

Audio

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ES

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Audio

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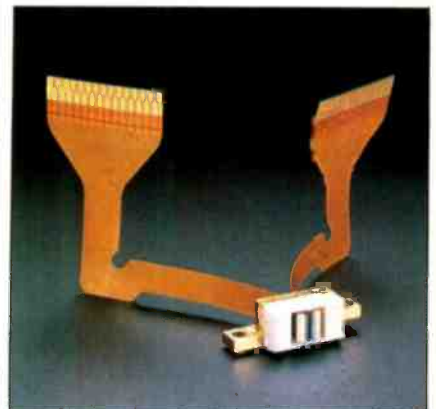
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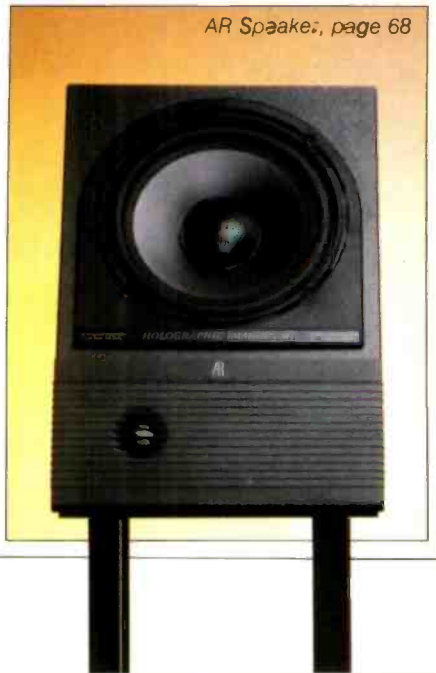
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MPA

The
Audit
Bureau

Nº 30

REFERENCE DIGITAL PROCESSOR

PRIDE IN THE DETAILS . . .

Mark Levinson® components have earned a reputation for their rugged reliability, uncompromising fit and finish and, above all, superior sonics. We at Madrigal Audio Laboratories are understandably proud of this reputation.

The presence of "high technology" in our society has, for some, come to mean the absence of craftsmanship. Mass-produced look-alikes are everywhere, even in the realm of so-called high-end audio. The quality that you see and hear in a Mark Levinson component is not the result of automated mass production—rather, it is the result of painstaking attention to the details of design, and of pride in the art of craftsmanship.



Mark Levinson components are handcrafted in limited quantities and to exacting specifications. All who participate in their production share the feeling of pride that comes from knowing that they contribute to a product that defines quality.

It is with great pride, then, that we introduce the Mark Levinson Nº 30 Reference Digital Processor. Five years of exhaustive research into digital audio yielded a processor worth waiting for, deserving of the Levinson marque.

The Nº 30 is a true reference: it neither adds to nor subtracts from the music. It brings to your home the accuracy as well as the essence of the performance. Finally, the promise of digital audio is fulfilled.

The Nº 30 is proof that state-of-the-art digital *and* analog technology can coexist with craftsmanship. The subject here, however, ultimately is music, and the heart of music is in the listening. To fully appreciate the quality of the Nº 30, we recommend that you visit your Mark Levinson dealer for a full audition.



mark levinson

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		Aerosmith	44487
Julia Iglesias	38640	James Taylor	34811
Johnny Mathis	34667	Sarah Vaughan	42519
Simon & Garfunkel	09269	Big Audio Dynamite	40705
Neil Diamond	38359	Bob James	35594
Ozzy Osbourne	44245	Ston Getz	33703
Quiet Riot	38443	Plácido Domingo	37243
Ted Nugent	33692	Branford Marsalis	42122
Marvin Gaye	38197	Judas Priest	34787
Isley Brothers	39240	Leonard Bernstein	46713
		Legálize It	34253
		Never Too Much	37451
		Eyes of Innocence	39622
		Stranger Than Paradise	44210
		Gems	44487
		JJ	34811
		Brazilian Romance	42519
		#10 Upping Street	40705
		Touchdown	35594
		The Best of Two Worlds	33703
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Museatex has always designed compact and elegant components with the convenience of remote control. The Melior Audio/Video Control Center inherits all of the convenience and critically acclaimed performance of our audio preamplifiers, and adds DC-coupled video switching to ensure perfect black-level retention for all video sources. Signal purity is maintained by completely isolating the video and audio signals through the use of special shielding, separate power supplies, and careful ground connections.

The Melior A/V is capable of integrating virtually any combination of audio and video components into a single system that is easy to use and convenient to control. The unit includes inputs, outputs, and tape loops for both regular and S-VHS video devices in addition to audio. A switchable processor loop is also included so that an external processor, such as a Dolby surround decoder, can be completely removed from the audio signal path when not required. Separate outputs with reversed phase permit amplifier bridging and a MIDI interface is provided for connection to the Melior Multi-Room System. And of course the Melior A/V Control Center is compact, elegant, and includes remote control.

One step ahead.



In 1986, Museatex introduced the first audiophile components with remote control.

In 1991, the rest of the high-end industry began to follow suit.

This year we have introduced the first audio/video control center for audiophiles.

The way we see it, you can either buy one from us now or wait five years to get one from someone else.



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Some on-screen
TV and VCR menu
systems utilize
all upper case letters
that are hard
to read, mysterious
instructions, or
strange, meaningless
abbreviations that
you have to be psychic
to understand.

Our new ViewPoint™ System prefers English.

SET-UP

TIME SET
▶ CH PROG
ERASE AD TV CATV
PICT PREF
AIR/CABLE
CHANNEL CAPTION

USE (▲▼) & RETURN
(EXIT) TO QUIT

Look at competitive on-screen displays and you may see something like this:*

◆ First Time Set-Up

Your choices are:
Set the clock
▶ Memorize channels
Add/delete channels
Use Home Theater: off
Rename the inputs
Name the channels

Use ADJUST to select.
Then press ENTER.

Press MENU to return
to TV Main Menu.



The same instructions in the easy-to-understand language of Mitsubishi's ViewPoint System.

When Mitsubishi created the concept of Home Theater, we figured it didn't make sense for people to sit down in front of the most incredible sights and sounds television could offer, only to focus most of their attention on making the thing work.

We wanted our technical expertise to enhance the experience, not to complicate it. To work for good, not evil.

This year, we're introducing one of the most remarkable examples of our philosophy to date.

An advanced on-screen operating system called ViewPoint which, using our latest interface technology, lets you control your Home Theater System without distracting from the enjoyment you bought it for.

The System is so elegantly

simple, two buttons are all you need to operate it.

The on-screen information is displayed in upper and lower case letters for better readability, and communicates in a familiar language: English.

That means fewer abbreviations to decipher. Functions like "Time Set" and "Ch Prog" become "Set the clock" and "Memorize channels."

For more complex operations, a logical question-and-answer format guides you through.

Our unique point-and-click interface allows you to simply point to the on-screen item you need. While a P.I.P. window lets you monitor the TV picture as you use any of the menu features.

ViewPoint is available with many of our big screen TV's, our

31" and 35" direct-view TV's, and three of our VCR models.

And because all Mitsubishi components are designed to integrate fully—not just from component to component, but from year to year, as far back as 1986—ViewPoint is also compatible with our previous menu systems.

So whether you're looking for a complete system, adding to an existing one, or building one a few components at a time, everything works together not only esthetically and electronically, but functionally as well.

Which is exactly what you should expect from a great Home Theater system.

At least, that's our viewpoint.



MITSUBISHI

TECHNICALLY, ANYTHING IS POSSIBLE™

Coda: Arthur A. Janszen

Arthur A. Janszen died October 16, 1991 at the age of 84. For audio enthusiasts, his name is associated with the development of electrostatic loudspeakers, although his talent extended into many other fields, such as measuring the modulus of elasticity of yarns at very high speeds used in the manufacture of parachutes and the introduction of conductive fibers into carpeting to prevent shocks to people and delicate machinery.

During World War II, Janszen was part of a U.S. Navy group at Harvard University doing research and development of underwater sensing devices. In 1945, this activity was moved to Pennsylvania State College, where, as an Associate Professor of Engineering, he was in charge of field testing at the Navy's Fort Lauderdale station. He returned to Harvard's Acoustic Research Laboratory in 1946 to work on the development of a sound source suitable for measuring the transient response of microphone arrays. This led directly to the development of electrostatic reproducers, an area of sound reproduction that had been largely abandoned due to the lack of suitable dielectric materials.



This research resulted in the introduction of the Janszen tweeter in the '50s and, several years later, in the KLH Model Nine and Acoustech-10 loudspeaker systems. Other systems were developed along the way which joined electrostatic tweeters with cone woofers.

Arthur Janszen will be long remembered by his friends and associates for his engaging humor. His knowledge of materials and acoustics has contributed to the quality of musical reproduction.

William Barton
Concord, Mass.

Where Credit Seems Due

Dear Editor:

I'm writing to compliment *Audio* and Michael Lane for the comprehensive article about sound restoration in the June 1991 issue. However, I wish that the author had cited my work in this area, especially about what he calls "canting." I described this process as "vectoring" in the November 1983 *Journal of the AES*, the July 1983 *SMPTE Journal*, and the September 1983 *American Cinematographer*.

Art Shifrin
Great Neck, N.Y.

Save the Threes

Dear Editor:

What has become of the CD? In these days of conservation and ecological concerns, where we are finally seeing recycled paper being used in the packaging of most boxed products, including CDs, why do we see

the waste of using 5-inch CDs when 3-inch discs are often more than enough?

For example, the CD single of "Another Day In Paradise" by Phil Collins is 10 minutes, 46 seconds total. Now that most CD players are manufactured to handle both 3- and 5-inch CDs, why do the record companies waste so much nonrenewable resources, like the petroleum-based plastic used for CDs? A 3-inch CD can hold over 22 minutes of audio information, so it doesn't make any sense to put less than 11 minutes on a [5-inch] disc that can carry over 76 minutes of music.

I have written directly to several record companies to let them know how I feel. Thank you for any assistance you can lend in helping stop this needless waste.

A. J. Aguilera
Miami, Fla.

Still Brainy Without Braun

Dear Editor:

I wish to publicly thank a/d/s/ and Mr. Leif Blackmon of their service department for their superior customer service.

I own a pair of Braun LV-1020 powered loudspeakers whose woofers recently required parts and servicing. Although a/d/s/ is no longer affiliated with Braun, they "walked the extra mile" by providing unstinting consultation and parts, gratis.

This level of service is uncommon and should be highly commended. It bodes well for a/d/s/ equipment owners, who, I believe, are in excellent hands.

Ronald B. Freeman
Freehold, N.J.

In Your Ear

Dear Editor:

I thoroughly enjoyed Ed Long's articles on headphone measurements (April 1991), and was delighted to read his comment that "The only other earphones I would presently consider for use as references are the Etymotic Research ER-1M, which are, at least at present, not available as a production item. They are an in-the-ear type and the most accurate of any I have ever heard."

I am happy to report that a production version of these earphones, the ER-4, is now available. It is an all-in-the-ear type with the same diffuse-field-equalized frequency response as the ER-1M but with a slightly higher undistorted output.

By providing some 20 to 30 dB of isolation from outside noise, such earphones permit enjoyment of the full dynamic range of recent recordings without requiring ear-shattering reproduction levels to overcome masking by the background noise levels of typical listening environments. They might also avoid the need for the "offset, dual-plate, double-stud 2 x 4-inch partition with two layers of 1/2-inch gypsum" to eliminate furnace noise, as described by Walter G. Jung in his letter to the editor appearing in that same issue of *Audio*.

Mead C. Killion, Ph.D.
President, Etymotic Research
61 Martin Lane
Elk Grove Village, Ill. 60007

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Natalie Cole—Unforgettable (Elektra) 422-279

C & C Music Factory—Gonna Make You Sweat (Columbia) 416-933

Boyz II Men—Cooleyhighharmony (Motown) 424-754

Tom Petty & The Heartbreakers—Into The Great Wide Open (MCA) 429-795

Mariah Carey—Emotions (Columbia) 428-029

Michael Bolton—Time, Love & Tenderness (Columbia) 415-711

Bonnie Raitt—Luck Of The Draw (Capitol) 423-186

Paula Abdul—Spellbound (Virgin) 420-257

R.E.M.—Out Of Time. (Warner Bros.) 417-923

Ozzy Osbourne—No More Tears (Epic/Associated) 428-128

Rod Stewart—Downtown Train/Greatest Hits—Selections From The Storyteller Anthology (Warner Bros.) 425-322

James Brown—The CD Of JB: (Sex Machine And Other Soul Classics) (Polydor) 425-025

Rush—Moving Pictures (Mercury) 423-798

Righteous Brothers—The Very Best Of—Unchained Melody (Verve) 423-772

The Moody Blues—The Story Of The Moody Blues (Polydor) 423-756

The Allman Brothers Band—Brothers & Sisters (Polydor) 423-624

Eric Clapton—Time Pieces/Best Of Eric Clapton (Polydor) 423-467

David Bowie—Changes/Bowie (Greatest Hits) (Rykodisc) 412-247

Lynyrd Skynyrd Band—Skynyrd's Innyrds Greatest Hits (MCA) 381-129

John Lannon/Yoko Ono—Double Fantasy (Capitol) 380-774

Grateful Dead—Skeletons From The Closet (Warner Bros.) 378-406

The Who—Who's Better, Who's Best (MCA) 376-657

Bruce Springsteen—Born In The U.S.A. (Columbia) 326-629

Richie Sambora—Stranger In This Town (Mercury) 427-831

Ratt—Ratt & Roll (Atlantic) 427-799

Best Of The Doors (Elektra) 357-616/397-612

Yes—Fragile (Atlantic) 351-957

Rolling Stones—Sticky Fingers (Rolling Stones Rec.) 350-645

Van Morrison—Moondance (Warner Bros.) 349-803

Buddy Holly—From The Orig. Master Tapes (MCA) 348-110

The Beach Boys—Made In U.S.A. (Capitol) 348-445

Elton John—Greatest Hits (MCA) 319-541

Creedence Clearwater Revival—20 Greatest Hits (Fantasy) 308-049

Led Zeppelin IV (Atlantic) 291-435

Eagles—Greatest Hits 1971-1975 (Asylum) 287-003

Chicago—Greatest Hits (Columbia) 260-638

Bruce Springsteen—Born To Run (Columbia) 257-279

Simon & Garfunkel—Greatest Hits (Columbia) 219-477

Bob Dylan—Greatest Hits (Columbia) 138-586

Aerosmith—Greatest Hits (Columbia) 306-225

Billy Joel—Greatest Hits Vols. 1 & 2 (Columbia) 336-396/396-390

Boyz N The Hood—Music From The Motion Picture (Owest/Warner Bros.) 426-908

James Taylor—New Moon Shine (Columbia) 429-209

Jethro Tull—Catfish Rising (Chrysalis) 428-870

The Smithereens—"Blow Up" (Capitol) 428-854

Jerry Garcia Band (Arista) 428-425/398-420



Van Halen—For Unlawful Carnal Knowledge (Warner Bros.) 420-273

Eddie Money—Right Here (Columbia) 428-037

Simple Minds—Real Life (A&M) 427-203

Young MC—Brainstorm (Capitol) 427-062

The Robert Cray Band—Midnight Stroll (Mercury) 426-197

Trisha Yearwood (MCA) 426-148

Seal (Sire/Warner Bros.) 425-827

Stevie Nicks—Timespace: The Best Of Stevie Nicks (Modern) 425-694

Vanessa Williams—The Comfort Zone (Wing) 426-510

The KLF—The White Room (Arista) 426-304

Aaron Neville—Warm Your Heart (A&M) 425-611

Carreras/Domingo/Pavarotti—Encore! (Sony Masterworks) 425-470

The Wonder Stuff—Never Loved Elvis (Polydor) 424-903

The Wonder Stuff—Never Loved Elvis (Polydor) 424-903

The Moody Blues—Keys Of The Kingdom (Threshold) 424-689

Sting—The Soul Cages (A&M) 424-440

Heavy D. & The Boyz—Peaceful Journey (MCA) 424-416

Gladys Knight—Good Woman (MCA) 424-382

Roger Waters—The Wall-Berlin 1990 (Mercury) 423-855/393-850

Tears For Fears—Songs From The Big Chair (Mercury) 423-848

John Cougar Mellencamp—Uh-Huh (Riva) 423-574

Murray Perahia—Mozart: Piano Concertos Nos. 21 & 27 (Chamber Orch. Of Europe) (Sony Classical) 423-343

