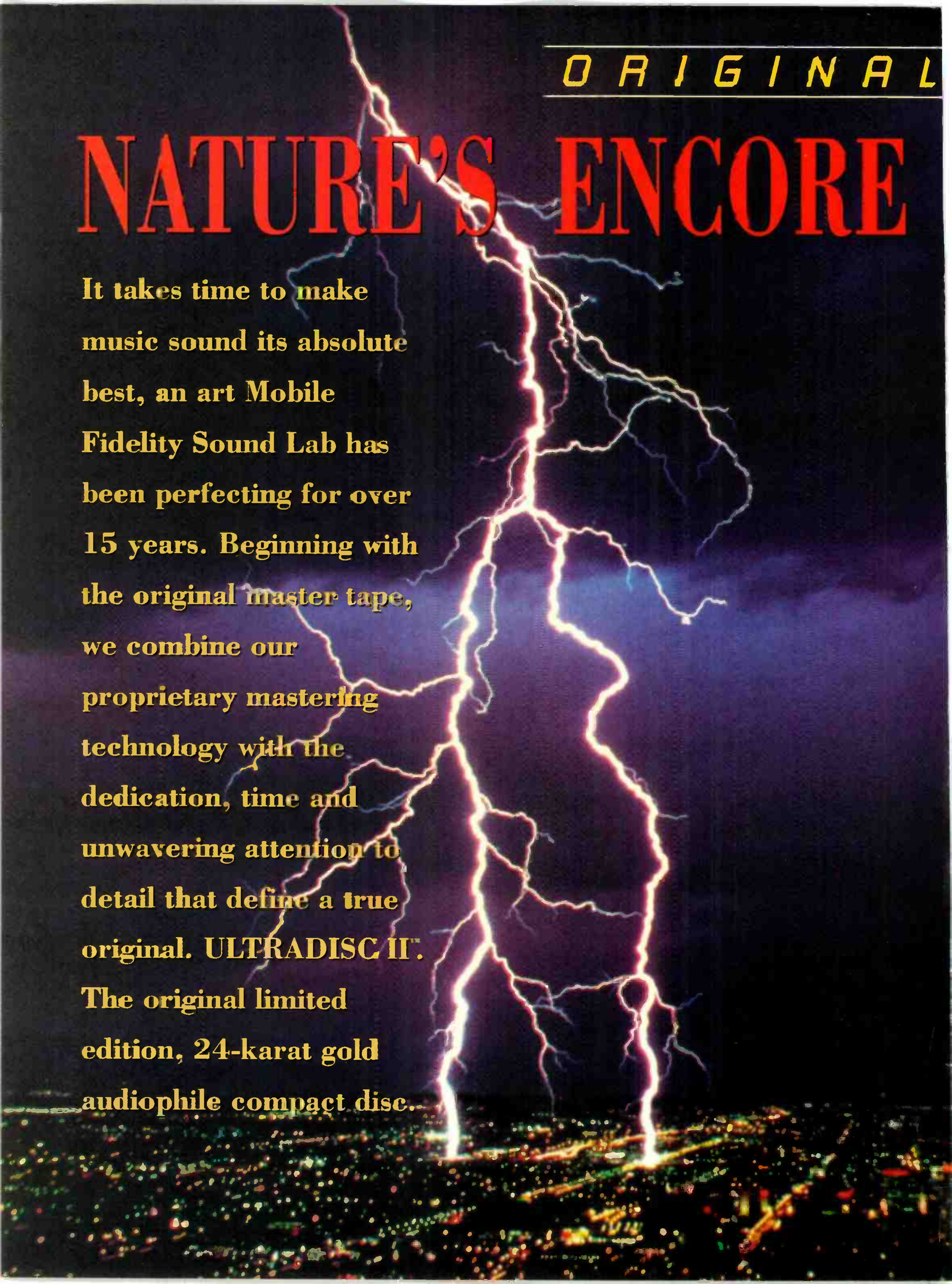
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MARCH 1993 VOL. 77, NO. 3

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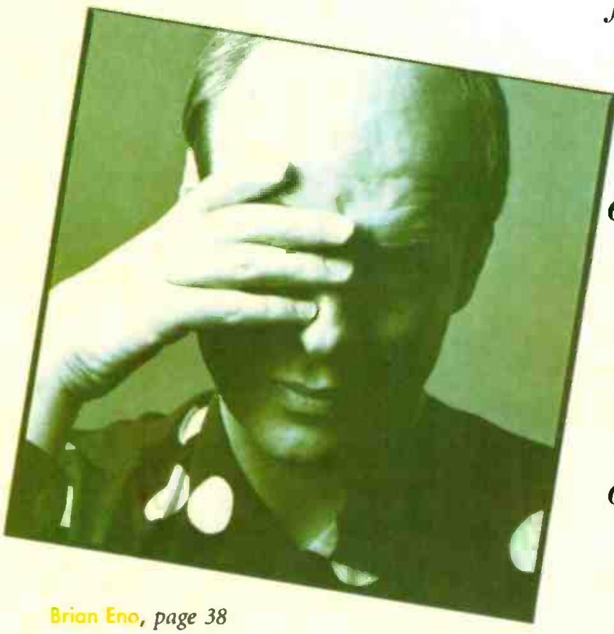
Sharp Projector, *page 24*



Brian Eno, *page 38*

features

equipment profiles

auricles

recordings

departments

Marantz DCC, *page 44*

Nakamichi Receiver, *page 14*

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The Audit Bureau

MPA

FAST FORE-WORD

Yesterday, I came back from the Winter Consumer Electronics Show in Las Vegas. The mood at the Show was good, better I think than for the past several years. It seems that dealers have been selling, some of them since about Labor Day, though others only during the holiday season just past. And, of course, when dealers sell, they are going to reorder, and that means manufacturers sell. Thus, I offer herewith the first in a boring series of Pompous Pitts Pronouncements: There's nothing like a little business to make people feel better.

What did I note of interest to you? Well, there is a definite move to less expensive A/V home theater systems. Altec and Kenwood made a joint announcement at a THX press conference that, together, their systems would sell for less than $5,000. (Naturally, Altec's speakers and Kenwood's electronics don't have to be used together.) There were two five-channel receivers with Dolby Pro priced at $499, a more accommodating level, one each from Onkyo and Yamaha. Cambridge Signal Technologies, a company new to me, showed a digital processor that dealt very effectively with room modes and did not require the use of a specific pair of speakers. John Eargle's forthcoming WCES wrap-up story will focus on the unit. Snell Acoustics and Audio Alchemy showed a similar kind of component, but one making use of a specific pair of speakers. Aura Sound, an aerospace spin-out, was showing a subwoofer that uses a new type of magnet arrangement in the cone-type driver. Instead of the usual ring magnet, the company uses alnico bars arranged so that the fields are radial. Speakers made with the new driver, says Aura Sound, have substantially more power, go naturally to lower frequencies, and are intrinsically shielded for use next to a TV monitor.

One of the things that plagues me most at CES time is the new company that comes out of nowhere with a good-looking piece of electronics or maybe a speaker system which sounds really fine. Inevitably, this brand-new firm wants a review, and my problem comes from a distinct lack of distribution for the item in question, like none. The firm's plan is to get *Audio* to review this Great Whiz-Bang of theirs and then use the "glowing review" to acquire dealers. This happened to me several times this past Show, and of course I gently suggested that they ought to have a dealer network so that consumers might buy the gear. From my point of view, equipment reviews are done for the reader, not the maker, and I see no reason to make a reader salivate over the latest New-and-Wonderful until the item is being sold in most of the major audio markets across the country.

AUDIO

THE EQUIPMENT AUTHORITY

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Have Audio Fairs, Consumers Will Travel

Dear Editor:

I read with interest John Eargle's column regarding, in his opinion, the unsuccessful attempt by the Electronic Industries Association to run a combined trade and consumer show at the Summer Consumer Electronics Show last year in Chicago ("Currents," November 1992). Much of what he wrote will find agreement from the high-end community, who also felt there was not enough emphasis promoting their exhibits at the Hilton.

Where I must take umbrage is with Eargle's comments on the lack of "audio fairs" in the United States. The *Stereophile* High-End Show was set up in 1987 to address the lack of consumer exhibitions. For the last six years, we have promoted audio in all its forms on both the East and West Coasts. Average attendance has been between 5,000 and 9,000, and we attract visitors from all over the world.

I do not agree with Eargle's argument that it is impossible to organize shows here due to the distances consumers would have to travel. We will be running our seventh show at the San Francisco Marriott from March 12 to 14.

Mark Fisher
Publisher, Stereophile
Santa Fe, N.M.

Another Velodyne Subwoofer Winner

Dear Editor:

D. B. Keele, Jr.'s "Thunder in the Listening Room: Subwoofer Shootout" in the November 1992 issue was enjoyable and informative. I have had a Velodyne ULD-15 Series II since August 1989 and enjoyed every minute of it. When my uninitiated guests ask, "What's that, and what does it do?" I play the finale of Mendelssohn's Prelude and Fugue in C Minor, Op. 37, No. 1, from *Mendelssohn: Organ Works* performed by Peter Hurford (Argo 414 420-2). At 2:13 into the finale, you hear and feel a solid 16-Hz note that no affordable full-range loudspeaker can reproduce. The demonstration was even more effective after I built a small bypass switch for the Velodyne servo amp, so that I could compare the full-range speakers (AR 610s) without Velodyne's high-pass filter against the entire system with the subwoofer active. Guests are impressed when the "full-range" speakers fail to reproduce any part of the 16-Hz note.

One other bone-rattling recording I'd like to share is "Pictures at an Exhibition" transcribed for organ by Jean Guillou on Dorian DOR-90117. This is a version of "Pictures" like no other you've ever heard. Guillou (also the organist in Saint-Saëns' Symphony No. 3 on Philips 412 619-2) does not spare the pedals and long pipes: Every loose object within range will rattle. The CD makes a splendid addition to a collection, especially if one already has the orchestral and original piano versions.

Alan L. Veargason
West Babylon, N.Y.

I Can Hear for Miles and Miles

Dear Editor:

I am surprised that *Audio* thinks AM reception of 800 miles is worthy of italics (Dymek DR333 General Coverage Receiver, "Equipment Profile," September 1992). Driving around the Twin Cities, I can hear on my car radio the Hawks from WSB Atlanta, the Knicks from WFAN New York, or the Bulls from WMAQ Chicago.

I am sure you remember the controversy some years ago when the FCC wanted to move stations 9 kHz apart and eliminate the clear-channel stations. Country music performers and fans protested because they would no longer be able to tune in the Grand Ole Opry from WSM Nashville. The FCC quickly dropped the idea.

In the early '50s, I used to listen to the disc jockeys who followed the 10 o'clock news. From WLAC Nashville, I first heard rhythm & blues on the Randy Record Shop program with Gene Nobles. I even sent away for "Hound Dog" by Willie Mae Thornton. A cover version came later by some artist who escapes my memory.

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★Letterbox

In other matters, Bert Whyte talks about hi-fi in the '50s ("Behind the Scenes," September 1992). I still use my Rek-O-Kut B-12. The rumble is terrible, but the turntable will never wear out. I had a Weathers FM pickup, which I used until I switched to a Shure V-15, although I still use the Weathers arm.

I remember Whyte's record reviews in *Radio & TV News*. He could not say enough good things about *Boléro* and *Le Sacre du Printemps* on Mercury. I also knew Edward Tatnall Canby from his program notes for the *Messiah* and from his recordings of Jean Ritchie.

Ah yes, those were the days.

Gilbert A. Johnson
Minnetonka, Minn.

Editor's Note: I, too, have routinely picked up distant stations on my car radio—in the Midwest. But here in the Northeast, where both the Dymek's reviewer, Leonard Feldman, and I live, distance lends impossibility rather than enchantment. On winter nights in Ohio, Indiana, Illinois, and southern Wisconsin, I've picked up Boston's clear-channel station WBZ. But I can't do it in New York and have never picked it up in Hartford. That wasn't always so. In the '50s, I regularly listened to WWVA Wheeling, West Virginia, in Connecticut.—*I.B.*

We Already Have Our DAT!

Dear Editor:

In reply to Edward J. Foster's various contentions about the upcoming preeminence of data-compressed audio ("Signals & Noise," August 1992), I must say that an important consideration is being ignored in the debate between proponents of full data and compressed data.

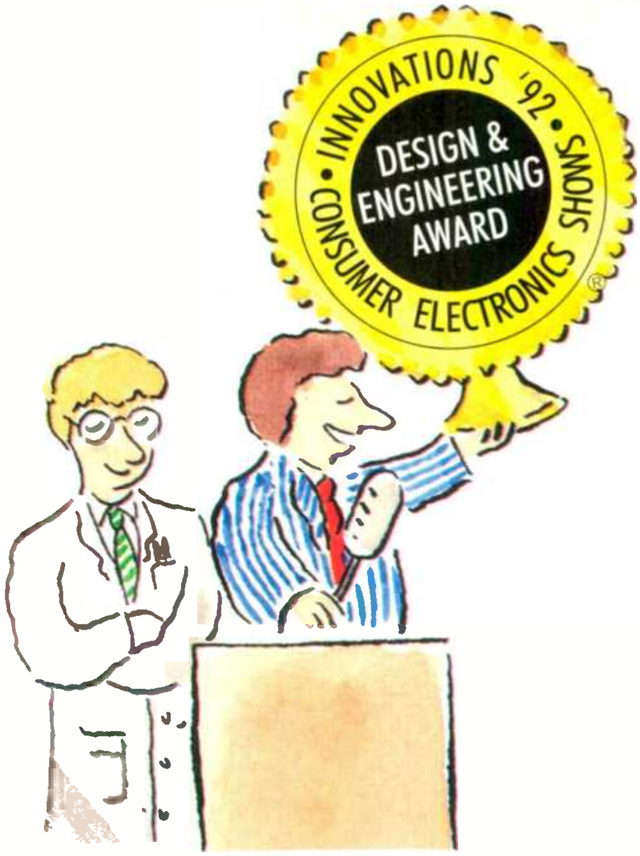
DAT machines are legendary not just for their cloning of digital data through coaxial and optical means, but for their astonishingly true replication (especially at a sampling rate of 48 kHz) of CDs and other sources through their analog inputs. It is possible to make several such successive analog copies of a high-grade source without audible deterioration.

But what of DCC and other data-compressed formats? I find it difficult to believe that successive reduction of data by recording with a DCC through analog means will not result in an irretrievable loss of quality. And the issue is not unimportant. Many musicians use samplers and other digital devices that output audio only through analog circuits.

Moreover, the very reasoning behind attempting to discover what some preconceived Everyman can or cannot hear—and then attempting to make a system that, however cleverly, tries to cater to those deficiencies—is suspect. We already have DAT. It works like a charm. *The bugs have been worked out!*

We have seen, in the case of American TV, how bad planning and jumping the gun led to a deficient television standard (NTSC) that plagues us to this day. DCCs are expensive, no more convenient than DATs, and may or (probably) may not sound as good. The world of professional audio is coming within the reach of the home enthusiast. No mastering engineer I know would even consider mastering a professional recording to DCC. They use DAT. And that, as they say, is DAT.

J. Patrick McGrail
Fitchburg, Mass.



"We wish to thank Mom; our 3rd grade music teacher; the members of the Academy..."

The Multi-Channel GFA-2535: yet another award-winning amplifier from Adcom.

A pattern appears to be taking shape here: Adcom introduces a new power amplifier, Adcom wins an award. The GFA-535, GFA-555, GFA-555II, GFA-565, and now the GFA-2535 — every single one has earned the immediate praise and plaudits of the industry's most respected authorities...perhaps because Adcom packs more performance and innovative technology into its amplifiers than you'll find in components that cost twice as much or more.

The innovative GFA-2535 is a worthy new standard-bearer. The GFA-2535 is really two GFA-535's in one case, with the flexibility to drive three *or* four channels. With individual level controls for precise control of each amp's volume, it's the ideal foundation for an authentic, ultra-realistic surround-sound theater system, or for a multi-room or multi-speaker audio system.

The Versatility of 3 Channels or 4.

A single switch on the GFA-2535's rear panel lets you select 4-channel operation, or bridge two of the channels for a 3-channel configuration. In the 3-channel mode, the GFA-2535 brings your home theater to life, delivering 200 watts of clean, distortion-free sound to the center channel, and 60 watts to each of the rear channels. Add it to your existing 2-channel amp, and you'll be at the center of a superbly balanced, awesomely powered stage with sound so real, you can practically touch it.

For audio applications, the GFA-2535 in the 4-channel mode acts as a pair of 60 watts-per-channel amps to drive two sets of speakers. With two of the channels bridged, it delivers 60 watts each to a pair of satellites, and 200 watts to a single subwoofer for an incredible display of musical strength so real, you definitely can feel it.

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Styling in the LS Series is not only breathtaking, it is highly functional. The slim, tapered cabinet design belies its technological contribution. The angled sides break up standing waves inside the cabinet, so detrimental to midrange performance. At the same time, this design feature also enhances the stereo presentation dramatically.

All LS Series speakers are available in a striking, gloss rosewood laminate. The LS50 and L70 are also offered in oak laminate with the LS90 available in natural Oak.

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Our pictures prove it. And so will your ears at your Polk Dealer.

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WHAT'S NEW

Bang & Olufsen Music Center

Besides the cassette deck and CD player so plainly visible through its sliding glass doors, the Beocenter 2500 incorporates an FM/AM tuner with an optional Radio Broadcast Data System (RBDS) decoder that shows station call letters and other data on the display. The award-winning design includes doors that open at the

approach of the user's hand, and visible disc rotation during CD play. For use with self-powered speakers or external amplifiers, the 2500 can be expanded into a multi-room system. A basic remote, the Beolink 1000, is included; an accessory remote, the Beolink 5000, allows remote programming of CD and radio play and of timer programming. Prices: Beocenter 2500, $1,750; Beolink 5000, $500.
For literature, circle No. 100

Nakamichi Receiver

The RE-1 uses Nakamichi's Harmonic Time Alignment amplifier technology to deliver 80 watts per channel at

8 ohms, with current output levels of up to 18 amperes. Multi-room and system remote-control capabilities allow the supplied handheld controller to operate a number of Nakamichi components and, with optional sensors, to operate the system from other rooms. Video inputs, outputs, and buffer circuits allow routing of video signals. FM usable sensitivity is 11 dBf, and stereo sensitivity for 50-dB quieting is 37.5 dBf. The tuner section also covers the newly expanded AM band. Price: $799.
For literature, circle No. 102

Autotek Car Amplifiers

Autotek's series of Silverado car amps have large, regulated power supplies and all-discrete audio sections. The Silverado 50 delivers 25 watts per channel in stereo, the Silverado 80 delivers 40 watts per channel, and the Silverado 100 (which has a built-in crossover) delivers 25 watts into each of its four channels. All three models are bridgeable and can drive 2-ohm loads. Prices: Silverado 50, $199.95;

Silverado 80, $269.95; Silverado 100, $369.95.
For literature, circle No. 101

1-Control Universal Remote

The 1 Control HE 8254, from Jasco Products, can substitute for the original remotes of up to six audio and video components of different brands. According to the manufacturer, it takes only seconds to program, and a toll-free customer hotline number is available

for assistance. Price: $59.99.
For literature, circle No. 103

AUDIO CLINIC

JOSEPH GIOVANELLI

Simultaneous Stereo and Mono?

Q. *If a receiver or integrated amplifier has outputs for two pairs of loudspeakers, is it possible to bridge the outputs and have stereo separation on one pair of loudspeakers while the other pair is in mono?*—Jeremy Whitfield, McGregor, Tex.

A. Many amplifiers are designed for either normal stereo or bridged monophonic operation. In bridged mode, the two amp channels work together to produce a monophonic signal, usually from a mono input (though some amps might bridge two stereo inputs into mono). Normally, connecting a load between the channels of an amplifier reduces separation—all the way to mono, unless the cross-connected load's impedance is extremely high.

Many car stereo amps permit simultaneous stereo and bridged mono operation, with the mono speaker being a subwoofer. This should lead to reduced channel separation at low frequencies, but that's no problem if you're using a mono woofer anyway. The low-pass filters that keep the woofer from handling upper frequencies also keep those frequencies from being bridged across the woofer, so separation is maintained in the satellite left and right speakers.

Can Hot Music "Fry" Tweeters?

Q. *Everyone knows that pushing a power amplifier into hard clipping will "fry" tweeters, because the clipped waveforms contain much more high-frequency energy than a typical music signal. What happens, however, if the music itself contains heavily distorted, clipped sounds—like those from some electric guitars? Will this burn out the tweeter's voice-coil even though the amplifier itself is not clipping? What is the difference between these two conditions?*—Steve Lindenfeld, St. Joseph, Mich.

A. Distortion produced by "fuzz" guitars is not nearly as destructive as amplifier clipping is. I don't believe that distortion created by guitarists and their special equipment is nearly as rich in harmonics as the distortion produced when a power amplifier clips. The upper frequency of the harmonics produced by the guitar is limited by the instrument amp and by the medium on which the music was recorded.

Just listening to such music makes me feel that much of the distortion occurs at midrange frequencies, rising into the treble range but decreasing in amplitude as frequencies of harmonics increase. I have *not* measured the spectrum of such music.

Further, if tweeters were being destroyed during the playing of such music, readers would have deluged me with tons of letters about this. I have not received one.

Headphone Hiss

Q. *I recently purchased a pair of headphones and found, to my surprise, a very noticeable hiss. It is most apparent with nothing playing, but I still hear it under most conditions. I also hear hiss through my loudspeakers, but it is not distracting. I can reduce the hiss somewhat with my graphic equalizer, but at the expense of highs. Is all of this just a limitation of my equipment? Can I add something to reduce this hiss?*—Philip C. Hagemann, North Babylon, N.Y.

A. Hiss is more noticeable through headphones than speakers for several reasons. Since headphones lie close to the ears, any hiss they reproduce is readily transferred to the eardrums. Headphones are far more sensitive than speakers, so they're more likely to pick up faint hiss in your system. And headphones that isolate your ears from outside sounds also keep such sounds from masking hiss.

If the hiss you hear comes from your signal sources, your recordings, or the portion of your preamp or amp that precedes the volume control, there's not much you can do about it other than to find its cause and cure it. But if the hiss originates in the circuits following the volume control (in which case it won't vary with the control's setting), there's a cure.

In such a case, turning up the volume will raise the signal level without affecting the noise. Unfortunately, that will also overload your headphones. You could switch to less sensitive 'phones, which would require such high volume settings, but an easier solution is to attenuate the signal between your amp and headphones. Before headphone jacks were common, many stores carried headphone extension boxes with ¼-inch phone jacks and level controls for the headphones. If your 'phones have ⅛-inch (3.5-mm) mini-jacks, you could use Radio Shack's headphone extension cord with built-in volume control (No. 42-2459, $4.95). If you can find an old extension box or can use the Radio Shack cord, plug it in between your headphones and your preamp or receiver. Listen to the 'phones with no signal, and turn down the attenuators until the hiss virtually disappears. Then play your equipment to see if the hiss is still a problem and if your equipment can provide all the signal the headphones now need.

Leaving a CD Player On

Q. *Is it necessary to press the stop button after the last CD has been played? Can you just press the power button when a disc is still playing? I was using my player late at night and fell asleep. I woke up wondering if it is harmful for the machine to be left on once a disc has been played. Should I use the repeat button so that, if I fall asleep, the system will be doing something specific rather than just sitting there?*—Joseph Barbera, Cheektowaga, N.Y.

A. If you just turn off the machine while the disc is playing, you can't usually open the player to get the CD out. Other than that, though I prefer to press "Stop" first so the mechanism won't be left somewhere in mid-cycle, none of my players has malfunctioned when I turned them off without hitting "Stop." Leaving the system running in repeat mode will increase mechanical wear and shorten the laser's life.

Don't worry if you fall asleep; the player's mechanism will stop itself, and the laser will turn off when the disc ends. The electronics will remain on but won't be harmed by running all night. A

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1633 Broadway, New York, N.Y. 10019. All letters are answered. In the event that your letter is chosen by Mr. Giovanelli to appear in Audioclinic, please indicate if your name and/or address should be withheld. Please enclose a stamped, self-addressed envelope.

MUSIC 1993

CLASSIC ROCK'S GREATEST HITS

Yes—Yesstory (ATCO) 446•211/396•218
Emerson, Lake & Palmer—The Atlantic Years (Atlantic) 444•414/394•411
Steely Dan—Gold- Grt. Hits (MCA) 435•693
Steppenwolf—Born To Be Wild (MCA) 430•678/390•674
The Byrds—20 Essential Tracks (Columbia/ Legacy) 428•940
Rod Stewart—Downtown Train (Warner Bros.) 425•322
Rush—Chronicles (Mercury) 423•780/393•785
Eric Clapton—Time Pieces (Polydor) 423•467
Lynyrd Skynyrd Band—Skynyrd's Innyrds/Their Grt. Hits (MCA) 381•129
Grateful Dead—Skeletons From The Closet (Warner Bros.) 378•406
Roy Orbison—The All-Time Hits, Vols. 1 & 2 (CSP) 377•945
Fleetwood Mac—Grt. Hits (Warner Bros.) 375•782
Journey's Greatest Hits (Columbia) 375•279
The Best Of The Doors (Elektra) 357•616/397•612
Rolling Stones—Rewind (Rolling Stones Rec.) 350•736
The Police—Every Breath You Take-The Singles (A&M) 348•318
Buddy Holly—From The Original Master Tapes (MCA) 348•110/398•115
The Cars—Greatest Hits (Elektra) 339•903
The Best Of Kansas (CBS Associated) 327•742
Joe Cocker—Greatest Hits (A&M) 320•911
Eagles—Greatest Hits Vol. 2 (Asylum) 317•768
Best Of Blondie (Chrysalis) 311•811
Creedence Clearwater Revival—20 Grt. Hits (Fantasy) 308•049
Electric Light Orchestra—ELO's Greatest Hits (Jet) 300•095
Alice Cooper—Greatest Hits (Warner Bros.) 291•476
James Taylor—Grt. Hits (Warner Bros.) 291•302
The Allman Brothers Band—A Decade Of Hits 1969-1979 (Polydor) 430•439
The Best Of The Doobie Brothers (Warner Bros.) 291•278
The Steve Miller Band—Greatest Hits 1974-78 (Capitol) 290•171
Eagles—Greatest Hits 1971-1975 (Asylum) 287•003
Chicago®—Greatest Hits (Columbia) 260•638
Santana—Greatest Hits (Columbia) 244•459
Janis Joplin—Greatest Hits (Columbia) 231•670
Simon & Garfunkel—Greatest Hits (Columbia) 219•477
Bob Dylan—Greatest Hits (Columbia) 138•586
The Moody Blues—The Story Of The Moody Blues (Polydor) 423•756

DANCE BEAT

Neneh Cherry—Home Brew (Virgin) 451•476
Expose (Arista) 449•306
Prince And The New Power Generation (Edited Edition) (Paisley Park) 448•514
Marky Mark And The Funky Bunch—You Gotta Believe (Interscope) 447•771
Various Artists—East Coast Family, Vol.1 (Motown) 444•646
Jon Secada (SBK) 438•184
TLC—Ooooooohhh... (LaFace) 434•621
New Edition—Grt Hits, Vol. 1 (MCA) 430•066
Paula Abdul—Spellbound (Virgin) 420•257
C & C Music Factory—Gonna Make You Sweat (Columbia) 416•933
Madonna—The Immaculate Collection (Warner Bros./Sire) 414•557
Janet Jackson—Rhythm Nation 1814 (A&M) 388•918
"Mo' Money" Orig. Sndtrk. (Perspective/A&M) 443•739

Wynonna Judd—Wynonna (MCA/Curb) 435•909
Bob Marley & The Wailers—Legend (Tuff Gong/Island) 337•857
Billy Joel®—Greatest Hits Volume 1 & 2 (Columbia) 336•396/396•390
Dire Straits—Brothers In Arms (Warner Bros.) 336•222
Bruce Springsteen—Born In The U.S.A. (Columbia) 326•629
En Vogue—Funky Divas (eastwest) 435•750
Suzy Bogguss—Voices In The Wind (Liberty) 449•736
Sinead O'Connor—Am I Not Your Girl? (Chrysalis) 447•532
Michael W. Smith—Change Your World (Reunion/Geffen) 446•955
The Charlie Daniels Band—A Decade Of Hits (Epic) 321•067
ZZ Top—Eliminator (Warner Bros.) 319•624
Kris Kross—Totally Krossed Out (Ruffhouse/ Columbia) 435•743
David Bowie—The Rise And Fall Of Ziggy Stardust (Rykodisc) 442•509
Otis Redding—The Dock Of The Bay (ATCO) 430•918
James Brown—The CD Of JB (Polydor) 425•025
The Very Best Of The Righteous Brothers—(Verve) 423•772
Barbra Streisand—Highlights From "Just For The Record" (Columbia) 444•372
Warrant—Dog Eat Dog (Columbia) 444•091
Kiss—Revenge (Mercury) 441•436
Tori Amos—Little Earthquakes (Atlantic) 436•352
Melissa Etheridge—Never Enough (Island) 435•180
"Beauty And The Beast" Orig Sndtrk. (Walt Disney Records) 432•690
Enya—Shepherd Moons (Reprise) 431•718
Kenny Loggins—Leap Of Faith (Columbia) 430•256
The Best Of The Waterboys—1981-'90 (Chrysalis) 421•040
U2—Achtung Baby (Island) 431•213
Derek & The Dominos—Layla And Other Assorted Love Songs (Polydor) 423•681
John Lennon/Yoko Ono—Double Fantasy (Capitol) 380•774
Marvin Gaye—Greatest Hits (Motown) 367•565
The Beach Boys—Pet Sounds (Capitol) 367•193

George Strait—Pure Country (MCA) 448•753
Pretenders—The Singles (Sire) 362•541
U2—The Joshua Tree (Island) 354•449
Jimmy Buffett—Songs You Know By Heart (MCA) ■ 339•911
Michael Jackson—Thriller (Epic) 318•089
Garth Brooks—Ropin' The Wind (Liberty) 428•862
Traffic—The Low Spark Of High Heeled Boys (Island) 351•924
Aretha Franklin—30 Grt. Hits (Atlantic) 350•793/390•799
Van Morrison—Moondance (Warner Bros.) 349•803
The Who—Tommy (MCA) 345•223/395•228
Trixter—Hear (Mechanic/ MCA) 445•627
Roxette—Tourism (EMI) 448•217
Red Hot Chili Peppers—What Hits? (EMI) 448•209
Jodeci—Forever My Lady (MCA) 430•959
Paul Simon—The Rhythm Of The Saints (Warner Bros.) 412•809
Garth Brooks—No Fences (Capitol) 411•587
Wilson Phillips—Shadows And Light (SBK) 440•271
Toad The Wet Sprocket—Fear (Columbia) 428•466
Red Hot Chili Peppers—Blood Sugar Sex Magik (Warner Bros.) ■ 428•367
Jethro Tull—Aqualung (Chrysalis) 345•157
The Doors—L.A. Woman (Elektra) 340•810
Smokey Robinson & The Miracles (Motown) 336•057/396•051
Motown's 25 #1 Hits From 25 Years (Motown) 319•996/399•998

Michael Bolton—Timeless (The Classics) (Columbia) 445•494
AC/DC—Back In Black (Atlantic) 305•045
Patsy Cline—Greatest Hits (MCA) 365•924
"Boomerang" Orig. Sndtrk. (LaFace) 442•335
Al B. Sure—Sexy Versus (Warner Bros.) ■ 446•088
Stevie Wonder—Original Musiquarium 1 (Tamla) 314•997/394•999
Reo Speedwagon—Hi Infidelity (Epic) 306•449
Jackson Browne—The Pretender (Asylum) 292•243
Deep Purple—Machine Head (Warner Bros.) 291•484
Eagles—Hotel California (Asylum) 286•948
Fleetwood Mac—Rumours (Warner Bros.) 286•914
Van Halen (Warner Bros.) 286•807
Linda Ronstadt—Greatest Hits (Asylum) 286•740
Meat Loaf—Bat Out Of Hell (Epic) 279•133
Boston (Epic) 269•209
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TAPE GUIDE

HERMAN BURSTEIN

Dolby, dbx, and HX Pro Circuits

Q. *I am still somewhat in the dark about noise-reduction systems. Please explain the differences among Dolby B, Dolby C, dbx, and Dolby HX Pro. Does HX Pro work in conjunction with noise reduction, or can only one or the other be used?*—Jeff Fehring, Milwaukee, Wisc.