Bebe & Cécé Winans—Different Lifestyles (Capitol) 423-137

Journey—Greatest Hits (Columbia) 375-279

Scorpions—Crazy World (Mercury) 423-608

The Fabulous Thunderbirds—Walk That Walk, Talk That Talk (Epic/Associated) 423-053

Nigel Kennedy—Brahms: Concerto In D Major Klaus Tennstedt/London Phil. (Angel) 423-004

John Williams—Love A Parade (Sony Classical) 422-717

Crowded House—Woodface (Capitol) 422-253

Lynyrd Skynyrd Band—1991 (Atlantic) 422-238

The Allman Brothers Band—Shades Of Two Worlds (Epic) 422-212

Ziggy Marley & The Melody Makers—Jahmekya (Virgin) 422-139

Travis Tritt—It's All About To Change (Warner Bros.) 422-113

Electronic (Warner Bros.) 422-097

Alice Cooper—Hey Stoopid (Epic) 422-063

Yanni—Reflections Of Passion (Private Music) 421-685

World Party—Thank You World (Chrysalis) 421-057

Alan Jackson—Don't Rock The Jukebox (Arista) 420-935

Mildot—Live At Carnegie Hall (Sony Classical) 420-570

Joe Jackson—Laughter And Lust (Virgin) 420-240

Billy Idol—Vital Idol (Chrysalis) 360-107

Bad English—Backlash (Epic) 422-170

Elvis Costello—Mighty Like A Rose (Warner Bros.) 420-182

Another Bad Creation—Coolin' At The Playground Ya' Know! (Motown) 419-903

Roxette—Joyride (EMI) 419-556

Peabo Bryson—Can You Stop The Rain (Columbia) 418-723

Pat Benatar—True Love (Chrysalis) 418-624

Hi-Five (Jive/RCA) 418-616

Drivin' N' Cryin'—Fly Me Courageous (Island) 418-160

Escape Club—Dollars And Sex (Atlantic) 417-964

Yes—Union (Arista) 417-824

Jesus Jones—Doubt (SBK) 417-691

Divinyls (Virgin) 417-519

Paul McCartney—Tripping The Live Fantastic-Highlights (Capitol) 417-477

Ricky Van Shelton—Backroads (Columbia) 416-909

Morrissey—Kill Uncle (Sire/Reprise) 416-750

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Station Search Problem

Q. My tuner is very sensitive. (I'm afraid that's true in more ways than one.) It will enter the "Search" mode, it will stop on a strong station, and there will be two or three stations that I can hear very loud and clear, all at the same time.

Also, when the tuner is searching, the search system is supposed to pass the weak stations, stopping only at the strong ones. Instead, it stops at virtually every station, even those that are unclear or have nothing except distortion. When I unhook my dipole antenna, the search behaves as I would hope it would. Of course, then I only receive five or six of the very strongest stations in my area.

I don't remember having this problem when I first purchased my tuner. After a tuner has been broken in, is it possible that it might have to be readjusted?—Joseph Barbera, Cheektowaga, N.Y.

A. My first thought is that your tuner is overloaded by at least one very strong signal. A sign of that is hearing several stations all at one time; the search system will not operate properly when circuits are overloaded. It will stop because of what it perceives to be usable signals, even though the signal in the i.f. passband is nothing but "garbage." The search system behaves as it should when the antenna is disconnected because the overload is no longer present.

We still have to account for the fact that you were not plagued by this problem when you first owned your tuner. It may be that, since that time, a new station has come on the air and is located close enough to you to overload your tuner.

I assume that this "dipole" antenna is the indoor type. You will gain some improvement by using just a short piece of wire connected to one antenna terminal. You will hear more signals than when no antenna is connected, and hopefully you will still not experience the overload problem.

There are a number of tunable r.f. amplifiers designed to be placed between an indoor antenna and the input of your tuner. You can tune in a weak signal, then adjust the tuning of the amplifier for a maximum amount of signal. Not only will this signal be boosted

in strength, but all other signals will be attenuated. This may help. You probably can't use the "Search" feature because the amplifier must be tuned to the particular signal you desire. Still, it may solve your problem. Of course, you won't ever want to tune in the signal causing overload when using the amplifier, for the overload problem will be greatly increased.

If I am wrong in that no new stations have come on the air, it still may be that one of those already on the air has increased its transmitter power, causing the problem.

If none of this is true, then you should have your tuner checked. Sometimes tuners do go out of alignment with age. Internal components can also fail.

Noisy Volume Control

Q. My integrated amplifier makes a very annoying "popping" sound that is audible through my speakers when I adjust the volume. It is especially noticeable on quiet passages, and it occurs on all sources. I have found that if I turn off the speakers and turn the volume control all the way up and down a few times, the noise is "flushed out" temporarily.

Could this sound damage my speakers? Is the amplifier repairable? Your thoughts would be appreciated.—Jay Kassavian, Lafayette, Cal.

A. What you have described is a classic case of a volume control that either needs cleaning or needs to be replaced. It won't be too many years before this scenario will be unknown because modern equipment will make more and more use of electronic controls rather than mechanical ones.


A brief review of the action of a conventional, mechanical volume control will help you understand what is happening. The device used to control the volume is what is called a "potentiometer." Whether it makes use of a rotating knob or a sliding knob, the principles behind the operation of this device are the same. There are three terminals. Two of these are attached to the two ends of a resistor. The third terminal is attached to a sliding contact that moves between the two ends of the resistor. When the slider is at either end of its travel, there is virtually zero resistance between it and the nearer

fixed terminal of the resistor, and the resistance to the opposite terminal is about equal to the potentiometer's total rated resistance. As the slider travels along the fixed resistor, the resistance between it and one terminal increases while the resistance to the opposite terminal decreases.

It is essential for the resistance change I have described to occur smoothly. If the control has become oxidized between the slider and the resistance element, there will be jumps in the action of the control. These erratic variations in resistance result in the noise you have mentioned.

When "flushing out" the noise, I strongly recommend that you turn off the amp altogether and not just the loudspeakers. I suppose you can get away with just turning off the speakers, but there is some danger, especially if you leave the control at full volume when you again turn the speakers on.

Usually, cleaning the volume control will cure the problem. To do it, see if there is space around the various terminals on the control. You'll probably find six terminals and not the three I mentioned. This is because there are actually two separate controls, operated by a common shaft. Squirt suitable contact cleaner into the openings that I hope you'll find. If this area is sealed, your last hope is to remove the knob and squirt the cleaner down the shaft. Some may find its way into the control, especially if you place the component on its back so that gravity assists you. In either case, move the control shaft back and forth several times after squirting in the fluid, to help distribute it more evenly.

If cleaning does not work, the control must be replaced with one having appropriate mounting arrangements and the same rated wattage, resistance, and "taper" (the relationship between change of slider position and change of resistance—usually logarithmic, in audio pots) as the original control. Hopefully, you can obtain an exact replacement from the maker, assuming the equipment is relatively new. 

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. Please enclose a stamped, self-addressed envelope.

Whatever Happened to Mike Inputs and dbx NR?

Q. Doesn't anyone record live sound anymore? I just went shopping for a new tape deck to replace my worn-out one. I really require only two features—dbx noise reduction, because I have over 200 tapes encoded in that fashion which I'd like to be able to play, and a pair of microphone inputs so that I can make recordings of my voice. There wasn't a single deck at any store in Seattle that would play dbx-encoded tapes—much less record from a microphone.

What's happening here? A few years ago, virtually every deck had inputs for microphones; now, none do. And, to make matters worse, there are no inexpensive microphone preamps available; the cheapest one I could find was \$300—more than I intended to pay for the entire tape deck.—Norm Strong, Seattle, Wash.

*A. If you look at the Annual Equipment Directory in the October 1991 issue of *Audio*, you will find several cassette decks with a list price under \$400 that are equipped with microphone inputs. Not many, and far fewer than in past years, but still some.*

True, dbx noise reduction has nearly disappeared from home tape decks, having been largely supplanted by Dolby C NR. Therefore, a deck with both dbx and mike inputs is a rare bird. You will find only one, the Proton AD-630HX, in the 1991 Directory, and its list price is \$800.

If the deck you employed to make dbx-encoded tapes is still in working order or if it can be put into working order at modest cost, I suggest that you get a deck with mike inputs and Dolby NR (of which there's still a reasonably wide selection) and use your old deck to play your old tapes for copying onto your new deck as Dolby-encoded recordings. (Editor's Note: As recording all 200 cassettes would be quite a job, you might want to copy only your favorite tapes and keep your old deck for occasional playback of the others.—I.B.) If your present deck is no longer operable, you might want to comb the second-hand market for a deck equipped with dbx NR.

Some audiophiles use mixers to feed microphones into tape decks. Radio Shack has several at quite reasonable

*prices, and *Audio* readers have given me favorable reports on these. Also at moderate price, Radio Shack has some P.A. amplifiers with mike inputs that will accept low- or high-impedance mikes.*

Optimizing Output Level

Q. I have a question concerning the output level setting of my tape deck. On playback, I have a choice between adjusting the deck's output level control or adjusting the volume control of my amp. Similarly, when dubbing from one deck to another, I have a choice between the output control of the playback deck and the input control of the dubbing deck. Is there an optimum output level for a tape deck?—Harvey S. Lee, Arlington, Mass.

A. There is probably an optimum output level setting for a given tape deck in given circumstances, but this optimum is usually quite broad and seldom, if ever, critical.

Two factors should be taken into consideration. First, one wishes to drive the following equipment, say, a preamp, adequately. This is not simply a matter of ultimately achieving sufficient volume. If the preamp's volume control follows active electronic stages, a low setting of this control reduces noise of these early stages. So a high setting of the tape deck's level control permits a low setting of the preamp's control for a desired volume. On the other hand, if there is a possibility of overdriving the preamp, resulting in distortion, the deck's control should not be set too high.

(If the deck's output control is turned all the way up or nearly so, one assumes—but should not be certain—that the manufacturer has had the good sense to ensure that the deck electronics, if any, following the control will not be overdriven by peak signals.)

The second factor is the possible effect of the volume control on treble response. The resistance of the control, together with circuit capacitance, may produce some high-frequency loss within the audio range. The loss tends to be greatest when the control is at electrical (not physical) mid-setting. Such loss can occur with both the deck's and preamp's level controls. Therefore, it is advisable, if one can, to avoid electrical mid-setting. On the

other hand, in today's well-designed equipment, one may well find that the possible treble loss is only of theoretical significance—that if it occurs at all, it may be too small to matter audibly.


Effects of Equalization Changes

In the August 1989 "Tape Guide," Thomas L. Savio of Bloomington, Minn. stated that when using 70- μ S equalization with Type II or IV tapes he gets "duller" sound than with 120- μ S equalization. I replied, "Theoretically, unless you record at excessively high levels, your recordings should not sound duller with 70 μ S. . . ." Reader Dan Overman of Albany, Ore. responded:

"I have another perspective. . . . Your response was very informative, but you did not offer any possible explanation for Mr. Savio's contention that 70- μ S equalization makes his Type II and IV tapes sound duller than does 120 μ S. Some cassette decks permit manual switching of equalization only when recording; they switch playback equalization automatically by reading the cassette shell notches. (My own deck combines record equalization switching with bias switching and automatically selects playback equalization.) If this were the case with Mr. Savio's deck, manually selecting 120 μ S for recording on Type II or IV tapes would result in an excessively bright sound when playing back at 70 μ S (which could be done unknowingly if the deck's features are not clearly understood), making tapes recorded at the proper equalization sound duller by comparison."

Mr. Overman is correct in that I didn't do justice to Mr. Savio's question, but his last sentence is not correct. Operation at 120/70 μ S (120 μ S in recording, 70 μ S in playback) causes dulling of the sound because 120 μ S in recording produces less treble boost than does 70 μ S; 70/70 μ S nominally produces flat response. Thus, 70/70 μ S is brighter than 120/70 μ S. Brightest sound is provided by 70/120- μ S operation. In comparison, 70/70 μ S is relatively duller. Δ

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. Please enclose a stamped, self-addressed envelope.



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THE REPEATER PRINCIPLE

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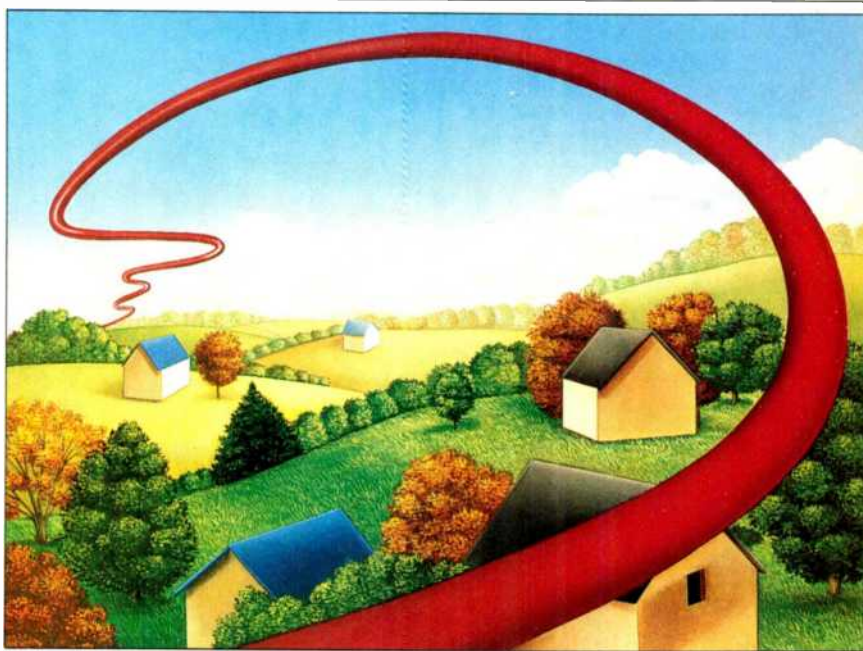
In all these years we haven't even remotely approached that kind of simplicity—and surely not in all our present, complexly layered chips and our incredible ICs and the travelling electrons and holes that race through them. But, even so, we have come astonishingly close to the ideal of no distortion. Just look at all those zeroes after the decimal point in current audio amp specs. It is an enormously complex miniature world, our present electronics, if highly "practical," to say the least. But no straight wire.