A. Dolby B and C and dbx are noise-reduction systems. HX Pro is not; it seeks to increase treble headroom during recording.

The Dolby and dbx NR systems work on the principle of compression during recording and expansion during playback. The downward expansion in playback also takes noise down with it. Dolby B and C NR operate only on the upper frequencies, where hiss and tape noise are most audible, and their effects vary with the signal's frequency content. In recording, there is treble boost which varies inversely with treble level; the lower the treble level (and hence the less the masking effect of strong treble), the greater the treble boost. In playback, there is complementary treble cut to restore flat response, again varying inversely with treble level; the lower the level, the greater the cut—and this cut reduces noise.

For Dolby NR to work properly, the level in playback must be matched to the level in recording. Without such "tracking," treble frequencies can be muffled or suppressed. The Dolby B circuit reduces noise above approximately 500 Hz and achieves about 8 to 10 dB of noise reduction; Dolby C NR is effective above approximately 150 Hz and achieves about 18 to 20 dB of improvement in S/N. Although Dolby C NR employs more treble boost than Dolby B NR, the former includes a special recording characteristic to avoid saturating the tape at extremely high frequencies. Therefore, Dolby C NR tends to have more headroom than Dolby B NR—that is, it is freer from tape saturation when recording high frequencies at high levels. Saturation not only causes distortion but also reduces the recorded treble level—a phenomenon called foldback.

The dbx NR system operates throughout the audio range and does not require matching record and playback levels. Thus, there is no tracking problem that can affect treble response. However, it has been noted that response at the frequency extremes, particularly at the treble end, tends to be not as good with dbx as with Dolby NR. The dbx system achieves about a 30-dB reduction in noise.

At this point, mention should be made of the newest development in Dolby noise reduction, Dolby S, which has made its appearance in high-quality cassette decks. It achieves a bit higher S/N ratio than Dolby C NR, covers the entire audio range, provides an anti-saturation characteristic for the bass as well as for the treble, is less subject to the effects of mistracking, is more resistant to such side effects as breathing (varying noise level), and tends to provide somewhat cleaner reproduction.

TAPE SATURATION NOT ONLY CAUSES DISTORTION BUT ALSO REDUCES THE RECORDED TREBLE LEVEL.

Dolby HX Pro is a variable-bias scheme to avoid tape saturation in the treble range. It takes into account the fact that treble frequencies add their own biasing effect to that of the high-frequency bias supplied by the deck's oscillator during recording. The HX Pro circuit senses the treble level and correspondingly adjusts the output of the deck's bias oscillator so as to keep total bias more or less constant. Excessive bias causes erasure of high frequencies; by preventing this treble loss, HX Pro allows improved treble response with less treble boost required in recording. This reduced treble boost lowers the chance of tape saturation, which produces distortion and treble loss.

Going Half Speed

Q. *I plan to modify a cassette deck for half-speed operation. I am an electronics engineer and have the equipment to do so. What are the equalization, bias, and Dolby NR issues involved in half-speed operation?*—Raymond J. Berry, Bellevue, Wash.

A. The usual requirement for bias is that its *frequency* be at least five times the highest audio frequency to be reproduced; this is to minimize audible interaction between bias and harmonics of the highest audio frequencies. Thus, if you seek response to, say, 10 kHz, bias should be at least 50 kHz.

To avoid an increase in distortion, it would be desirable to keep the *amount* of bias the same at half-speed as at full speed. However, if all else remains the same, treble response drops with a reduction in tape speed, so you may want to decrease bias *somewhat* to avoid excessive treble loss. This entails an increase in distortion; a moderate increase in distortion may be tolerable.

At half speed, you will probably want to use something other than 70-µS ("Type II" or "CrO_2") playback equalization, because the more bass boost employed in playback (which may conversely be visualized as treble droop), the more treble boost is required in recording to maintain good treble response. But excessive treble boost may overload the tape, causing distortion and treble loss. Therefore, 120-µS ("Type I" or "Normal") playback equalization would be more satisfactory, requiring less treble boost in recording.

Given a specific playback curve, the standard requirement for record equalization is that it should be such as to achieve substantially flat response over the intended audio range. At half speed, I think you should not aim at overall response beyond 10 kHz; perhaps 8 or 9 kHz would be a more realistic objective.

There might be a minor interaction with Dolby noise reduction because a reduction in tape speed entails a reduction in recorded level. This would affect tracking, namely the matching of recorded and playback levels necessary for proper Dolby NR performance. A

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1633 Broadway, New York, N.Y. 10019. All letters are answered. In the event that your letter is chosen by Mr. Burstein to appear in Tape Guide, please indicate if your name and/or address should be withheld. Please enclose a stamped, self-addressed envelope.

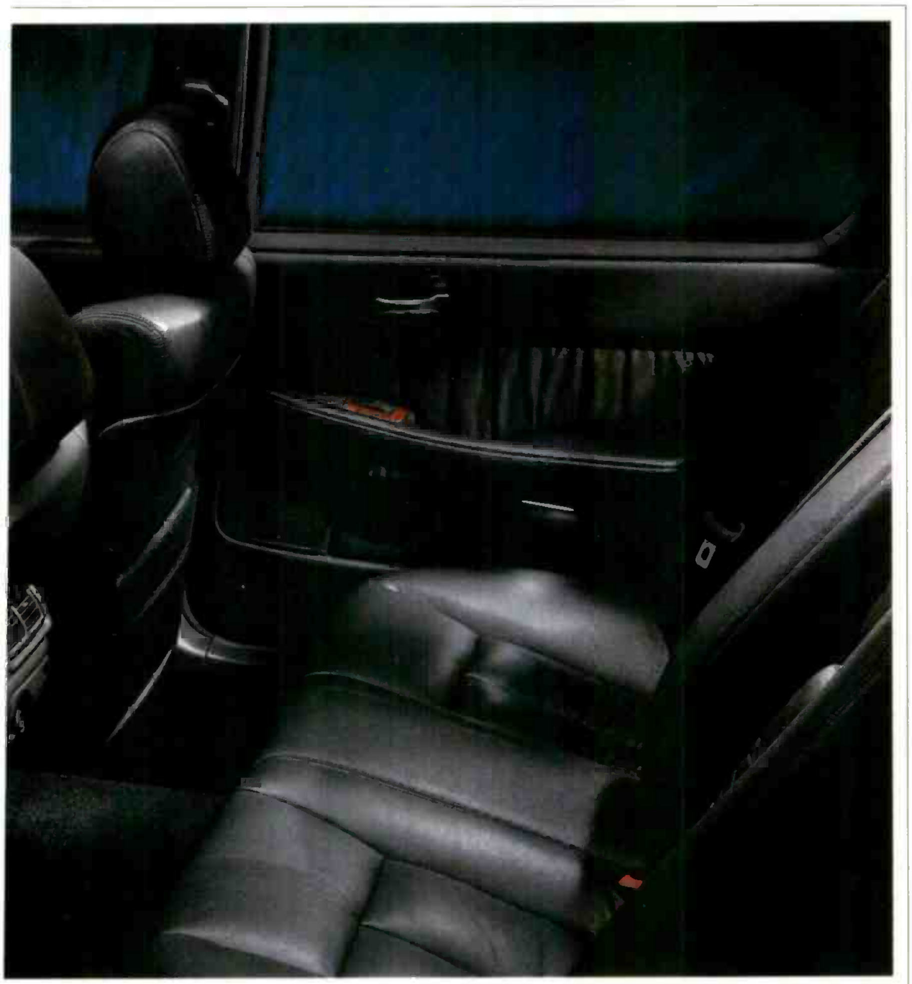
A Cabin? Or A Re

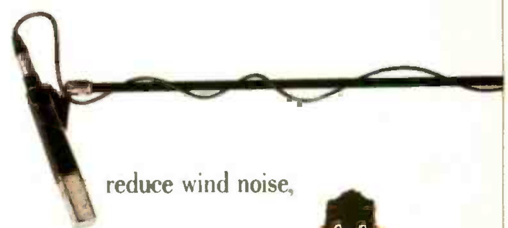
One day last December, the classical guitarist Manuel Barrueco performed and recorded a suite by the 19th-century Spanish composer Isaac Albéniz for later broadcast on radio stations across the country. By itself, this fact is not unusual. What *is* unusual is that his performance wasn't recorded in a sound studio. It was recorded in the cabin of the 1993 Lexus LS 400. *At 55 mph.*

Outside: the rustling of leaves caused by the speed generated from the 32-valve, 250-hp V8.

Inside: the sweet and pure notes from Mr. Barrueco's handmade, cedar-topped guitar.

cording Studio?

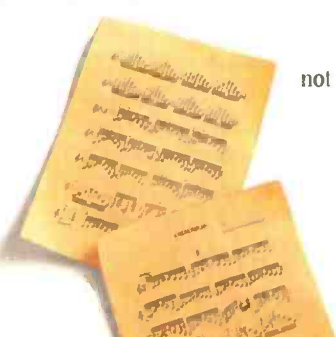




reduce wind noise, even the radio antenna automatically lowers whenever the cassette or CD is played.

All of which means that the cabin of the 1993 Lexus LS 400 is a great place to listen to your favorite recording artists. Whether they're sitting beside you, or emanating from the audio system.

How could we be so confident that the sound from one environment would not intrude too much upon the other?



A steel-resin-steel sandwich insulates the cabin from the engine and trunk. Sound-dampening materials are under the hood, in the dash, under the floor, and within the roof pillars. And to

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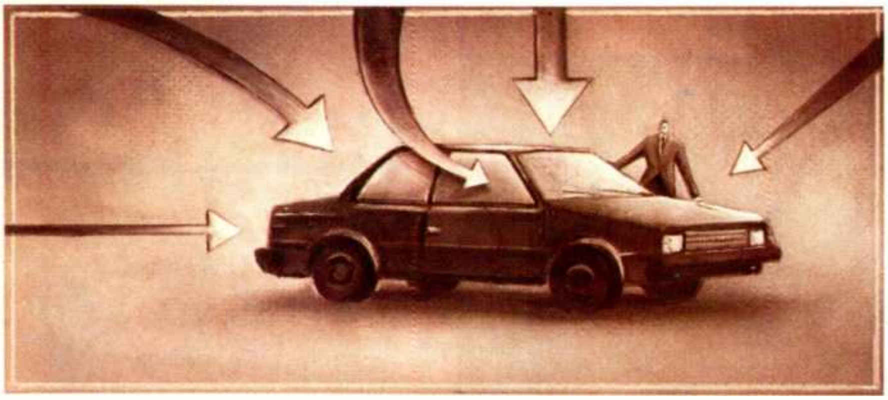
MODULES FOR MOTORISTS



Good home stereo systems are built up from separate components—as are most home computers, though the components are actually plug-in, internal boards. So far, car stereo systems have generally been far less modular, but this could soon change.

Once past the dashboard slot, fancy car stereo systems have a lot of modularity. My own has two power amps, a crossover, and an equalizer in the trunk; many systems also have CD changers back there. But what's usually in the dash is still an all-in-one combination of tape (or CD) player, FM/AM tuner, and system controller/preamp—functions that are all separate in equivalent home systems. Given the tyranny of the dashboard slot, can modularity go further?

In the '70s, several Japanese companies offered car systems that copied the home component approach, with separate tuner, tape deck, preamp, and so on. This approach required custom consoles to hold all the control panels. Worse, it required that the driver's hands roam all around the dash to operate a zillion separate controls.

It makes more sense to keep all the controls in the dashboard slot. Having the head unit control a remote CD changer is a good beginning, but still more can be done. For example, many in-dash CD players have outboard tuner modules. I used to think this was due to space problems or a need to get the r.f. section well away from noisy digital circuits. But the manual for the Pioneer KEX-M900 I tested a few months ago stated its tuner module was an option. That's not the case in the U.S., but it may well be true in Japan, where there are fewer radio programs to hear. And I know that several Pioneer models share the same outboard tuner pack. So why not offer a choice of tuner packs, with different features and performance?

Everything could be optional: Frequency bands (AM, FM, even TV sound and short wave), number of memories, tuning modes, timers to ensure you don't miss your favorite programs, and more. With microprocessor technology, the tuner could tell the controller what features to show on its display, and change the labels as well as the functions of controls accordingly.

The tuner module could be mounted in the trunk, for shorter audio cables to a separate power amplifier and a shorter path for r.f. signals from rear-mounted antennas. (I know Alpine offers at least one such tuner option, and I think Sony ES may, too.)

Changers could offer a similar range of choice, including magazine size, programming facilities, and other functions. Outboard D/A converters are already here, available from Alpine, Kinergetics, Nakamichi, and Soundstream. Equalizers, crossovers, and ambience processors could also be available in several flavors, each reporting back to the head unit what functions and features are available and what should be displayed.

Such multiplicity of choice would be more than any single manufacturer could offer. But manufacturers already make different bets on what features the market will require—producing, for example, changers that take three-, five-, six-, 10-, and 12-disc magazines. If all manufacturers adopted common interface standards—so manufacturer A's head unit could control manufacturer B's tuner module and manufacturer C's changer—then car stereo buyers would have as flexible a choice as common standards gave buyers of home stereos decades ago.

Don't hold your breath, however. Despite what common standards have done for the home component industry, car stereo manufacturers resist the idea, tooth and nail. Last I heard, many car stereo manufacturers who follow European standards for common plug arrangements and color coding in equipment sold over there use a nonstandard jumble of connection schemes in equipment they sell here. And two-way interfacing standards, where the outboard components control the head unit's display, would add technical complexity to the search for standards. A

Illustration: Karen Stolper

Turn Your Stereo Into An All-Out Dolby Surround Pro-Logic System.

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Our new PL100 Dolby Pro Logic decoder with 3-channel amplifier; magnetically shielded Center Channel speaker; The Surround II dipole radiating surround speakers. Factory-direct price, $799.

Until now, adding Dolby Surround to a stereo system has been complex and expensive. Add-on decoders were inadequate, costly, and often required separate amplifiers. We've changed all that with our affordable, high performance Pro Logic Add-On Systems.

Both systems are centered around our new PL100–a Dolby Pro Logic decoder with three channels of amplification (40 watts to the center channel, 15 watts to the surround channels) and a wireless remote. Its built-in signal generator enables precise balancing of the left, center, right and surround speakers. The signal delay applied to the surround channel is selectable for room size. Other controls include master volume, rear and center level, and a Phantom mode enabling the use of the PL100 without a center speaker. Purchased separately, the factory-direct price of the PL100 is $399.

Our new PL100 Dolby Pro Logic decoder with 3-channel amplifier; low profile Center Channel Plus speaker; The Surround dipole radiating surround speakers. Factory-direct price, $999.

$799 Dolby Pro Logic Add-On System.

The center channel speaker in our $799 Dolby Pro Logic Add-On System is our new magnetically shielded Center Channel (see ad on following page). The rear/side speakers are a pair of The Surround™ II. Unlike any other surround speaker in its price range, The Surround II uses advanced dipole radiator technology. Properly mounted on the side walls of a listening room, their high frequency drivers direct out-of-phase sound signals towards the front and rear of the room. The sound then reflects off the surfaces in the room, finally reaching listeners from all directions, "surrounding" them with sound.

Because the drivers are out of phase with each other, they create a null area directly in front of the speakers, so listeners can't pinpoint the source of the sound. The result is surround sound the way it was meant to be heard.

$999 Dolby Pro Logic Add-On System.

Our $999 Dolby Pro Logic Add-On System combines the PL100 with our new low-profile Center Channel Plus speaker and our highly acclaimed surround speaker, The Surround. Center Channel Plus is a magnetically shielded speaker with four 3" long-throw woofers and a ring radiator tweeter. Because of its wide, low profile (25" wide, 4" high, 6½" deep), it is ideal for placement directly on top of, or, with optional support unit, *beneath* a TV. The frequency range of the outer pair of 3" woofers is intentionally limited to maintain proper dispersion. We don't know of any speaker, at any price, that outperforms Center Channel Plus.

The surround speakers in this system are The Surround, a dipole radiating speaker with higher volume level capability than The Surround II. We feel The Surround is one of the very best surround speakers made, despite the fact that it costs hundreds less than competing models.

So if you already own a fine stereo system, TV and VCR, why not create an all-out home theater with one of our Dolby Pro Logic Add-On Systems?

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BERT WHYTE

PROJECTING A WINNER

As I write this, the Winter Consumer Electronics Show in Las Vegas is a few days hence. While DCC and MD will undoubtedly generate a great deal of interest, the explosive home theater market will most likely occupy center stage. For weeks now, my mailbox has been filled with bulletins and press releases from manufacturers of all types of equipment for surround sound: Loudspeaker arrays, multichannel amplifiers and A/V receivers, decoders, A/V switchers, TV monitors, front and rear projectors, and LaserDisc players. Needless to say, there is great diversity in all this equipment, from basic entry-level components to the most sophisticated high-tech A/V systems at stratospheric price levels. Obviously, consumers interested in setting up a surround sound theater in their homes have a very wide choice of systems in all price ranges.

The prospective owner of a home theater would be wise to keep in mind that synergy between the audio and video components is of primary importance. One can temporize and rationalize on all aspects of the theater system, but the inescapable conclusion is that you should not combine high-quality audio components with small-screen video or mate a high-resolution, 100-inch projection system with underpowered, mediocre surround loudspeakers. To subvert either audio or video performance is to greatly diminish the impact and realism of the home theater experience.

Sharp's XV-S250U LCD projector is nearly as bright and about as sharp as a CRT model, but much smaller.

Unfortunately, this lofty attitude must often be compromised to some degree by the physical constraints and decor considerations imposed by the room in which the theater system is to be installed. Large-screen video—72 to 100 inches or more—usually means that front projectors must be used. Although some of these projectors are remarkably compact, they are still far from inconspicuous, especially when mounted in a cabinet on the floor or from the ceiling. If your room doesn't allow for a front projector, take heart—all is not lost.

Joe Kelly, a friend of mine who was vice president of sound and projection for United Artists Theaters, told me about an industrial version of a Sharp liquid-crystal display projector, the Model 2000. Now retired and an A/V consultant, Joe says he has used this unit in a number of small community recreational theaters and found it quite satisfactory for screen sizes up to 120 inches. Now Sharp has introduced a consumer version of the Model 2000, the XV-S250U, and I have been evaluating its performance.

The Sharp XV-S250U is housed in a charcoal-gray plastic cabinet measuring a very compact 9 inches wide, 17⅜ inches deep, and 12⅛ inches high. Its light weight, less than 29 pounds, and its folding handle on top make for easy carrying. It has two composite video inputs and two S-video inputs. A VCR serves as the video tuner, and audio output is taken from the VCR. The projector's remote control affords switching between various video sources and activates on-screen displays to adjust contrast, color, tint, and sharpness. Five memories are available to store selected parameters, while a "Reset" button returns the S250 to the factory preset values and balances. (For most TV programs, the factory setting is quite satisfactory.) The ad-

The Powered Subwoofer That Has The Audio And Video Press Jumping Out Of Their Seats.

NEW FROM CAMBRIDGE SOUNDWORKS

A jet roaring in *Top Gun*. The heavy-footed killer robot in *Robocop*. A semi hitting concrete after a 20 foot fall in *Terminator 2*. These are examples of the substantial, very low-frequency effects on the soundtracks of today's movies. Such frequencies are rare in music, and are beyond the capabilities of most speakers designed for music.

The new Cambridge SoundWorks Powered Subwoofer by Henry Kloss was created to reproduce those ultra-low, ultra-strong bass signals with the power and impact you would experience in movie theaters with the very best sound systems. It's designed to *supplement* (not replace) the subwoofer(s) of Ensemble or Ensemble II. It will also work with speakers from other companies.

Powered Subwoofer *Slave Subwoofer*

Remarkable bass performance.

The Powered Subwoofer consists of a heavy duty, 12 inch long-throw acoustic suspension woofer integrated with a 140 watt amplifier–all in a high-pressure black laminate cabinet. Its control panel includes a bass level control and an 18dB per octave, four-position electronic crossover frequency selector (to match the subwoofer to your other speakers).

Additionally, an optional electronic crossover* will provide 18 dB per octave, high-pass, line-level filters for the main and center amplifiers. These filters allow you to keep strong, low frequencies of sound effects out of the front speakers. These signals can cause distortion, even in speakers designed for full-range music.

The Powered Subwoofer's bass performance is simply *awesome*. It reproduces accurate bass to below 30 Hz. You'll hear soundtracks the way they were meant to be heard. In fact the bass is *better* than most theaters! At the press event when we introduced our Powered Subwoofer, we had startled members of the audio and video press literally "jumping out of their seats" during demonstrations of movie soundtracks. The factory-direct price of the Powered Subwoofer is $599.

Our Ultimate Home Theater Speaker System consists of our dual-subwoofer Ensemble system; our low profile Center Channel Plus speaker; a pair of our critically acclaimed surround speakers, The Surround; our Powered Subwoofer; our Slave Subwoofer. Factory-direct price: $1,999.

Optional "slave" subwoofer.

For all-out home theater performance, you can add our optional Slave Subwoofer, which is identical to our Powered Subwoofer except that it lacks the amplifier and controls. It uses the amplifier and controls built into the Powered Subwoofer. Amplifier output jumps from 140 to 200 watts when the Slave Subwoofer is connected.

The combination of the two speakers can reproduce a 30 Hz signal cleanly to a sound pressure level of over 100 dB in a 3,000 cubic foot room! That's enough clean, deep bass for the largest home theaters, and the most demanding listeners. The factory-direct price of the Slave Subwoofer is $299.

No compromises. No apologies.

The combination of our Ensemble speaker system, Center Channel Plus speaker, The Surround rear/side speakers, Powered Subwoofer and Slave Subwoofer (see photo at left) creates a home theater speaker system that we believe is the best of its kind.

Although you can spend thousands more on competing systems, we don't know of *any* that outperform this $1,999 package. If you'd like more information, a free catalog or our new booklet, "Getting The Most From Your Dolby Surround System," call our toll-free number any time.

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justment controls are also found under a panel on the top left side of the projector's cabinet.

An f/4.5 zoom lens with a 2:1 range (105 to 210 mm) is fitted to the front of the projector's cabinet. This lens adjusts the size of the projected image and is then focused in the same manner as a 35-mm projector lens. The light source is a high-intensity metal halide lamp, which, by the way, generates considerable heat that is dissipated by a fairly noisy fan. The lamp activates red, green, and blue (RGB) liquid-crystal display panels, each 2.8 square inches. The translucent LCD panels are driven by thin-film transistor (TFT) active matrices. Each panel has 217,945 pixels, so the RGB panels total 653,835 pixels. The RGB images are combined via dichroic mirrors and configured and aligned so that they produce a full-color image that is projected through the single lens to the screen.

With LCD projectors, the more pixels available, the better and brighter the image will be. Frankly, earlier models of Sharp LCD projectors had low pixel counts and thus unacceptably low brightness. The XV-S250U, which costs $7,495, is the first LCD projector that compares favorably in brightness to cathode-ray tube projectors in the same price range. In Japan, Sharp has an HDTV LCD projector whose 3,500,000 pixels permit the 1,125-line resolution of the NHK "Muse" HDTV system. The slight hitch is its $105,000 price tag!

SYNERGY BETWEEN AUDIO AND VIDEO ELEMENTS IS OF PRIMARY IMPORTANCE IN A HOME THEATER.

The XV-S250U is said to be capable of more than 400 lines of horizontal resolution. With an S-VHS VCR and a LaserDisc player as sources, the image sharpness was excellent and comparable to CRT projectors using these sources. More important, the picture excelled in color balance, saturation, and contrast, affording a very lifelike image with minimum eye fatigue.

In comparison to the elaborate and tedious convergence adjustments necessary to set up a projector with separate red, green, and blue cathode-ray tubes, setting up the XV-S250U is simplicity itself. It takes longer to read the instruction manual than to set up this LCD projector! A "throw," or distance from projector to screen, of just 12½ feet will provide a 100-inch (diagonal) image. Just place the S250 on an appropriate table or stand, and make sure the projector is not angled too much (or "keystoning" will occur). As with almost all projectors, there are a few caveats. Sharp does itself a disservice in advertising "just aim it at a white wall." For one thing, the usual flat paint on a wall will diminish brightness. For another, "white" walls are rarely of the purity of a good projection screen. The typical matte white roll-up screen gives nice, contrasty images with reasonable brightness, even though the screen's gain is 1.0 or perhaps 1.2.

Using the Sharp S250 projector with a "disappearing" electric roll-up screen allows you to have large-screen video images more or less on demand. If you're expecting a lot of family or friends to visit or are giving a party, the screen can be rolled up and the projector can be unplugged, picked up, and put into a closet. When the festivities are over, the projector can just as quickly and easily be reinstalled. This flexibility is one of the most appealing features of the unit.

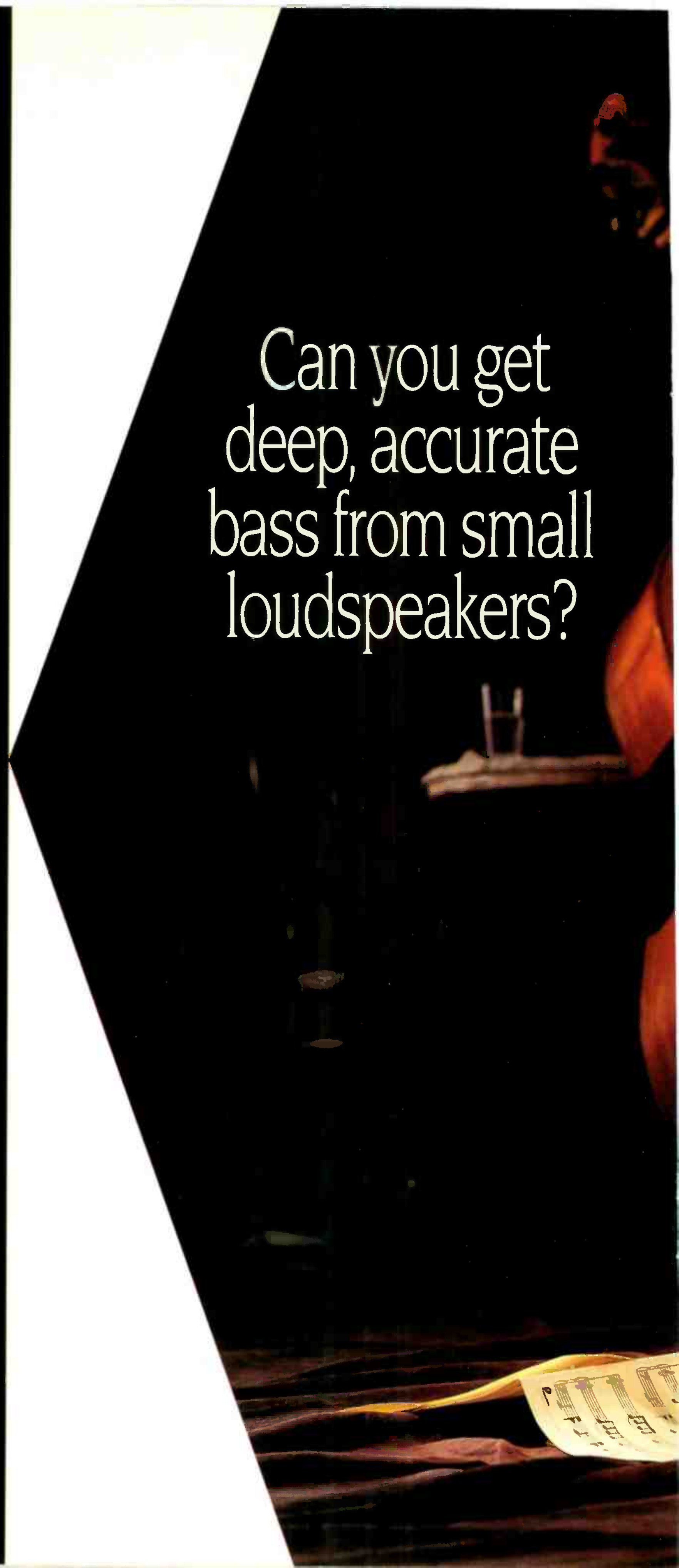
Optimum performance from the Sharp LCD projector, however, entails the use of a stand-mounted, high-gain projection screen. I used the S250 with a Vutec 100-inch screen that has a gain of 13. With this setup, the brightness of the LCD is on a par with that of most CRT projectors. I spoke to several engineers and executives at Sharp, and they told me they were meeting with the Vutec (formerly National Viewtech) people about furnishing a 72-inch, high-gain, stand-mounted screen for less than $475. I also spoke to the head of Vutec, who said they were developing a roll-up screen with a gain of 2.5, which would provide an acceptably bright image.