What is now in existence, after the usual many years of dormancy for such profound developments, is a straight *fiber* with gain. Our friends in the glass business have done it. A tiny glass thread doped with a small collection of rare-earth ions, the most favorable being those of a substance that is new to me—erbium. No, not an herb! You do not grow erbium in your home 'erbarium. Think in another direction, of such now-familiar substances as germanium, gallium, indium, the very basics for modern electronics, and thus you will fit erbium into your consciousness.

It was some 20 years ago that the amplification principle was discovered—as usual, ahead of its time, a sort of curiosity. Dope a glass fiber with your choice of rare-earth ions (others also exhibit the effect), "bombard" them with a few tiny milliwatts of laser power, and lo! Amplification. The ions are pumped up a state or two, and as they fall down, they emit a more powerful version of whatever light signal is passing by. Pardon my non-engineering approach.

I picked up my first account of this extraordinary phenomenon from that useful reporting vehicle, *Scientific American*, back in March 1991. I left it out of my October 1991 column because I had instantly realized that this astonishing development needed its own space, plus a bit of background.

The straight-fiber amplifier is, you see, essentially a repeater, inserted in a long optical-fiber channel to boost up the light signal as it begins to fade. The



digital aspect of fiber optics means that extraneous material, as always, can be ignored for the essential bits, and even missing bits can be restored by methods becoming more familiar to us every day. The repeater is simply the first use for a straight-fiber, laser-pumped light amplifier, and for a good while it will be overwhelmingly the most important. You will remember, as of October's *Audio*, that in the mid-'80s a single-throw distance of some 117 kilometers had been achieved with fiber transmission, a notable advance over the earlier "long" distances, across town, achieved by the telephone company. But 117 kilometers (about 73 miles) is not a real long distance. So repeaters were quickly developed to extend fiber cables for enormous distances—but, as I understand it, entirely via an unhappy substitute for the real thing, a sort of A-to-D and D-to-A conversion, from light into electronics and then, amplified, back into light. Apparently (I have not pulled up any glass fibers to see for myself) the entire present world fiber network depends on this workable but highly unsatisfactory procedure.

The erbium-laser amplifier is still mostly prototype, and some absolutely vital standards are not yet decided on. Alas, at this point the optimum laser is incompatible with the optimum tailored

digital fiber, the bit rates, and much, much more, as the ads say. Do we rip up thousands of miles of glass communications with electronic repeaters and substitute all-new erbium-doped fibers throughout? That is one horrendous possibility. Do we compromise—the old, old game of compatibility at a sacrifice? Or do we sweat it out until some ingenious guy or corporate team discovers the perfect way to adapt an optical amplifier to existing fiber? Let us hope so. Evidently all sorts of important outfits, the world over, are plugging hard; it is a vital matter for future communications. We probably will not see a useful resolution for a settled worldwide fiber network, all digital, all optical, until the middle of this decade.

Note that the repeater principle has an ancestry that goes back to the beginning of the human race, whereas plain amplification, a small effort, a small signal, into a much larger facsimile, is a more obscure and much later idea. Think of the relay race; think of the ancient human messenger, running full speed until he totters half-dead as a new and fresh messenger takes over; think of the smoke-signal repeaters, by which hideous emergencies could be made known across hundred of miles in remarkably short order. Then there was the stagecoach or the hired private coach, dashing

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*Letterbox

23/592

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The repeater principle goes back to the start of the human race; think of smoke-signal repeaters or the stagecoach.

ahead at full horsepower, and the highly perfected change of horses where, in early 19th-century England, a complete new "motive power" could be installed on a large coach in literally seconds, scarcely a pause at all. Human and animal repeaters have always been with us, as essential parts of communication.

Think also of the telegraph, the first true electrical means of communication and far ahead of all the rest, back in the 1840s. Morse had the first digital system—can anyone question it? Two symbols (and only one transmission wire) coded into the entire language. But the repeater was a very tough problem. The first Morse line, between Washington, D.C. and Baltimore, got by without a repeater, if I am right—but barely. It still created a sensation, just as had the original discovery that electricity moved instantaneously. But the telegraph that followed the railroads across our continent and everywhere else was in dire dependence on some sort of repeater to keep the signal going. All too often it was human. A fading message was written down, as much as could be deciphered, and then tapped out anew on a fresh circuit. After dozens of such transcriptions, most telegrams were reduced to jargon! Like the children's game where a few words are whispered ear to ear around a large circle, the message ending up in chaos.

The true repeater solved much of the jargon problem—it was an electrical amplifier that actually was mechanical. A feeble make-and-break actuating a much stronger, fresher current. An *electronic* repeater, which had to involve amplification, was not devised for three-quarters of a century, by then applying also to the telephone.

The digital nature of the telegraph gave it a tremendous boost—retrieve the "bits," and you had the signal but not the noise. You can see, thus, that the phone network began with a very serious handicap, which is probably why, when I was a child, a long-distance call was for some extreme emergency and a clumsy thing at best. I still tend to talk loud when I phone across the country. We all did.

I am no authority on the inner details of the new light-amp repeater-amplifier, and I refer you to the *Scientific*

Our own electronics have explored the furthest reaches of our kind of bandwidth, but we can never compete with light.

American source. In nontech language, I can give you a rough idea as to how it works. The pumping laser, whatever type is eventually perfected, is hearteningly similar to our ubiquitous CD lasers and their relatives. Not big, very modest in power requirements, not expensive—especially for professional communications networks. As I understand it, the signal fiber is joined at its doped area by a second fiber, which carries a diode-laser pulse that makes the erbium amplify. The doping may be concentrated in a small loop or distributed over a long distance. The erbium (or other similar material) emits light in the familiar way, imposing its new power on the light signal that is passing through. Lots of ifs and buts in that, I am aware. But I assure you it exists. It will be perfected. And multiplied. Moreover, its use will soon expand, without any doubt at all. Into audio? Extremely likely.

There is a lot more than just amplification involved in this new way to repeat an optical signal. As we know, light has an enormous bandwidth. For our purposes it might as well be infinite, a million or so separate digital "channels" imposed on a single beam of light! (See October.) Our own electronics have explored the furthest reaches of our kinds of bandwidth, but we can never compete with light. What, then, do we do when a wideband, multi-channel light signal fades and heads into an electronic repeater system? For lack of bandwidth, we must sort out the channels and amplify them separately. We are limited in all sorts of ways by this—can you imagine a repeater that needs a thousand amplifiers for an easy and casual thousand channels carried in the light signal? Also much associated clean-up equipment and assorted filters—you know what filters get you into—both to separate and to recombine the numerous electronic channels. And then, of course, the repeat conversion back to a single light-beam signal. These are the light repeaters now in use, and they are roughly equivalent to the mechanical repeaters of the early telegraph. What a bottleneck!


By the way, just as the erbium ions can be doped in concentrated clumps at one point in a transmitting fiber, or spaced out thinly for a sort of gradual

amplification over considerable distances, so too can the pumping laser adapt to conditions. Its light-conducting fiber can couple with the signal fiber perhaps only inches away. Or if your repeater happens to be under the English Channel or at the bottom of an ocean 30,000 feet deep, you can set up your laser on the nearest convenient land and run a second parallel fiber alongside the first, two human hairs together, to carry the laser beam to the point of junction and amplification. How flexible can you get? And then there is the soliton, a "wave-like optical pulse" that will go 10,000 kilometers without spreading out. . . .

The Japanese, according to the *Scientific American* article, plan a brand-new, 2.4-gigabit all-optical network under the Pacific, to open up in 1996. Details not yet settled—they aren't settled anywhere.

As to audio itself, the first thing to note is how much of this new technique meshes into existing knowledge and practice of many sorts and definitely into our own ever more profound concern with semiconductors and the laser, in particular, so familiar in audio CD players. How can we possibly NOT get involved? But in new ways, not just repeaters.

I suspect erbium amping will show up first in our near neighborhood, the video cable, already carrying plenty of audio, feeding most of our equipment with its signal. Have you seen those fat things that now bring cable into a million homes? They are an expensive vested interest, but new territories await the cable that is hair-like and can carry absolutely anything, with repeaters built in. My town does not have cable—not enough houses. If our local outfit has heard of erbium, they may merely be stalling until it arrives. If not, sooner or later they will discover it. A cable revolution again, maybe the end of networks, maybe even radio, going along on cable for the ride? Well, big changes anyhow.

In specific audio equipment for the home and car, I can only give a guess that erbium-light amplification would be most useful in the low-level areas, the delicate and critical preamp and its numerous relatives where simplicity and purity are of the essence. Right? The straight wire turned fiber. 

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**Aiwa
Portable DAT Recorder**

Weighing 1.1 pounds, the HD-S100 uses one-bit A/D and D/A decoders, with 64- and 256-times oversampling, respectively. Digital and line inputs and outputs are provided, as is a microphone input with a three-step attenuator. Slider pots control left and right recording level, and the display is on the unit's top panel. Subcode functions include absolute time, automatic and manual start-ID recording, program numbering, program renumbering, and automatic location of the last recorded portion. The unit is powered by a 6-V rechargeable battery. Price: \$950.

For literature, circle No. 100

Parasound Power Amp

Designed by John Curl, the HCA-2200 is a high-current design, rated to deliver 50 amperes rms, 90 amperes peak. Rated power in stereo ranges from 220 watts per channel into 8 ohms to 385 watts per channel into 2 ohms; bridged for mono, the amp delivers 750 watts into 8 ohms and 1,000 watts into 4 ohms, all at

0.07% THD. Rated THD at more typical listening levels is 0.005%. Bandwidth at rated power is 20 Hz to 20 kHz, ± 0.5 dB—or 3 Hz to 90 kHz, +0, -3 dB. Damping factor is greater than 120 at 20 Hz. Features include Class-A cascode input circuitry and MOS-FET driver transistors, as well as fully balanced inputs. Price: \$1,585. For literature, circle No. 102.



Clarion Car CD Changer

The 6201CD holds six CDs in a newly designed magazine whose compactness keeps the changer's overall height down to 2 $\frac{7}{8}$ inches. The

unit should be easy to install, not just because of its size but because all power, signal, and control connections are handled by a single plug and because its suspension is adjustable for mounting at any angle from horizontal to vertical. The D/A section is a dual one-bit bitstream type, and an oil-damped suspension system floats the 6201CD's mechanism inside the chassis to isolate it from road shocks. Price: \$399.95.

For literature, circle No. 103



**Sennet Concepts
Center Speaker**

Designed for use as a surround system's center-channel speaker, the SH44 is shielded to allow placement near a video monitor without distorting the picture, and the speaker's response is optimized for dialog clarity and intelligibility. The system incorporates two

4-inch woofers with carbon-filled polypropylene cones plus a 14-mm dome tweeter. Bandwidth is rated at 80 Hz to 20 kHz, sensitivity is 90 dB SPL at 1 meter for 1 V input, and power handling is 100 watts. The system is 11 inches wide, 5 $\frac{3}{8}$ inches high, and 7 $\frac{7}{8}$ inches deep. Price: \$90.

For literature, circle No. 101



Vortex Loudspeaker

A three-way system, the Vortex Screen uses an 8-inch woofer in a hybrid transmission-line enclosure, a separately enclosed 4-inch midrange, and a 1-inch aluminum dome tweeter. The crossover incorporates servo circuits to compensate for impedance variations, hysteresis, and back EMF. Rated frequency response is 27 Hz to 25 kHz ± 3 dB, and sensitivity is 88 dB SPL at 1 meter for 1 watt input. Price: \$1,750 per pair. For literature, circle No. 104

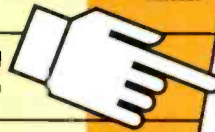
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A SENSE OF DIRECTORY



Illustration: Elaine Cardella

Back in January 1985 in this space, Ivan Berger got out his abacus and tallied how much a stereo system would cost if it included the most expensive item from each category of the Annual Equipment Directory in our October '84 issue. Yore score seven years ago: \$121,200. Grab our current Directory, and you'll need almost all of that to buy just the peak power amps. So we thought it high time to update the entire setup. Assuming the 22 products get along with one another, we present The System To End All Bank Accounts.

Sequerra had the tuner in '84, the Model 1 Broadcast Analyzer at \$5,000. In our October '91 Directory, Day Sequerra has the FM Reference Panalyzer at \$12,800. If you want AM stereo—and we want *everything*—add Audio Design Associates' MT-3000 (\$2,500).

For tape enthusiasts, Revox repeats with a cassette deck, this time the B215S (\$2,900), while Fostex provides both the G24S open-reel deck (\$14,500) and the D-20 DAT recorder (\$8,000). That last category also includes a new product yet to find a Directory home of its own: Marantz's CDR-1 CD recorder, which we'll put in our home for \$10,000.

As for a plain old CD *player*, we could spring for the Wadia Digital 2000, but its price tag of \$7,450 prompts the Ralph Kramden in us to respond, "A mere bag of shells!" So let's marry the company's WT2000 CD transport (\$5,600) to the Mark Levinson No. 30 D/A converter (\$13,000) for a much more impressive \$18,600. That takes care of single-disc study. For hour upon hour (upon hour) of background music, we also require Proceed's CD Library (\$14,000), a 100-disc changer with

15 programmable categories and 2,970 (count 'em!) programmable selections. You could Proceed to play every version of Beethoven's Fifth Symphony listed in *Schwann's* most recent *Opus* catalog and still have room for 33 discs—which may or may not be space enough for Alan Douglas' exhumations of Jimi Hendrix.

Let's not forget, we have plenty of black vinyl that deserves respect. "I want my SME!" you cry, noticing the Model 30 turntable with Series V tonearm, all for \$20,000. "Peanuts! Peanuts!" we reply. Not only can you have a choice of turntable at \$15,000—Rockport Technologies' Sirius or Symphonic Line's RG 6—but you can add Basis Audio's separate Reference tonearm (\$10,900) and Audio Note's AN-MC-2/LTD Signature phono cartridge (\$8,000) and be proud to have conspicuously consumed to the analog tune of \$33,900. (The \$3,500 for the Kiseki Lapus cartridge from '84 would today buy you only the Audio Note *replacement stylus*.) But this handles just 33⅓ and 45 rpm. Plunk down another \$705 for Rega Research's 78-only Planar 78 turntable with RB250 tonearm (\$575) and Rega's RB78 cartridge (\$130).