One of the drawbacks of early LCD projectors was that their pixel elements were too visible on the screen. While you can see the S250's pixels if you're just a foot or so from the screen, they are not perceptible at normal viewing distances of 12 to 15 feet. The Sharp engineers also told me that by late this summer, the company expects to have LCD projectors with even more pixels and that they'll have a scanning rate of better than 31.5 kHz, thus permitting the use of line-doublers for high resolution! If I had my druthers, I'd like to see LCD projectors with f/3.5 or even f/2.8 lenses, separate RGB inputs, and acoustic baffling to reduce fan noise.

With a compact video projector like the Sharp S250, you need a high-quality A/V receiver. Colleague Leonard Feldman did an "A/V Receiver Roundup" in the December 1992 issue, and one he was most favorably impressed with was the $1,795 Onkyo TX-SV909PRO. It has seven amplifiers of fairly high output, and Len cited its superb FM tuner section. Included are such niceties as digital Dolby Pro-Logic and, uniquely, an Ambisonic decoder.

I acquired one of these Onkyo A/V receivers, mainly to check out the Ambisonic decoder. I am happy to say that it does one of the best jobs of properly decoding Ambisonic CDs I have heard thus far. The Ambisonic functions are accessed by remote control and are unusually comprehensive; all pertinent information is noted on the receiver's display. I tried the decoder with many Ambisonic CDs from Nimbus as well as with some of the superb Ambisonic CDs from Collins Classics, which utilize the more advanced Ambisonic encoding/mixing of the new British Audio + Design equipment. Paul McCartney's *Liverpool Oratorio* on EMI CD7-543712 was Ambisonically recorded (even though this is not indicated). Recording engineer John Timperly did a splendid job of capturing the glorious voice of Kiri Te Kanawa and all the other soloists and choruses, as well as the Royal Liverpool Philharmonic Orchestra. Although the music is often naive and even trite, it is nonetheless quite melodic and has some exciting moments. Not only was the sound ultra-clean, but the Ambisonic presentation through my Shure surround sound speakers transported me into the vast Liverpool Cathedral and its huge, spacious perspective.

The Onkyo receiver is wonderfully versatile, and I can certainly commend it for use with the Sharp LCD projector. Of course, the choice of speaker systems for surround sound is very wide indeed, at all price ranges. Just remember, large-screen video demands large-scale sound to achieve that magic synergy which can be so involving and exciting! A



Can you get deep, accurate bass from small loudspeakers?

The laws of physics dictate that deep bass can only be produced by larger loudspeakers or by inefficient, smaller designs. While the laws of physics can't be broken, they can be bent a little.

KEF's loudspeaker science has developed the Coupled Cavity Bass system, which combines the deep bass extension of sealed enclosures with the high efficiency of ported designs. The result? Speakers capable of full concert volume with deep, tight bass and crisp transients... without requiring excess power or space.

THE KEF COUPLED CAVITY BASS SYSTEM COMBINES DEEP BASS WITH HIGH EFFICIENCY.

Realistic deep bass and audio/video compatible magnetic shielding make KEF Reference loudspeakers ideal for home theater applications.

The Coupled Cavity Bass System, joins such other KEF scientific advances as the Uni-Q® Driver, which helps eliminate the adverse effects of room acoustics; and Conjugate Load Matching, which makes it less strenuous for your amplifier to drive your speakers. Together, these advances have earned KEF its international reputation for real-world performance.

For KEF, the world's finest speakers are those that sound best in your home.

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COLORATION OF ROOM

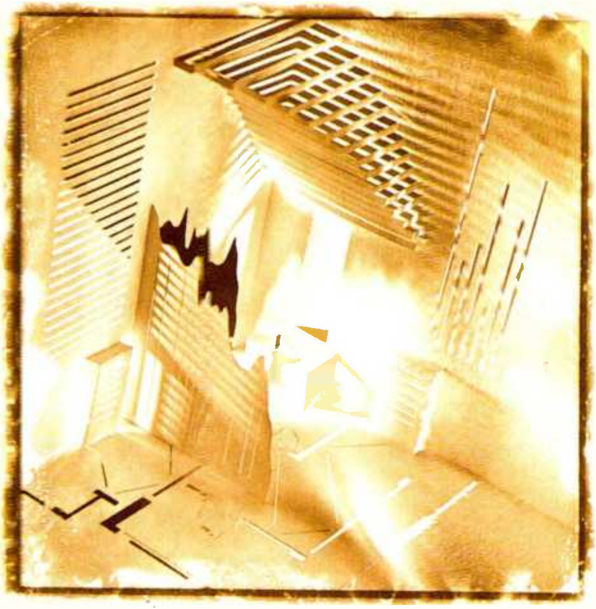
F. Alton Everest

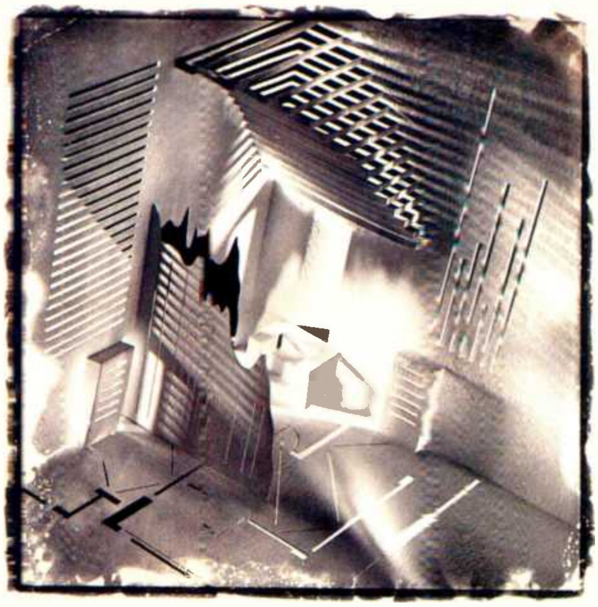
Every home listening room is beset with sound reflected from walls, floor, and ceiling. These reflections may enhance or degrade the quality of the music, depending on subjective opinions or on such objective factors as the loudspeakers' and the listener's positions, the size of the room, and the reflective properties of the room surfaces. A basic understanding of the effect of reflections on the listener's perception of music is important to the audiophile.

The first sound to arrive at the listener's ears is the sound directly from the loudspeaker. This localizes the source of the sound. Reflected sound arriving immediately after the direct is masked as far as localization is concerned, but it does affect the quality of the sound.

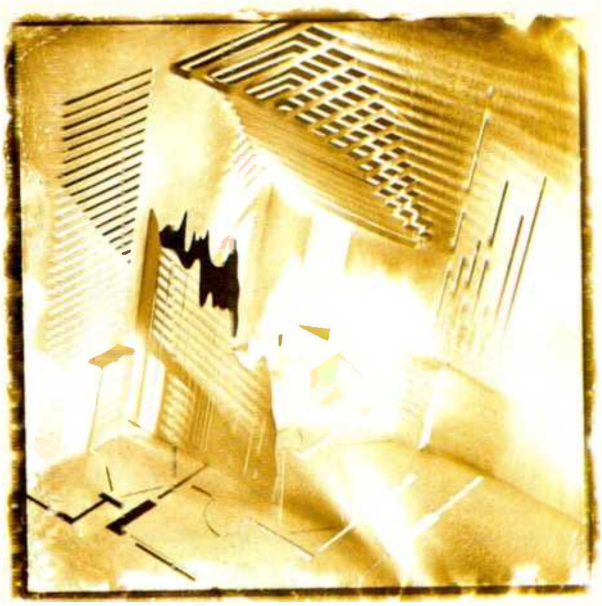
The sound directly from the loudspeaker arrives first at the listener's ear, because it travels the shortest path. Reflections arrive later because of the time required to travel to the side wall (for example) and back to the listener's ear. The reflection is weaker than the direct sound because of the greater distance travelled and because of losses at the reflecting surface. The three variables descriptive of a reflection are its level, delay, and angle of incidence. Level is expressed in dB below the amplitude of the direct sound, delay in milliseconds after the direct sound's arrival, and angle of incidence in degrees horizontally and vertically relative to the direct sound.

A normal stereo arrangement in the average home listening room usually yields strong early reflections, predominantly in the range from 1 to 20 mS. Multiple reflections and reflections from the rear of the room are delayed much more than 20 mS, but they often are of less immediate significance because their level is low due to the greater distance travelled and to multiple reflection losses. Single-bounce reflections from front and side walls, ceiling, and floor are dominant because their levels are high-





SOUND BY REFLECTIONS



Bill Milne/photography
Ian Colliety/paper sculpture

est. The levels of these early reflections in a typical listening room are rarely more than 10 dB below the direct, with delays from 1 to 20 mS. The questions then boils down to, "What effect on listening will reflections have if their delay is 1 to 20 mS and their levels are within 10 dB of the direct signal?" Some very interesting psychoacoustical research can help answer this question.

Reflection Research

Many psychoacoustic experiments have been conducted in the past, involving perception of a direct signal in the presence of a simulated reflection. Curiously, most of these have been done with loudspeakers and observer arranged very much like the standard stereo setup. Many of the earlier experiments applied more to listening conditions in the concert hall. It remained for Sean Olive and Floyd Toole at the National Research Council of Canada to verify some of the early experiments and to perform many others applying directly to the home listening room [1].

One intuitively senses that the quality of the direct sound in the listening room is affected by reflections from the surfaces of the room, but actual measurements are needed. To measure the effect, the observer is seated in an anechoic room facing a loudspeaker that radiates the direct, or primary, signal (Fig. 1). A second loudspeaker, the simulated reflection, 30° to 60° off to the side, radiates the same signal with adjustable level and delay. With the direct signal at a comfortable level, the level of the side loudspeaker, representing a lateral reflection, is varied both in level and delay to investigate the audible effects of the "reflection." The monophonic results of such tests are directly applicable to stereophonic listening.

Some fundamental information is shown in Fig. 2. At a certain delay setting, say, 20 mS, the level of the reflection is slowly increased from a very low level until something different is first heard. This is termed the threshold of audibility of the simulated reflection. If the same delay is maintained, a sense of spaciousness is perceived as the reflection level is increased slowly above threshold. This sense of spaciousness is very real, even making the anechoic chamber sound more like a normal room. Increasing the level of the reflection continues to increase the spatial effect. About 10 dB above the threshold of audibility of the reflection, a second threshold is found. Now the direct signal is perceived in a still different way: As a broadening of the image and, at still higher reflection levels above the second threshold, as a shifting of the image (away from the direct source). Spaciousness generally persists in addition to these new effects.

As the strength of the reflection is increased still more, a third threshold is approached, delineated by curve C in Fig. 2. The direct sound is now perceived along with a discrete echo.

Reviewing the meaning of Fig. 2, we can see that reflections having level and delay values which place them in the shaded area below the solid curve are not heard at all; they have no effect on the quality of the direct sound. Reflections having level and delay values which place them in the shaded area above curve C of Fig. 2 are detrimental to the primary sound because discrete echoes are introduced. The reflections whose level and delay place them in the unshaded central area are, potentially at least, useful. A single, lateral reflection from a side wall can produce varying amounts of spaciousness and image broadening if the absorption of the wall surface at the point of impact is changed. This gives hope to the serious listener that something may be done about optimizing his own listening situation.

Olive and Toole stated that the observers in these experiments felt they were "responding to directional and spatial effects, rather than to changes in timbre or sound coloration." Therefore, gathering these spatial and directional effects under the term "coloration" may be questionable. The word color, as applied to sound, carries a meaning of frequency response, or timbre, in an analogy to light. For better or for worse, the title of this article lumps spatial and directional effects together with timbral effects.

Reflection Direction

The reflections on which Fig. 2 is based all came from roughly the same direction. Do reflections from the ceiling and the side walls have the same effect? In other words, how general is the data of Fig. 2? It has been demonstrated by Olive and Toole (and others) that the direction from which the reflection arrives has practically no influence on its effectiveness—with one important exception. When the reflection comes from the same direction as the direct signal, detection of the reflection is somewhat suppressed. The direct signal tends to mask, by about 5 to 10 dB, reflection effects from the same direction. This would seem to mean that delayed reflection effects recorded with music would be somewhat discriminated against as they are reproduced in the listening room.

Spaciousness Recorded with Music

Spaciousness has been eagerly sought after in the concert hall. The effect has been variously described as ambience, envelopment, apparent source width, subjective diffusion, spatial impression, etc. It is the goal of the acoustical consultant to guide the architect toward a structure that will produce lateral reflections to give the music these desired attributes for those in the audience. The microphones recording a music event, however, are not placed at the listener's position in the audience; hence they will record a different spaciousness, one better described as the ambience of the room. The reflection effects picked up by the microphones will differ from those

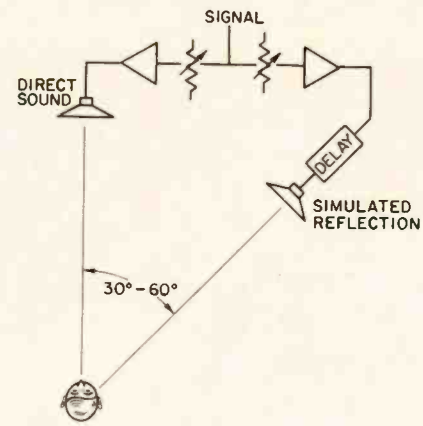


Fig. 1—Setup for testing effect of simulated reflections on direct signal.

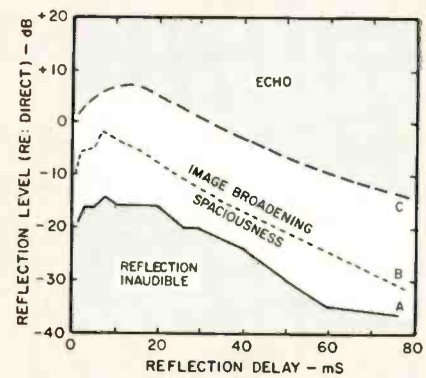


Fig. 2—Absolute thresholds for a single lateral reflection of a speech signal under anechoic conditions.

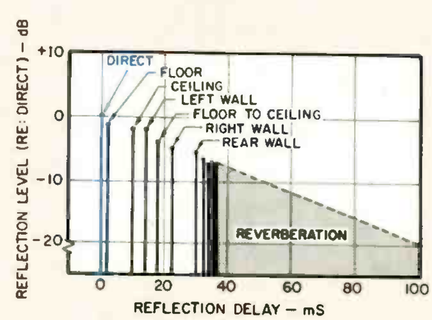


Fig. 3—Early reflections in a typical home listening room.

A REFLECTION'S EFFECT ON PERCEIVED SOUND DEPENDS UPON ITS LEVEL, DELAY, AND APPARENT SOURCE.

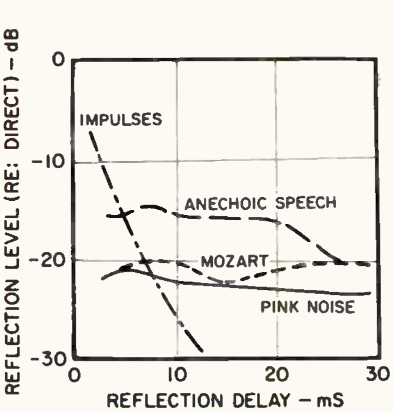


Fig. 4—Audibility thresholds for reflected sounds of different types.

perceived by the audience. It is even possible that some artificial reverberation will be added. Recorded ambience effects will be played back in the home listening environment along with the music. This results in two possible sources of spaciousness in the home listening room: That which is on the CD or other medium, recorded along with the music, and that which is produced in the listening environment. The spaciousness in the original recording tends to be masked by the direct signal, which comes to the listener from the same direction, the loudspeaker.

Spaciousness in Listening Rooms

What audiophile isn't interested in the sharpness or broadening of the perceived image or in optimizing to taste the ambience or spaciousness of the listening environment? Adjustment of these factors would seem to be possible through controlling level and delay of early reflections, shown in Fig. 3. Actually, the delay part is determined by the geometry of the listening room and the arrangement of loudspeakers. The absolute threshold of audibility of a single reflection in Fig. 2 is essentially independent of delay below 20 mS. This leaves the adjustment of the level of the reflection as the variable for achieving the desired results. (More on this later.)

Classification of Signals

Olive and Toole gathered data from afar to add to their own, which compared the threshold of audibility of different types of signals [1]. They compared the effects of Handel's Concerto Grosso, pizzicato violin, music of Mozart, speech, castanets, clicks, and pink noise. This study suggested the desirability of classifying signals as continuous or noncontinuous. Pink noise may be taken as the epitome of the continuous type; a series of clicks (pulses) at a rate of two per second is the noncontinuous extreme, while speech and music are in between. The role of pink noise as a reasonable, easily measurable signal as a surrogate for music is supported by studies of reflection threshold (Fig. 4).

A modest amount of reverberation (either on the recording or generated in the room) tends to make a noncontinuous signal act like a continuous one. The very existence of a reverberant field in the typical listening room is questioned by some. There is no denying, however, the existence of many late reflections, which tend to become merged (as in Fig. 3).

The thresholds of audibility of a single lateral reflection for signals varying in "continuousness" are compared in Fig. 4. Note that the slope of the threshold curve increases as the discontinuity of the signal becomes more apparent.

Spectrum and Reflection Audibility

The early studies were conducted with identical signals for both the direct sound and the simulated reflection, but this is an unreal situation. The spectrum of the direct sound in the listening room is usually as flat as the state of the art will permit. The off-axis sound of the loudspeakers striking the side walls (for example) is deficient in highs. The sound reflected off the side walls loses even more highs because of the absorption characteristics of the surface. (See Table I.) This means that the reflection coming back to the listener from the side wall has a spectrum differing greatly from that of the direct sound. Tests revealed that extreme low-pass roll-off had little effect on the absolute threshold of audibility of reflections. It should be noted, however, that although the detection of the reflection was not altered, the audible effects above the threshold were strongly affected by the spectral changes, in terms of both spatial effects and timbre.

Adjustment of Spaciousness

Can this new knowledge of the effect of reflections on the quality of the signal be put to use in the home listening room? In

Table I—Absorption coefficients of general building materials and furnishings. (Reprinted with permission from *Handbook for Sound Engineers—The New Audio Cyclopedia, Second Edition,* Glen Ballou, editor; Howard W. Sams, publisher; 1991.)

	Absorption Coefficient					
Material	**125 Hz**	**250 Hz**	**500 Hz**	**1,000 Hz**	**2,000 Hz**	**4,000 Hz**
Brick						
Unglazed	0.03	0.03	0.03	0.04	0.05	0.07
Unglazed, painted	0.01	0.01	0.02	0.02	0.02	0.03
Carpeting, heavy						
On concrete	0.02	0.06	0.14	0.37	0.60	0.65
On 40-oz. hairfelt or foam rubber	0.08	0.24	0.57	0.69	0.71	0.73
With impermeable latex backing on 40-oz. hairfelt or foam rubber	0.08	0.27	0.39	0.34	0.48	0.63
Concrete block						
Coarse	0.36	0.44	0.31	0.29	0.39	0.25
Painted	0.10	0.05	0.06	0.07	0.09	0.08
Fabric, velour						
Light, 10 oz. per sq. yd., hung straight, in contact with wall	0.03	0.04	0.11	0.17	0.24	0.35
Medium, 14 oz. per sq. yd., draped to half area	0.07	0.31	0.49	0.75	0.70	0.60
Heavy, 18 oz. per sq. yd., draped to half area	0.14	0.35	0.55	0.72	0.70	0.65
Floor						
Concrete or terrazzo	0.01	0.01	0.15	0.02	0.02	0.02
Linoleum, asphalt, rubber, or cork tile on concrete	0.02	0.03	0.03	0.03	0.03	0.02
Wood	0.15	0.11	0.10	0.07	0.06	0.07
Wood parquet in asphalt on concrete	0.04	0.04	0.07	0.06	0.06	0.07
Glass						
Large panes, heavy plate	0.18	0.06	0.04	0.03	0.02	0.02
Ordinary window	0.35	0.25	0.18	0.12	0.07	0.04
Gypsum board, ½ in., nailed to 2 × 4s, 16 in. on center	0.29	0.10	0.05	0.04	0.07	0.09
Marble or glazed tile	0.01	0.01	0.01	0.01	0.02	0.02
Openings						
Stage, depending on furnishings			0.25-0.75			
Deep balcony, upholstered seats			0.50-1.00			
Grilles, ventilating			0.15-0.50			
Plaster, gypsum, or lime						
Smooth finish on tile or brick	0.013	0.015	0.02	0.03	0.04	0.05
Rough finish on lath	0.14	0.10	0.06	0.05	0.04	0.03
Smooth finish on lath	0.14	0.10	0.06	0.04	0.04	0.03
Plywood panelling, ⅜-in. thick	0.28	0.22	0.17	0.09	0.10	0.11
Water surface, as in a swimming pool	0.008	0.008	0.013	0.015	0.020	0.025
Air, sabins per 100 cu. ft. at 50% relative humidity				0.9	2.3	7.2

control rooms, sharp image localization and spatial discrimination are generally desirable. In the concert hall, spatial enhancement is the goal. The most favorable conditions in the home listening room are far less specific and subject to personal preference. What follows is based on the assumption that the creative and discriminating listener will welcome suggestions for controlling the degree of spaciousness to fit a specific listening space and a favorite type of music.

The first step is to examine the details of the early reflections in the listening room, much as in Fig. 3. The delay of each specific early reflection may be found from the difference in path length between the direct and reflected sounds, based on the speed of sound, 1,130 feet per second. For example, the direct distance from the left speaker to the listener's ears is measured. The length of the path of the floor bounce from that speaker is also measured. The delay of this first reflection to arrive at the listener's ears is then calculated. To obtain the reflection delay, subtract the direct path from the reflected path and then divide this result by 1,130. If, for example, the reflected path is 7.8 feet and the direct path is 7.5 feet, the floor bounce is delayed by only about

Sinéad O'Connor: Am I Not Your Girl? (Chrysalis) 00139 †

Neil Young: Harvest Moon (Reprise) 00208

The Doors: L.A. Woman (Elektra) 00215

The Cure: Wish (Elektra/ Fiction) 11116

Guys And Dolls/New Broadway Cast (RCA Victor) 61964

Billy Ray Cyrus: Some Gave All (Mercury) 41711

Bonnie Raitt: Luck Of The Draw (Capitol) 15567

Enya: Shepherd Moons (Reprise) 53190

Pat Metheny: Secret Story (Geffen) 82267

Two Rooms-Celebrating The Songs Of Elton John & Bernie Taupin (Polydor) 35407

The Baddest Of George Thorogood And The Destroyers (EMI) 84002

Temple Of The Dog (A&M) 31124

Clint Black: The Hard Way (RCA) 35458

Carreras, Domingo, Pavarotti: 3 Tenors (London) 35078

Eagles: Greatest Hits 1971-1975 (Asylum) 23481

Natalie Cole: Unforgettable (Elektra) 83452

The Very Best Of The Righteous Brothers: Unchained Melody (Verve) 44658

John Mellencamp: Whenever We Wanted (Mercury) 74582

Michael Penn: Free-For-All (RCA) 20668

Van Morrison: Tupelo Honey (Warner Bros.) 00217

Suzanne Ciani: The Private Music Of Suzanne Ciani (Private) 00225

Neneh Cherry: Home Brew (Virgin) 00239

Meltdown: The Birth Of Fusion (Rykodisc) 00244

Mo' Money/Sdtrk. (A&M) 71593

Beastie Boys: Check Your Head (Capitol) 92473 †

The Smiths: Best...I (Reprise) 24868

Skid Row: B-Side Ourselves (Atlantic) 00127

Jethro Tull: A Little Light Music (Chrysalis) 00140

Chicago: Greatest Hits 1982-1989 (Reprise) 63363

DAS EFX: Dead Serious (Atco/EastWest) 25328

Mötley Crüe: Decade Of Decadence (Elektra) 40298

Shirley Horn: Here's To Life (Shirley Horn w/Strings) (Verve) 11134

Emerson, Lake & Palmer: Brain Salad Surgery (Atlantic) 54608

The Rascals' Greatest Hits: Time Peace (Atlantic) 00357

Guns N' Roses: Use Your Illusion I (Geffen) 35469 †

Guns N' Roses: Use Your Illusion II (Geffen) 25534 †

Color Me Badd: C.M.B. (Giant) 25479

Kenny Rogers: 20 Great Years (Reprise) 25449

David Benoit: Letter To Evan (GRP) 00251

The Barcelona Games Ceremony (RCA) 35167

Eagles: Greatest Hits, Vol. 2 (Asylum) 63318

Yes: Classic Yes (Atlantic) 50248

Tom Petty & The Heartbreakers: Into The Great Wide Open (MCA) 35409

Kronos Quartet: Pieces Of Africa (Nonesuch) 10472

Linda Ronstadt: Frenesi (Elektra) 24810

Randy Travis: Greatest Hits Vol. I (Warner Bros.) 21091

Randy Travis: Greatest Hits Vol. 2 (Warner Bros.) 11125

Larry Carlton: Kid Gloves (GRP) 02487

Patty Smyth (MCA) 25090

David Bowie: Changesbowie (Rykodisc) 43693

Elvis Presley: The Number One Hits (RCA) 72190

Don Henley: The End Of The Innocence (Geffen) 01064

R.E.M.: Out Of Time (Warner Bros.) 24762

Madonna: The Immaculate Collection (Sire) 54164

Traffic: The Low Spark Of High Heeled Boys (Island) 25169

GRP All-Star Big Band (GRP) 63298

Bernstein: The Final Concert (DG) 35095

Moody Blues: Greatest Hits (Threshold) 34284

Neil Diamond: 12 Greatest Hits (MCA) 84050

Sinéad O'Connor: I Do Not Want What I Haven't Got (Chrysalis) 33512

Bonnie Raitt: Nick Of Time (Capitol) 54410

The Police: Every Breath You Take—The Singles (A&M) 73924

Peter Gabriel: Shaking The Tree-16 Golden Greats (Geffen) 11089

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Soundgarden: Badmotorfinger (A&M) 05637

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Aerosmith: Pump (Geffen) 63678

Michael Crawford: Songs From Stage And Screen (Atlantic) 53704

Horowitz The Poet (DG) 25258

Sting: The Soul Cages (A&M) 25218

Foreigner: The Very Best...And Beyond (Atlantic) 24722

Van Halen: For Unlawful Carnal Knowledge (Warner Bros.) 10016

Suzanne Vega: 99.9° F (A&M) 83406

Blues Brothers: The Definitive Collection (Atlantic) 43711

The Beach Boys: Pet Sounds (Capitol) 00513

Maucerl: Hollywood Dreams (Philips) 25299

Vince Gill: I Still Believe In You (MCA) 21063

Beauty and the Beast/Sdtrk. (Disney) 10780

Arrested Development: 3 Years, 5 Months And 2 Days In The Life Of... (Chrysalis) 25357

Asia: Then & Now (Geffen) 93358

Brecker Brothers: Return Of The Brecker Brothers (GRP) 00261

Chieftains: Another Country (RCA Victor) 00268

Siouxsie And The Banshees: Twice Upon A Time- The Singles (Geffen) 00273

The Heights/ Soundtrack (Capitol) 00206

Roy Orbison: King Of Hearts (Virgin) 00241

G.E. Smith & The Saturday Night Live Band: Get A Little (Liberty) 00227

Maucerl: Rodgers & Hammerstein Opening Nights (Philips) 00190*

Roxette: Tourism (EMI) 00193

Television: Marquee Moon (Elektra) 00198

R.E.M.: Fables Of The Reconstruction (IRS/ MCA) 00165

Grand Puba: Reel To Reel (Elektra) 30262 †

Nine Inch Nails: Broken (Interscope) 00145 †

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Robert Cray: I Was Warned (Mercury) 82335

George Strait: Pure Country (MCA) 83064

Miles Davis: Doo-Bop (Warner Bros.) 71151

Gipsy Kings: Live (Elektra, Musician) 73604

White Lion: Greatest Hits (Atlantic) 93654

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THE LEVEL AND ARRIVAL TIME OF AN INDIRECT SOUND DEPEND ON HOW MANY BOUNCES IT MAKES EN ROUTE TO OUR EARS.

0.0003 S, or 0.3 mS. The delay of all other reflections will be greater than this.

The level of a given reflection at the listening position may be estimated by measuring the lengths of the direct and reflected paths. To calculate the reflection level at the listening position, divide the direct distance by the reflection distance, ascertain the log of this result, and then multiply by 20. As an example, say the distance of the loudspeaker to the listener's ear is 12.0 feet and the distance from the loudspeaker to the side wall and then to the listener's ear is 14.1 feet. The reflection level is therefore 20 log (12.0 divided by 14.1), which equals 20 log (0.851) or –1.4 dB with respect to the direct level. This assumes inverse-square propagation and 100% reflection at the wall surface.

With a helper, a measuring tape, and patience, a reflection graph like Fig. 3 can be built up for one of the loudspeakers of the stereo pair and one side wall. The graph itself is not as important as the experience of focusing attention on the early reflections.

It is suggested that reflections from the floor, the ceiling, and the wall behind the loudspeakers be reduced so that the left and right wall reflections will be left in control of the situation. The effects of the floor reflection can be reduced somewhat by a thick rug. The placement of this rug is determined by having the helper move a mirror on the floor so that the person in the listening position can see the tweeter of the left loudspeaker first, and then the right one, in the mirror. The rug should then cover both of these spots.

This same procedure can locate the two spots on the ceiling responsible for the ceiling reflections to the listener's ear. A defined area that includes these two spots can then be covered with acoustic tile, glass fiber, or acoustic foam.

Reflections from the wall behind the loudspeakers are more difficult to pinpoint, as the sound source is primarily diffraction from the edges of the loudspeaker cabinets. The critical area for these reflections can be covered by a sheet of absorbent material (carpeting or heavy drapery). This material should extend from a foot or so to the left of the left loudspeaker to a foot or so to the right of the right loudspeaker, and from the floor to a foot or so above the top of the loudspeakers.

This leaves the energy of the left and right wall reflections to be the first returned to the listener after the direct sound. Cleaning up the floor, ceiling, and front wall reflections has probably already improved the sound quality. Now, the amount of spaciousness to be generated in the listening environment by the side wall reflections can be adjusted. First, the point on the wall responsible for the reflection can be easily found by the mirror method. If no absorbent material covers this spot on the left and right hard walls, the reflection efficiency is close to 100% and the reflection level is at its maximum. If critical listening reveals that this gives too much spaciousness, the reflection level at the listener's position can be reduced by covering the reflecting areas with absorbents having different reflection efficiencies. Selecting material for this is left to the ingenuity of the listener. You will probably find that the optimum wall treatment may be different for different styles of recordings, which makes life interesting.