Time to process all those signals. We're still buying the Packburn noise suppressor, now dubbed the Model 323 A and costing \$2,650 (up only \$200 from '84). Add to that Lexicon's CP-3 surround processor (\$2,995) and Cello's Audio Palette/MIV equalizer (\$17,000), and you've just burned another \$22,645 in one paragraph.

The power amps we mentioned in the first paragraph are Audio Note's tube mono pair called the Gaku-On, listed at \$120,000 (versus, in '84, the

pair from Esoteric Audio Research at \$10,000). You could then choose Dynaudio's Arbiter preamp for \$41,000, but let's go a little further by combining Audio Note's M-7 Phono (\$25,000) with FM Acoustics' line-only Resolution Series 266 (\$16,980) for a preamp total of \$41,980.

Which leaves headphones and, oh, yes, speakers. For ultimate privacy at ultimate expense, Koss offers the ESP/950 'phones at \$2,000. But there will be times when we'd like the rest of the household—and possibly the neighborhood—to hear the fruits of our outlay. Let's see . . . Entec and Reuben Guss each have a speaker system for \$100,000. Not bad, but here comes Wilson Audio Specialties with the WAMM Series VI at \$125,000 (the WAMM system in '84 had the biggest speaker ticket at \$42,000). But that includes an equalizer, so no fair. Our choice instead is R. Sequerra Associates' Colossus MkII, each weighing 800 lbs. (with a grille material of, ahem, silk) and costing \$75,000—which means \$150,000 per pair, which means \$300,000 for basic two-front, two-back surround sound.

The Sequerras do save us from having to buy a separate subwoofer as well as an external crossover, and because our system is intended primarily for audio-only purposes, we'll also bypass a center-channel speaker. As for cables and other accessories that don't appear in our Directory, spare no expense—but hurry before DCC and the Mini Disc force you to realign the whole *enchiada*.

That said, dear reader, our grand total stands at a very dear indeed \$604,530. *Five times* the 1984 tally. The cost of our Directory issue itself hasn't even doubled—from \$2.95 in '84 to \$4.95 in '91. Then again, if a certain company's threatened takeover of *Audio* comes to pass—and they go ahead with plans to print the Directory on gilt-edged deli paper, bind it between slabs of aged macadamia fruitcake, and rename it *LIRPA Labs' New and Improved Annual Equipment Directory to LIRPA Labs' Equipment and Maybe Some Stuff from Those Other Companies*—you might have to take out a loan.

Ken Richardson



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BITTER JITTER AND SWEETER DITHER



The words "dither" and "jitter" crop up often in reviews of CD players, and I know that there are many readers of *Audio* who aren't sure just what these terms mean. Both words have their root in Middle English, and both connote some degree of nervousness or unease. In general, jitter usually means physical shaking, while dither often carries the meaning of indecision or confusion.

In digital technology, jitter refers to uneven timing in the sampling of digital data being converted back into the analog domain. By design, the sampling of data from the CD is under the control of a crystal oscillator, which is a highly accurate operation. Even motion irregularities of the disc transport mechanism itself are carefully corrected by feeding the digital data into a buffer, from which it is carefully "clocked out" under the precise control of the crystal oscillator. Any degree of jitter remaining in a modern CD player is usually quite small and is not likely to be a function of any mechanical parameter of the player.

Which gets us to the subject of CD rings. Many people are still in love with

analog, and CD rings provide an element of comfort for those users who feel that anything they can do to their systems under the rubric of tender loving care will make it sound better. In the analog days, TLC could improve sound; anti-static devices, record cleaners, and a host of other accessories could make greater or lesser improvements. CD rings are sold for the purpose of "smoothing out" variations in the angular velocity of the CD itself and are supposed to make it sound better. But as we have seen, the data from the disc goes into a buffer and out again under crystal oscillator control. Nothing we do to the disc can improve this. In fact, there is good reason for some players to misperform if a CD ring is used, due to the added rotational inertia which the CD ring causes.

In any event, jitter is bad, but if it occurs at all, it is usually as a result of electronic—not mechanical—design or function. It can be audible, if not properly addressed, but most CD players and other devices take measures to prevent or cure it.

Dither is something else entirely. It is quite beneficial in digital recording sys-

tems and has been a part of signal transmission systems for years. Basically, dithering is a method of adding low-level noise to a system for the purpose of randomizing, or confusing, the small-signal behavior of the system. It has been used in mechanical systems to minimize backlash in gear trains, and it is widely used in TV transmission.

Nakajima et al. mention in *The Sony Book of Digital Audio Technology* that dither can be generated by amplifying noise from a zener diode.

Recall the early days of digital, when many critics stated that decaying reverberant signals often "disappeared" when those signals fell below the theoretical lower limit of system resolution. It is not likely that this was truly observed in normal recordings, but in theory—and in the laboratory—it could be demonstrated! In a 16-bit digital system, the maximum signal-to-noise ratio is on the order of 96 dB. Any attempt to encode a signal that is smaller than the least significant bit of the system will result in *nothing at all* being encoded. In a manner of speaking, the signal is too small and simply falls in the cracks!

Another problem widely discussed in the early days of digital recording was that system distortion, as a percentage of the input signal, actually *increased* as the system input was lowered. This too was true, in a system completely without dither, whereas in any analog system, distortion almost always diminishes as the input signal level is reduced.

These two problems can be eliminated by adding a small amount of dither to the input. This added noise input effectively lessens the maximum S/N ratio of the digital system ever so slightly, but it's a small price to pay for the advantages obtained. I'll briefly try to explain how it works.

First, the human hearing mechanism has a remarkable ability to hear a signal buried in noise. If the noise is fairly broadband (free of any specific, prominent frequency components), then we can easily detect a midrange sine-wave signal buried some 10 to 12 dB below the level of the broadband noise. That is, we can detect a signal that has a negative S/N ratio! The ear's ability to do this is a measure of its ability to "lock on" to a signal when

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The RX-950 features ToP-ART. A new system design that virtually eliminates interference between channels and delivers maximum signal purity.

40 Presets

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Speaker terminals with heavy gauge connectors for optimum results.

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Sleep Time (From Remote Control)

UL Listed

The RX-950 delivers 120 watts RMS per channel into 8 ohms from 20-20,000 Hz at no more than 0.015% THD. Or 180 watts RMS per channel into 4 ohms from 20-20,000 Hz at no more than 0.03% THD.

To keep output impedance to a minimum, speakers are switched in front of their terminals, rather than at the switch position.

For signal purity, exceptionally thick 1.6 mm high quality wire is used to route signals through the amplifier.

The thick base of the RX-950 has exceptional anti-resonance, anti-magnetic and superior damping characteristics.

Offers 4 dedicated audio inputs and 2 video inputs.

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The new RX-950 combines the performance of the finest separates with the convenience of a receiver.

Ideally suited for multiple speaker installations. Up to six different zones can be controlled at one time through additional amplifiers connected to the two extra pre-amp outs.

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High Gain AM Loop Antenna

The heavy chassis and extra large feet of the RX-950 are designed for maximum vibration damping.

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Paradoxically, dither can both lower the system's S/N ratio and raise the audible dynamic range!

there are no nearby frequency components to mask that signal. This means that the ear's dynamic range—its ability to detect signals from the loudest all the way down to the quietest—is sometimes greater than the S/N ratio of the signals being detected.

The second factor operating here is that the presence of dither noise keeps the digital system from ever attempting to encode an input signal below the system's theoretical limit. What the system does instead is to encode a mixture of dither noise *and* that low-level input signal. Under these conditions, the low-level signal will be modulated by the noise itself and will appear as what is known as duty-cycle modulation or, more formally, pulse-width modulation of the noise. When this is done, the ear tends to average out the signal from the noise, just the way it does in an analog tape recording system, where a sine wave may be similarly buried below broadband noise. In fact, the digital system at this point in



its low-level operation resembles an analog system in many ways, surprising as that may seem.

Now, let's get back to those critics who said that reverberant signals often disappeared at low levels in digital recording. I earlier implied that this did not actually happen in real-world re-

cordings, but only in the laboratory. The reason? There has always been a certain amount of unintentional dither noise in most signal paths. It can be due to the self-noise inherent in microphones or to the input noise in all recording consoles. In order to function as dither, these various noise sources must have an amplitude about one-half (or more) of the least significant bit, and this is almost always the case.

This discussion has pointed up the difference between two often confused terms, dither and jitter. It has also pointed up the differences between two other terms, signal-to-noise ratio and dynamic range, which themselves are often confused. Remember, the maximum S/N ratio of a system is simply a measure, in decibels, of the maximum signal level relative to the level of the system's noise floor. The effective dynamic range of the system may be some 10 to 12 dB greater, taking into account the ability of the ear to detect signals below the noise floor. A

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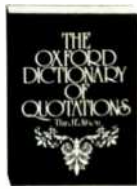
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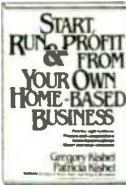
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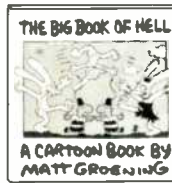
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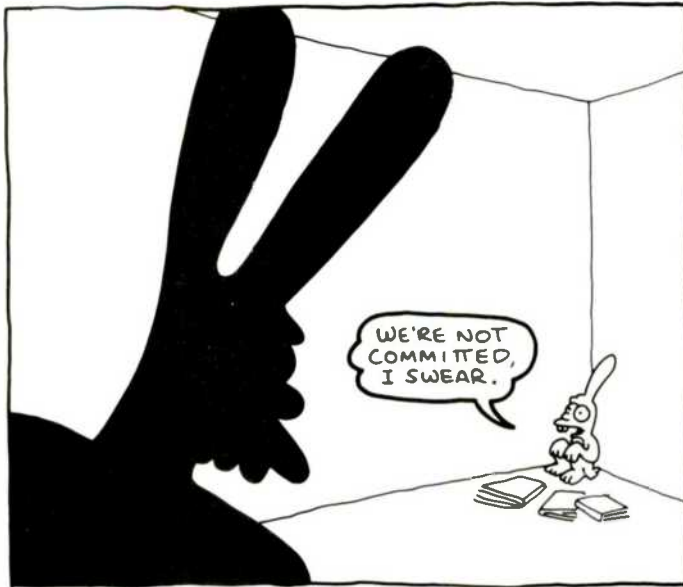
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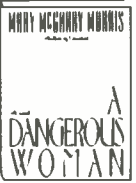
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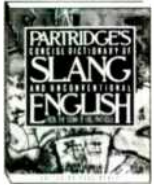
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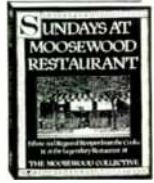
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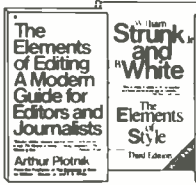
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TWISTS & TERMS

Recently, I got a letter with some irate comments about an August 1989 article on loudspeaker cables that I wrote for *Audio*. The letter called me to task for saying that the inductance of cables increases as the two wires in a cable pair are moved further apart. I was taken aback by this comment since this result is very well known to anyone who knows anything about electromagnetics, and I never expected the conclusion to be questioned.

With careful reading of the complaint, however, I realized that the claimant was talking about the "mutual inductance" between two pairs of wires and not about the "self-inductance" of a single two-wire cable. To confuse these two types of inductance is a serious misunderstanding, and it is very important in considering cable applications to recognize the difference.

Self-inductance exists in a single cable that consists of two conductors carrying a current to a load (and back, of course). This is the situation for a regular loudspeaker cable (two wires) that has an amplifier at one end and a loudspeaker at the other. It is this self-inductance that is important when considering the parameters of the cable connecting the amplifier to the load; it is also the self-inductance that was under consideration in the *Audio* article.

There is a second type of inductance that exists between two cables carrying currents. This is the mutual inductance between the two cables, each of which consists of a pair of wires carrying current, generally to two different loads. This mutual inductance

results in an interaction between the currents in the two cables. For example, the signals to the left and right loudspeakers in an ordinary stereo system should be independent of each other. If there is significant mutual inductance between the cables, there will be crosstalk. Since the left- and right-channel cables are usually separated by a distance somewhat greater than the wire separation within the cable, the mutual inductance is usually small. But the mutual inductance between two current-carrying cables might be significant in some cases. You can easily imagine a system that has two cables carrying the left and right channels in a stereo system, or even more pairs of wires carrying the high- and low-frequency signals in a bi-amplified system, or a case where the loudspeaker cables and some power-line cables lie parallel to each other. It is informative to consider what happens when several runs of cable are laid down parallel to each other for a considerable distance.

Parallel pairs of wires, when tightly spaced physically, can easily have significant mutual inductance; thus, some signal from one circuit might leak into the other. This interaction, cross

coupling, or leakage between the two circuits can have some minor effect on the stereo signal in each or, at worst, might cause some audible crosstalk interference between the signals.

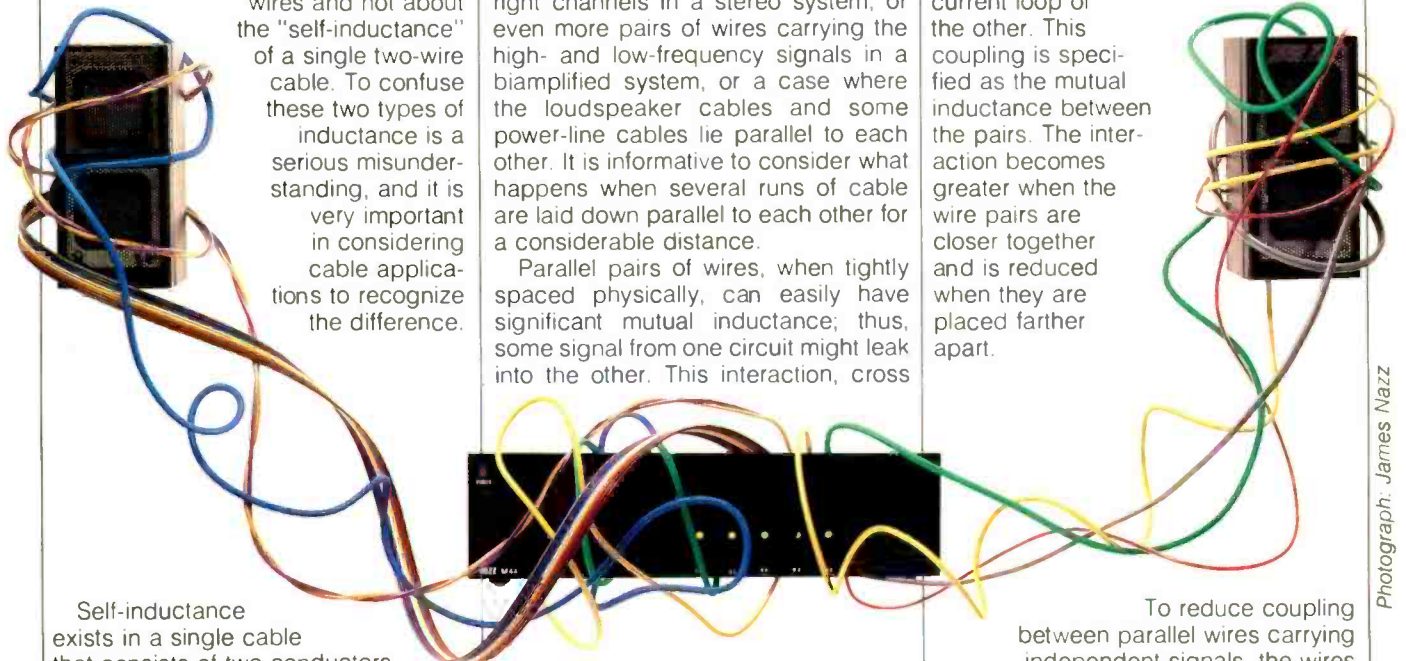
Normally we would hope to have isolation between the signals in the wires carrying the information to the left and right loudspeakers. Because the left and right channels in normal program material are substantially correlated, such crosstalk is usually not serious. But in a case where the loudspeaker cable interacts with a nearby power line, we might find hum introduced into the loudspeaker cable. While all of this crosstalk and stray pickup can hap-

pen, these problems can be minimized by reducing the mutual inductance between the circuits. Fortunately this can be done easily.

First, we must understand the source of mutual inductance. Mutual inductance is the coupling phenomenon that causes currents in one circuit to result from currents in another, nearby circuit. For example, if you have a rather long cable consisting of a pair of wires stretched out in a straight line and then you place a second pair of wires down near and parallel to the first, there will be mutual coupling between the pairs. That is, some of the flux from each pair of wires will cut the current loop of the other. This coupling is specified as the mutual inductance between the pairs. The interaction becomes greater when the wire pairs are closer together and is reduced when they are placed farther apart.

To reduce coupling between parallel wires carrying independent signals, the wires should not be bound together in a bundle. This seems like a rather strict requirement; in fact, straight parallel cables should not even be laid down next to each other.

There is a very easy way to reduce the mutual inductance or mutual interaction between cables. It happens that mutual inductance has a sign (polarity) associated with it. If the wire pairs are alternately interchanged in position, the mutual inductance can be made to cancel almost completely. This is why professional loudspeaker cables are always twisted pairs of wires. It is the reason that telephone companies use twisted pairs to transmit telephone sig-



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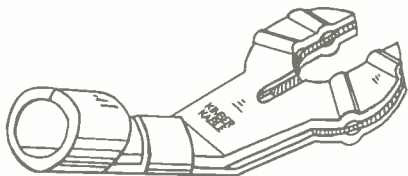
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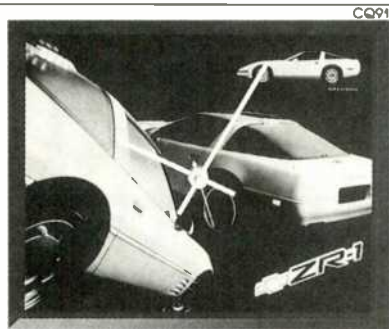
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nals and why they interchange wires, from left to right, when running long lines parallel to power lines along a roadway.


Once we recognize the problem, a solution is easy. The rules are quite simple. If cables are run next to each other, they should consist of twisted pairs of wires. All professional loudspeaker cables are designed with just such construction.

But what about the ubiquitous zip cord used by so many consumers? All zip-cord-type cables, that is, cables having two parallel wires molded in a jacket holding them side by side, have the potential for interaction with similar cables laid next to them. What is the solution? The flat parallel zip cords must be twisted in order to reduce the interaction between them as well as to reduce the interference from external fields.

This simple tactic will reduce cross-talk between cables and will also serve to keep out power-line radiation and

If cables are run next to each other, they should consist of twisted pairs of wires; all pro speaker cables are made this way.

radio interference of many types. We must realize that we are immersed in a conglomeration of low- and high-frequency radio waves, power-line radiation, and who knows what other electrical interference. Twisted pairs will save the day. It is usually more important to use twisted pairs at low power levels, which is, of course, the reason why professional microphone cable consists of twisted, shielded pairs and why telephone wires are usually twisted pairs as well.

It is for these reasons that I do not recommend wire with zip cord construction, no matter what the gauge, for loudspeaker applications. But I do highly recommend the use of professional-quality, twisted-pair loudspeaker cable. The gauge selected should be large enough so that the cable has a resistance that is less than a small percentage of the lowest resistance presented by the speaker. 

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In the world of professional audio, engineers usually interconnect their equipment with balanced lines (cables), while audiophiles hook up their component systems with "single-ended," unbalanced, lines. Knowledgeable audiophiles have become aware of the advantages of using balanced interconnect lines. For the past few years, some high-end manufacturers have been marketing preamplifiers, power amplifiers, and other devices that they claim have balanced input and output stages. In the world of high-end audio, equipment using balanced lines has acquired a certain cachet, but as might be expected, there is considerable misinformation and misunderstanding in respect to balanced audio circuitry.

Since the earliest days of hi-fi, audio components have been interconnected with single-ended, unbalanced, cables. These cables have a single conductor and a shield. The shield is connected to ground on the chassis of the component. While the shield can prevent electrostatic noise on the inner conductor, the shield itself carries audio signal currents. Thus, if the shield is near the magnetic field produced by the power line, 60-Hz hum will be induced in the shield and added to the

audio signal. In the average audio component system, cable lengths are relatively short, and by routing the cables away from power lines, hum levels are fairly well attenuated.

In the professional audio fields of recording and broadcasting, the balanced line is the standard for interconnection of equipment. Audio professionals want absolutely pristine transmission of signals, and this means no hum, noise, or r.f. interference from emergency service vehicles, CB radios, fluorescent lights, or even radar sweeps!

Essentially, a balanced cable uses two conductors for the audio signals, and both conductors are sheathed with a metal shield; neither of these conductors is connected to the shield. Unlike the shield in an unbalanced cable, the balanced cable's shield does not ordinarily carry any audio current. To help reduce magnetically induced hum, the conductors within the shield are also twisted together. This twisting reverses the direction of the induced current, causing self-cancellation throughout the length of the cable.

In contrast to the often flimsy, unreliable RCA pin-type connec-

tors in common use with unbalanced cables, balanced cables are terminated with the ubiquitous XLR three-pin connectors. These relatively massive connectors are very reliable, and by international agreement IEC 268-11, pin one is for ground (or shield), pin two is for positive (hot, signal), and pin three is for negative (return or common). Balanced cables with XLR connectors are rarely used with audiophile equipment. That's partially for reasons of expense, and partially because there's no technical advantage to a balanced line if it must connect to an unbalanced input or output at one end—and most audio components have only unbalanced connections.

However, some "balanced" outputs are not truly balanced with respect to ground. All that is done in such circuits is that an inverting stage (a circuit that inverts the signal's polarity by 180° and feeds it to the second signal line) is added. As two conductors and a shield are now used to transfer the signal, the audiophile thinks his system is balanced. But true balancing requires much more than just the presence of two signal lines!

It is actually not so difficult to detect the more primitive balancing circuits. One way to detect this is to look at the specs; if the output impedance of the unbalanced output is lower than that of the balanced one, it is likely that a simple polarity-inversion circuit is being used in the product. Such a product will also fail the "floating test": The output from one signal lead will decrease by 6 dB if you ground the other lead. If the output is not truly symmetrical or balanced, it will not have the same frequency and phase response, let alone interference rejection, as a truly balanced system.



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Equipment using balanced lines has a certain cachet, but there is considerable misinformation regarding balanced audio circuitry.

The foregoing remarks on balanced and unbalanced cables are a necessary preamble to this report on the Resolution Series FM 266 preamplifier from the Swiss company, FM Acoustics. This preamp has fully balanced inputs and outputs to match the company's 811 balanced-input power am-

plifier, which I reported on in the November and December 1990 issues.

The FM Acoustics 266 is an overwhelming component—from the sheer beauty of its high-tech appearance to the breakthrough technology of its design and circuitry. As with the 811 amplifier, the 266 is clearly in the realm of

hi-fi fantasy and wish fulfillment as far as most audiophiles are concerned. Needless to say, at \$17,000 the 266 preamplifier will find far more sales appeal and appreciation in the professional audio fraternity.

The FM 266 uses proprietary discrete Class-A circuitry with high-speed semiconductors. No overall feedback or feedforward is employed, and the circuitry is totally modular to help avoid obsolescence. The output level and balance potentiometers, specially made for FM Acoustics, are precision laser-trimmed. These controls use a new shielding technology, not just the usual metal case, to reject noise and interference and prevent them from entering the signal path. In addition, the level and balance controls are isolated from the gain stages by Class-A buffers. To take advantage of shorter paths from circuit elements to power supply, an on-board power supply is used, made possible by a proprietary transformer with double shielding. Many of the parts and components of the circuitry are individually matched and are of Mil-spec standard.

Of particular interest to phonophiles is the optional FM 222 phono module, which has an RIAA linearization circuit offering compensation for Neumann and Ortofon cutters, as well as the more usual selection of impedance and capacitance to match various cartridges. Ironically, in the twilight of the vinyl era, the sophisticated circuitry of the FM 222 (and FM 266) will permit true balanced input of moving-coil cartridges. All phono cartridges are, in principal, balanced. But when the usual RCA pin-terminated cables are used, they are transformed into an unbalanced configuration. FM Acoustics' CA25140 series of cables will provide a balanced interface for MC cartridges and the FM 222. For well-heeled, rock-ribbed, die-hard devotees of the LP, the FM 266, outfitted with the FM 222, is likely to be the component that affords the ultimate expression of vinyl LP reproduction.

I could fill pages with the many features of this extraordinary FM 266 balanced preamplifier, but among the more salient are six identical, balanced (symmetrical) high-level inputs and a balanced tape/accessories loop (also isolated by a Class-A buffer). These

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Aragon 24Ksp	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	U.S.	\$1250
Aragon 24K	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	U.S.	\$1500 with phono

Conventional specifications have little to do with sound quality. They also bear little relationship to the value of a preamplifier. The above specifications, on the other hand, are found exclusively in the world's finest and costliest preamplifiers.

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The FM Acoustics FM 266 preamp is an overwhelming component—a high-tech beauty with breakthrough technology.

jacks have floating grounds and both inverting and noninverting connections, and the main output has a 180° polarity-inversion switch. Unbalanced (asymmetrical) signal lines are automatically converted to true symmetrical signals at the input of the FM 266; sensor circuitry automatically recog-

nizes what type of connection is employed. The balanced output automatically compensates for differences between balanced and unbalanced loads. All outputs are short-circuit-proof, and all input and output impedances are completely linear and identical over the full audio bandwidth. The

balanced output can maintain absolute stability while driving any load through more than 500 feet of cable.

As a result, according to FM Acoustics, the FM 266 has an excellent common-mode rejection ratio of 100 dB over the full audio bandwidth, and it easily passes the "floating test" without causing any effect in the other signal-carrying line. The FM 266 claims a whopping headroom of +20 dBv (7.75 V rms); I can easily believe it, with some of the great dynamic expression I've heard on certain CDs. Maximum output level is stated to be +28 dBv (18.5 V rms) into a 4.7-kilohm balanced load. Hum and noise are claimed to be 120 dB below full output from 20 Hz to 20 kHz. Rise- and fall-times are said to be a super-fast 0.3 μ S! Bandwidth is said to cover 1 Hz to 2 MHz, with no more than 1° of phase shift from 20 Hz to 20 kHz. The rated output impedance is less than 10 ohms, and channel separation is said to be greater than 95 dB. Distortion at 1 V over the full audio bandwidth is rated at 0.003%, with no higher order harmonics at all up to clipping level.

As always, even spectacular specifications are merely a guide to the sound of a component and its musical veracity. After extended listening with the FM 266, I was impressed in much the same way as I was by its companion FM 811 power amplifier, which is to say that its absolutely effortless dynamic music expression could take me from hushed string pianissimo to awesome fortissimo orchestral tuttis instantaneously. There was no lag or delay, no sense whatever of any kind of compression or limiting due to circuit inadequacies. The full gamut of orchestral dynamics was present with a verisimilitude equalled only by the live concert experience. You expect a truly clean signal from equipment of this caliber, but I was amazed at the low-level sounds or, when there were rests in the music, at the utter silence. The FM 266 was utterly and absolutely sonically transparent, with not even a vestigial hint of hum or a single noise artifact. I've used balanced equipment for many years in my recording activities, and the stunning performance of the FM Acoustics 266 preamplifier made the case for a balanced system more convincing than ever. 