It is imperative that a clear distinction always be made between the spaciousness and image broadening of the concert hall fixed on the recording and that produced in the environment of the listening room. Attention must also not be diverted from the overall reverberant character of the listening room. If too much absorbent material is added, the room may become too dead for good music listening or even for comfortable conversation. As Olive and Toole [1] say, "... spaciousness and timbral enhancement of the kind that are expected of a concert hall may be unwe come if they are added by an environmer for stereo listening." This is a point to be settled experimentally by the creative listener, who is urged first to study carefully [1] and [2] before embarking on a program of room adjustments. A

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THE AUDIO INTERVIEW

purist producer/artist, sick of gloss, discovers distortion

BRIAN ENO ADDS TAPE HISS TO HIS RECORDINGS.

I thought that might get the attention of some *Audio* readers.

While many may not know his name, Eno's productions have included recordings by David Bowie and Talking Heads. Along with Daniel Lanois, he produced U2's hit albums, *The Unforgettable Fire*, Grammy Award-winning *The Joshua Tree*, and *Achtung Baby*.

Not so much a pop music producer as a *provocateur*, Eno has roots in the 1960s avant-garde of John Cage and Cornelius Cardew and later the minimalism of Steve Reich.

brian eNO

John Diliberto

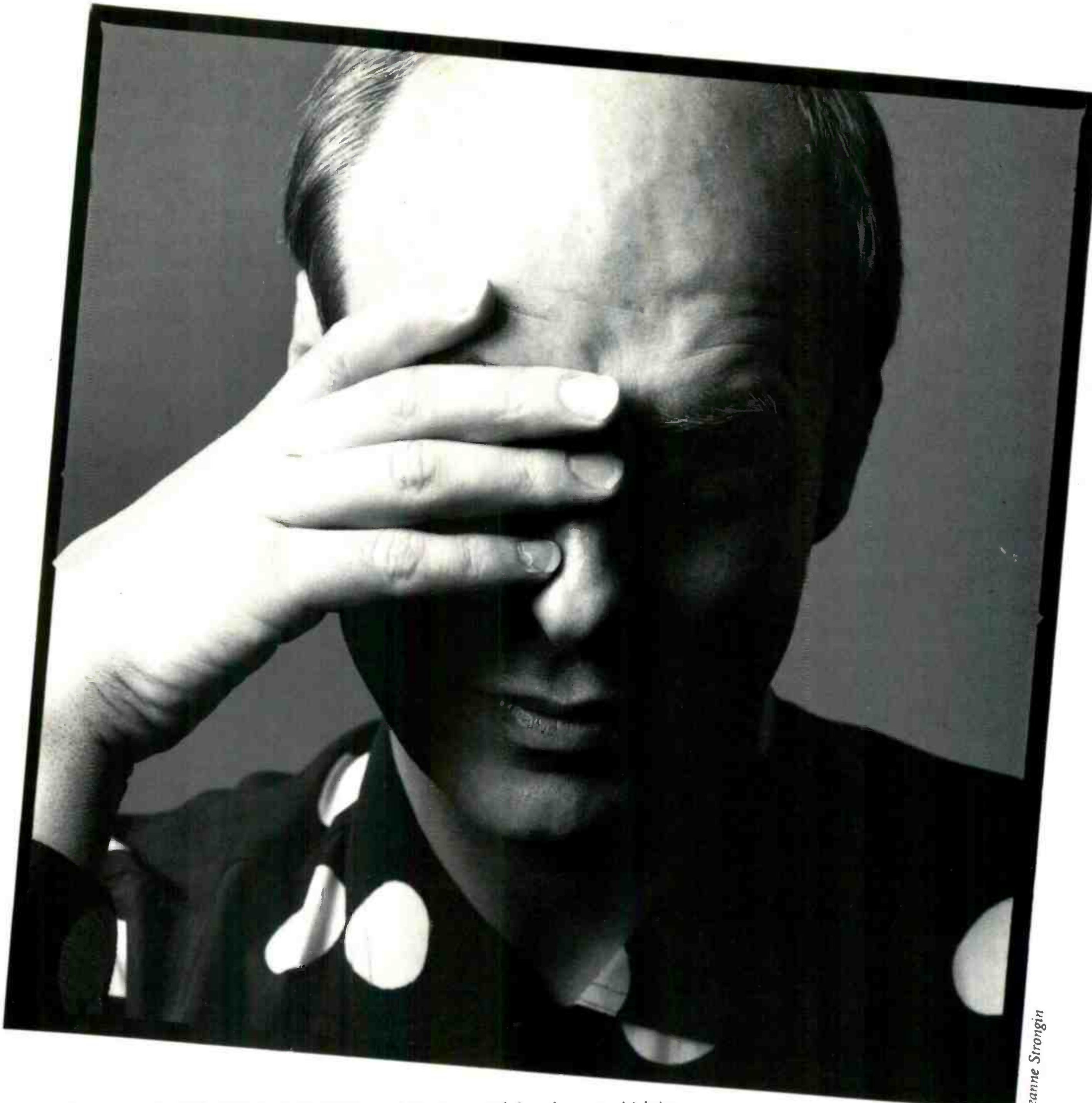
music for listeners

Eno was a member of the influential rock group Roxy Music and has released several solo albums. His best known is 1975's *Another Green World*, which was recorded with the help of his "Oblique Strategy" cards. Created with artist Peter Schmidt, each card had an aphorism on it such as "Emphasize differences" or "Honor thy error as a hidden intention." When Eno reached a creative impasse, he'd select a card that would hopefully point out a direction.

Eno is also a facilitator and collaborator. He created a system of tape loops for King Crimson guitarist Robert Fripp and brought the music of Harold Budd, Jon Hassell, and Laraaji to recordings. His concepts of environmental sound resulted in his Ambient Music series of albums, an influence on new age music. He's straddled the fence between pop music and the avant-garde. His Obscure label recorded Cage compositions and introduced minimalist composer John Adams. Conversely, minimalist composer Philip Glass recently wrote and recorded *The Low Symphony* based on the Bowie/Eno collaborations for the Bowie album *Low*.

In the late 1970s and early '80s, Eno produced Talking Heads' *More Songs About Buildings and Food*, *Fear of Music*, and *Remain in Light*, as well as collaborating with David Bryne on *My Life in the Bush of Ghosts*.

John Diliberto is the host and producer of Echoes, *a nightly music soundscape broadcast on more than 130 radio stations from American Public Radio.*



Jeanne Strongin

After an extended period working in visual art forms, including the design of U2's Zoo TV Tour, he's released three albums in the last two years, including *Wrong Way Up* with John Cale, and two solo albums, *Nerve Net* and *The Shutov Assembly.* *J.D.*

You've done something that I don't think I've ever seen an artist do. In the fall of '91, you delivered an album, called My Squelchy Life, *that you then decided not to put out. What happened?*

I also returned the advance, which is something you've *never* seen an artist do at all [laughter]. This actually broke all known industry standards and caused tremendous consternation [laughter]. "What, he's giving the money back? What the hell is going on?" This had never been heard of before.

What happened was, I finished a record and as nearly always happens to me, in finishing the record I started to get a glimpse of the next step. There's always a cutting edge and a trailing edge to what you are doing. Well, when I finished that rec-

What impressed me about '50s and '60s **R&B** songs was how unclocked they were—how loose, frail, and organic.

ord, I knew what the cutting edge was. The record was due out in September 1991. And so I went straight back into the studio and had begun working on some new material, which followed what I felt was the cutting edge of this soon-to-be-released record.

Then the company said, "Well, September is a terribly bad time to release; can you leave it to February?" And I said, "I don't mind leaving it to February, but I won't release this record then. I'll release what I've finished in February, which is likely to be quite a lot different." So that record just disappeared in the mist of time and I carried on working with the new material, and that's what became *Nerve Net.*

You wouldn't want to have My Squelchy Life *out as a snapshot of where you were at that moment?*

I might have then, but not now. For me it was important to put out a record now that was not retrospective in some way, but which was forward-looking. And some of the songs that were on that previous record, very nice songs, were somewhat retrospective, I felt, at least in comparison to the three songs that I thought were the leading edge of that record—the three songs that actually moved over to form the core of *Nerve Net.*

It's not a question of whether I like things or not. I pretty much like everything I do. But my feeling is that things don't come with intrinsic and timeless value. Where you place them in time, the context they fall in, is what charges them. For instance, if I released *Another Green World* now, it wouldn't make a whole lot of sense. It made a lot of sense then. It would still be a nice record, but it wouldn't be a major contribution to the cultural conversation that's going on. It became one at that time. It had a place, and it made a lot of people think about how you might approach making a record.

One thing that was striking to me about Nerve Net *is that on almost every track you used live drummers. Yet overall, like on "Fractal Zoom," you get a very mechanistic kind of feel in the sound and the rhythms.*

Yes. Now one of the things that this record is, I think, is a reaction against the tightly locked-together MIDI-sequencer type sound of '80s pop music. I just got so sick of that. I mean, I know I was one of the people who got it going [laughter], but that's no reason to continue it. I got really fed up with the tightness and the kind of granite solidity of the way music sounded.

For people who aren't into music, they might not know what kinds of revolutions have been going on. There were three things that I think mainly created the sound of '80s music. The first thing was MIDI, which enabled you to lock together a lot of instruments so that they all marched precisely in step. The second was computer mixing, which enabled you to finesse mixes by polishing very tiny details of the mixes. It was a deadly process and produced some of the worst music ever heard. And the third thing was the mass availability of quite cheap preprogrammed synthesizers. So, suddenly there was available to everyone a library of relatively exotic electronic sounds. And I think it's those three things that made '80s music.

ENO, FRIPP, AND BOWIE

I enjoyed that sound in its time, but I just got completely fed up with how easy it had all become and how you switched the radio on and you'd hear another tightly locked piece of music: Clock-clock-clock. And you could just hear all the clocks ticking in it, you know.

And then, as always, I was listening to a lot of '50s and '60s music, R&B and old pop songs. What impressed me so much about them was how unclocked they were, how loose and frail and organic. You'd hear a song where instead of every single moment and part of the space being filled with some bloody cheap synthesizer sound or other, there were sometimes real spaces, where people didn't play anything in particular. The track would just groove along.

If you listen to early Al Green records or something like that, there's really nothing happening a lot of the time. Sometimes, there's just the guy singing in the studio, and you can hear feet tapping and the musicians are just playing in a quite relaxed way. This gentleness and this lack of the desire to fill every moment with some kind of special, little event started to become more and more attractive to me.

I started to find jazz more and more attractive as well. It seemed to me to be music on the verge of a nervous breakdown the whole time. It always seemed like it was going to fall apart, as opposed to this '80s music, which seemed so invulnerable and so totally rock solid, tightly bolted together. And I started to think that '80s music was actually very un-modern. It was very "industrial revolution" in a way. It was filled with musical rivets everywhere. There was no biology to it. It will die. It's on its way out now.

On Nerve Net *you have two mixes of "Web" that are almost polar opposites. And you released an EP with 12 different mixes of "Fractal Zoom" and another of "Ali Click." Why isn't a song a song? Why does it have millions of possible permutations?*

C. Simonpietri

What remixing is, is regarding a 24-track tape as a palette of possibilities, which does not have a single, definitive end product. Remixing is really allowing yourself to make different versions of one piece of music or to say that actually there is no such thing as one piece of music. There's one cloud of musical possibilities that can be shaped in lots of different ways. So you might make one mix for the dancefloor. This would obviously stress rhythm and often stresses quite simple rhythmic elements. You might make another mix for the late-night dancefloor, when people are a bit tired, and they want to get a bit more trippy. This is, of course, where all this ambient-house thing is from, where my work was revived [laughter] and recognized for its true value. Then you might make another, an extended mix for an album, for example. Then a short mix for a radio single. All these listening situations really demand different kinds of music.

That's one thing when you are dealing with your own music. But you've also remixed, fairly recently, the EMF song "Unbelievable" for Red Hot + Dance, *and that bears almost no relationship to the original song.*

If you think that bears no relationship, you should hear the one I've just done for a

Jeanne Strongin

eNO

I know I was one of the people who got '80s pop music going, but that's no reason to continue it.

band called The Grid who had a song called "Heartbeat," which was a hit in England. Quite a nice poppy, simple song. But I think they may have been a little bit embarrassed by its sweetness because they asked me to remix it and they said, "We'd really like it if you did something weird with this." So I said, "Right!" and rolled up my sleeves. That's the kind of invitation I like.

What's interesting about the remixing scene in England is that often the remixes bear no resemblance whatsoever to the original. If they didn't share the same title, you wouldn't know they were connected.

The Grid and I did a nice exchange. They did some remixes for me, of "Ali Click," which are real dancefloor remixes—the kind of thing I could never do. Very machine-like, locked up. Everything I don't want to do. But it's nice to have somebody else do it for you. I did some mixes for them, which are exactly the opposite. I took "Heartbeat," which was a dancefloor kind of song, a nice, light pop song, and turned it into this incredibly grungy, theatening, menacing, terrifying, weird, ambient, dissonant . . . it's a beautiful remix, I think.

Well, doesn't "Ali Click" originate in a drum-loop that you lifted from EMF?

This is very interesting. I never realized the connection. Yes, it went from remix to remix. This is a redigestion process, isn't it? Chewing the cud.

You've been recycling music from the beginning. For instance, the drum sound on Ultravox's "My Sex" is actually a Phil Collins track lifted from one of your records.

That's right, yes. In fact, that bass drum had quite a checkered, busy life in my music. Because that was also "Sky Saw" on *Another Green World.* Then it became a piece called "M386" on *Music for Films.* And it went on to even become something else now. I've forgotten what it was. This is a very, very interesting aspect of recording. An element can keep being reused and change identity in each place it slots in, you know.

Phil Collins said a very nice thing to me recently. I hadn't seen him for years. But I met him just about eight months ago, and he said, "You know, I've always wanted to thank you." I said, "Really, what's that for?" Because *I* have always wanted to thank *him* for these bloody parts he played that I've reused 800 times.

He said, "When I was in Genesis and I became aware of the way you were working, I realized I could do this [laughter]. If it hadn't been for you, I would not have had a solo career."

I thought, oh, that's very nice of you, thanks. Because at that time, the idea that you could just start really from nothing and make music was quite a new idea.

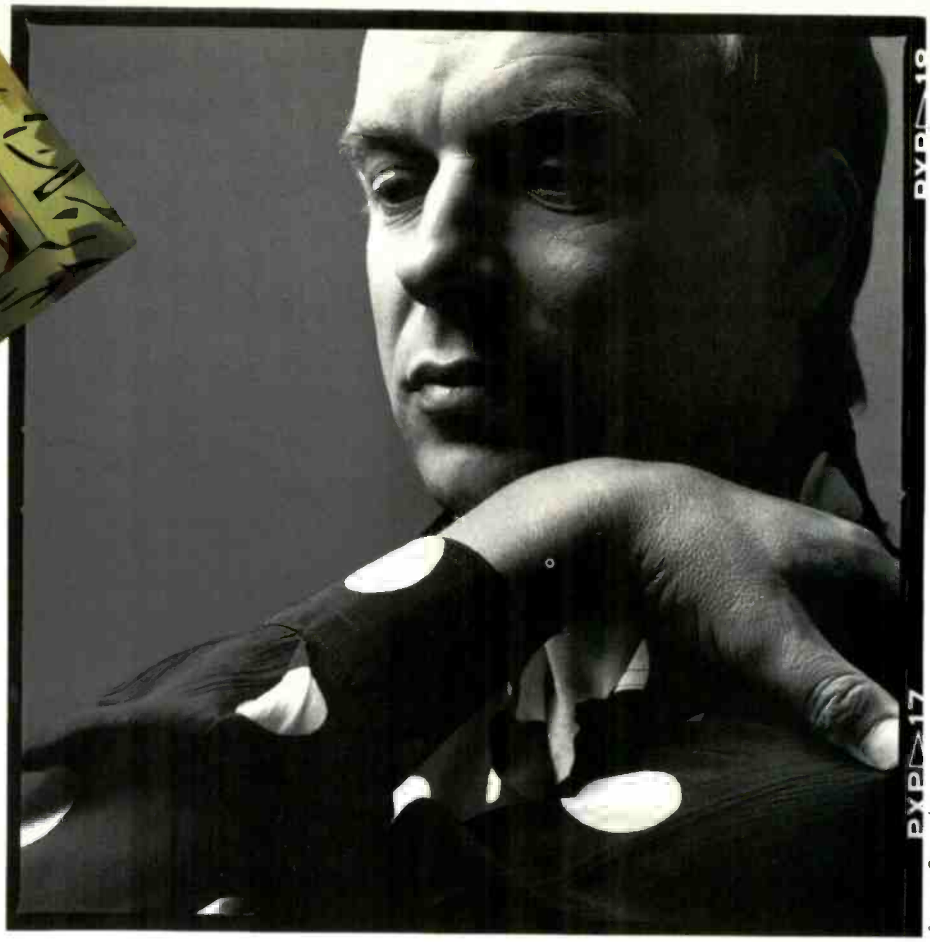
"My Squelchy Life" was interesting. It's fairly malevolent, but then Robert Fripp does a cool Wes Montgomery guitar on it.

It's like there's this little nightclub scene. I said to him, "Robert, can you play the corniest, cheesiest horrible electric jazz guitar thing?" Because that early jazz guitar—I never have been able to get into that era where the idea was just to make an acoustic guitar that sounded louder. It's a horrible sound to me. It has no personality. Anyway, he got it immediately like that.

He used to play it. That's his Giles, Giles & Fripp sound.

Yes, yes, I suppose it's true. It's part of his own history. It's like you open a door and

eNO



Jeanne Strongin

In the '90s, people will be experimenting with texture and with a retro approach to recording.

suddenly you are in this early '60s beatnik club and with people jostling drinks and probably smoking pot. You can almost smell it in there.

Well I bet other people have mentioned this to you—speaking of smoking pot—it's a very psychedelic mix that you've laid on Nerve Net.

Yeah, I came up with a new word, "somadelic." You know psychedelic means mind-expanding. I thought somadelic was interesting because it was body-expanding. Because it's quite dancey as well, a lot of this record. I mean, it is trippy but it's not "lay back in your chair" trippy. It's quite uppish, a lot of it. So I was thinking somadelic might be a nice word for this.

I predicted the return of psychedelia about eight years ago. I kept telling people that it was due back, and I kept waiting and finally it came. It is certainly a big feeling in England at the moment. We have so many retro '60s bands. For me, it's really funny. It's like walking through my teens again, seeing people dressed exactly the same way.

I'm thinking that the drums on "What Actually Happened" have to be the most poorly recorded drum sound in modern music, outside of maybe a bootleg.

I can't think of a better compliment [laughter]. Well, it's interesting to note that that drum sound started as one of the best recorded drum sounds in modern music. I had been working with an engineer, Ben Fenner, who is a great recording engineer. He's not a fixer-in-the-mix guy. He gets things great on tape to begin with.

We always work in very frantic situations where I've assembled a group of musicians. They've never played together, and they walk into the studio and, of course, they always start jamming. And I say, "Ben, get the tape running." Ben hasn't even got a mike plugged in yet, you know. So the tape starts running as the mikes are being plugged in. And one of the things I like about him is that he can deal with a situation as difficult as that. So he always gives me these wonderful recordings, which I then proceed to squeeze and stretch and disturb in various ways. And that particular song is a very good example.

This isn't exactly an audiophile aesthetic of recording.

Now a message to high-end audio lovers [laughter]: Don't expect too much high end in the future of music, at least for this decade. I think people are going to be experimenting with texture and with a retro approach to recording. Which will give us a lot of things that sound like "What Actually Happened."

One of the reasons for people doing this is because part of our listening history now includes old R&B songs recorded in garages, demos with extreme limiting on, poor live recordings that for some reason sound terribly exciting.

Cheap limiting is very interesting, I think. That's used on this track quite a lot. And the other thing is, in many tracks on *Nerve Net* I'm sending everything to a fuzz box or to some kind of system of distortion. I've got a loudspeaker that I slashed with a razor blade so it's in ribbons. And I often send something out to that speaker and remike it through that.

It's a little bit like those African instruments, mbiras. Where you have little tongues of metal that you play with your thumbs. And around the base of each tongue is a piece of wire that rattles and buzzes as you play. I like this kind of halo that you can get on a sound. And it's a halo of distortion really.

But distortion is a negative word for a very interesting situation. Distortion is really the production of the harmonics, strange harmonics. If you forget the idea that the medium is in some way connected with realism, with reproduction, then these aren't problems. That's still a good argument for having good-quality audio equipment.

So you can hear the distortion better.

Because you can hear the distortion better, yes, exactly. That's the value of good-quality recording equipment. That you can really reproduce distortion well.

I'm still wondering why a group like U2 came to you. What had they heard in your work that they thought could contribute to their work? Or was it a friendship thing?

No, no, I didn't know them at all before. It was more that I had already developed a reputation at that time for, I don't know, encouraging people to open up a little bit in the studio, I guess.

So I suppose they really wanted someone who'd sit around in the studio and not say, "Oh, that's a bit weird. It didn't sound like U2," but would say, "Hey, that doesn't sound like U2, that's great" [laughter]. Which was what I ended up saying.

I think to a lot of people the U2 records that you've produced are not audiophile recordings, and they would blame you for that.

Oh good [laughter]. I'm very pleased to take credit for tarnishing the gloss of modern recording.

Is that your input to those albums, creating the overall atmosphere of the pieces or . . .

Partly, yes. I suppose my inputs are on two fairly different levels. One is an overview of asking, "What are we doing? What is this piece about? Where does it fit into the picture of this record? Where does it fit into the pictures of your records in general? Where do your records fit into the picture of modern records? Where does modern recording fit into the picture of modern music? Where does music fit into the picture of culture? Why are we involved in culture?" Those are the kind of things that we actually end up talking about.

So these discussions range from the quite topical and microcosmic, you know, what drum sounds should we have—and they often blossom out into questions about why are we here, where did the universe begin [laughs]. No, it's really true. So I'm sort of the moderator or chairman for those discussions. U2 are a very philosophical bunch actually. I think they spend more time in the studio talking than anything else. But the talking is not just about anything, it is really about what they are doing. But what they are doing can be framed in universal or quite local terms.

But I have another job, which is sometimes quite specifically creating a feeling in something. Now this can be done by taking a raw track, which just has bass, drums, and guitar, and seeing what I can do to expand that quite limited vocabulary into something that makes such a strong and positive identity. So that when Bono comes in to sing, he'll forget that he hasn't got any words and get so excited that he will just start singing words. And this trick sometimes works [laughter]. Anything to short-circuit the word-writing process is very essential.

Anton Corbijn

U2, SOUNDING UNLIKE U2

Well, how would you do that?

The song called "The Fly" [from *Achtung Baby*], which actually I can't take so much credit for, because Flood had a lot to do with that. Flood is a brilliant, brilliant engineer, producer too. But that track really got its identity when it was fed through a quite cheap guitar-effects box.

One innovation I've made in the recording studio is having sends going to very strange places, like my ribboned speaker I told you about. I'll have just a fuzz box set up somewhere, and I can send out to that. But I'll send lots and lots of the audio tracks out to it, and so coming back up to channels will be this huge, grumbling sound. That sound can create such an aura around a track that it suddenly gives it a fiery, bristling edge. And as soon as musicians hear that, they think, "Oh God, where am I? This is amazing." And that's the way you get results somehow. Even if it doesn't last. Even if that doesn't stay in the mix at the end. That's the process of discovery. That's what you want to make happen all the time.

So "The Fly" had everything going to this bizarre treatment, which was a combination of compression, distortion, and delay. That was coming back up the main track and it was all going to other things. So when these two tracks come back from the distortion unit, they can then be fed back into other treatments and echoes. You can create highly reactive landscapes where one drum hit will suddenly create a whole color change. Musicians immediately start to listen to that and respond. And it shapes the way they play. They find they are playing differently. They are playing in a way they wouldn't have done otherwise.

You did that for your earlier collaboration with Harold Budd on The Plateaux of Mirror, *didn't you?*

Yes, it is actually a technique that I really learned from working with Harold Budd. Because with him I used to set up quite complicated treatments and then he would go out and play the piano. And you would hear him discovering, as he played, how to manipulate this treatment. How to make it ring and resonate. Which notes work particularly well on it. Which register of the piano. What speed to play at, of course, because some treatments just cloud out if they have too much information in them.

So all of this, of course, creates things that aren't hi-fi. Hi-fi is all to do with clarity. I'm really not interested in it. Clarity is only one of a number of effects, as far as I'm concerned. Clarity is something that you use in the architecture of a piece, like you use windows. You don't have all windows. You also want dark places, and places where you can shut the door, and places where you can hide things. Places that are warm. Places that are cool. Places that are bright. There's an assumption—which is very much like that building over there—that all glass is marvelous. Well, it isn't. That's a horrible kind of building to be in. There's nowhere to hide. I want places to hide. A

EQUIPMENT **PROFILE**

MARANTZ DD-92 DCC RECORDER

The best way to describe the top-of-the-line Marantz DD-92 Digital Compact Cassette deck is to call it a truly elegant machine. It employs high-quality, 18-bit A/D converters, more than necessary to achieve the dynamic range of 100 dB claimed by the manufacturer. In addition, the DD-92 differs from Marantz's other DCC deck, the lower priced DD-82, by its use of a fully shielded copper chassis and hand-selected, audiophile-grade, passive components. In their D/A stages, both decks use 20-bit digital filters with eight-times oversampling, feeding into bitstream D/A converters. According to Marantz, this is the same D/A stage used in the company's reference-grade CD player, the CD-11 Mk2, which has a suggested price of $2,500.

The convenience features include an easy-to-read text display for information contained on prerecorded DCC tapes, timer recording (when connected to an external timer), and audible fast search in either direction while a tape is playing. You can insert 3-S silent passages (even during playback mode) and mark long sections to be skipped in playback. Track-start ID markers can be inserted, as can end-of-side markers (to trigger an immediate reverse) or "Next" markers (to end recording on one side but wind to the start of the next side before resuming). Tracks can also be renumbered automatically, and any marker can be manually erased.

Control Layout

Controls are sensibly laid out on the traditional Marantz champagne-gold front panel, with major controls in the most prominent positions. A "Power" switch and "Timer" selector are at the lower left of the panel. Only the power switch can turn the deck completely off, but the remote can place it in "Standby" mode (indicated by an LED), with enough control circuitry running to let the remote turn the DD-92 on again. Small buttons under the cassette drawer handle the manual marker functions, and an "Open/Close" button is below and to the right of the drawer. Beneath the large display are buttons for tape monitoring, resetting the counter, counter "Time" (absolute time, track time, remaining time, or counter), and text display modes plus "Repeat," "Blank Skip," and Auto Music Scan ("AMS"). The large buttons to the right of the display are standard

SPECS

Digital Cassette (DCC)

Frequency Response (±0.2 dB): 48-kHz sampling, 10 Hz to 22 kHz; 44.1-kHz sampling, 10 Hz to 20 kHz; 32-kHz sampling, 10 Hz to 14.5 kHz.

S/N (A-Weighted): Greater than 103 dB in playback.

Dynamic Range: At least 100 dB.

THD: Less than 0.003% at 1 kHz in playback.

Channel Separation: 100 dB at 1 kHz in playback.

Analog Cassette

Frequency Response (±3 dB): 20 Hz to 18 kHz, with Type II tape.

S/N (A-Weighted): Without NR, greater than 59 dB on Type II tape.

Wow and Flutter: 0.035% wtd. rms or less.

General Specifications

Output Level: Analog, 2 V at fixed output, 0 to 2 V at variable output; digital coaxial, 0.5 V peak to peak; digital optical, –19 dBm.

Output Impedance: Analog, 1.5 kilohms; digital coaxial, 75 ohms.

Power Requirements: 35 watts, 120 V, 60 Hz.

Dimensions: 17⅞ in. W × 5¾ in. H × 14¼ in. D (45.4 cm × 14.6 cm × 36.2 cm).

Weight: 28.7 lbs. (13 kg).

Price: $1,200.

Company Address: 1150 Feehanville Dr., Mt. Prospect, Ill. 60056.

For literature, circle No. 90

tape-transport functions (though with a rocker for forward and reverse playback) plus the forward and reverse track-selection buttons familiar from CD players. Just below are buttons for "Record," "Append," and "Rec Mute." Pressing "Append" positions the DCC tape for recording and sets the deck in record/pause mode. If the tape is blank, a lead-in buffer area is set up at its beginning; if the tape has been recorded, the final 10 S of the last recording on it is played. To record over part or all of a recorded DCC, you press "Append" along with various tape-transport buttons.

A headphone jack is along the lower section of the panel, as are knobs and buttons for headphone level, Dolby NR selection, "Auto Start" (which toggles automatic start-ID marking on and off), "Sync Record" (for synchronizing the start of the recorder and a CD player via Philips

PERHAPS THE MOST OUTSTANDING ASPECT OF THE DD-92 WAS ITS SUPERB LOW-LEVEL LINEARITY.

ESI bus links), "Input Select" (analog, digital optical, or digital coaxial), and recording balance and master level controls.

In addition to showing text, the display area features a bar-graph stereo level meter, indications for track, time/counter, and "Mode," as well as the status of a number of other functions to let you know exactly what the deck is doing at any given moment. The supplied remote control duplicates just about all of the control functions

on the front panel and has number buttons for accessing a given track directly.

The rear panel of the DD-92 is equipped with variable and fixed pairs of analog output jacks, coaxial digital in and out jacks, Toslink optical input and output connectors, input and output jacks for a system remote link to other components, and an "External/Internal" switch that selects control via the link or the supplied remote.

Measurements

When I first starting testing CD players some 10 years ago, I was concerned that all of them would sound and measure pretty much the same. (Remember the ads that promised "Perfect sound—forever"?) As we all know, that concern was ill founded. The same applies to DCC equipment. While all DCC components use the same PASC algorithm for bit-rate reduction, other design elements will vary from model to model. Marantz has taken the high road with the DD-92, as evidenced by just about all the bench and listening tests I performed.

Figure 1A shows the DD-92's frequency response through the entire record/play cycle, using the analog inputs. Results surpass the claimed tolerance of ±0.2 dB from 20 Hz to 20 kHz. Deviation from ruler-flat response was even less when I applied a sweep of frequencies via the coaxial or optical digital inputs (Fig. 1B). I wanted to keep all tests of frequency response together, so I slipped in an analog calibration cassette supplied by BASF and measured response for this Type II tape (Fig. 1C). The spot frequencies on the tape extend from 31.5 Hz to 18 kHz; at the high-frequency extreme, the roll-off amounts to exactly the 3 dB claimed by Marantz.

Next, I assessed harmonic distortion plus noise as a function of frequency (Fig. 2). Recording via the analog inputs and measuring at

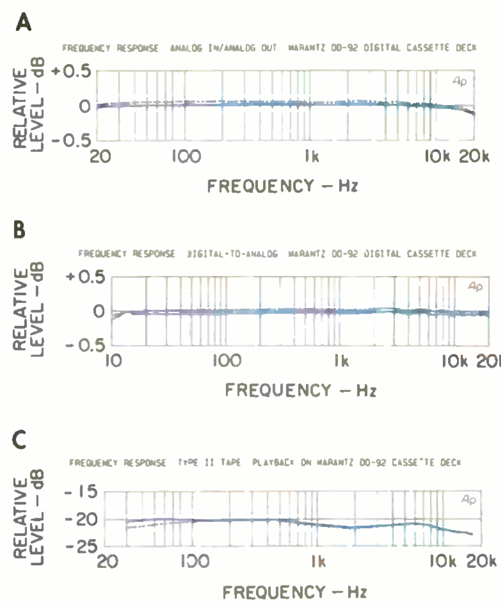


Fig. 1—Frequency response for digital recording via analog inputs (A) and digital inputs (B), and for playback of analog test tape (C; note change of scales).

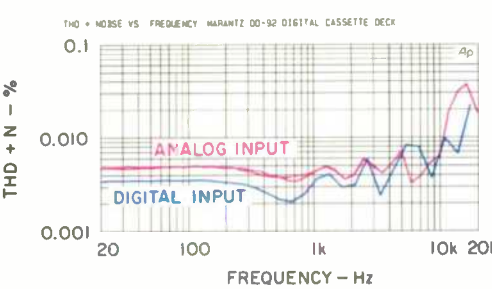


Fig. 2—THD + N vs. frequency for recording via digital and analog inputs.

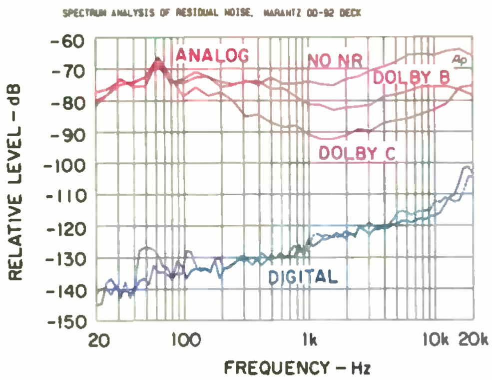


Fig. 3—Spectrum analyses of residual noise when playing DCC copy of "no-signal" CD track and of analog cassette.

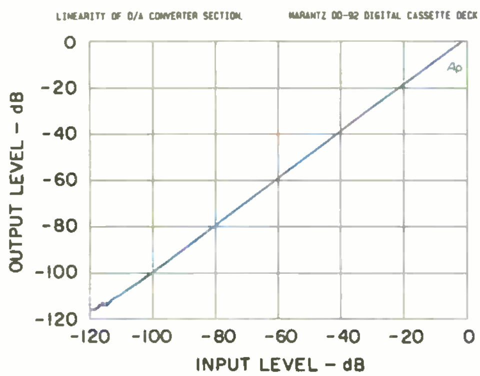


Fig. 4—Linearity at 500 Hz.

the analog outputs, I found that THD + N at 1 kHz is around 0.004%, increasing to about 0.04% at 17 kHz. Recording via the DD-92's digital inputs, I obtained even lower THD + N, from a minimum of just over 0.002% at 650 Hz, to just over 0.003% at 1 kHz, and reaching a maximum of just over 0.02% at 18 kHz.

Reverting to analog playback, I inserted a "no-signal" recorded tape that I normally use to measure S/N ratios on analog cassette decks. Results, plotted as a function of frequency, are shown in Fig. 3 for playback without noise reduction and with Dolby B and Dolby C NR. For the Type I tape I used, the A-weighted overall readings were 55.8 dB without noise reduction, 65.2 dB using Dolby B NR, and 72.8 dB using Dolby C NR. In all likelihood, these numbers would have been a bit better, and met Marantz's claims, if a Type II tape had been used.

Having transcribed the contents of my CBS CD-1 test CD to DCC tape, I played back the "no-signal" track of that tape and plotted an analysis of the residual noise as a function of frequency, using a third-octave bandpass filter. Results were astounding, with residual noise never exceeding –100 dB at any frequency (bottom curve, Fig. 3). A reading of A-weighted noise yielded overall numbers of –103.87 dB for the left channel and –106.21 dB for the right channel, referred to 0-dB (maximum) digital record level. I had viewed the manufacturer's specification with some skepticism until I made this test. Obviously, Marantz's choice of 20-bit digital filtering with eight-times oversampling, and their use of the latest generation of bitstream D/A converters, play an important role in achieving this excellent S/N ratio.

EIAJ dynamic range in the digital record/play mode was 100.79 dB for the left channel and 100.42 dB for the right channel, exceeding the unusually high published specification by a fraction of a dB.

Perhaps the most outstanding aspect of the Marantz DD-92 was its superb low-level linearity. Using a prerecorded test tape supplied by Philips, I plotted output linearity versus input from 0 down to –90 dB (not shown). I could detect no significant deviation from perfect linearity over that entire range. When I generated a digital signal of steadily decreasing amplitude with my Audio Precision test equipment, results were even more spectacular (Fig. 4). I could detect no deviation from perfect linearity down to –110 dB; even at 120 dB below maximum record level, deviation amounts to less than 3 dB.

As in my first test of a DCC recorder (January 1993 issue), I wanted to evaluate the effects of the DCC format's bit-rate reduction system (PASC) on complex signals that contain a rich mixture of harmonics. Therefore, I again used a 700-Hz sawtooth waveform to evaluate the effects of PASC. Spectrum analysis (not shown) revealed that while the input signal contained a mixture of high-order odd and even harmonics past 23 kHz, the even harmonics in the playback signal had far lower amplitude, and there were no harmonics above about 15 kHz. This is because the PASC algorithm determined that these harmonics would fall below the hearing or the masking threshold that is used in determining which signal data need not be recorded. I also noted that the noise floor over the range from 20 Hz to 15 kHz was higher in the playback version of the signal than it was in the original input signal.

I'M A BELIEVER: DCC RECORDINGS CAN BE EVEN FREER OF NOISE AND DISTORTION THAN 16-BIT LINEAR CDs!

The reason I'm not presenting the sawtooth-wave spectra is that a new Philips test CD, *Audio Signals Disc 1* (SBC429), contains an even more useful signal for this type of analysis. This signal consists of a train of single, maximum-amplitude positive-pulse samples, spaced 69 samples apart. The precise repetition frequency is 630 Hz. As revealed in the spectrum analysis of Fig. 5A, this signal generates a series of equal-amplitude harmonics over the entire audio range, each separated from its adjacent harmonic by the 630-Hz repetition frequency. Anyone familiar with the principle of low-bit-rate encoding will appreciate that the DCC PASC encoding system would have a difficult time trying to reproduce *all* of these harmonics. Such was the case when I played back a DCC recording of this test signal, as shown in Fig. 5B. Although the peaks of the signal's harmonic components are all there, the noise floor over much of the spectrum has been raised by about 40 dB! Happily, most music does not subject the DCC system to this kind of signal degradation, as became obvious during my listening tests.

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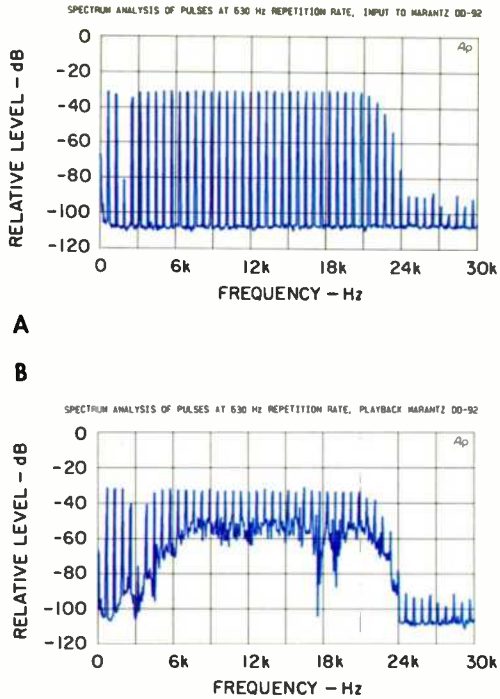


Fig. 5—Spectrum analyses of repeated pulse signal (A) and of signal recorded and played back (B); see text.

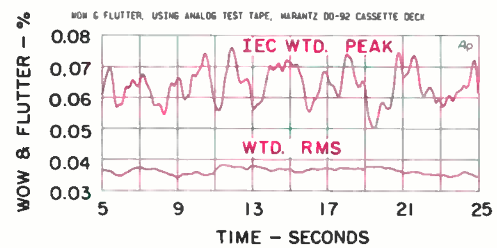


Fig. 6—Wow and flutter.

Before conducting the listening tests, I wanted to check out one more aspect of the DD-92, wow and flutter when playing back standard analog cassettes (Fig. 6). Wow and flutter was measured two ways, the first using the accepted wtd. rms method and then using the peak weighted method endorsed by the IEC. Weighted rms wow and flutter is around 0.035%, exactly as specified, and even the IEC-weighted measurement is basically below 0.07%. In the digital mode, wow and flutter was below measurable limits, as Marantz correctly stated.

Use and Listening Tests

I can't wait to get my hands on more DCC software. At the moment, I have only about five prerecorded DCCs, and only one of these contains classical music (which I find much more suitable for subjective listening tests than pop or rock material). So, once again I trotted out my precious DCC version of Mahler's First Symphony (London 425-718-5) and listened to all four movements, first on a pair of high-quality headphones (I hoped to detect flaws inherent in the bit-rate reduction system) and then through my reference stereo system terminating in KEF 105.2 speakers.

Although I tried to conduct some comparison tests between a CD version and the DCC version of Mahler's First Symphony, I must confess that true comparisons were not possible since the two performances are by different orchestras and conductors. What I can say, without qualification, is that the DCC was every bit as "musical" and enjoyable as the CD, despite some differences in tempo and interpretation. As far as I could detect, the bit-rate reduction system used in DCC did not in any way degrade the performance, nor did I hear any noise or distortion anomalies in the reproduced music, notwithstanding the elevated noise levels noted in my bench tests when I used complex test tones.

The originators of the Digital Compact Cassette format have done their psychoacoustic homework very well indeed, and the engineers at Marantz have outdone themselves in making the most of the DCC format. I frankly was skeptical when I was told that, using 18-bit A/D conversion, it might be possible to produce DCC recordings that were even freer from noise and distortion than 16-bit linear CD recordings. After extensive experimentation with the Marantz DD-92, I have abandoned my skepticism and become a believer!

Leonard Feldman

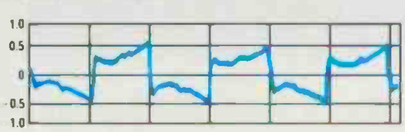
An ideal loudspeaker would convert electrical signals to sound pressure signals with "flat frequency response" and "zero phase nonlinearity". In practice, however, all loudspeakers, no matter how expensive, exhibit significant imperfections. Technically, the electrical signal is improperly dispersed (blurred) by the loudspeaker resulting in audible distortion. This blurring effect is the result of a physical phenomenon called "CONVOLUTION". Until now, it has been the dream of the hi-fi enthusiast to have a blur-free loudspeaker.

The DDA-1 amplifier contains a digital signal processing (DSP) module to which the incoming audio signal (digital or analog) is routed. At the heart of the DSP module is a proprietary, state of the art, application specific integrated circuit (ASIC) developed by DGX.

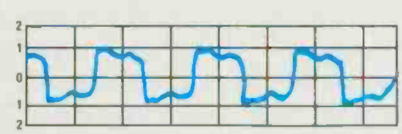
The DGX Deconvolution Processor

Using a patented algorithm, 383 numbers describing the loudspeaker characteristics are provided to the ASIC, whose sole purpose, through DECONVOLUTION PROCESSING, is to prevent the speaker from blurring the signal. With a pair of high quality DGX loudspeakers, whose coloration (blurring) is virtually eliminated by the deconvolution process, the sound produced by this revolutionary system is so pure and clean, we dare say it is better than any audio system available, regardless of price.

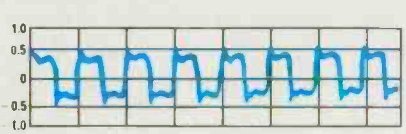
Speaker sound pressure measurement for square wave input.



100 Hz Response



500 Hz Response



1 kHz Response

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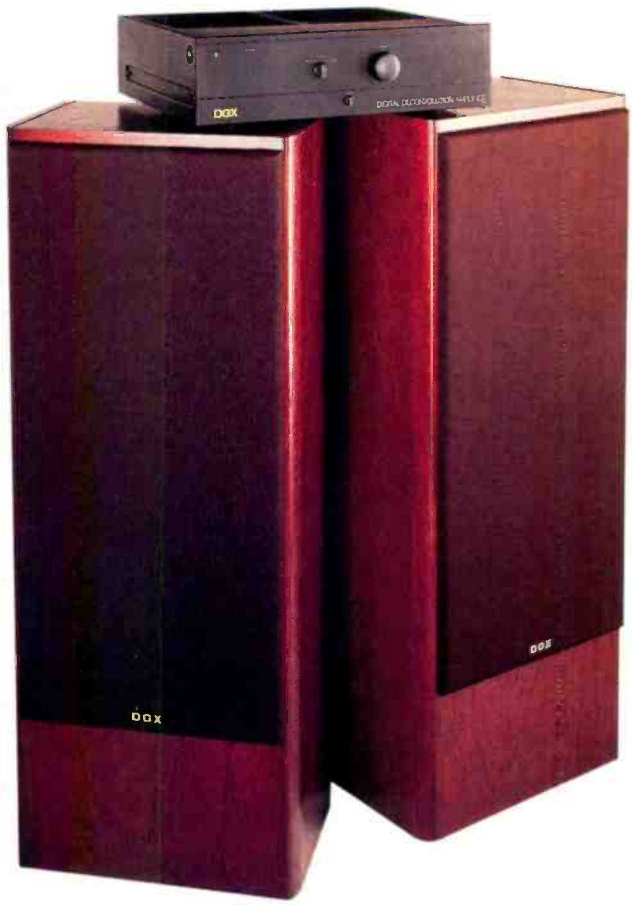

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DDA-1 DIGITAL DECONVOLUTION POWER AMPLIFIER

POWER AMPLIFIER

Construction	Dual mono
Rated power output (per channel)	100 W min @ 8 Ohms 140 W min @ 4 Ohms
Power bandwidth	20 Hz-20 kHz
Power supply filter capacitance	60,000 microFarads
Damping factor	150
THD at rated power	0.01%
IM distortion at rated power	0.16%
IM distortion at 1 8 W output	0.02%
Residual noise	0.3 mV unweighted

ANALOG TO DIGITAL CONVERTER

Type	Oversampling delta-sigma modulation
System sampling rate	44.1 kHz
Internal oversampling	64 X with quadruple integration
Dynamic range	92 dB
S/(N + D)	90 dB

DECONVOLUTION FILTER

Type	Finite Impulse Response
Filter length	383 taps
Arithmetic unit	Fixed point 16 bit multiplicand 16 bit multiplier 36 bit accumulator Automatic roundoff
Multiply-accumulate time	54 nsec.
Overflow detect	1 second LED indication Supressed polarity reversal

DDL-1A LOUDSPEAKERS

Shown with optional Rosewood veneer finish

Power rating	150 W
Input impedance	8 Ohms
Drivers	1 inch ferro fluid cooled soft dome tweeter 2 inch ferro fluid cooled soft dome mid-range 12 inch high young's modulus mica/pp cone with die cast frame woofer
Construction	Simulated or real wood veneer over 100% MDF
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EQUIPMENT PROFILE

CELESTION 300 LOUDSPEAKER

Celestion, founded in the early 1920s, fills roughly the same niche in England that JBL does in the United States. Although not as large, Celestion has been around for a long time, has an excellent reputation, and has extensive home and professional loudspeaker lines.

The Model 300 extends Celestion's efforts in the no-compromise mini-monitor market that started over a decade ago with the well-received SL6. The floor-standing 300 and the smaller, stand-mounted 100 are cost-effective systems with high-end performance that take advantage of Celestion's experience in designing and manufacturing small high-performance loudspeakers. The 100 is a closed-box design, while the 300 uses a transmission line in a tall, slim cabinet to provide extended bass response.

Both speakers, however, share the same drivers, front plates, and crossovers. The drivers are flush-mounted within the cabinet by the use of zinc die-cast plates that hold the drivers in place and provide a good-looking, low-diffraction front surface. The high-frequency driver is an evolution of Celestion's 1¼-inch, one-piece, aluminum-dome tweeter, developed through laser interferometry research. Its voice-coil is wound directly on the dome to maintain mechanical integrity and improve thermal power handling. The bass driver is a long-throw unit with a 6½-inch Cobex plastic cone and a dual half-roll cone surround, in a die-cast frame. The design is said to maximize bass precision while minimizing cone surface waves and reflections that detrimentally affect midrange detail.

The crossover, a third-order Butterworth design, has relatively simple topology and uses a minimum of components: Two resistors, three capacitors, and two inductors. All parts are high quality, including polypropylene capacitors, air-core inductors, and inductors with cores of compressed powdered iron. Bi-wiring is supported through the use of dual gold-plated

SPECS

System Type: Two-way, floor-standing, transmission-line system.

Drivers: 6½-in. cone woofer and 1¼-in. aluminum-dome tweeter.

Low-Frequency Performance: –3 dB at 48 Hz and –6 dB at 26 Hz (free-space conditions).

Sensitivity: 84 dB SPL at 1 watt/1 meter.

Crossover Frequencies and Filter Slopes: 2.2 kHz, third-order Butterworth.

Impedance: 8 ohms.

Recommended Amplifier Power: 25 to 120 watts per channel.

Dimensions: 38³⁄₁₆ in. H × 8¼ in. W × 12¹³⁄₁₆ in. D (97 cm × 21 cm × 32.5 cm).

Weight: 43.4 lbs. (19.7 kg) each.

Price: $1,799 per pair; available in black oak, walnut, and mahogany wood veneers.

Company Address: 89 Doug Brown Way, Holliston, Mass. 01746.

For literature, circle No. 91

five-way binding posts at the top rear of the system. All driver connections are soldered.

The transmission-line bass configuration of the 300 utilizes the results of original research at Celestion by research engineer Martin Roberts. While designers of closed-box and vented systems have long been able to make heavy use of computers, transmission-line systems up to now have been mostly designed by cut-and-try methods. Transmission-line systems are more complicated to design because of their inherent distributed-parameter nature. (Sealed and vented systems can be treated as much simpler, lumped-parameter acoustic systems.) Also, there is very little research literature to guide the designer. To optimize the design, Roberts used some of the latest computer simulation techniques to coordinate the many variables of transmission-line loading.

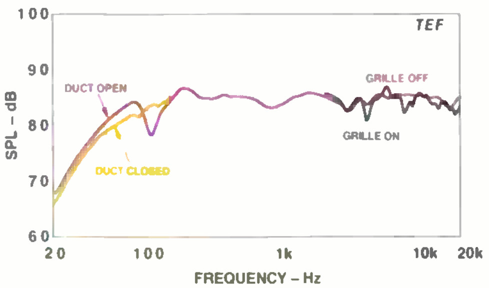

Fig. 1—One-meter, on-axis frequency response.

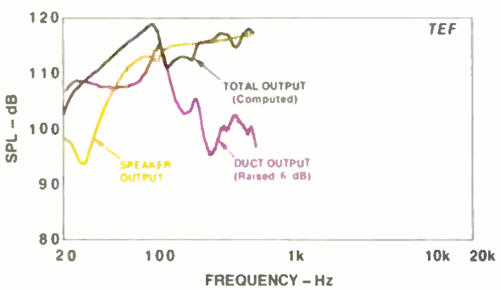

Fig. 2—Near-field response; see text.

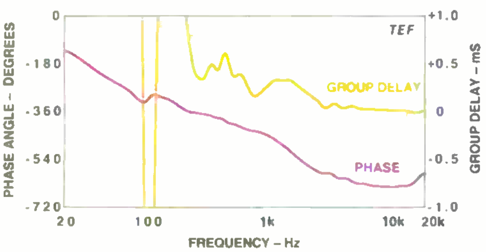

Fig. 3—On-axis phase response and group delay.

Transmission-line systems come in two basic flavors: Absorptive closed end and resonant open end. The open-end version has been more common, because the acoustic output of the line can be used to enhance the output of the main speaker. The open-end transmission line depends on organ-pipe-like resonances to load and enhance the system's output. Unfortunately, the line's output does not only beneficially load and add to the output of speaker, but can also detrimentally subtract as well! The trick is to utilize the line's beneficial output at the first quarter-wave resonance, but not to utilize the line's output at all of the detrimental higher order resonances, which occur at odd integer multiples of the quarter-wave resonance. These higher order resonances can cause severe peaks and dips in the response if left to radiate unhindered from the open end of the line.

One conventional way of suppressing the higher order line resonances is to use a large amount of absorption to fill the line. Unfortunately, the added damping reduces the line's beneficial output at the fundamental resonance in addition to reducing the detrimental higher order resonant modes.

Another method, discovered and investigated by Roberts, is to use an acoustic low-pass filter between the speaker and the line to roll off the drive to the line at higher frequencies. An acoustic low-pass filter can take the form of an expansion chamber or a restriction in an acoustic transmission line. The expansion-chamber approach was chosen for the 300. The driver's rear radiates into a chamber that connects to the input of the line, whose open end radiates to the outside. This is not the whole story of the 300's transmission-line system, however; much additional effort, simulation, and experimentation went into selecting many other variables in the design. These variables include just how much and what kind of damping to include and where it should be placed, the configuration and folding of the line, driver characteristics, etc.

Measurements

The on-axis frequency response of the Model 300 is shown in Fig. 1. Also shown are the effect of the grille on high-frequency response and the effect on low-frequency response of blocking the transmission line's duct. Measurements were taken at a distance of 1 meter on the tweeter's axis, with 2.83 V rms applied. The response below 800 Hz was derived from 2-meter ground-plane measurements, using an input of 2.83 V rms (rather than 5.66 V rms) to compensate for the ground plane's 6-dB boost.

Aside from a dip at 100 Hz, the response is fairly smooth and flat and fits a compact window of ± 2 dB from 60 Hz to 20 kHz, referenced to 1 kHz. Above 2 kHz, the grille causes moderate interference in the response, as shown by slight dips at about 4, 8, and 14 kHz.

The major feature of the response below 200 Hz is a 7-dB dip at 100 Hz, one-half octave wide. This is caused by the transmission line, as can be seen by the dip's disappearance from the response curve I made after closing off the line's exit duct. When the exit is blocked, the 300's low-frequency output, in the range from 20 to 80 Hz, is reduced by about 2 to 3 dB. The transmission line thus increases system output over a broad range below 90 Hz but decreases the output between 90 and 150 Hz.

THIS TRANSMISSION LINE WAS OPTIMIZED WITH A COMPUTER, NOT JUST BY CUT-AND-TRY METHODS.

According to Roberts, the 100-Hz dip is caused by the line's second major resonance, which occurs at the frequency where a line is three-quarters of a wavelength long. At this frequency, the line's output is 180° out of phase with the driver's output. Apparently, his scheme of adding an acoustic low-pass filter to the line to minimize the effects of higher frequency line resonances is not as effective as it could be at the second, 100-Hz, resonance. At higher frequencies, however, the low pass is quite effective, as there are no discernible ripples in the response.

To further investigate the contribution of the transmission line to the system's output, I ran individual 1-V rms near-field curves of the woofer's and transmission line's outputs. This was done by placing the measurement mike close to the speaker's cone and to the exit of the transmission

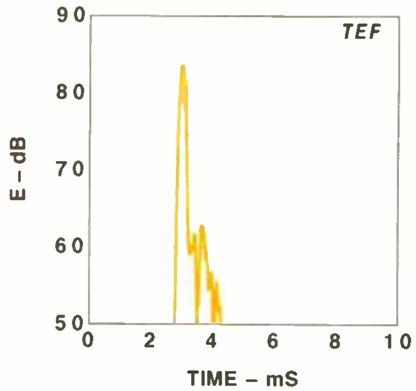

Fig. 4—Energy/time response.

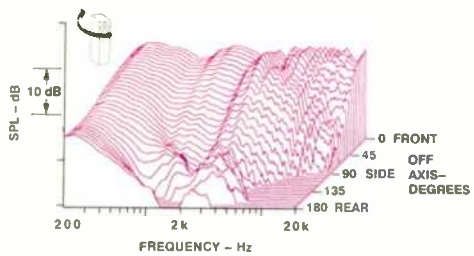

Fig. 5—Horizontal off-axis frequency responses.

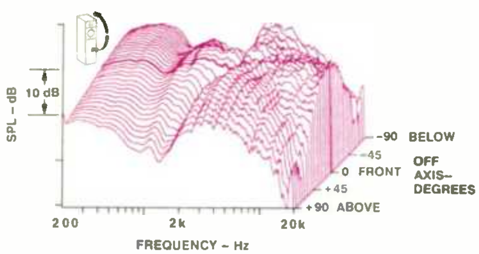

Fig. 6—Vertical off-axis frequency responses.

line, to measure their individual contributions. These curves are shown in Fig. 2 along with a computed total output, calculated by doing a vector summation of the individual outputs.

Between 20 and 50 Hz, the transmission line provides most of the system's output. The line's loading reaches a maximum at 29 Hz, where the driver's output is at its minimum and the line's output almost at its maximum. It is at this frequency, for which the transmission line is a quarter of a wavelength long, that the line provides most of its beneficial effects. Above 90 Hz, the line's output goes rapidly out of phase with the cone's output, thus causing a dip in the total output. The duct output also exhibits secondary resonance peaks above 150 Hz, which show up in the computed total curve. A comparison of the computed total output curve of Fig. 2 with the on-axis curve of Fig. 1 shows that the axial response is even smoother than the predicted total output. This is presumably due to the fact that the duct is at the bottom rear of the cabinet, and thus its higher frequency output is attenuated.

Above 20 kHz (data not shown), the response had a high-Q, 14-dB peak at 25.3 kHz, presumably due to the breakup resonance of the aluminum-dome tweeter. Averaging the response over the range from 250 Hz to 4 kHz yielded a sensitivity of 84.8 dB, slightly higher than the Celestion's 84-dB rating. The right and left systems matched within a close ±0.5 dB, and should provide stable lateral imaging.

Figure 3 shows the phase and group-delay responses of the 300, referenced to the tweeter's arrival time. Between 1 and 10 kHz, the phase curve rotates 180°, a relatively small amount. The group-delay excursions just above and below 100 Hz coincide with the dip in the axial response and the change in phase slope, indicating a possible minimum-phase aberration. If the response were equalized flat in this region, the phase and group-delay responses would also be much smoother.

Figure 4 shows the energy/time response measured at 1 meter on axis for a 2.83-V rms signal. The test parameters were chosen to emphasize response in the region from 1 to 10 kHz, which includes the crossover. Except for some delayed responses about 20 dB down from the peak, the time response is quite compact and sharp.

Figure 5 shows the 300's horizontal off-axis responses. The curve at the rear of the graph is the on-axis response. In the primary lateral listening window, ±15° of the axis, the coverage is extremely uniform.

IN AN OPEN-END TRANSMISSION LINE, THE TRICK IS TO USE THE GOOD RESONANCES YET SUPPRESS THE BAD ONES.

Even out to 45° off axis, not much high-frequency roll-off is evident. It's not clearly seen in the curves, but in the range from 2.5 to 4 kHz the off-axis response is actually about 1 to 2 dB higher than the on-axis response. This broadening of polar response may be due to diffraction effects related to the cabinet's width.

Figure 6 shows the vertical off-axis curves. The Celestion 300 was measured at 1 meter from the tweeter, with the tweeter the center of rotation. The bold curve in the center of the graph (front to rear) is the on-axis response. In the crossover region from 1.5 to 3 kHz, the curves from +15° to –15° show that the response is significantly flatter for downward angles than upward angles. As the listening angle is raised from 0°, a progressively sharper dip appears at about 2.2 kHz (not visible), reaching about 17 dB at +15°. These vertical-coverage asymmetries indicate substantial lobing as a result of phase differences between the tweeter and woofer through the crossover range.

The 300's impedance, plotted over the wider range of 10 Hz to 20 kHz, is shown in Fig. 7. A minimum impedance of 6.3 ohms occurs at 160 Hz and a maximum of 46 ohms at 56 Hz. The low-frequency impedance curve, which has two peaks straddling a dip, looks exactly like that of a typical vented-box system, with the box tuning occuring at the 29-Hz impedance dip. A secondary, much smaller peak and dip is observed at about 100 Hz, which coincides with the second line resonance. Even though the curve has a high max/min variation of about 7.3 to 1 (46 divided by 6.3), the 300 will not be very sensitive to cable resistance because the minimum impedance is on the high side. Cable series resistance should be limited to a maximum of about 0.085 ohm to keep cable-drop effects from causing response peaks and dips greater than 0.1 dB. For a typical run of about 10 feet, 16-gauge or heavier wire should be used.

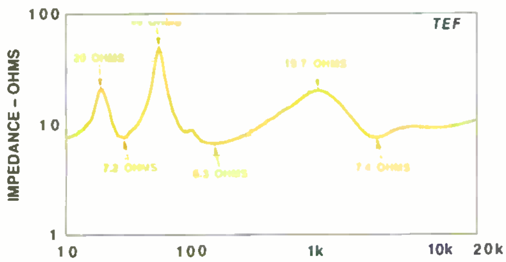

Fig. 7—Impedance.

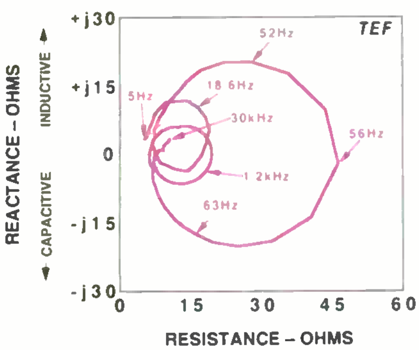

Fig. 8—Complex impedance.

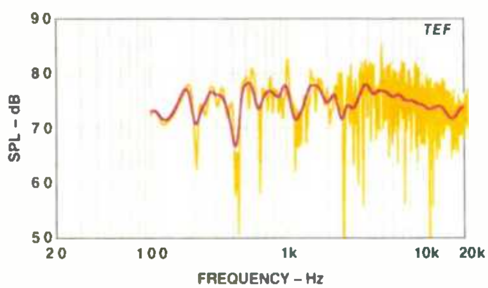

Fig. 9—Three-meter room response.