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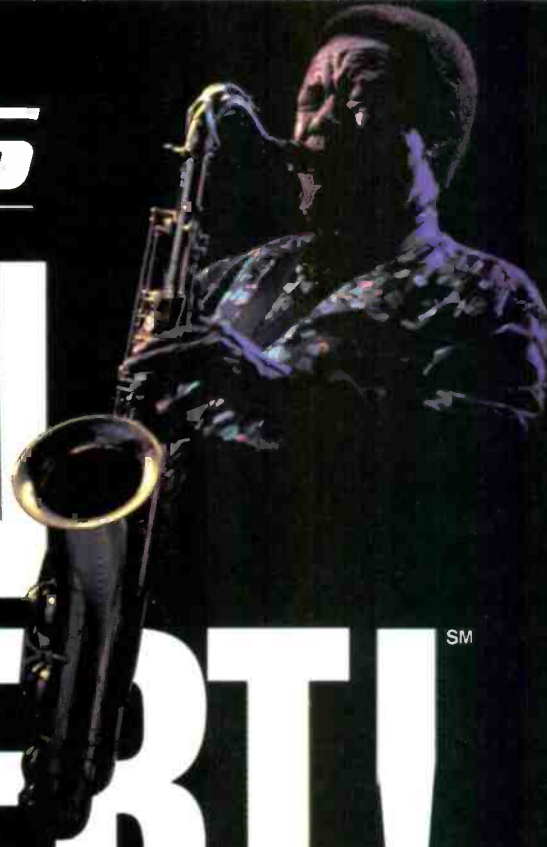
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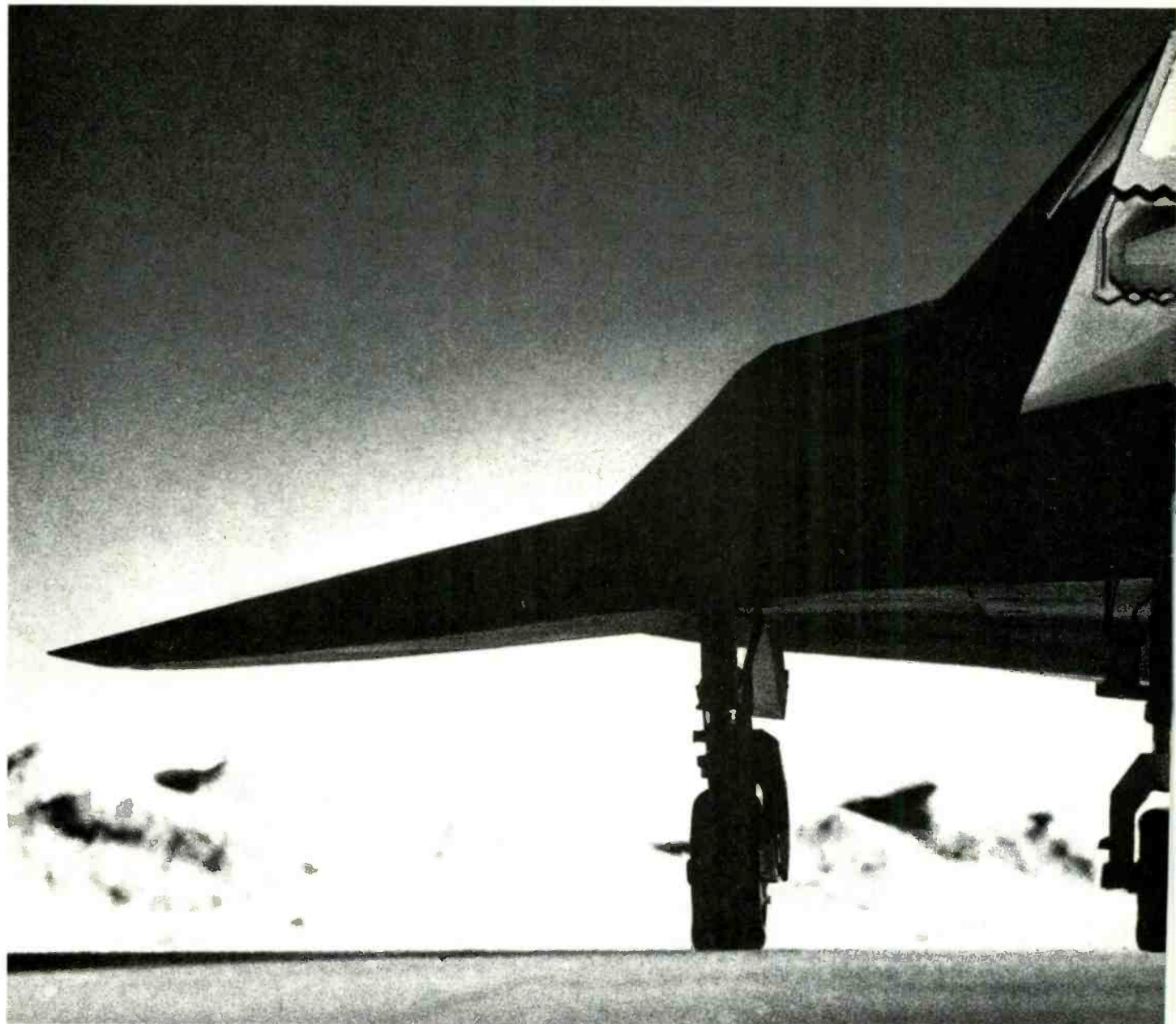


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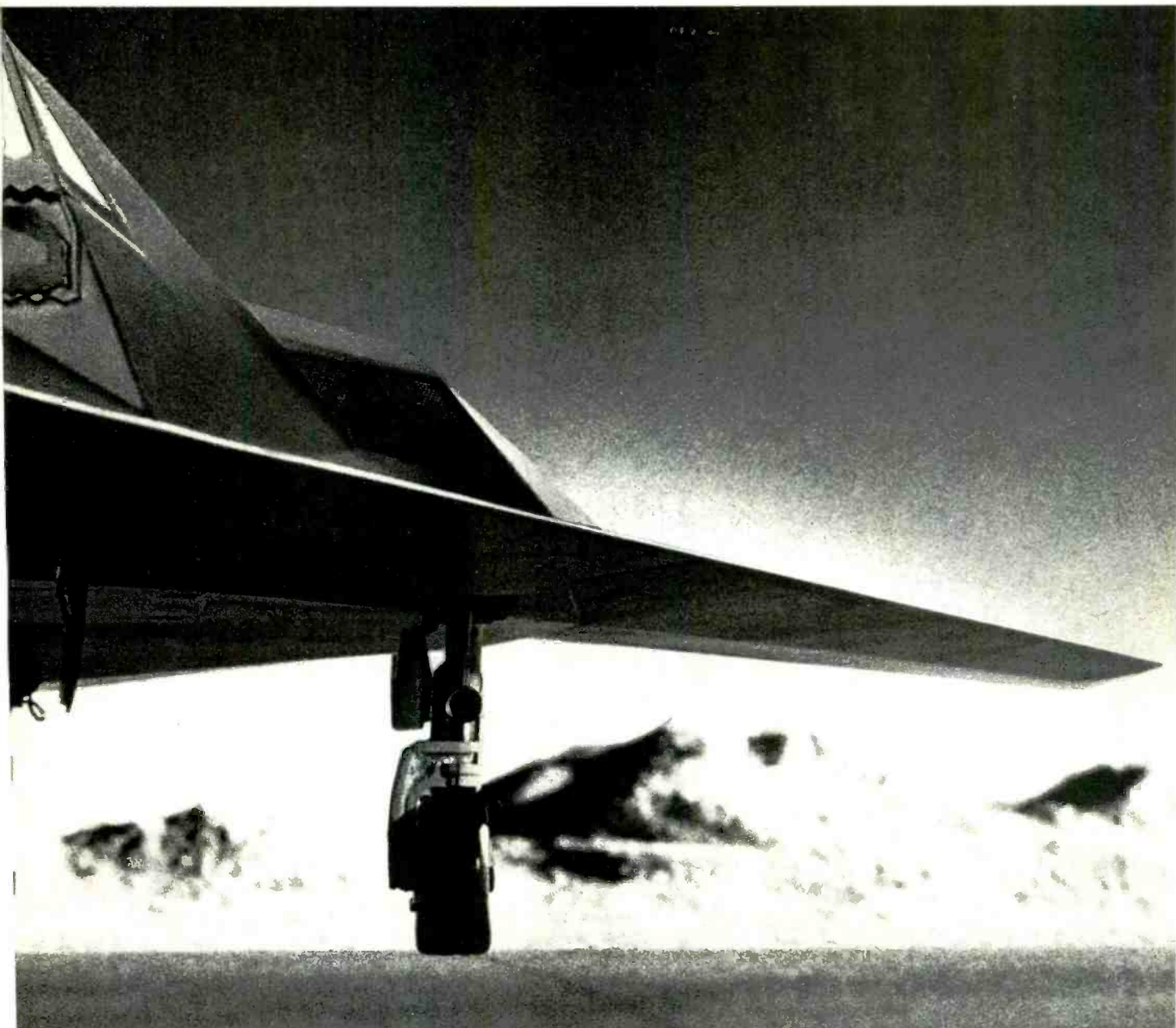
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Inside, the tape is formulated

with Black Magnetite—a higher energy magnetic material harnessed by Maxell engineers.

It contributes to the sound *CD Review* magazine described like this: "Bass response that doesn't stop, staggering dynamics, real music." And in their review of Type II tapes, they



THE SMALLER THE WINDOWS.

rated XLII-S, "Head, shoulders and torso above the rest."

Of course, an XLII-S cassette is going to cost you more than one with big, low-performance windows and matching sound.

But not so much more that you have to go to Congress for it.



TAKE YOUR MUSIC TO THE MAX.

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The ABCs



Of DCC

LEONARD FELDMAN

In the September 1991 issue of *Audio*, David Ranada explored the principles of Precision Adaptive Sub-Band Coding (PASC), a form of low bit-rate coding that Philips, Tandy/Radio Shack, and Matsushita (the parent of Technics and Panasonic), among others will be applying to the Digital Compact Cassette (DCC). While the psychoacoustic principles of that high-efficiency system were fully explored in the article, little information has been available about various physical parameters of the DCC system.

These digital cassettes, whether blank or prerecorded, have the same length and width as the more familiar analog cassette tapes, as shown in Fig. 1. The DCC shell is narrower than an analog cassette shell, however,

70-micron portion of each track width. This makes transport accuracy less critical, reducing the possibility of mis-tracking even when playing back tapes made on another DCC recorder. A ninth, auxiliary, track is used in each sector. This track contains control information as well as other non-audio data. To handle the narrow track pitch of 195 microns (185 microns for the actual track and 10 microns of spacing between the tracks), DCC machines will use precision record/play heads fabricated using thin-film technology. This technology is similar to the lithographic processes used in the manufacture of large-scale integrated circuits (LSIs). During recording, new digital data is simply overwritten, so no separate erase head is needed.

measurements & mechanics

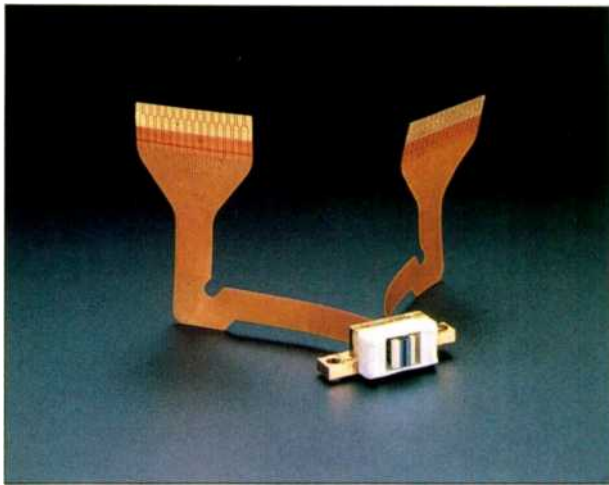
since the top of the shell is flat and doesn't have the "step" found in an analog cassette shell. A DCC has hub holes that are accessible only from the underside, so, unlike analog cassettes, you do not flip a DCC over when Side A has been recorded or played to access Side B. Furthermore, a sliding metal shutter covers the DCC's hub holes and tape, protecting the tape against dust, dirt, fingerprints, and tape slack. The sliding metal shutter operates in much the same way as the shutter on a 3½-inch floppy disk used in computers.

As is apparent from Fig. 2, DCC tape is divided into an upper sector and a lower sector, corresponding to the familiar Side-A and Side-B layout of an analog tape. During recording, eight tracks are laid down, each only 185 microns in width, whereas during playback, the DCC tape head reads only a

Compatible Head Configuration

The track diagram of Fig. 3 is for a DCC head configuration. In addition to the nine tracks for recording and playback of DCC tapes, a wider left and right pair of tracks is provided at the lower portion of the thin-film head for playback of conventional analog cassettes. It is this configuration that provides for the backward compatibility that is an important feature of the DCC format. The DCC standard, as formulated by its co-developers, does not specifically exclude the possibility of some manufacturer offering a DCC recorder/player that will also be able to record analog cassettes. At the moment, however, it appears that all first-generation DCC recorder/players will offer digital record and play capability but only play capability for analog.

ILLUSTRATION: VICTORIA KANN



Technics fixed twin head for DCC, with flat, printed-circuit cables for connection to record and playback circuits.



Except for the new head block and DCC detection sensors, DCC transports can be much like those in analog cassette decks.



Because DCCs can only be inserted in recorders and players one way, it is necessary that some form of auto-reverse mechanism be used in DCC machines. For bidirectional operation, two types of head configurations are possible. A turnover head, containing a nine-track upper section and a two-track lower section, such as that shown at the right side of Fig. 4, could be mounted to a rotatable mechanism. Alternatively, a fixed twin head could be used, such as that illustrated at the left of Fig. 4. Such a twin-head arrangement has actually been developed by Technics and a photograph of the pro-

TOTYPE head is shown. Details of the thin-film head construction of a single, rotatable head are shown in Fig. 5.

Besides the thin-film head, a DCC mechanism must provide for movement of the metal shutter and recognition of the ID holes of Digital Compact Cassettes. And, of course, it must also accept analog cassettes. It must be bidirectional and able to reverse tape direction in response to a command from a built-in microprocessor. Except for the new head block and the DCC detection sensors, tape transports used in DCC machines can be pretty much the same as those used in better quality analog cassette decks.

New DCC Functions

Besides the excellent sound quality that DCC will offer (more on that later), DCC offers several additional features not available with analog cassettes. For example, in DCC, approximately 400 characters per second of text data can be retrieved during playback. This is more than enough to display the complete lyrics of songs and album notes, not to mention simple graphics. Stored text data can be displayed on an LCD screen built right into the DCC recorder/player or on a TV screen, and several levels of data display are optional. The most basic level, which all prerecorded DCC tapes will include, has 12 characters by one line for display of album title and song titles. Depending on the tape, other levels could be 40 characters by two lines, or 40 characters by 21 lines for such information as performers, composers, history of the song or selection, or lyrics.

Table of contents (TOC) and other subcode information will allow for the same kind of access convenience found in CD and DAT machines. A user will be able to program a DCC machine to play desired songs in any order. Direct access, repeat, music scan, and other familiar facilities can be easily implemented. Absolute-address and TOC data will allow DCC decks to find and access any desired position on the tape reliably and precisely. Of particular interest is the ability to record ID markers that will make the DCC machine automatically skip over undesired portions of the tape—a kind of soft editing. Similarly, a "home" marker can tell a DCC machine to rewind or reverse direction before it reaches the physical end of a tape. How many of these convenience features will be implemented in DCC machines will, of course, depend on the manufacturer of the machine and its price category.

Fig. 1— Comparison of DCC and analog cassette shells and track patterns.

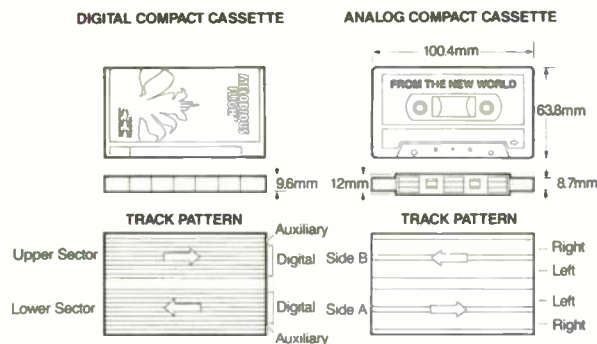


Fig. 2— Digital track layout of DCC. Dimensions are in microns.

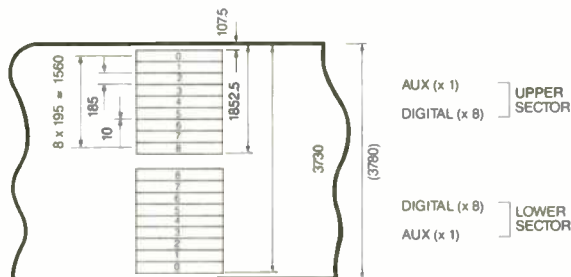


Table I illustrates the functional differences between prerecorded music tapes and home-recorded tapes. Notice that two levels of features will be available for home DCC recording, depending on the quality and cost level of the machine used. For the machines categorized as suitable for the "super user," such table-of-contents features as track number, track time, and absolute time would be recordable and other TOC recording capability might be made optionally available. In simpler, less expensive DCC recorders, such recordable features would normally not be available.