In Fig. 8, the Model 300's complex impedance is plotted over the range from 5 Hz to 30 kHz on 60-ohm impedance scales. The large circle in the plot is the 56-Hz impedance peak (the flattened sides of the circle are due to my measuring gear). The impedance phase (not shown) reached a maximum angle of +49° (inductive) at 16.9 Hz and a minimum angle of –51° (capacitive) at 67 Hz. The moderate phase values and relatively high impedance of the 300 make it an easy load for any amplifier.

No significant cabinet resonances were evident when the Celestion speaker was subjected to a high-level, low-frequency sine-wave sweep. However, there was some minor activity of the top and sides from 420 to 430 Hz. The cabinet of the 300 is quite solidly constructed and is well braced due to the internal construction of the transmission line. A sharp minimum of woofer excursion occurred at 29 Hz, the primary quarter-wave resonance of the transmission line. Peak excursion occurred between 45 and 50 Hz, where levels above about 8 V rms (8 watts) caused audible distortion. The 300's excursion versus frequency characteristic appeared the same as that of a well-operating vented-box system.

The peak linear excursion of the 6½-inch woofer was about 0.4 inch, peak to peak, with further higher distortion travel to about 0.6 inch, peak to peak. No bad sounds were generated when the woofer was overloaded, and no dynamic offset effects were exhibited. The effective diameter of the woofer is 5¼ inches, measured from the center of the surround on one side to the center of the surround on the other.

The 3-meter room curve of the 300, with both raw and sixth-octave smoothed responses, is shown in Fig. 9. The Celestion was in the right-hand stereo position, aimed at the listening location, and the test microphone was at ear height (36 inches), at the listener's position on the sofa. The system was driven with a swept sine-wave signal of 2.83 V rms (corresponding to 1 watt into the rated 8-ohm load). The direct sound plus 13 mS of the room's reverberation are included. Excluding a room-effect dip at 410 Hz, the averaged curve fits a relatively tight 7-dB (±3.5 dB) window from 100 Hz to 20 kHz. The only marked feature of the curve is a gradual roll-off of high-frequency response above 5 kHz of about 2.5 dB/octave. This roll-off is presumably caused by the 300's increased directivity at higher frequencies due to the relatively large, 1¼-inch dome tweeter.

The single-frequency harmonic distortion spectra for the musical notes of E_1 (41.2 Hz), A_2 (110 Hz), and A_4 (440 Hz) are shown in Figs. 10 to 12. The power levels were computed using the rated system impedance of 8 ohms. A maximum power of 50 watts (20 V rms) was set as the upper limit, due to the high distortion at the E_1 tone.

Figure 10 shows the E_1 (41.2-Hz) harmonic distortion. Even though the power was limited to 50 watts, the distortion at maximum power level rose to a high 46% third harmonic, with generous amounts of higher order harmonics. The second harmonic rose to an intermediate peak of about 15% at 6 watts, fell, and then attained 15.5% at 50 watts. Unfortunately, the E_1 tone falls approximately at the Model 300's maximum excursion point within its low-frequency passband. The harmonic distortion at the much lower frequency of 29 Hz, where the transmission-line loading is maximum, is actually significantly lower than at 41.2 Hz. At 41.2 Hz with an input of 50 watts, the Celestion generates a not very loud 96 dB SPL at 1 meter, in free space.

YOU DON'T USUALLY HEAR THIS MUCH USABLE 32-Hz BASS FROM A 6½-INCH WOOFER!

Figure 11 shows the A_2 (110-Hz) harmonic data. The second harmonic reached the low value of only 2.4% at 50 watts, with negligible amounts of higher order harmonics. However, at 110 Hz with an input of 50 watts, the 300 generates only 96 dB SPL at 1 meter. The maximum level is low because the A_2 tone coincides with the dip in the 300's response curve caused by the out-of-phase condition of the transmission line's output.

Figure 12 shows the low-value A_4 (440-Hz) harmonic data. The second harmonic reached only 1.9% at 50 watts, and the third harmonic was only 1.6%. The higher harmonics were below the threshold of my measuring gear. At 440 Hz with a 50-watt input, this speaker generates a usable 102 dB SPL at 1 meter.

Figure 13 displays the IM created by tones of 440 Hz (A_4) and 41.2 Hz (E_1) of equal input power. The IM distortion rises to a fairly high 16% at full power. The Celestion's 6½-inch woofer handles both frequencies of this IM test.

Figure 14 shows the short-term peak-power input and output capabilities of the 300 when the speaker was reproducing 6.5-cycle third-octave tone bursts. The peak input power was calculated by assuming the rated 8-ohm impedance.

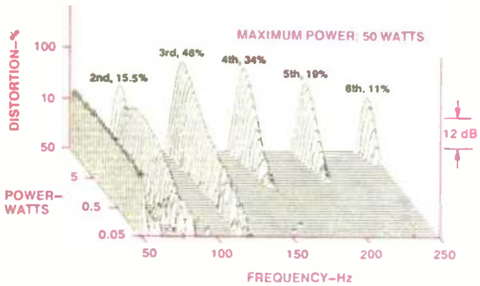

Fig. 10—Harmonic distortion for E_1 (41.2 Hz).

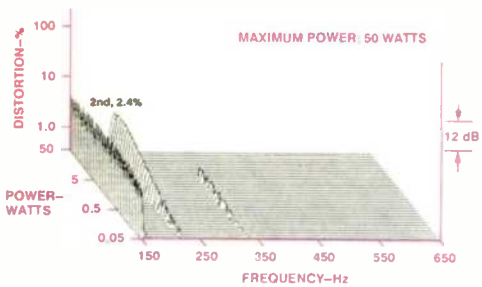

Fig. 11—Harmonic distortion for A_2 (110 Hz).

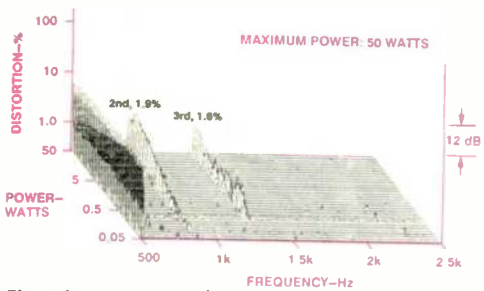

Fig. 12—Harmonic distortion for A_4 (440 Hz).

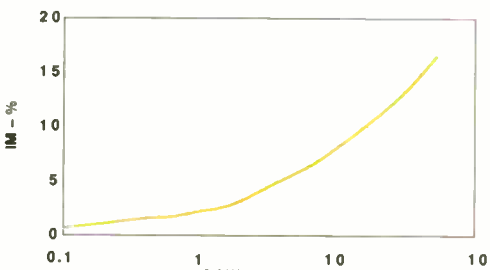

Fig. 13—IM for A_4 (440 Hz) and E_1 (41.2 Hz).

The peak input power starts at 10 watts at 20 Hz, rises to 100 watts at 32 Hz, falls to 30 watts at 50 Hz, and then rises smoothly to 4 kW above 1 kHz. The peak acoustic output rises rapidly to a small peak at 32 Hz, fluctuates, and then attains levels in the 120-dB range above 300 Hz. Also shown is the "room gain" of a typical listening room at low frequencies, which adds about 3 dB to the response at 80 Hz and 9 dB at 20 Hz. With room gain, the Celestion can generate 110 dB SPL only above 120 Hz, and 120 dB above 350 Hz. However, the 300 can generate usable levels of 100 dB and higher at frequencies above 30 Hz. With two systems playing bass signals common to both channels, levels may be in the quite usable range of 105 to 106 dB.

Use and Listening Tests

Although the 300s are supplied with two sets of quite robust double-banana binding posts, for conventional and bi-wiring connections, they aren't arranged the way you might expect. Instead of pairing positive and negative terminals for easy use of a standard double-banana plug, Celestion has paired the two negative terminals close together and paired the two positive terminals some distance away. As a result, either bare wire ends or individual banana plugs must be used. The generously sized holes in the posts accept quite large cables. The terminal pairs are normally connected by short, golden wires which must be removed for bi-wiring. I left these supplied jumpers in place for all my listening tests.

The speakers are supplied with carpet-piercing spikes but can be used without them on bare wood floors. My review samples were finished in a quite attractive-looking mahogany; black oak and walnut are also available. The systems are designed to be used both with and without the grille and look very good either way. In fact, when I first received these speakers, I thought they were designed without grilles; there was no obvious way to attach the grilles, and the systems looked quite good without them. Grilles are supplied, of course (I found them when I went back and looked through the packing material!). They attach with four flat projections on the rear, which mate with corresponding rubber-filled slots on the four corners of the driver mounting plate.

The 300 comes with a well-written six-page manual (actually a 25-page manual, if you count its English, French, German, Italian, and Spanish translations!). It covers the usual topics of conventional and bi-wire connections, room positioning, and power handling. Celestion recommends placing the speakers about 8 to 10 feet apart and 18 to 24 inches from the back wall, with a 30° toe-in aimed at the listener. I did most of my listening in my usual review position, which is much farther out in the room. I did experiment by placing the 300s

THE CELESTION IS A SOLID COMBINATION OF LOOKS, BASS EXTENSION, AND WIDE-RANGE ACCURACY.

closer to the rear wall but experienced a moderate loss in imaging along with the expected increase of bass.

My equipment lineup includes some new amplification: Krell's new remote-controlled KRC preamplifier and the Krell KSA-250 power amplifier (which develops 250 watts per channel into 8 ohms, 500 watts into 4 ohms, 1 kW into 2 ohms, and 2 kW into 1 ohm!). I enjoy the preamp's remote-control capability, which extends even to the tape monitor, and its real volume-control knob for making those infrequent manual adjustments. Other equipment remains the same: Onkyo and

Professional type, balanced output jacks are grounded, and shield the signal against noise

In airline pilots, brain surgeons, and CD players, steadiness is a pretty fundamental requirement.

In the case of the Elite® line of CD players and the uncompromising Elite transport, their rock-solid stability has rocked the world of music lovers and audio critics. It's

[How A Concept Called The Stable Platter Turned The CD Upside Down.]

apparent from the reviews and the awards that Elite has advanced CD standards dramatically.

At the very apex of CD technology today is our PD-S95 transport. To insure optimum sound quality, it mobilizes an unprecedented array of mechanical and electrical isolation techniques, including rigid acoustic shell construction and discrete power supplies.

But its most significant innovation – incorporated

The Elite PD-75 Compact Disc Player. Its elegant urushi finish reflects technical elegance within

throughout the Elite line – is the stable platter.

Two basics of physics – mass and inertia – combine to make the stable platter an obviously superior platform to support a disc spinning at high velocity. Next, the stable platter, by supporting the entire area of the CD disc, minimizes wobble and chatter. A wobbling disc presents a difficult target for the laser, while a chattering disc creates resonance, distorting the signal, which distorts the sound.

The stable platter, with its great mass and driven with precision by a new transport mechanism, spins solidly in place generating no vibration. The result is sound that is perceptibly superior.

An advanced linear drive motor moves the laser pickup with smooth speed and precision.

Another problem for conventional CDs is gravity. Spinning above the laser pickup and supported only in the center, the disc sags microscopically. Which to a laser beam is significant. But on the Elite CD platter, the disc is turned upside down and lies firmly clamped to a solid surface. Meanwhile, the laser pickup reads the disc's digital code from above, where it is immune to dust settling on the laser optics.

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And usher in a new era of stability.

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Rotel CD players, B & W 801 Matrix Series 2 speakers, and Straight Wire cabling.

First perceptions of the Celestion 300s were that they had a bright, open, and airy sound with sufficient but not thunderous bass. Imaging and clarity were first-class. Low/high spectral balance was quite satisfying, without any of the usual "small speaker" sound character.

Occasionally, however, it was easy to overload the Celestions on material having high-level bass. This included tracks 7 and 13 of Mickey Hart's *Planet Drum* (Rykodisc RCD 10206), an excellent demo CD with lots of rhythm and percussion. The 300s also exhibited good dynamics and impact on this disc. I did notice some major midrange spectral differences between the 300s and my reference systems when reproducing the tom-tom on track 4; the tom-tom was more prominent on the B & Ws.

I noticed some definite tonal differences on pink noise compared to my references. The 300s' evenness of vertical coverage on pink noise was only average on the stand-up/sit-down test; they exhibited moderate upper midrange spectral changes between the two listening positions.

On the low-frequency, third-octave pink-noise test, the 300s did quite well on the 25-, 32, and 63-Hz and higher bands but had a tendency to overload and distort on the 20-, 40-, and 50-Hz bands at high input levels. You must realize, however, that the band-limited third-octave test material is *very demanding* and not like typical program material, whose higher frequency spectral information can mask lower frequency distortion. On wide-range program material having low bass, the 300s made a good account of themselves because of their usable response to below 30 Hz and their relatively graceful overload characteristics. Even when the 300s were moderately overloaded, on wide-range program material the audible effect was not too obvious or objectionable.

On other, less bass-demanding, acoustic instrument sounds—such as the flute, guitar, dulcimer, and fiddle played by the Helicon group on *Horizons: Traditional Music from Around the World* (Dorian Discovery DIS-80103)—the 300s did an excellent job of reproducing the fine nuances of the material, providing great realism and a detailed and open soundstage. (This recording is particularly impressive, not only because of the fine performance, music, and recording techniques but because, when played back in a typical room with average reverberation on a top-grade system, the relatively dry recorded instrument parts sound *very realistic,* with a you-are-there sound quality.)

The 300s also did very well reproducing such other material as symphonic, piano, and chamber music, where their well-balanced and wide-range neutral response was quite welcome. Only on rock music and pipe organ material with heavy bass, played at high levels, did their low sensitivity and relatively limited bass output act as a major obstacle. Even on this demanding material, at moderate levels the 300s did justice to the music. The bass output of the 300 is low only when compared to loudspeakers having 10- or 12-inch woofers. Compared to systems with a single 6- or even 8-inch woofer, the 300's bass output is quite impressive. After all, you don't often hear much usable 32-Hz bass from a speaker with a 6½-inch woofer!

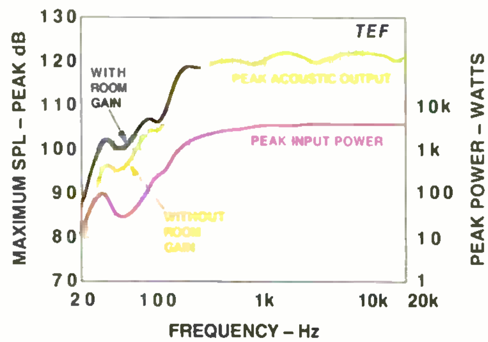

Fig. 14—Maximum peak input power and sound output.

Only when you compare the 300s to larger systems with bigger woofers, at similar prices, do they come up short. For small systems, the 300s have a solid combination of excellent appearance, high technology, extended bass, and wide-ranging accurate response. They would be a welcome addition to any home setup. *D. B. Keele, Jr.*

THE DIFFERENCE

AR

In any endeavor there are individuals and companies that come to exemplify the spirit of an idea and a time. These are the people and organizations that have made a difference in history, science, and music.

In high-fidelity, Acoustic Research is one of these companies. The seminal work of this company has actually formed the cornerstone of an industry, as much from a business standpoint as a technological one.

AR's approach to developing products has brought the world the acoustic suspension loudspeaker, dome high frequency and midrange drivers, the three-point suspended subchassis turntable and liquid cooled drivers. Each of these has become an industry standard because each bettered musical reproduction in a tangible, practical way. These successes come directly from two principles: First, the products must set a standard not previously achieved, or they must perform far beyond similarly priced competitors. And, second, no matter how advanced the technology may be, music is always the essential purpose and ultimate measure.

CLASSIC

The AR Classic loudspeakers are the first products to come from a new AR engineering team. Their research encompassed acoustics, physics and pure mathematics. They listened and measured – in labs, in sound rooms and in their own homes. The remarkable loudspeakers that they designed are classic AR products in every sense of musical performance and honest value.

For middle and high frequencies, the AR Classics employ a Symmetrical Radiation Array (SRA) that acts as a virtual point source. The SRA is made

AR CLASSIC LOUDSPEAKERS

up of an all-new soft cloth dome tweeter, flanked above and below by die-cast mid-bass drivers. A sophisticated third-order crossover network, derived by extensive computer modeling, seamlessly integrates the SRA module with acoustic suspension woofers optimized for bass reach and dynamic definition.

With the AR Classic Series you will find a difference. They don't cast their own shadow over the music. Timbre, musical texture and air are intact. The image has height, width and depth. Dynamics appear to be limitless.

Listening will tell you far more than reading can. When you are considering and evaluating loudspeakers, bring along music you care about. Ask your dealer to play the AR Classics and hear the difference between the ordinary and the classic.

THE AR CLASSIC 26

Tapered cabinets minimize frontal area and diffraction

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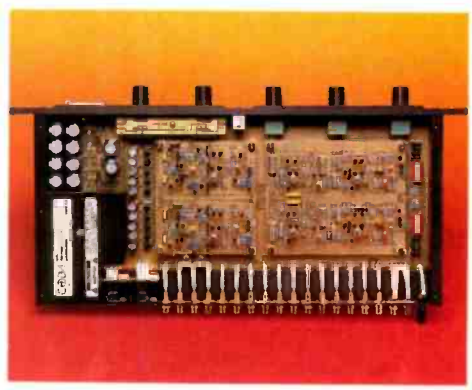
CODA TECHNOLOGIES FET PREAMPLIFIER 01 AND AMPLIFIER SYSTEM 100

Coda Technologies was started by a small group of people who had formerly worked at Threshold. This amp and preamp share some of the physical attributes of Threshold equipment, aesthetic beauty and wonderful build quality, but what sets this equipment apart from the crowd is the Amplifier System 100. It is in two sections: The front-end of the overall power amplifier, the 100v voltage amplifier, is in a chassis the size of the preamp; the larger part of the amp, the 100i current amplifier, contains the output stages and their power supply. The 100v and 100i are connected via two-conductor shielded cables, one per channel, terminated with XLR connectors. The fundamental reason, according to Coda Technologies, for separating these functions is to keep crosstalk from the high currents in an output stage from getting into the front-end circuitry and causing distortion. The use of XLR connectors for the interconnects suggests balanced operation, but that is not the case here. One conductor is the unbalanced signal to the 100i, and the other conductor carries the d.c. control voltage that switches the related channel of the 100i between standby and full operation. Although it is not specifically mentioned in the owner's manual, I believe the intention is for the 100v to be placed with your system preamplifier and for the 100i to be placed wherever it is convenient. There is no mention in the manual about any limit to the interconnect length between the two pieces, and it would seem that the 100v would be capable of driving quite long lines without any problems.

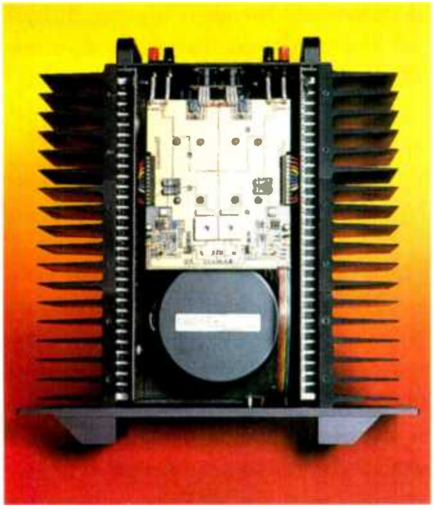
Another thing that distinguishes the System 100 from other power amplifiers is the number and type of output devices used. There are 58—count 'em, 58—output transistors per channel in this beast! They are high-speed, TO-220 plastic-package devices that are usually used for driver and small-signal applications.

The front panel of the 100v features a rotary function switch with positions for "Standby," "Balanced/Bias On," and "Unbalanced/Bias On." A red LED indicator to the left of this switch comes on in either of the "Bias On" positions. Another red LED at the right half of the panel indicates when power is on. There is no power on/off switch on the 100v, as it is intended to be powered all the time for best sound. Rear-panel connectors include an IEC a.c. line-cord socket, a pair of XLR jacks for hookup to the 100i, a pair of XLR jacks for balanced signal input, and a pair of phono jacks for unbalanced input.

While there are no controls on the front panel of the 100i, LEDs indicate the presence of a.c. power and when each channel's bias is off (the standby state) or on. As with the 100v, the 100i is intended to be powered all the time, with the pair's operation controlled by the standby/operate knob on the 100v. In the standby state, the power consumption is very low, on the order of 15 to 20 watts for the System 100. In the operating state, the a.c. line current is a healthy 3.5 amperes, as the idling current in the output stages is rather high. On the 100i's rear panel are an IEC a.c. input connector with integral fuse-holder, the power switch, two pairs of dual binding posts for speakers, and a pair of XLR connectors for the input signal from the 100v.



The FET Preamplifier 01 does not have tone controls, and a phono stage is optional. Both balanced and unbalanced outputs are included. The unbalanced outputs use a pair of phono connectors, while the balanced outputs use a pair of XLR connec-



tors. The optional phono stage has two gain settings, for MM and MC cartridges. Phono input resistance and capacitance are each selectable via internal DIP switches. Front-panel controls include "Input Selector," "Record Selector," "Mode" ("Mono/Stereo/Reverse"), "Balance," and "Output Level." The "Record Selector" arrangement in the FET 01 allows possible feedback oscillation in a connected tape recorder when the deck is in record mode. Coda Technologies does caution about this explicitly in the owner's manual, however. A red LED power indicator is above the Coda logo, near the right edge of the panel. On the rear panel are an IEC a.c. line-cord connector, a pair of XLR balanced output connectors, nine pairs of phono connectors, and a binding post for ground.

The amp and preamp chassis are constructed of machined aluminum plates that are bolted together to form the whole. The FET 01 and the 100v each contain one large p.c. board that carries, either directly or via smaller daughterboards, the majority of the parts. The 100i has a large toroidal power transformer, mounted towards the front, and filter capacitors at the rear. A p.c. board, mounted on top of these filter capacitors, serves as a control circuit, audio power supply, and signal-distribution board. Two more large p.c. boards, one per channel, are mounted to the heat-sinks; these boards interconnect all the power transistors with the supply rails and the output buses. Needless to say, build and parts quality used in this equipment is of the highest order.

SPECS

Preamplifier

Frequency Response: Line section, 0 Hz to 200 kHz, +0, –3 dB; phono stage, RIAA ±0.2 dB, with subsonic roll-off at 14 Hz.

THD (20 Hz to 20 kHz): Line section, less than 0.01% at 6 V peak into more than 600 ohms; phono stage, less than 0.01% at 3 V peak.

S/N (re: 1 V): Line section, greater than 100 dBA; phono stage, greater than 85 dBA.

Phono Stage Gain at 1 kHz: MM, 37 dB; MC, 57 dB.

Maximum Output: 26 V, peak to peak.

Output Impedance (Resistive): Unbalanced, 75 ohms; balanced, 150 ohms.

Dimensions: 19 in. W × 1¾ in. H × 8 in. D (48.3 cm × 4.4 cm × 20.3 cm).

Weight: 8 lbs. (3.6 kg).

Price: With phono stage, $2,750; without phono, $2,450.

Amplifier

Power Output (20 Hz to 20 kHz): Stereo, 100 watts per channel, Class A, into 8 ohms; bridged, 400 watts (100 watts Class A) into 8 ohms; paralleled, 100 watts, Class A, into 8 ohms or 200 watts into 4 ohms.

Frequency Response: 0 Hz to 100 kHz, +0, –3 dB.

Distortion (10 Hz to 20 kHz): Stereo, less than 0.1% at 100 watts into 1 to 8 ohms; bridged, less than 0.1% at 400 watts into 2 to 8 ohms; paralleled, less than 0.1% at 100 watts into 0.5 to 8 ohms.

Gain: Stereo, 26 dB; bridged, 32 dB; paralleled, 26 dB.

Maximum Peak Current: Stereo and bridged modes, more than 100 amperes; paralleled, more than 200 amperes.

Slew Rate: Stereo, 50 V/µS; bridged, 100 V/µS; paralleled, 50 V/µS.

Noise (re: Rated Output): –100 dB.

Input Impedance: Unbalanced (stereo and paralleled modes), 100 kilohms; balanced (stereo and bridged modes), 2 kilohms.

Output Impedance (20 Hz to 20 kHz): Stereo, 0.03 ohm; bridged, 0.06 ohm; paralleled, 0.015 ohm.

Power Requirements: 450 watts.

Dimensions: 100v voltage amplifier, 19 in. W × 8 in. H × 1¾ in. D (48.3 cm × 20.3 cm × 4.4 cm); 100i current amplifier, 19 in. W × 7 in. H × 19 in. D (48.3 cm × 17.8 cm x 48.3 cm).

Weight: 70 lbs. (31.8 kg).

Price: $6,500; additional 100i current amplifier, $4,350.

Company Address: 9941 Horn Rd., Suite A, Sacramento, Cal. 95827.

For literature, circle No. 92

Circuit Description

The FET 01's phono circuitry consists of two gain blocks. The first block appears to be flat, with the high-frequency RIAA roll-off taking place in the coupling between gain blocks. The RIAA bass boost is accomplished in the feedback loop of the second gain block. The line section's gain function is implemented with one gain block and produces the positive phase output. Another gain block, configured as a unity-gain inverter, is fed from the output of the main line-amp output and generates the negative phase for the balanced output. A simple J-FET source follower with a J-FET current source functions as a tape output buffer and connects whatever is selected by the "Record Selector" to the tape out jacks. The selected source for listening goes through the balance control, into the volume control, and then into the line amplifier input.

BEAUTY AND BUILD QUALITY SHOW THE HERITAGE OF THIS CODA EQUIPMENT.

The basic circuit topologies used in the preamp gain blocks and the 100v power amplifier front-end are variations on the following theme: An N-channel J-FET differential amplifier as the first stage, followed by a P-channel MOS-FET or PNP bipolar differential second stage with NPN bipolar turnarounds. In all cases except the phase inverters for the line output, this second stage is cascoded with a PNP bipolar common-base stage. Both first and second stages have bipolar current sources. Complementary emitter followers are used in the FET 01 line output amplifiers and in the output of the 100v. The output of the first gain block in the phono stage is a single-ended NPN emitter follower; the second phono block has no output-follower circuit but is coupled directly from the collectors of the appropriate phase of the second stage's output. In the phono input stage, the input amplifier uses two J-FET devices in parallel for each half of the differential configuration, to lower input noise.

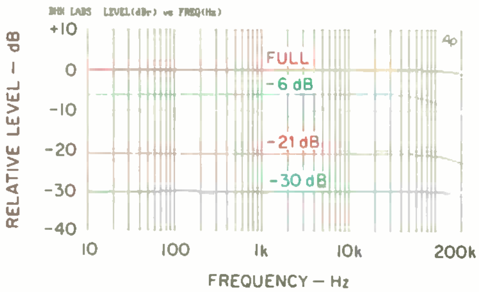


Fig. 1—Frequency response of FET 01 line stage vs. volume setting.

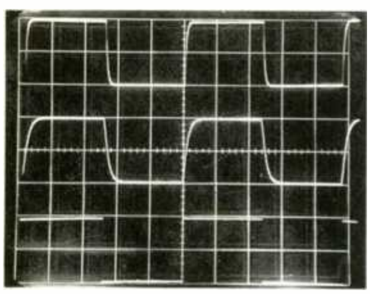


Fig. 2—Square-wave response of preamp line stage; see text.

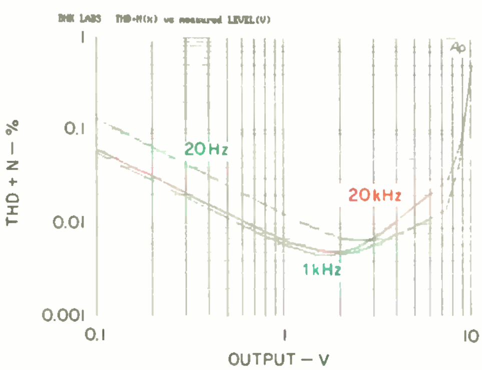


Fig. 3—Preamp line section THD + N vs. output level.

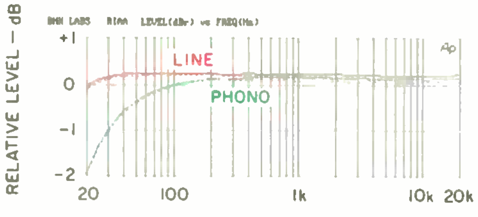


Fig. 4—RIAA equalization error; see text.

Power-supply circuitry in the FET 01 consists of a full-wave, capacitor-input, positive and negative d.c. supply followed by constant-current-fed zener diodes for regulated positive and negative reference voltages. After these zener diodes come emitter followers, of appropriate polarity, in five regulator pairs. These regulator pairs serve to feed each gain block with its own regulated supply.

The 100i is basically one giant Darlington complementary power emitter follower. Input from the 100v is appropriately level-shifted to the bases of a pair of complementary driver transistors. Output from the drivers is to the 58-transistor composite complementary emitter-follower output stage. No negative loop feedback is used in the 100i, only the current feedback inherent in the emitter-follower topology. A separate bias supply for each channel applies regulated voltage to the input bias-voltage dividers in each channel. These bias supplies are enabled by the d.c. control voltage from the 100v, to place the 100i in the operative state. In the standby state, the bias supply is shut off and the giant output stages sleep, with their supply rails up but current conduction cut off and signal input shorted by a relay.

Power circuitry in the 100i consists of a generous-sized toroidal transformer with individual-channel secondary windings, capacitor-input filtered to the positive and negative supplies that power the two channels. The filters use four 50,000-µF, 50-V capacitors. Two more secondary windings power the bias supplies.

Measurements

Voltage gain and IHF sensitivities of the FET Preamplifier 01 are listed in Table I.

Performance of the preamplifier in general was well matched between channels, and any of the measurements cited here are representative of both channels unless otherwise mentioned. Frequency response of the main positive phase of the 01's line amp is shown in Fig. 1 as a function of the volume control's setting. Results were substantially the same with either my instrument load or the IHF load. High-frequency bandwidth is reduced a bit with the volume set about 6 dB down from maximum but returns to full bandwidth at attenuations of about 20 dB or more.

THE CODA AMP HAS 58—COUNT 'EM, 58—OUTPUT TRANSISTORS PER CHANNEL!

Square-wave response of the preamp's line section with instrument load is shown in Fig. 2. The top trace is for 20 kHz at an output level of about 10 V peak to peak. In the middle trace, the volume control was reduced to an output level of about 4 V peak to peak, and the reduced high-frequency response is evidenced by an approximate doubling of the rise- and fall-times (lengthened from about 1 to 2 µS). The bottom trace is for 20 Hz; the d.c. coupling in the line amp is evident in the absence of any tilt in the waveform's steady-state levels.