As is true of all digital audio recording media, such as CD and DAT, the DCC standards will incorporate powerful error-correction capability. Of the total data rate of 768 kilobits per second of PASC-encoded audio information (assuming an original sampling rate of 48 kHz), fully 50% is devoted to redundant information that can be called on when error correction is required. The now-familiar Reed-Solomon error-correction scheme is used, and data is distributed amongst the eight data tracks in such a manner that large amounts of data can be lost to burst dropouts without affecting or altering musical reproduction quality during playback. Figure 6 illustrates just how much data can be missing. In fact, one entire track of the eight tracks used in the DCC system can be missing without affecting playback reproduction. If additional tracks are involved, the length of burst error it's possible to correct decreases as the number of tracks containing the error is increased. For example, as shown in Fig. 6, if the burst error involves as many as four track widths, full error correction can take place for a burst error lasting as long as 58 mS, corresponding to a tape length of 2.8 mm.

Objective Versus Subjective Evaluations of DCC

Because of the nature of DCC encoding and decoding, the usual single-tone tests of DCC recorders will not yield as meaningful results as would similar tests on linear digital systems. As explained earlier, the PASC-encoding system assigns bits on a priority basis. Thus, if a single tone is recorded, for example, there will be enough bits in the bit pool to encode that tone in a fully linear manner, with no data reduction whatsoever. In fact, there would be ample bits left over during such a test recording. The same would hold true even if twin-tone intermodulation distortion testing were attempted.

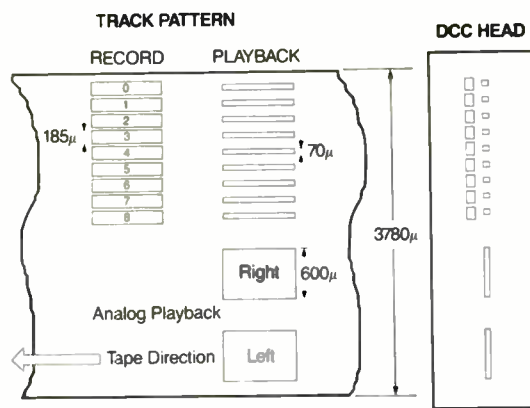


Fig. 3—Track layout for analog-compatible DCC head, showing both digital record/play and analog gap widths and positions.

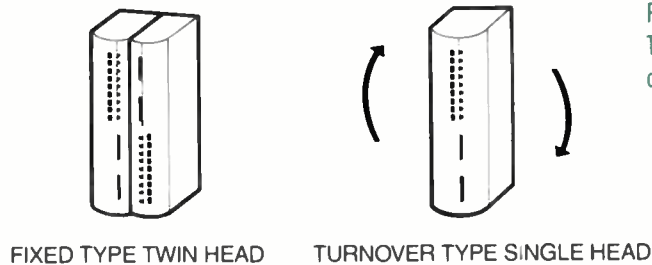


Fig. 4—Two DCC auto-reverse configurations.

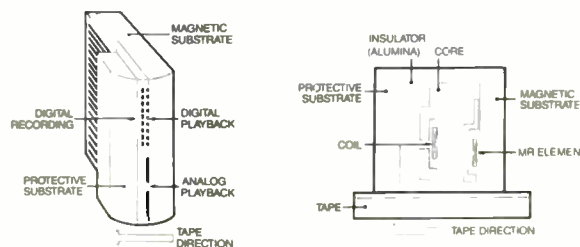


Fig. 5—Structure of single, turnover head for DCC record/play and analog playback, showing front and top views.

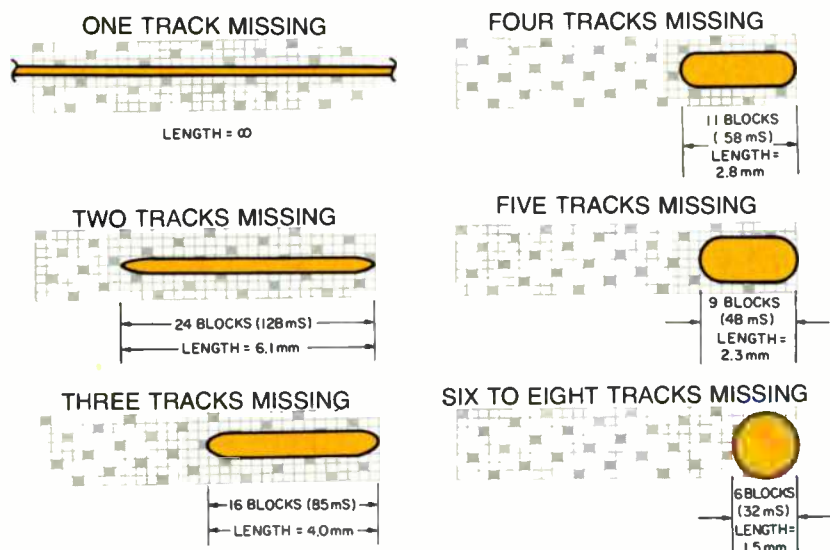


Fig. 6—How the length of a correctable DCC burst error varies with the number of tracks affected. The area shown represents one "frame" of the recording (32 blocks, or 170 mS), covering a bit

less than half the tape area. The control track (not shown) would be above these tracks. Shaded blocks contain parity information for error correction.



□
A DCC tape's "cover" is its flat, decorated top, visible through its slipcase (rear). A sliding cover protects the tape and hubs (left).

□
 The DCC format provides for the input of 18-bit data, so conceivably DCC might someday sound better than CD and DAT.

Accordingly, while such tests will no doubt continue to be performed by reviewers, including me, their significance will be considerably reduced. The more meaningful evaluations of DCC recorders and recordings will require more subjective testing than objective, quantified testing.

Such subjective evaluations were, in fact, conducted during a recent visit by hi-fi writers to Technics headquarters in Osaka, Japan. There I listened to a wide variety of musical fare. Technics personnel had on hand a complete PASC encoder/decoder combination. A switch enabled us to compare sound reproduced directly from CD sources

versus the same musical material fed through the PASC encoding and decoding process in real time. Care was taken to add a short time delay to the direct, non-PASC, signal path, so both the direct and PASC signals would remain perfectly synchronized, but the switching between the direct and PASC encode/decode modes was not a "double blind" test. Most of the listeners at these sessions were experienced enough to judge sound quality without being prejudiced by knowing which sound source was which, even with the less-than-optimum room acoustics that existed. Several times, I detected a minimal difference in sound quality between the DCC equivalent (PASC encoded and decoded) version and the direct-from-CD version. There were also several musical selections during which I could detect no difference in sound quality between the PASC/DCC equivalent and the direct-from-CD sounds. In any case, I must emphasize that even those times when I did hear a difference, I could not honestly say which sounds were "better" or more faithful in musical terms.

I have no doubt that debates will abound once DCC hardware and software become available. I will say this about DCC even at this early stage, however: The sound quality I heard, as well as the dynamic range and signal-to-noise ratios inherent in music reproduced via DCC certainly surpassed what I've heard from even high-end cassette decks with Dolby B and C noise reduction. And after all, DCC is intended as an ultimate replacement for the analog cassette and not as a substitute for CD or, for that matter, DAT, which is likely to remain the recording medium of choice for professional applications and for audiophile purists who insist on nothing less than the ultimate.

Interestingly, however, DCC standards make a provision for inputting signals that have 18-bit resolution. Since CD and DAT standards limit signal resolution to 16 bits, it is even conceivable that at some time in the future we may actually encounter DCC recordings that sound noticeably and unarguably better than some CDs. It would be ironic if those audio purists who disparaged Compact Discs when they were first introduced would ultimately embrace a recording format that eliminates three-fourths of the data that would have been needed to capture all of the sound of an audio program in a traditional manner. ▲

(Editor's Note: The line drawings in this article are courtesy of Technics.—E.P.)

TABLE I
FUNCTIONS AVAILABLE ON EACH DCC RECORDING TYPE.

Data Type	Type of Recording		
	Prerecorded Music	Home-Recorded	
		Ordinary	Super-User
TABLE OF CONTENTS			
TOC Location	Throughout tape	—	Beginning of tape
Track Number	Prerecorded	No	Recordable
Track Time	Prerecorded	No	Recordable
Absolute Time	Prerecorded	No	Recordable
Index Number	Prerecorded	No	No
Chapter Number	Prerecorded	Optional	Optional
Remaining Track Time	Prerecorded	No	No
Remaining Tape Time	Prerecorded	No	No
Other TOC Data	Prerecorded	No	Optional
MARKER			
Start Marker	Prerecorded	Recordable	Recordable
Reverse Marker	Prerecorded	Recordable	Recordable
Other Markers	Prerecorded	No	No
TEXT INFORMATION			
Data Recording	Prerecorded	No	Optional
Data Copying	Cannot be home-copied	No	Optional
AUDIO CHANNEL			
Two-Channel Stereo	Yes	Yes	Yes
Two-Channel Mono	Yes	No	No

YOU'VE LITERALLY NEVER SEEN OR HEARD
ANYTHING LIKE IT.

IT PLAYS MOVIES, CONCERTS AND EDUCATIONAL PROGRAMS ON
LASERDISC WITH STUNNING PICTURE CLARITY AND CD SOUND.

IT ALSO LETS YOU PLAY AND PROGRAM *FIVE* CDs.

INTRODUCING THE WORLD'S FIRST 5-CD/LASERDISC PLAYER,
THE CLD-M90 FROM PIONEER.

FIVE HOURS OF CDs. TWO HOURS OF LASERDISC.
ZERO BOREDOM.

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The Art of Entertainment



CLD-M90 5-CD/LaserDisc Player

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ATWATER KENT MUSEUM

TUNING IN TO YESTERDAY

Vintage Sets from the
Golden Age of Broadcasting





"Sit back, relax . . . turn on your imagination, and pull your easy chair closer to the Atwater Kent's tapestry-covered speaker." These words were heard nightly in 38 states as Gary Hodgson introduced his show *Radio Classics* on clear-channel WCAU-AM in Philadelphia. (The program ended when the station changed hands in 1990.) Hodgson's loyal fans, scattered throughout the eastern and central states, demonstrated that people of all ages are discovering or rediscovering the magic of early radio. I especially enjoyed his rebroadcasts of radio drama, and I learned that the "picture" was much better on radio than on television because it was in my mind. Of course, audiophiles know

that listening to radio or recordings permits you to do useful tasks at the same time, thus preventing you from becoming a tube turnip.

Hodgson promoted and participated in a splendid exhibit of early radio receivers at the Atwater Kent Museum in Philadelphia. The exhibit honored the 50th anniversary of the museum's founding by radio magnate A. Atwater Kent, as well as 48 years of service by his son A. Atwater Kent, Jr., as its founding president and later president emeritus. This is Philadelphia's history museum, and radios usually account for only a small portion of the items on display, but they were the stars of *Tune In*—

Jon R. Sank



Photographs: Dave King

☀

ATWATER KENT MUSEUM



Philco Neutrodyne Model 512 with Speaker Model 214 (1928)
A seven-tube, a.c.-powered TRF receiver. It was made in Philco's first year of radio production and cost \$125.
 COURTESY OF RALPH AND ELINOR WILLIAMS.



Philco Model 81 (1933)
A four-tube superbheterodyne receiver. Designed for low cost because of the Depression, it sold for about \$25. Seventy percent of the radios sold in 1935 were of this "cathedral" style.
 COURTESY OF BILL AND CAROL DIGEL.



Atwater Kent Model 40 with Speaker Model E (1928)
A seven-tube TRF receiver, made during AK's most productive period. This metal-cased unit sold for \$77 (without tubes).
 COURTESY OF ATWATER KENT FOUNDATION.



Philadelphia Radio, 1920-1950. Although the exhibit included some memorabilia from local broadcasting stations, most of the items were radio receivers from the '20s, '30s, and '40s.

At that time, Philadelphia was a world center for radio manufacturing. From 1927 to 1928, the Atwater Kent Co. sold one million sets, becoming the world's largest maker of radios. Philco, also based in Philadelphia, made only batteries for radios until 1928, when it first made its own sets, selling 96,000. Just across the Delaware River in Camden, New Jersey, RCA took over



Atwater Kent Model 3925 (1922)
AK's first factory-wired receiver in the "breadboard" style, selling for \$52. (Prior sets were sold as components and wired by the buyer.) The two-tube unit, with an r.f. amp and a detector/audio amp, required a battery as well as headphones. The buyer added a vario-coupler to make it a regenerative circuit, thus saving AK from infringing on the Armstrong-RCA patent.
 COURTESY OF RALPH AND ELINOR WILLIAMS.

RCA Aeriola Senior (1921)
One of the most popular sets, made by Westinghouse for RCA and costing \$65. This one-tube, battery-powered regenerative receiver required headphones.
 COURTESY OF RALPH AND ELINOR WILLIAMS.





Grebe Synchrophase (1925)
A five-tube TRF set, costing \$155. It was battery-powered but worked with a speaker. The name reflected a popular interest in new technology.
 COURTESY OF BILL AND JANE DENK.



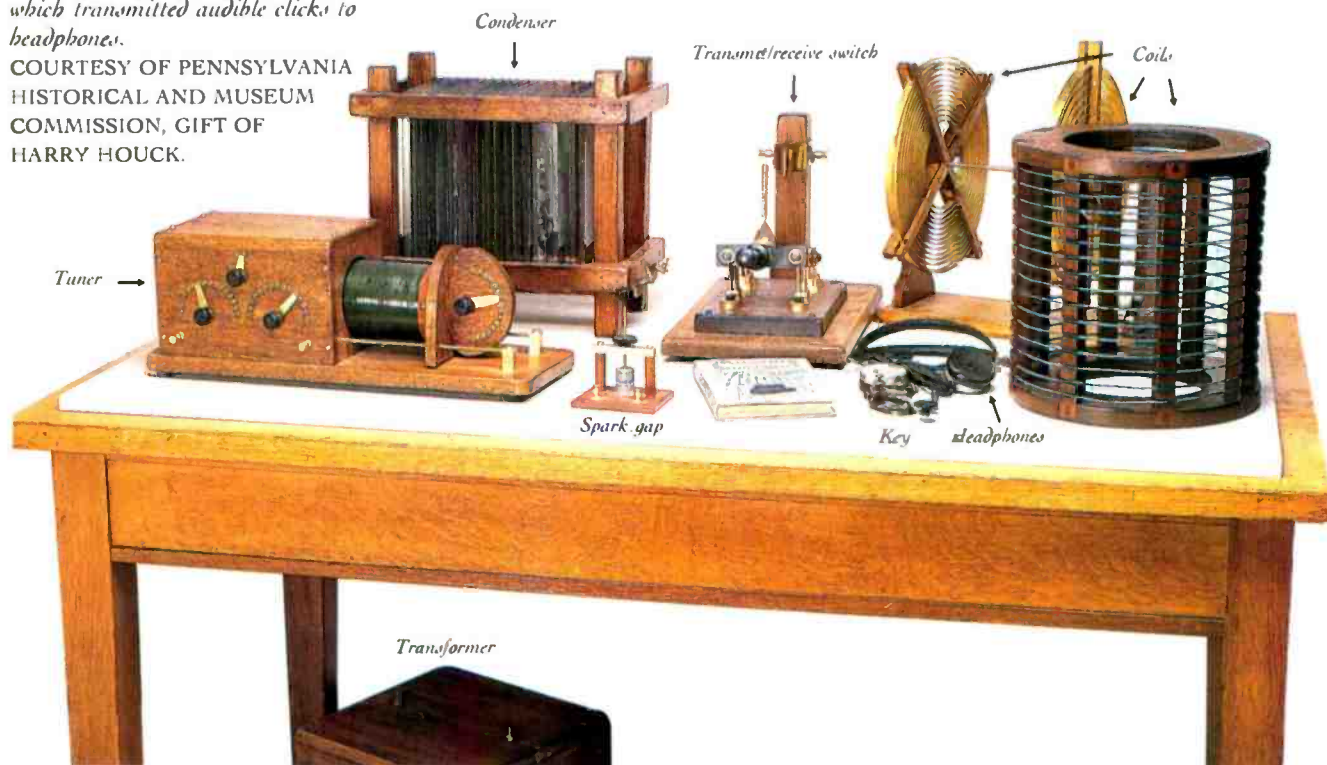
Spark-gap transmitter and receiver (1909)

Made by 13-year-old Harry Houck, this apparatus sent and received Morse code (CW) signals only. When connected to a battery, the telegraph key and the high-voltage transformer caused a spark to jump the gap when the key was released. The r.f. component of this energy was tuned by the coils and condenser and then radiated by an antenna. A distant antenna was connected to the tuner and a crystal detector, which transmitted audible clicks to headphones.