The preamp's distortion as a function of output level is plotted in Fig. 3 for three frequencies. The measurement bandwidth for the 20-Hz curve extends down below 10 Hz; consequently, there is more hum in these readings than in the 1- and 20-kHz curves, whose measurement bandwidth extends only down to 400 Hz. Results were about the same with the instrument or the IHF load. The turn-up in distortion at about 7.5 V is due to premature clipping on the positive peak of the output waveform.

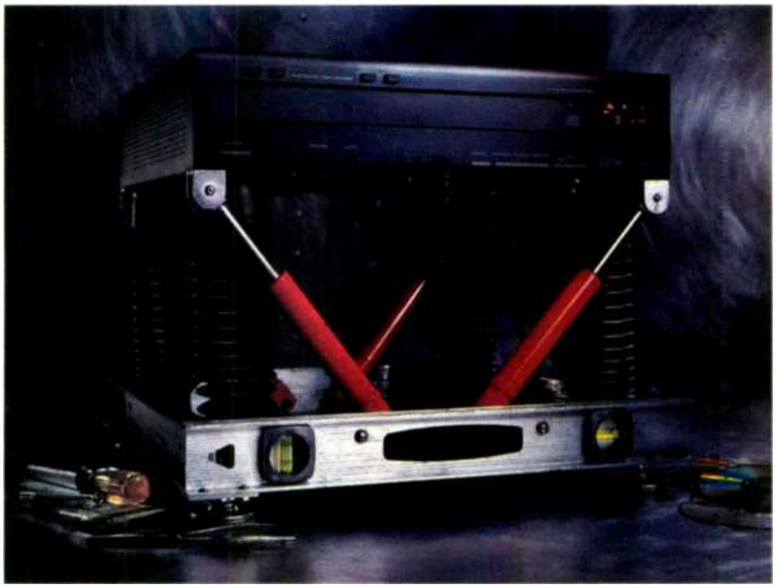
Remember the first time you heard a CD? It sounded so good, you hoped the music would never stop.

Which is the whole idea behind the CD changer.

Unfortunately most companies, in their rush to produce one, neglected to isolate the disc that's playing from the changer platform. A big mistake. (Not as big as the Hubble telescope, but pretty darn serious.)

One that transfers internal and external vibrations to the playing disc. Creates resonance. Distorts the sound. And defeats a primary reason for buying a CD player in the first place.

Fortunately Yamaha avoided this common problem by developing an entire line of CD changers that are virtually vibration-free. A pretty amazing feat in itself.



Or buy one of Yamaha's new CD changers.

How they do it is something called PlayXchange. A unique design which not only isolates the playing disc from the loading tray, providing vibration-free playback, but also allows you to change four CDs without disturbing the fifth one that's playing.

Yamaha's PlayXchange System. The only carousel mechanism that doesn't transmit vibration to the playing disc. An important feature that permits four discs to be changed without disturbing the one playing.

And because you're supposed to spend your time listening to your CDs and not the machine that plays them, Yamaha's developed a new changing mechanism that's exceptionally quiet, quick and reliable.

But you can't judge a superior CD player merely by its changing mechanism. What makes the difference between a good player and a great one has to do with attention to details.

Take Yamaha's new CDC-835 for example. With Yamaha's S-Bit Plus Technology, twin balanced D/A converters and Class A amplification at every stage, the CDC-835 outperforms most single disc CD players on the market.

S-Bit Plus

Its fluorescent display can be dimmed or set to automatically shut off during playback, eliminating any chance of interference.

And the CDC-835 is equally impressive in the convenience department.

Its TOC Memory memorizes the contents on each disc, speeding up access to specific songs, especially during random disc-to-disc play.

And to give your favorite kind of music even more presence, there's a built-in equalizer with five digital presets.

In fact, the CDC-835 can remember your favorite songs on up to 100 discs and play them back in any sequence. It even remembers EQ settings.

The CDC-835. The only changer with a five-mode digital equalizer.

Then there's 5-Disc Tape Edit. A useful recording feature that arranges the tracks you select so they fit neatly on two sides of your tape.

By now, if you're not quite sold on the CDC-835, you only have two options. You can drop by your nearest Yamaha dealer and let your ears make up your mind.

Or you can buy another changer. Which when you stop to think about it, would be a total shock to your system.

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The output amps of the FET 01 can drive a 600-ohm load with reasonable grace, putting out some 20 dBm (7.78 V) at about 0.25% distortion.

Output impedance of the line outputs was 60 ohms, and the input impedance varied from about 20 kilohms (with volume at max) to a higher value of more like 25 kilohms (with the volume control at 50% rotation).

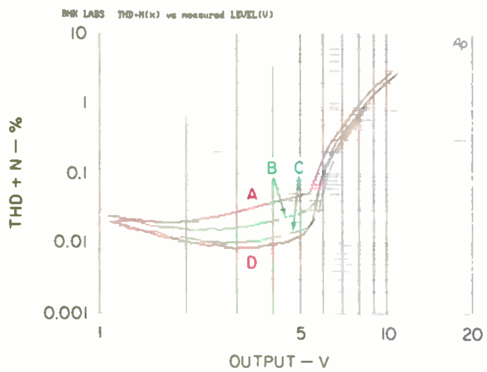

Fig. 5—THD + N for 20 kHz into IHF load (A) and instrument load (B) and for 1 kHz into instrument load (C) and IHF load (D).

Table I—Gain and sensitivity, FET 01 preamp.

	Gain, dB			
	LEFT		RIGHT	
	Instr. Load	IHF Load	Instr. Load	IHF Load
Phono to Tape Out				
MM	40.55	40.07	40.50	40.03
MC	61.36	60.88	61.28	60.81
Phono to Main Out				
MM	56.72	56.67	56.63	56.58
MC	77.52	77.47	77.40	77.34
AUX to Tape Out	–0.14	–0.62	–0.15	–0.62
AUX to Main Out	16.06	16.00	16.00	15.95
	IHF Sensitivity			
Phono to Tape Out	LEFT		RIGHT	
MM	4.96 mV		4.98 mV	
MC	452.0 μV		455.5 μV	
Phono to Main Out				
MM	733.6 μV		741.3 μV	
MC	66.9 μV		67.9 μV	
AUX to Tape Out	536.4 mV		536.4 mV	
AUX to Main Out	78.9 mV		79.5 mV	

Table II—Output noise of FET 01's line section for full-clockwise and counterclockwise positions of volume control. IHF S/N was 85.5 dB for the left channel and 87.3 dB for the right.

	Referred Input Noise, μV			
	LEFT		RIGHT	
Bandwidth	**CCW**	**CW**	**CCW**	**CW**
Wideband	60.0	127.0	60.3	116.0
22 Hz to 22 kHz	35.6	119.6	31.8	106.0
400 Hz to 22 kHz	23.0	56.5	19.5	49.0
A-Weighted	22.0	56.5	18.0	47.7

Output noise levels as a function of measurement bandwidth, channel, and volume-control position are listed in Table II. Usually, output amplifier noise in a preamp is lowest when the volume is turned down, becomes worse at some point about 6 dB down from full volume, and goes back down nearly to its minimum value when the volume control is fully up. (The preceding assumes that the inputs are terminated normally, with a source impedance of 1 kilohm or less.) The FET 01's output noise, however, is highest at full volume, due to some line-harmonic noise from the filter-capacitor charge currents getting into the line amp when the volume is up and the selected input is terminated. With the inputs open-circuited, there was somewhat less noise at full volume. The noise level here, some 100 μV or more, might be audible with a quiet source connected and volume set near maximum in a system using a power amplifier with high gain (30 to 40 dB) and high-efficiency speakers.

Interchannel crosstalk of the FET 01 was found to be down by more than 90 dB at frequencies up to 400 Hz, increasing at 6 dB per octave up to –60 dB at 16 kHz—this with the volume control at maximum. With the volume control set for 6 dB of attenuation, crosstalk was better than 90 dB down at frequencies up to 200 Hz, increasing at 6 dB per octave up to –60 dB at 10 kHz.

Volume-control tracking was within 0.5 dB down to –55 dB, increasing to a 1-dB error at –66 dB and further increasing to about a 2-dB error at –95 dB. This is quite good performance.

Phono performance was mostly investigated in the high-gain (MC) mode, and differences between this and the low-gain (MM) mode are noted where significant. The RIAA equalization error, measured at the tape output jacks, is plotted in Fig. 4 for two different settings of the input selector. The curves are flatter when the selector is set to a line input and show a low-frequency roll-off when the selector is set to "Phono." This latter condition loads the phono output's coupling capacitor with the impedance of the volume and balance-control circuitry and forms a first-order high-pass filter with a cutoff frequency of some 14 Hz, by intent, to reduce effects of turntable rumble. The reason the frequency response is flatter in the low end when the input selector is not set to "Phono" is that the input impedance of the tape output buffer is much higher than that of the volume and balance-control circuitry, resulting in a much lower low-frequency cutoff. If you want the best low-frequency response from records, don't monitor directly by setting the input selector to "Phono"; set the tape deck to record mode, and listen through the tape playback monitor. In the case of the flatter curve, equalization accuracy is very high, but in practice you don't get this curve when listening through the "Phono" input setting. I don't care for this high-pass filter being a default condition without a defeat.

THE AMP'S FREQUENCY RESPONSE VARIES SO LITTLE WITH LOAD THAT ALL THE CURVES OVERLAP.

Phono distortion at two frequencies as a function of output level and loading is shown in Fig. 5. The right channel (shown), starts its distortion rise at about 6 V, noticeably sooner than the left channel did (whose distortion rise started at about 8 V). In the MM mode, distortion was virtually identical to Fig. 5 above an output of 5 V, with lower readings due to lower noise below 5 V. The noise was lower because the phono input was being fed with 10 times greater signal levels, due to the overall lower MM gain. Figure 6 shows phono overload versus frequency and load, both for attainable output levels at 3% THD + N and for the input levels corresponding to them; the curves for IHF and instrument loads are almost identical. Again, data is shown for the right channel, which has a reduced output capability below 100 Hz, whereas the left channel was more flat below 100 Hz. Overload capability is gener-

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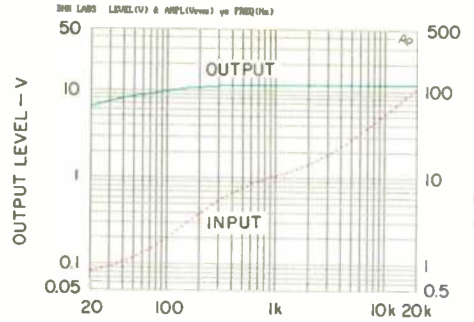

Fig. 6—Phono overload vs. frequency at 3% THD + N.

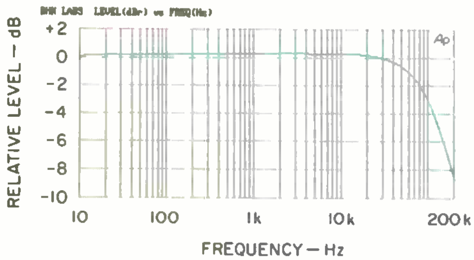

Fig. 7—Frequency response of System 100 amplifier; see text.

Table III—Output noise of phono section with inputs short-circuited, with 100-ohm load on MC input, and with 1-kilohm load on MM input. With IHF MM artificial source, A-weighted noise for the left and right channels was 0.87 and 0.75 dB, respectively. IHF S/N for the MC section was 66.3 dB for the left channel and 68.5 dB for the right; for the MM section, it was 75.4 and 76.5 dB for the left and right channels, respectively.

	Referred Input Noise, μV			
	LEFT		RIGHT	
MM Gain	**Shorted**	**1 Kilohm**	**Shorted**	**1 Kilohm**
Wideband	1.0	1.1	1.2	1.3
22 Hz to 22 kHz	0.89	1.0	1.0	1.1
400 Hz to 22 kHz	0.35	0.42	0.3	0.38
A-Weighted	0.35	0.42	0.3	0.38
MC Gain	**Shorted**	**100 Ohms**	**Shorted**	**100 Ohms**
Wideband	0.79	0.89	0.79	0.89
22 Hz to 22 kHz	0.71	0.79	0.71	0.79
400 Hz to 22 kHz	0.25	0.25	0.18	0.2
A-Weighted	0.24	0.25	0.19	0.2

Table IV—Output noise, System 100 amplifier. The A-weighted IHF S/N ratio was 89.9 dB for the left channel and 91.3 dB for the right.

	Referred Input Noise, μV	
Bandwidth	LEFT	RIGHT
Wideband	430.0	475.0
22 Hz to 22 kHz	425.0	461.0
400 Hz to 22 kHz	47.0	55.0
A-Weighted	77.0	91.0

ally quite good, about 10 mV at 1 kHz in the MC mode and about 100 mV in the MM mode. As an example, imagine an MC cartridge with a 1-mV output at standard cutting level at 1 kHz; this phono preamp would allow a 20-dB increase over standard cutting level through most of the audio range, an event of low likelihood. Obviously, an MC cartridge of lower output would have even more margin. I wouldn't recommend using moving-coil outputs of greater than 2 mV for the MC mode. With those and MC or MM cartridges of higher output, you should switch to MM mode.

Noise levels in both MM and MC mode are listed in Table III. The results are satisfactorily low here, although nowhere near state of the art. Noise is greater in the MM mode due to the use of a high-value shunt feedback resistor in the first phono gain block and, possibly, to a greater contribution from the second phono gain block.

Crosstalk versus frequency in the MC mode was found to be better than 80 dB down from 20 Hz to about 13 kHz, where it crossed over the –80 dB level at a slope of +6 dB per octave.

The two pieces of the System 100 amp were interconnected by two 6-foot, two-conductor shielded cables supplied by Coda. Voltage gains and sensitivities for both channels were found to be virtually the same, at 26.5 dB and 133 mV. Again, as with the FET 01, performance of the two channels of the System 100 was very close and the results of the lesser channel are presented unless noted.

With the unit operating and the top cover off, I noted that the main power-supply rectifiers, mounted to the p.c. board atop the filter capacitors, do not have any heat-sinking other than free-air radiation and convection. I think that they get too hot; I wasn't able to keep my fingers on them for more than an instant.

Frequency response for open-circuit, 8-ohm, and 4-ohm loading is plotted in Fig. 7. The results are so close that all three conditions just make the curve appear to be a little thicker with the resolution used in the graph. It would be fair to say that the System 100 is rather impervious to loading in regard to changes in frequency response. Related is the square-wave response (Fig. 8). Here, the top trace is for a 10-kHz square wave and an 8-ohm load at an output level of 10 V peak to peak. Of interest is that the waveform remains exponential in shape all the way up to clipping. Rise- and fall-times were 3.6 μS. In the middle trace, a 2-μF capacitor has been added across the 8-ohm load. The 100i does not have an RL output-buffering network, which usually causes much greater and slower ringing than shown here. The System 100 has unusually low reaction to the added 2 μF, an excellent and desirable result. The bottom trace in the figure, for 40 Hz, illustrates the d.c., low-frequency response of the System 100.

THE SYSTEM 100 HAS VERY LOW DISTORTION, EVEN THOUGH THERE'S NO FEEDBACK LOOP AROUND ITS OUTPUT.

Both THD + N at 1 kHz and SMPTE-IM distortion are plotted in Fig. 9 as functions of power output with 4- and 8-ohm loading. Even though Coda says their Class-A biasing scheme is relatively insensitive to the effects of "running out of Class-A current" into lower impedance loads, the effect of this is visible in the plot of 4-ohm IM distortion as a null and a rise to greater distortion beyond. Overall, however, the System 100 has very low distortion, especially considering that there is no overall feedback loop encompassing the output stage. This design doesn't have much margin beyond its specified power output at stated distortion. As can be seen, the distortion is on the rise at the 100-watt power point. All these measurements were made from a 120-V a.c. line; lower line voltages would make the amplifier clip at lower power levels. Figure 10 shows THD + N as a function of frequency and power. A spec-

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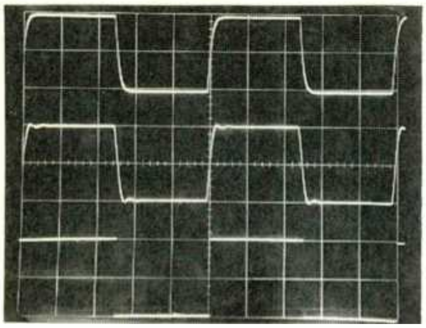

Fig. 8—Amplifier square-wave response; see text.

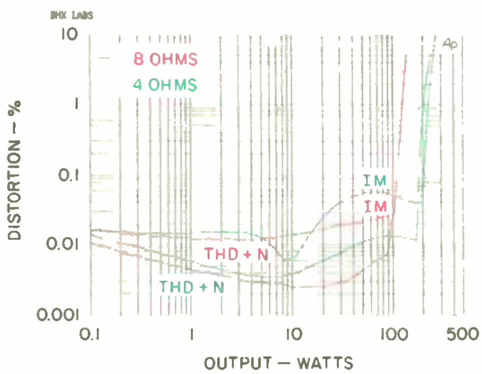

Fig. 9—Distortion vs. power output.

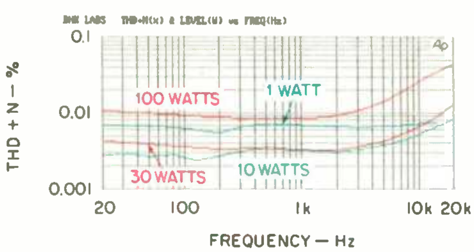

Fig. 10—Amplifier THD + N vs. frequency.

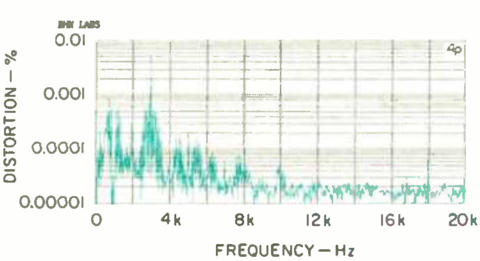

Fig. 11—Distortion spectrum of 1-kHz signal at 20 watts into 4 ohms.

trum analysis of a 1-kHz signal at an output of 20 watts is shown in Fig. 11 for the left channel; the right channel had a bit more second harmonic but about the same amount of third. The amounts and orders of distortion are admirably low, but what appears to be some line-harmonic sidebands are quite visible up to several kHz.

Output impedance was found to be about 0.03 ohm over most of the frequency range. This corresponds to a damping factor of some 267 referenced to 8 ohms, which is quite high for an output stage without global feedback.

Output noise as a function of measurement bandwidth, along with IHF S/N ratios, are listed in Table IV. The values obtained are exemplary.

Dynamic power, measured using the IHF tone burst, was found to be 115 watts and 220 watts into 8 and 4 ohms, respectively. Since the unit is not rated explicitly for 4-ohm loading in normal stereo operation, the dynamic headroom of 0.61 dB applies to 8-ohm loading. Peak current attainable into a 1-ohm load was ±39 amperes at the point of clipping. I don't have a lower impedance load to find out what this output stage can really do, but judging by its beef, I have no problem imagining 100-ampere peaks, as claimed. Steady-state output at the onset of clipping was 112 watts into 8 ohms and 198 watts into 4 ohms, yielding a clipping headroom of 0.5 dB. Power-supply regulation is pretty good in this design, as the steady-state draw off the power supply is rather high and is in the flatter portion of the power-supply regulation curve. As a matter of interest, the power supply's rail voltage and a.c. line current was ±47.5 V and less than 100 mA in standby, ±42.9 V and 3.5 amperes at idle, and ±42.2 V and 4.0 amperes at 100 watts per channel into 8 ohms.

Use and Listening Tests

Equipment used in evaluating the System 100 amp and FET 01 preamp consisted of an Oracle turntable with a Well Tempered Arm and Spectral Audio MCR-1 Select cartridge, a Krell Digital MD-1 CD transport feeding PS Audio Ultralink and VTL D/A converters, a Nakamichi ST-7 FM tuner and 250 cassette recorder, and a Technics 1500 open-reel recorder. Other preamplifiers on hand during the review period were a Quicksilver Audio, a First Sound Reference II, and a Counterpoint SA-5000. Other power amplifiers used were Quicksilver Audio M-135 prototypes, the Arnoux Seven B (a prototype switching design), and a Crown Macro Reference. Speakers used were Win Research SM-10 monitors and an early experimental Genesis Technologies two-way design.

I first listened to the Coda equipment with the 100v located with the front-end

THIS EQUIPMENT SOUNDS DAMN GOOD, BOTH INDIVIDUALLY AND IN COMBINATION.

equipment and stacked with the FET 01 preamp. A pair of AudioQuest Lapis 20-foot balanced cables were used to interconnect the 100v and 100i. My impressions at this time were that the sound was musically enjoyable but that tonal balance was just a little on the dark or muted side although highs were smooth and inoffensive.

My next listening was done without the FET 01, stacking the 100v on top of the 100i and treating the pair like any other power amplifier. The two were linked by a pair of 6-foot interconnects supplied by Coda. The preamp was linked to the amp by a pair of 20-foot Masterlink LP cables, from Music and Sound Imports, which I have been using happily for the better part of a year. At this time I thought the amplifier was very good; it gave an excellent sense of space. It also had excellent definition, bass quality, and dynamics and was free of irritation. The high end was a little subdued but very complimentary to CDs.

For my final evaluations of the sonic quality of this amp and preamp, I first listened to the preamp mostly with the

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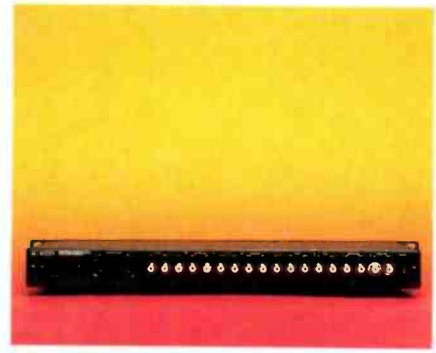
Crown Macro Reference amp, which has really endeared itself to me for its sonic honesty and good sound. Results were generally pretty good, with any sins generally being ones of omission. Compared to the same signals heard through the First Sound passive preamp/controller and the Crown amp, the sound of line-level sources played through the Coda Technologies equipment seemed to have lost a bit of its "thereness" but was otherwise nicely musical and very listenable.

Using the Coda pair together yielded very listenable musical results. As a final test of the System 100, I used the First Sound preamp to feed the amp via 1-meter interconnects. I felt the resolution and presence to be superior to what I'd heard when feeding the amp from the FET 01 preamp via my 20-foot interconnects. This makes me think I like the amplifier a little better than I like the preamplifier. Don't get me wrong, though; this equipment sounds damn good, both individually and in combination.



I REALLY THINK THIS CODA EQUIPMENT IS STUNNINGLY BEAUTIFUL AND WELL MADE, AND IT SHOULD LAST FOREVER.

In conclusion, and nit-picking aside, I really think the Coda Technologies equipment reviewed here is stunningly beautiful and well made. The System 100 and FET 01 should last "forever," with little or no trouble, and provide excellent sonics in the process. Go out and give this pair a listen.

Bascom H. King

AUDIO RESEARCH LS3 B LINE PREAMP

Audio Research has been a top high-end preamplifier manufacturer for many years. The brand name has been synonymous with advances in the design of tube and phono preamps. While most other firms focused on transistors, Audio Research helped bring tubes their finest hour.

Although Audio Research's top-of-the-line products are still tube units, the company has worked with transistor designs for many years. It also has been one of the first firms to focus on simplifying the signal path and to discover that reducing the number of active and passive components in the signal path, and improving the components' quality, has a perceptible impact on sound quality in a high-resolution system.

Company Address: 5740 Green Circle Dr., Minnetonka, Minn. 55343.
For literature, circle No. 93

The LS3 B line stage preamplifier is a logical extension of that experience. It is a transistor unit, and as its name indicates, it does not have a phono gain stage. Audio Research does, however, make two separate phono preamplifiers that can be used with the unit. The LS3 B sells for $1,995 with a balanced output and $1,495 without. Interestingly, Audio Research shows its tube heritage by making a higher priced hybrid tube/transistor unit with very similar features, the LS2, which costs $2,995 with a balanced output and $2,495 without.

THE LS3 B EMPHASIZES SIMPLICITY BOTH IN ITS CIRCUITRY AND IN ITS CONTROLS.

The LS3 B emphasizes simplicity, eschewing the host of switches and features common on many mid-fi preamps and receivers. The main controls are for gain (in 31 steps), balance, and mono/stereo, with an additional knob allowing selection of five high-level inputs. There are also switches for off/on, muting, tape monitoring, and "Direct/Normal" operation.

The "Direct/Normal" switch is the only special control feature on the unit, and it is symbolic of the emphasis Audio Research places on simplifying the signal path. The "Direct" setting bypasses the controls for balance, mode, and even input selection, and it activates (via a relay) a pair of "Direct" inputs on the rear panel that enter the circuit just before the volume control. This provides a way of getting a signal with the least possible coloration from a CD player or D/A converter hooked up to that input pair.

I question the practical value of comparing most preamp specifications. The frequency response and distortion specifications of today's good preamps are well within the area where any differences between units are psychoacoustically irrelevant. The LS3 B is specified as having less than 0.01% distortion at an output of 2 V rms from 2 Hz to 100 kHz, and less than 0.005% in the mid-band. This is impressive, but no more so than for most preamps, and it is the same specification given for the LS2 B.

In Vienna,

where they live and breath music, a survey of 17 D to A converters was conducted by the noted musicologist and audio critic, Dr. Ludwig Flich. Only two converters earned the "Reference Class" status. One of these converters sells for $13,500. The other, at one seventh the price, is pictured below.

In Tokyo,

where they live and breath consumer electronics, and where one can purchase anything made by anyone in the world, that same D to A converter was chosen as 1992's **Component of the Year.**

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Below, a sampling of available DACCards

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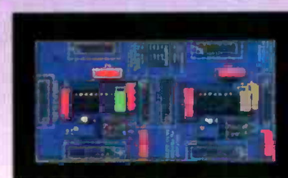
Philips 20-bit Bitstream DAC

Crystal Semiconductor 18-Bit Sigma Delta DAC



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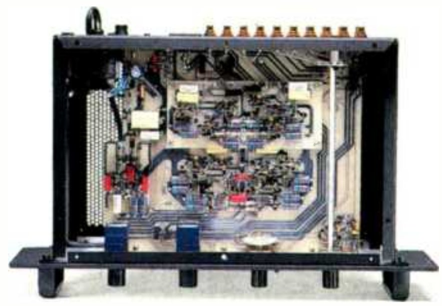

What may be more relevant is that the rated frequency response is a wide 2 Hz to 100 kHz, ±0.5 dB. Gain is 18 dB, with an optional reduction of 10 dB. There is no gain at the tape output and 24-dB gain at the balanced output. Noise is rated at more than 100 dB below a 2-V output signal with regular outputs and 4 V with the balanced outputs. Input impedance is 50,000 ohms for most inputs, with 100,000 ohms for the direct input. Output impedance is 250 ohms, allowing the use of long interconnects.

The basic circuit is pure Class A, with a high-voltage supply. No push-pull circuits are used. There are three sections to the active gain stage. The first is a differential input using J-FETs. The feedback drives the negative input of the differential pair, which allows the feedback to include the output capacitor and improves the sound quality. The second stage has a J-FET follower driving a MOS-FET in a common gate, with feedback to limit its gain to 14 dB. The third stage is a source follower with a constant source load. The gain is limited by feedback, and the output capacitor is again included in the feedback loop.

The circuit design emphasizes short, simple signal paths and has d.c.-coupled inputs and a tightly regulated power supply. The circuit board uses relay switching and has board-mounted switches. The input-selector knob on the front panel is actually connected, by a long shaft, to a switch at the rear of the circuit board, near the input jacks. This input switch configuration, and the fact that other front-panel switches actually control internal relays, allow the LS3 B to eliminate any wires in the signal path except for the oxygen-free copper jumpers from the connectors to the circuit board.

Audio Research emphasizes the quality of the power supply and claims that the electronic line regulation is better than 0.01%. Construction, the layout of the p.c. board, and component quality of this unit are excellent.

This kind of preamp is obviously designed for the audiophile who is creating a stereo system with the best possible CD player (or CD transport and D/A converter), power amplifiers, and loudspeakers. In all frankness, the LS3 B's superior sound will not show up in mid-fi systems using mediocre CD players and colored speakers or in systems where speaker placement and the overall setup do not focus on accuracy in imaging and soundstage or provide a clear path between the speakers and the listening position. Only in a more demanding system does the LS3 B reveal its outstanding performance.

Before I began my listening tests with music, I tested the LS3 B's noise and coloration by inserting it into the tape monitor loop in my reference preamp. I compared the sound of a setup in which I put the LS3 B in and out of the signal path between a Theta Digital Balanced DS Pro Generation III D/A converter and my reference power amplifiers. The LS3 B did virtually nothing to alter sound quality. I noticed only a tiny increase in noise when I listened at high volumes with my ear close to the speaker, and there was an almost imperceptible loss of detail and reduction in dynamics. No active or passive device is ever totally neutral, but this unit's neutrality in these two tests ranks with some of the most expensive line stage preamps I have reviewed.

THE AUDIO RESEARCH LS3 B WAS AS NEUTRAL AS SOME OF THE MOST EXPENSIVE LINE PREAMPS I'VE TRIED.

I also compared the LS3 B to a totally passive custom line stage preamp that has somewhat similar switching features. As has been my experience in the past, the purely passive preamp was slightly more silent and less colored *if* all impedances were carefully maintained, *if* I selected a CD or other digital player with the right output level for the power amp's input, *if I* used special low-capacitance and low-impedance interconnects, *if* I did not connect a tape recorder, and *if* I carefully set the level control in the passive unit to the "sweet spot" that produced the best possible sound.

I regard these conditions as totally impractical for most real-world systems and listening conditions, and the LS3 B outperformed such a jury-rigged approach to listening under virtually all conditions. It was neutral enough so that its added gain and buffering provided far better overall sound quality than the passive device. The LS3 B also worked well with a variety of different front-end devices, power amplifiers, and interconnects, and I did not encounter any interface problems in the course of my testing.

It is difficult to review the individual aspects of the sound quality of a unit this good. The LS3 B's colorations are very slight and often masked by the interactions involved in using it with specific types of interconnects, front-end devices, and amplifiers. The following comments should, therefore, be taken as more of a guide of what to listen for than for predictable nuances you will hear at an equipment dealer or in your own system.

- *Overall timbre:* Flat, with just a slight hint of reduced energy in the lower midrange that was still further reduced by using the "Direct" signal path.
- *Bass:* Excellent. The only qualification I can think of is that some d.c.-coupled units may provide slightly more energy in the lowest part of the lowest octave with the few speakers and subwoofers that can resolve such differences, but such added bass energy may not be more accurate.
- *Upper bass and lower midrange:* Also excellent. At the nit-picking level, perhaps just a slight hint of leanness.
- *Midrange and upper midrange:* Very neutral, with excellent transient life, detail, and dynamic energy. There was just a slight

touch of added dryness or constraint of subtle harmonics and transient detail, but no competing transistor preamplifier exists at any price that is not without similar levels of coloration.

- *Treble:* Clean and detailed. No exaggeration or edge.
- *Dynamics:* Excellent and very similar to the best tube units.
- *Transparency and overall transient detail:* As noted, even the best equipment is not perfect.
- *Soundstage:* Very neutral. Just a tiny reduction in depth.
- *Imaging:* Very good right-to-left imaging and very revealing of different layers of depth.
- *Compatibility:* No interface or special placement problems. Perfectly reliable and no unusual operating problems.

I did, incidentally, experiment with using the LS3 B in both the balanced and unbalanced modes. As has been my previous experience, the difference in sound quality was very minor provided I used top-quality cables for both the balanced and unbalanced connections and kept the interconnects and equipment free of potential hum fields.

Under these conditions, the real-world benefits of the balanced output were then very slight and might well not be worth an additional $500 to an audiophile on a budget. At the same time, the balanced outputs did provide a minor reduction in noise levels but more audible improvement under less optimal conditions. Like many high-end audiophiles, I now use balanced connections as standard practice. Indeed, many of the more expensive line stage preamplifiers have balanced inputs as well as balanced outputs.

In summary, the Audio Research LS3 B is an excellent piece of high-end equipment that can be used reliably in a very demanding system. The only question that I had about the unit after prolonged listening had nothing to do with its sound quality. My question was whether its hybrid counterpart, the LS2 B, could really provide $1,000 more in sound quality. This is a test you may wish to conduct for yourself. Given Audio Research's history, you can be sure that both the LS3 B and LS2 B line preamplifiers will be excellent units.

Anthony H. Cordesman

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Vol. 15, No. 10, October 1992

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— *Peter Moncrieff*
International Audio Review #64

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BEYERDYNAMIC DT 770 PRO EARPHONES

The DT 770 Pros are designed to be used as monitoring earphones by recording engineers. They are similar, in some respects, to the DT 990 Pro earphones that I reported on in the April 1992 issue, but while the DT 990s were an open design, Beyerdynamic has designed the DT 770s to reject outside sounds. This makes them much more suitable for a wide range of recording applications, and anyone who has made field recordings with open-type earphones will appreciate this. The DT 770 earphones use a bass-reflex design; the reflex ports and the transducer diaphragm are on the face of the earcups and are coupled directly to the ear. Beyerdynamic has also designed the DT 770s to have a diffuse-field response, although, as I have said in previous reports, there is still no consensus among manufacturers as to the exact equalization necessary to accomplish this.

The DT 770 Pro headband consists of two spring-steel bands covered by a removable, foam-filled leatherette cushion. The spring tension was perfect for me, and the bass increased only slightly when I pressed the earcups more tightly to my head. The headband springs are terminated at each end by a plastic retainer that is held in place by two screws. A label is recessed into each of them—"Right" and "Left" in light lettering on a black background that is easy to see, even in the dim lighting found in some control rooms and field recording situations. There appears to be a serial number stamped into the rear of the left retainer; this is another indication that the DT 770 is definitely a professional product. The bails holding the earcups are also metal rather than the plastic used on most earphones; they have embossed detent pits that mate with position-holding springs inside the retainers. The top of the bails swivel slightly to allow a really good fit to the head.

The cushion covering the headband springs has four snaps that allow easy removal for cleaning and replacement. The foam-filled earcushions, of the same leatherette material as the headband cushion,

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MEASURED DATA

D.c. Resistance: Left, 568 ohms; right, 571 ohms.
Absolute Polarity: Positive.
Cord: Coiled, 10$\frac{3}{4}$ feet long, with $\frac{1}{4}$-inch stereo phone plug.
Adjustments: Headband slides in bail, with detents.
Weight: 9 ounces.

are also removable for cleaning. A soft circular flap on the rear of each earcushion fits around the hard rim of the plastic earcup; if you have ever replaced a bicycle tire, you will know how to replace these earcushions. The transducer elements are mounted in the face of the earcup plate. This plate, which also has the openings for the bass-reflex ports, is covered by acoustically transparent foam, which touches the outer ear when you put on the earphones. The DT 770s are very comfortable, which you will appreciate very much if you do any extended recording or listening. The coiled cord exits from the bottom of the left earcup through a flexible strain relief; it extends to about 10¾ feet and is extremely flexible.

THE DT 770 PROS' ABILITY TO REJECT OUTSIDE SOUNDS WILL BE RELISHED BY ANYONE WHO DOES FIELD RECORDING.

The seal between the DT 770s and the head is, as with most earphones, most effective at reducing the penetration of outside sounds at higher frequencies but is still very good down to the bass range. A leak between the earphones and the head can cause a reduction in the bass output, but Beyerdynamic engineers appear to have compensated the DT 770s for a slight amount of leakage. When I wore them in the normal position, with the earcushions against my head, the sound of pink noise was very smooth and without noticeable coloration; when I pulled them away from my head, the sound varied from an "oooh," close to my head, to an "awww," further away. The bass output also was reduced when I did this, as would be expected.

I compared the sound of the DT 770 earphones to that of the Stax SR-Lambda Pro Earspeakers, which serve as my present reference. The bass of the DT 770s was definitely stronger, and the comments of all the members of my listening panel—such as "stronger bass than reference," "full bass," and "bass slightly boomy"—agree with my perception. Perhaps Beyerdynamic designed the DT 770's bass response to compensate for the sort of leakage that is caused by long hair. I asked the members of my listening panel to rate the sound of the Beyerdynamic DT 770, compared to that of the Stax, and also to write down their comments while listening to a variety of program material.

My lab measurements showed that the response extended down to 20 Hz, with a bump at about 40 Hz. This correlates well with the panel's subjective comments about the quality in the bass range. Comments about the midrange (such as "clean and full," "very articulate on voices," and "slightly forward") also correlate very well with my measurements. The listening panel all commented that the DT 770 sounded slightly brighter than the reference. There was a broad dip in frequency response at about 5 kHz; this may have caused one panel member to comment that the treble sounded "rolled off" and was "less than the reference." Since the measured high-frequency response of the DT 770s was about the same as for the Stax, I think this comment must be related to the fact that this panel member heard the midrange as being "clean and full" rather than "bright," as did other panel members. Another panel member, who had commented that the midrange was "slightly forward," said that the treble was "clear and extended." Sorting out comments and correlating them with my measurements isn't as easy as it might seem!

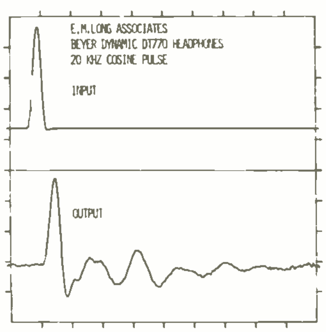

Fig. 1—Cosine-pulse test.

EARPHONE EVALUATION

PARAMETER	RATING	COMMENTS
Overall Sound	Very good	"Good bass and transients" and "Clear and bright"
Bass	Very good	"Full bass" and "Slightly boomy"
Midrange	Excellent	"Slightly forward" and "Clean and full"
Treble	Good	"Clear and extended"
Overall Isolation	Very good	"Very good attenuation of outside sounds"
Bass	Good	"Good low-frequency sound isolation"
Midrange	Very good	"Outside voices are hard to hear"
Treble	Excellent	"Highs attenuated completely"
Comfort	Very good	"Easy to adjust" and "Very comfortable"
Value	Very good	"Very good for recording"

GENERAL COMMENTS: Smooth-sounding; a little heavy in bass range; very good transients and articulation; overall, very good value, especially for recording.

Figure 1 shows the output of the Beyerdynamic DT 770 earphones for a 20-kHz cosine-pulse input. The shape of the output pulse is very close to that of the input; the undulations, after the input stops, indicate that the damping is less than ideal but is nevertheless very good. The shape of the initial part of the output pulse correlates with panel comments such as "very good articulation" and "excellent on cymbals, blocks, etc." The pulse also shows that the earphones produce a positive acoustical output for a positive electrical input.

The impedance of the DT 770 Pros is a high 600 ohms, so they have no measurable effect on the response or output level of such different sources as receivers, preamps, and CD players. Despite their high impedance, these 'phones can produce a reasonably high sound pressure level from relatively little input power.

The Beyerdynamic DT 770 earphones are comfortable and can be worn for long periods; only the lack of outside noise makes you aware that you have them on. The listening panel rated the sound quality and the comfort as "very good." The DT 770s are surprisingly close to the Stax SR-Lambda Pro reference earphones, with more bass output and slightly less smooth response between 5 and 10 kHz. If you are looking for an excellent pair of earphones for recording or for listening without hearing outside noises, there is nothing available now that is better than the Beyerdynamic DT 770s. *Edward M. Long*

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THE COMPLETE RECORDINGS

Sergei Rachmaninoff: The Complete Recordings
Sergei Rachmaninoff, piano; Fritz Kreisler, violin; Philadelphia Orchestra; Rachmaninoff, Leopold Stokowski, and Eugene Ormandy
RCA VICTOR GOLD SEAL 09026-61265-2, 10 CDs; 10 hours, 42 minutes

This deluxe set contains everything the great composer and pianist Sergei Rachmaninoff ever recorded for Victor, as well as several of his 1919 Edisons and a couple of private acetates. (His complete Ampico piano rolls are available on a London CD.) Nearly three-quarters of these historic recordings are on CD for the first time, in chronological order and remastered directly from the original sources. In addition to the 95 short piano pieces written by him and others, Rachmaninoff is heard as soloist in all five of his piano concertos (counting the Rhapsody as one), as accompanist to Fritz Kreisler in three lovely violin-piano sonatas, as half of a duo with one of his daughters, and even as conductor of the Philadelphia Orchestra in his Third Symphony.

Rachmaninoff only embarked on a concert career when he needed money after leaving everything behind in Russia following the Revolution. His memory, sight-reading ability, and virtuosity were phenomenal. Especially magical was his skill at highlighting the different voices in a piano work through dynamics and phrasing, almost as if a separate mind controlled each hand. He thus made even chestnuts like "The Swan" or "Flight of the Bumblebee" fresh and interesting.

Perhaps more than any other composer, Rachmaninoff brought into 20th-century music the Russian Romantic tradition of the 19th century. His rhapsodic and sweeping melodies and frequent melancholy make him nearly a Tchaikovsky double. His Second Piano Concerto has been taken to heart by the international public for almost a century, and has become a sort of model for piano with orchestra works in general. His two performances of it, recorded in 1924 and 1929, can be compared in this set. There are also two, and in some cases three, performances of some of the piano pieces. Due to the chronological sequencing, you have to skip around the discs to make comparisons, but the effort will be rewarding.

The early Edisons prove disappointing. While Edison's sonics at the time were ahead of Victor's, the engineer placed Rachmaninoff's upright (!) piano too far away from the recording horn. The sound is thin, distant, and noisy.

THREE-QUARTERS OF THESE RECORDINGS ARE ON CD FOR THE FIRST TIME.

Jack Pfeiffer, BMG's producer in charge of classical reissues, is a purist in restoring 78s. He hews to the

Illustration: Amy L. Wasserman

"archival" rather than the "enhancement" approach. Although BMG has its own CEDAR computer noise-reduction equipment now, it doesn't appear to have been used here. The classical department's policy on this is at the opposite pole from that of the Bluebird jazz reissue section.

Comparison with previous RCA CD reissues of the concertos show a vast improvement. The earlier tries were thin-sounding, full of distortion, and even had a pinch of pseudo-stereo reverb added in. Some climaxes sounded as though a worn stylus, or one with an improper diameter, was bouncing around in the 78s' grooves. Earlier LP issues differ from this new CD set in many respects. They had a more compressed frequency and dynamic range, an altogether different timbre.

The wider-range transfers of the new set seem to permit all the fidelity of the original 78s (and with the Edisons, 80s) to come through in the digital form. There is an added naturalness and even brilliance to the top notes of the piano, making the LP versions sound dull and, on occasion, muffled. BMG's purity of approach is to be commended. However, collectors who are in the "hair shirt" section of the high end, and so are without tone controls or scratch filters, will just have to suffer. These CDs are *extremely* heavy on the 78-rpm hiss and scratch. Recent improvements in restoration of old 78s have shown it is not true that they all roll off at 5 kHz. Let's say the very best examples get up to 8 kHz; with the CD format cut off sharply at 20 kHz, that leaves us 12 kHz above the actual music. Must we listen to a wider bandwidth of hiss and scratch than the bandwidth of the music, along *with* the music?

Stuck with a hair-shirt preamp myself, I had to divert the signal through (one at a time, mind you) three fairly basic consumer processors: A parametric equalizer, a Burwen dynamic noise-reduction unit, and an RGR expander (set to noise-reduce only). All three were able to tame the hiss/scratch to nonirritating levels without losing the piano's treble overtones. I rest my case.

John Sunier

Jack Pfeiffer hews to the archival approach rather than the enhancement one—commendable on this 10-disc Rachmaninoff set.

Rameau: Pygmalion; Nélée & Myrthis
Soloists, Chorus, Orchestra Les Arts Florissants, William Christie
HARMONIA MUNDI HMC 901381, CD; 78:05

The peroration of this long CD of two *actes de ballet*, its last superb moments, is one of the grandest recordings for chorus, soloists, and orchestra I have ever heard. It's absolutely thrilling. Go for it first. Begin at No. 19, Annonce, with heralding trumpets. And on to the end.

The rest, from France's finest composer of the late Bach-Handel-Vivaldi era, is high baroque but so utterly French that old Francophiles with a sense of humor will just have to smile. When French culture goes on the rampage, even today, it devours everything but the performers' names. Conductor William Christie, for instance, and lead tenor (Pygmalion) Howard Crook! Not to mention others, such as violinist Martha Moore, bassist Jonathan Cable, and a trumpeter named Susan Williams. They are as French as they come, in the performing, and supported by the French government too. Vive la France! A rose is a rose. . . .

The liner notes define in exhaustive detail what an *acte de ballet* was, but the music speaks for itself. What we have here is a one-long-act theater piece that combined a fancy stage show, a marginal plot (about as heavy as an old-style "musical") with the usual solo characters, plus long stretches of orchestral dance music, presumably the ballet portion. There's a large content of recitative and aria, in the French style, of course, with elaborate vocal ornamentation, zealously preserved. Not easy, requiring enormous study and vocal accuracy in the singing, but today this has been mastered or, should I say, remastered, by those who perform in France. You soon adapt yourself to it.

Pygmalion is a familiar name, as of numerous other adaptations, including that by George Bernard Shaw. But as so often happens on CD, the blockbuster is the unknown opus with the funny name, *Nélée & Myrthis*. Nellie & Myrtle? Its scene, amusingly, is at the Greek Games—not the Olympics but something called Argive, similar. The hero has won the gold, though it doesn't say in what. Whimsically, he decides to test his girlfriend by pretending to fall for *her* girlfriend, which predictably leaves No. 1 quite desolate. Needless to say, the farce is undone and the two are united at the end in glorious bliss to Olympic-like fanfares. But *which is which*?

You will guess wrong. Nellie, Nélée, an emphatically feminine name, is the hero! His gal is Myrthis. And when you hear this hero, the fun really begins—he is a big, bottom-heavy basso, sounding middle-aged and quite beer-barrel-like. He's good, even so.

There are some recording problems throughout. Long stretches of splendid orchestral music. You turn up the volume, and wham—a solo voice enters and blows you through the ceiling. Turn him down, and the orchestra becomes background. This is certainly a matter of mike technique, but the basic error—after almost 75 years of microphoning "classical" vocal music—is made by the singers. They are *still* today trained to let loose vast powerhouse sounds to fill huge spaces without microphones. (Not so, pop singers; they are the opposite.) Until singing teachers and audio engineers get together, maybe with luck after another 75 years, we will continue to suffer from faulty balance and ear-shattering vocals. But hang on for the thrilling end. *Edward Tatnall Canby*

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HISTORY
LOUDON WAINWRIGHT III

THE FUTURE
LEONARD COHEN

History
Loudon Wainwright III
CHARISMA V2-86416,
CD; 46:22
Sound: A–, Performance: A–

The Future
Leonard Cohen
COLUMBIA CK 53226,
CD; 59:42
Sound: B, Performance: C+

To be prepared for the future, one must first understand history, or so it's been said. It's also been said that those who do not understand history are condemned to repeat it. Whether these musings have anything directly to do with the new Loudon Wainwright III and Leonard Cohen albums is an open question, but they provide a context that feels relevant.

Wainwright's *History* is an intense and revealing ride. I guess you could say it's the world according to Loudon, as told by his somewhat battered yet resilient soul. *History* reflects upon his experiences (particularly fatherhood), emotions, and philosophies throughout his fortysomething-year life. It opens humorously enough. "People in Love" is an upbeat lampoon of other couples openly in love, but with a face behind the mask that warns of love's very possible collapse. However, things turn dark in a hurry: "Men" muses on male heroics in battle and at sea and is an attempt at demythification, while "The Doctor" is about the onset of the ravages of age. On a humorous upswing, there's "Talking New Bob Dylan," a fond and funny recollection from a former "new" Bob on the occasion of old Bob's 50th birthday. The soul-baring continues. "When I'm at Your House" details the anxiety of visiting an ex's place, while "I'd Rather Be Lonely" and "So Many Songs" are Wainwright's tender, aching attempts to put his most recent failed marriage behind him.

Production by Wainwright and Jeffrey Lesser sparkles, regardless of whether Loudon is doing a solo guitar and vocal thing or is accompanied by players such as multi-instrumentalist David Mansfield, who deserves special recognition. *History* is one of Loudon's best.

Leonard Cohen's heavily anticipated *The Future* is thornier, very bleak, and daunting. Cohen's self-described "golden voice" is, this

Photograph: ©David Gahr

THE FUTURE, COURTESY OF LEONARD COHEN, IS BIGGER THOUGH NOT NECESSARILY BETTER.

time, more of a growling thing—deeper than Barry White's and with menace and danger aplenty. It creates a disturbing, unsettling effect. No, *The Future* is not pretty.

The compositions are more tableaux than songs, with sprawling scope and grandiose concepts. Cohen's usual tight focus is thus not so much in play here. "Democracy" is the album's centerpiece. It's a fierce statement set to a compelling martial beat. "Light As the Breeze" is a dreamy song about love's healing powers. The album's last two are most odd. Irving Berlin's "Berlin" gets a sardonic, bluesy setting with a soul chorus, horns, and ice-rink organ with voices chattering away obnoxiously in the background. "Takoma Trailer," the closer, is a six-minute instrumental, a peaceful yet doomy-sounding thing that seemingly has no reason to be there except as a place to let the credits roll. Curiouser and curiouser.

I have always had the highest respect for Leonard Cohen, and *The Future* does nothing to alter that. I'm really impressed with this album, but I just don't *like* it very much. It moves slowly but inexorably and with its own sense of time and space. *The Future* is bigger but not necessarily better. I don't think I'll visit it often.

Michael Tearson

Neneh Cherry
Homebrew
VIRGIN V2-86516

Well, let's see now . . . on "Trout," the half-Swedish, half-African stepdaughter of jazz trumpeter Don Cherry trades sex education raps with R.E.M.'s Michael Stipe over drums seemingly on loan from Led Zeppelin's "When the Levee Breaks" and guitar chords actually sampled from Steppenwolf's version of "The Pusher." (Pause for deep breath.) If that's not enough, try the great rock chorus of "Money Love" or the foundation of "Somedays," built from Beethoven's "Moonlight" Sonata. The way Neneh Cherry's womanchild voice glides mid-verse from quiet rap to lifting balladry on "Move with Me" shows how well she and her collaborators stir everything together. Though not as hip-hopped up as *Raw Like Sushi*, this album is more natural, more mature, and ultimately better.

Ken Richardson

Blue Moons & Laughing Guitars
Bill Nelson
VENTURE/CAROLINE 1878-2

In the '70s with Be-Bop Deluxe and later with Red Noise, Bill Nelson developed a somewhat large cult following as a singer/songwriter/guitarist, and since then he has devoted much time to producing other artists as well as his own recordings. Nelson is an extremely talented guitarist and a worthy songwriter, but it seems a shame that his gift is fritterred away on recordings that few of us have the opportunity to hear. This is a low-budget project of primarily home demos with Bill playing all the instruments, and with the exception of "New Moon Rising" these are less like pop tunes and more like ideas. There are enjoyable moments, but one would think that at this point in time, Nelson could be a tad more ambitious.

Jon & Sally Tiven

Cafe Days
Chris Spedding
MOBILE FIDELITY MFCD 752

After nearly three decades, Chris Spedding should by now have found himself either a great singer or perhaps a great band to join (he turned down The Stones when they were looking to replace Mick Taylor). Instead, he continues to make meandering, half-brilliant albums that seem more like interim efforts than fully conceived ventures. Although *Cafe Days* has its standout tracks—"Flirt" and "Save a Life" in particular—it seems unlikely that the album will bring Spedding a larger following. Nevertheless, his guitar playing is brilliant, as usual, and he has become a better songwriter. Those familiar with Spedding's '70s output will find *Cafe Days* to be a fair embodiment of his rock 'n' roll attitude and guitar playing.

Jon & Sally Tiven

Grave Dancers Union
Soul Asylum
COLUMBIA CK 48898

The Twin Cities-based Soul Asylum was written off by its former label as yesterday's news or has-beens. The logic went like this: The Replacements and Hüsker Dü are gone and the Minneapolis scene is history, replaced by Seattle—which, in case they haven't realized, is becoming pretty staid itself. Yet Soul Asylum was doing the Seattle thing—loud and raucous—back when it was known as the Minneapolis thing. In fact, they did it 100 times better. Singer/songwriter Dave Pirner still writes songs for loud guitars, but in the two-year interim between albums, his craft has matured. *Grave Dancers Union*'s neo-country ballads are excellent examples of this. The music that these four unpretentious guys create from this point forward will likely be their best and most important.

Mike Bieber

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JAZZ ~ BLUES
RECORDINGS

DEVIL'S GOT YOUR TONGUE

ABBEY LINCOLN

Devil's Got Your Tongue
Abbey Lincoln
VERVE/GITANES 513 574-2,
CD; 70:02
Sound: A, Performance: B+

Last year, vocalist Abbey Lincoln lit up the jazz world with *You Gotta Pay the Band*, sounding truly up-to-the-minute. Her follow-up, *Devil's Got Your Tongue*, may not reach the same stratosphere (I don't think her support is as strong or as consistent), but it strikes with the same sense of urgency, poignancy, and hopefulness.

Lincoln is an emotional gem, and her instantly recognizable voice sounds as rich as before. She maintains her probing way with ballads, including "Rainbow," the date's opener, and the evocative "Evalina Coffey (The Legend Of)," Lincoln's personal tribute to her mother.

Veteran peers, such as trombonist J. J. Johnson and saxophonist Stanley Turrentine, deliver solid if not brilliant performances—the former on Thad Jones' moving "A Child Is Born" and the latter on a remake of "People in Me," a 20-year-old selection that stands as something of an Abbey Lincoln anthem. As on *You Gotta Pay the Band*, Maxine Roach contributes viola. Percussion is provided by a variety of sources, including Grady Tate and Olatunji. The Noel Singers, a children's chorus led by namesake Randolph Noel, enhance generously with a sense of naiveté, giving *Devil's Got Your Tongue* a delightfully uninhibited feel at a multiplicity of junctures. The Staple Singers—Pops, Mavis, and Cleotha—contribute on pieces such as the gospel-and-blues-drenched "Story of My Father," underscoring the meaning of the word "timely."

Ultimately, *Devil's Got Your Tongue* is a pure delight.

Jon W. Poses

It's Not About the Melody
Betty Carter
VERVE 314 513 870-2

It's about dramatic vocalization, romantic nuance, harmonic adventure, and rhythmic interplay. Betty Carter's at the peak of her stylized powers, plumbing subtleties of adult love with an alto that's as luscious and fluid as a seductress' embrace. Wry, realistic, and vulnerable too, she swings hard and floats melismatically over the three sublime piano trios (led by her longtime collaborator John Hicks, gentlemanly Mulgrew Miller, and newcomer Cyrus Chestnut, each of whom deals in

AT THE PEAK OF HER POWERS, CARTER PLUMBS SUBTLETIES OF LOVE.

pearls). Melody isn't precluded: Tenor saxist Craig Handy twice provides another strand of sound around which Carter twines—but consider what she does with melody. Besides Carter originals, the program includes "I Should Care," "You Go to My Head," "In the Still of the Night," and "When It's Sleepy Time Down South," each radically remade by the sweeping drapery of her lines. *Howard Mandel*

Carnegie Hall Concert
Toshiko Akiyoshi Jazz Orchestra
Featuring Lew Tabackin
COLUMBIA CK 48805

Recorded in September 1991, *Carnegie Hall Concert* marks the courageous Toshiko Akiyoshi's 35th year as a professional jazz musician, and it is her orchestra's first domestic major-label release in more than a decade. The backbone again proves to be Akiyoshi's original compositions and their decidedly sophisticated orchestrations. A lifetime of East-meets-West allows her to paint musical pictures with numerous textures and layers. She also found this concert to be the perfect opportunity for acknowledging altoist/flutist Frank Wess, who performed with Akiyoshi during her first Stateside appearance at New York's Town Hall in 1967. The orchestra's reading of the Wess composition "Your Beauty Is a Song of Love" is poignant and beautiful. *Jon W. Poses*

Crossing Borders
Deanna Bogart
FLYING FISH FF 70601

Cross a '40s big band singer with a pianist who has more than her share of chops and a honking R&B sax, and what do you have? Multitalented Deanna Bogart doesn't know either, but that hasn't stopped her from energetically pursuing a refreshing amalgam of styles. "Backstage Boogie" flaunts her piano, "Don't Know a Thing (About Love)" communes with the spirit of The Andrews Sisters, and "Ding Dong Daddy" reflects her work with the western swing group Cowboy Jazz. She matches a craftsman's sense of arrangements with a fan's sense of fun in her second strong release.

According to her press notes, Bogart was accepted at the tender age of five by the New York Conservatory of Music, but was dismissed a year later for being "incorrigible." Somehow that sounds credible for an artist still hellbent on following her own vision. Even if no one's sure where Deanna Bogart is headed, it promises to be one heck of a ride. *Roy Greenberg*

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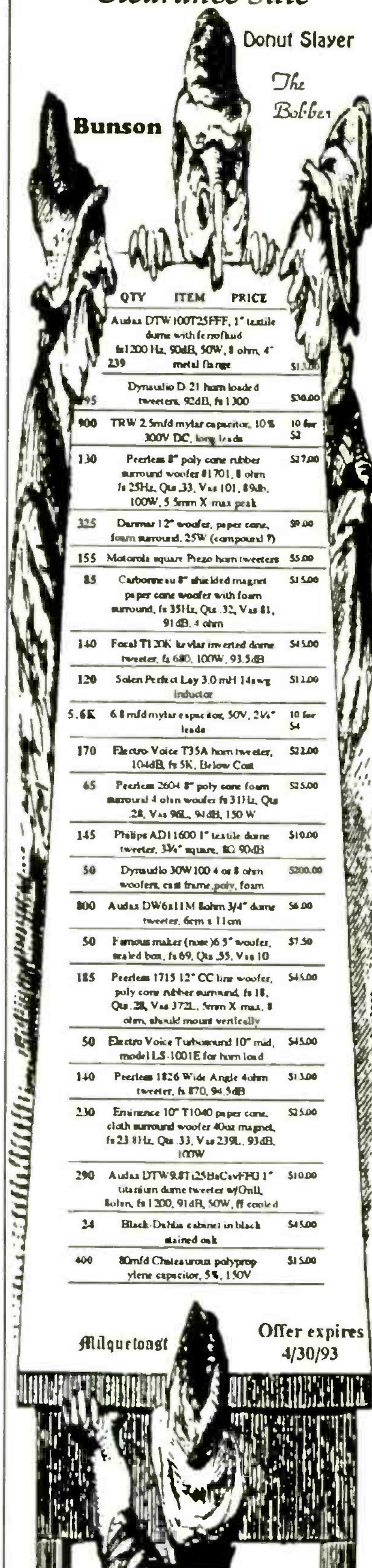

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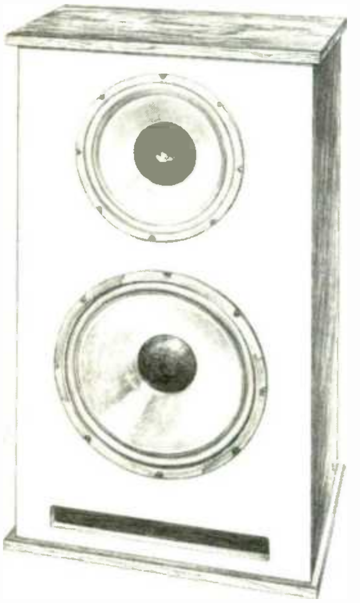

The Larger VMPS Subwoofer 39 · 21½ · 17 available in gen oak or walnut

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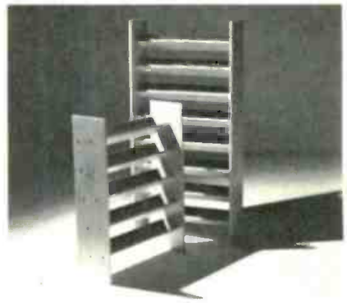

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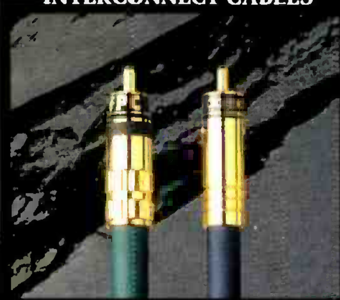

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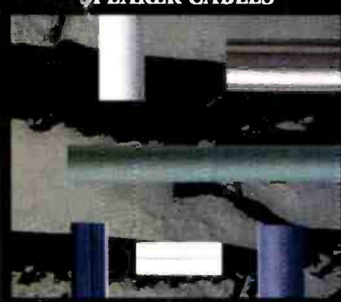

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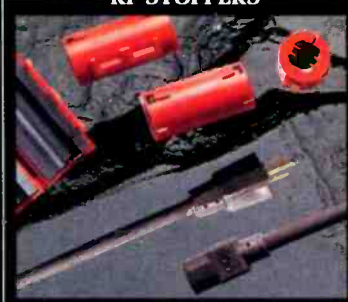

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