COURTESY OF PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION, GIFT OF HARRY HOUCK.

the Victor Talking Machine Co. plant in 1929 and began manufacturing radios itself, whereas before they had been built for RCA by Westinghouse and General Electric.

RCA held inventor Edwin H. Armstrong's patents for the superheterodyne and regenerative receivers in the 1920s (the company also had a monopoly on vacuum tubes until 1927). So Atwater Kent, Philco, and other competitors initially had to make tuned radio frequency (TRF) receivers. (The TRF circuit lacked selectivity but could offer higher audio fidelity than the super-





RCA Radiola 60 with Model 103 Speaker (1928), shown with Atwater Kent Doublet Antenna Kit Type D (c. 1927)

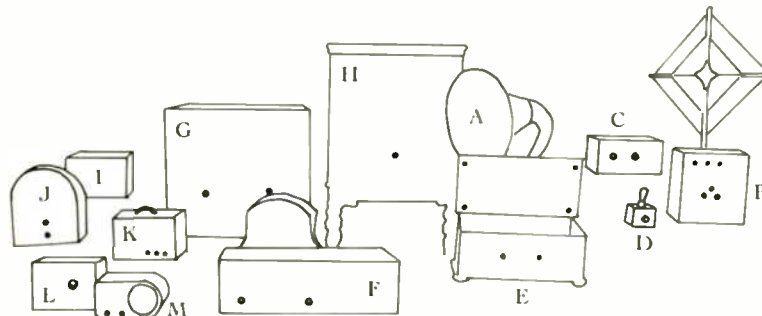
The first superheterodyne receiver powered by a.c., costing \$147. This nine-tube set used the newly developed RCA heater-cathode tube (Type 27), which reduced audio hum.

RADIO AND SPEAKER COURTESY OF RALPH AND ELINOR WILLIAMS. ANTENNA KIT COURTESY OF ATWATER KENT MUSEUM.

het.) To compete with the more advanced superhet circuit, the TRF sets had various high-tech-sounding names, such as Neutrodyne, Synchronphase, and Radiodyne.

After the museum exhibit closed but prior to its dismantling, *Audio* was granted the privilege of photographing the display. The pictures here show the most popular radios of the Golden Age of Broadcasting, each representing an important milestone in the history of its manufacturer. (The notable exception is the one-of-a-kind spark-gap transmitter/receiver.)

I am indebted to the Atwater Kent Museum and to Curator of Exhibits John Mayer for providing detailed information on the exhibit, as well as to the owners and donors of the radios for permitting us to photograph their precious antiques. A



The changing face of radio receivers, 1921 to 1941 (see opening pages)

- A. *Magnavox R-2 horn speaker* (c. 1921). COURTESY OF DELAWARE COUNTY INSTITUTE OF SCIENCE, JOHN WORK COLLECTIONS.
- B. *DeForest D-10* (1922). COURTESY OF PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION.
- C. *Transcontinental/Gimbel Brothers Type ZR-4* (1924). COURTESY OF RALPH AND ELINOR WILLIAMS.
- D. *Crosley single-tube Pup* (1925). COURTESY OF BILL AND JANE DENK.
- E. *Grebe Synchronphase* (1925; see separate photo).
- F. *RCA Radiola 17 with matching Model 100A speaker* (1927). COURTESY OF RALPH AND ELINOR WILLIAMS.

- G. *Atwater Kent Model 44 "bigboy" in Red Lion cabinet* (1928). COURTESY OF RALPH AND ELINOR WILLIAMS.
- H. *Philco Model 95 "bigboy"* (1929). COURTESY OF BILL AND JANE DENK.
- I. *Atwater Kent Model 275* (c. 1955). COURTESY OF RALPH AND ELINOR WILLIAMS.
- J. *RCA Victor Model 4-T "cathedral"-style set* (c. 1955). COURTESY OF BILL AND JANE DENK.
- K. *Philco Model 40-125* (c. 1959). COURTESY OF ATWATER KENT MUSEUM, ESTATE OF ROBERT C. ALEXANDER.
- L. *RCA Model 75X18* (c. 1940). COURTESY OF RALPH AND ELINOR WILLIAMS.
- M. *F.A.D. Andrea Model 1000 with Art Deco design and plastic case* (1941). COURTESY OF BILL AND CAROL DIGEL.

Atwater Kent Model 10 with Model L Speaker (1923) AK's most popular "breadboard"-style radio, a five-tube, battery-powered, factory-wired set. About 15,000 sold at \$57.50 each. The Model 30 (background) was similar but had ganged condensers and was housed in a cabinet.

MODEL 10 COURTESY OF ATWATER KENT MUSEUM, GIFT OF PAUL CLAPFFER IN MEMORY OF FRANK LUDTKA. MODEL L COURTESY OF ATWATER KENT FOUNDATION. MODEL 30 COURTESY OF RALPH AND ELINOR WILLIAMS.



Stromberg-Carlson Model 420R (1939) A typical console radio, featuring AM and short-wave bands. COURTESY OF ATWATER KENT MUSEUM, GIFT OF JOSEPH DERRY.



Perhaps you got a chemistry set instead of a pony on your birthday. Or had to share a room through those crucial formative years.

Take heart. You can now own an automobile that gives you just what you want.

The Lexus Coupe.

Its smooth, flowing lines can turn even the most

If You

stubborn of heads. And the 32-valve V8 engine can turn those heads very quickly indeed. There's also a racing-inspired suspension system to help straighten curves.

But performance isn't the only focus. The Coupe is, after all, a Lexus.

The seats are studies



**Lexus/Nakamichi Premium Sound System and 12-CD auto-changer are optional.*



Weren't Spoiled As A Child, Here's A Second Chance.

in advanced ergonomics wrapped in supple leather. The trim is fine Bird's-Eye Maple. Even your ears are indulged; there is a seven-speaker Nakamichi sound

system* that brings your favorite CDs remarkably to life.

In fact, the Coupe pampers you as few automobiles can. And it has a lot more horsepower than a pony.


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1

NAKAMICHI 1000mb CD TRANSPORT AND 1000p DIGITAL PROCESSOR

Manufacturer's Specifications

CD Transport

Disc Capacity: Seven.

Digital Outputs: Optical and 75-ohm coaxial.

Power Requirements: 110 to 127 V, 50/60 Hz, 23 watts maximum.

Dimensions: Transport, 17 $\frac{1}{8}$ in. W \times 5 $\frac{1}{4}$ in. H \times 14 $\frac{1}{8}$ in. D (43.5 cm \times 13.3 cm \times 37 cm); remote control, 12 $\frac{1}{16}$ in. W \times 1 $\frac{3}{4}$ in. H \times 4 $\frac{7}{8}$ in. D (30.7 cm \times 4.4 cm \times 12.4 cm).

Weight: Transport, 35 $\frac{1}{4}$ lbs. (16 kg); remote control, 2 lbs. (0.92 kg) including two AA batteries.

D/A Converter

Sampling Frequencies: 48, 44.1, and 32 kHz.

Frequency Response: 0 Hz to 20 kHz, \pm 0.5 dB, for 44.1-kHz sampling.

S/N: Greater than 106 dB for 44.1-kHz sampling.

Dynamic Range: Greater than 100 dB for 44.1-kHz sampling.

THD: 0.0005% for 44.1-kHz sampling.

THD + N: 0.002%, from 20 Hz to 20 kHz, for 44.1-kHz sampling.

Channel Separation: Greater than 106 dB for 44.1-kHz sampling.

Digital Inputs: Three; switch-selectable optical or 75-ohm coaxial.

Analog Output Levels: Fixed, 2 V; variable, 2 V maximum.

Analog Output Impedances: Unbalanced, 1 kilohm; balanced, 100 ohms.

Headphone Output: 40 ohms, 100 mW maximum.

Power Requirements: 110 to 120 V, 50/60 Hz, 70 watts maximum.

Dimensions: 17 $\frac{1}{8}$ in. W \times 5 $\frac{1}{4}$ in. H \times 14 $\frac{1}{2}$ in. D (43.5 cm \times 13.3 cm \times 37 cm).

Weight: 38 lbs., 9 oz. (17.5 kg).

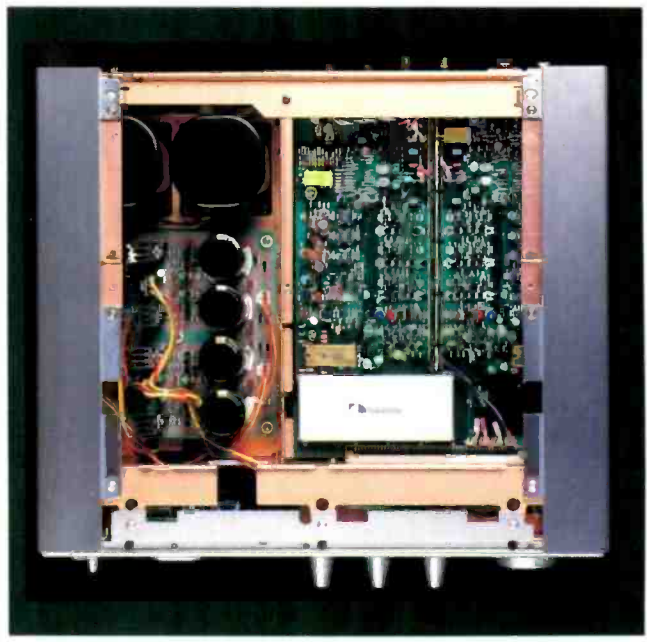
General Specifications

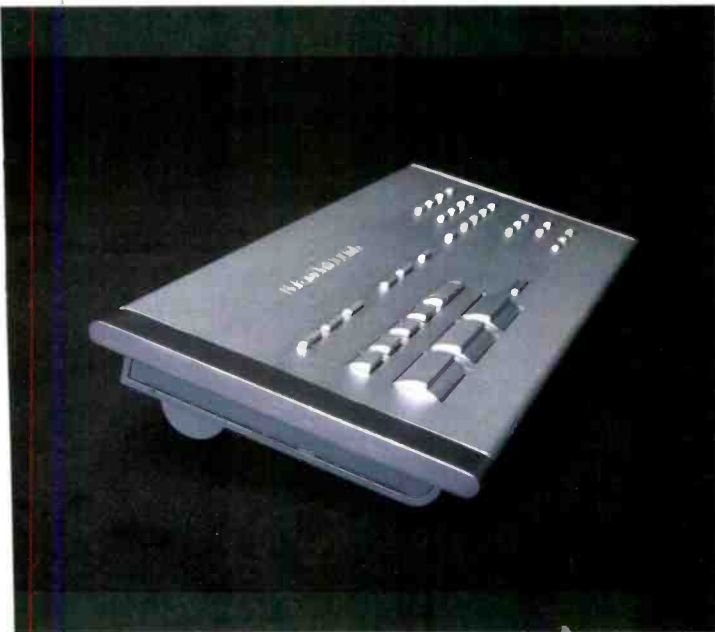
Prices: 1000mb transport, \$6,000; 1000p processor, \$6,000; DA-111p D/A board for earlier 1000p processors, \$1,400.

Company Address: 19701 South Vermont Ave., Torrance, Cal. 90502. For literature, circle No. 90

Nakamichi, let me state at the outset, does not assign a "1000" model number to its products lightly. The company reserves this designation for components it believes will become standards of comparison within the industry. Their 1000 DAT recording system, which I reported on in the November 1989 issue, consisted of a DAT transport/recorder and a separate digital audio processor. That processor, the 1000p, had both A/D encoding and D/A encoding at the standard digital audio frequencies (32, 44.1, and 48 kHz) plus input and output facilities to handle several digital transports. Now Nakamichi has come up with the 1000mb, a state-of-the-art CD transport and changer to go with the processor, and the DA-111p, an upgrade D/A converter board that plugs right into the original 1000p.

As a component with only digital outputs, the 1000mb CD transport can, of course, be used with any D/A converter. Several of its features are worth mentioning in some detail. Nakamichi has developed an acoustic isolation system that takes care of airborne vibration as well as vibrations that occur internally. The unit's main chassis is formed of extruded aluminum encapsulated by a thick external shell to form an extremely rigid structure. This structure is hermetically sealed by filling all joints with a special compound. Another isolating feature is the 9-mm-thick aluminum door which





hides the disc tray. The door opens automatically when a disc is ejected, but it must be closed manually to assure an airtight seal.

Thus sealed, the enclosure could become a resonant chamber, reinforcing internal vibrations. Nakamichi addresses this problem by reducing the amount of vibration generated and by isolating it from sensitive components.

To cut down on grinding vibration, the 1000mb uses a brushless, slotless drive motor whose shaft is extra-long and is supported by dual bearings. To prevent vibration from the disc itself (especially if the disc is slightly warped), the transport clamps the CD with a large-diameter stabilizer made of an anti-resonant crystal polymer.

For isolation, the pickup is mounted to the mechanism by a vibration-attenuating base of die-cast zinc, isolated by a rubber bushing. The subchassis that holds the mechanism is then floated off the main chassis by coil springs (cone-shaped to prevent lateral displacement) and rubber dampers. The power transformer is also isolated from the mechanism to block potential vibration from that source.

The 1000mb incorporates Nakamichi's MusicBank 6+1 changer system, which requires no separate disc cartridges. A single disc is loaded in the slot, as with any conventional player, but up to six more discs can be load-

Nakamichi's redesigned D/A converter board replaces 30 ICs with one LSI chip, then adds an all-discrete audio stage.

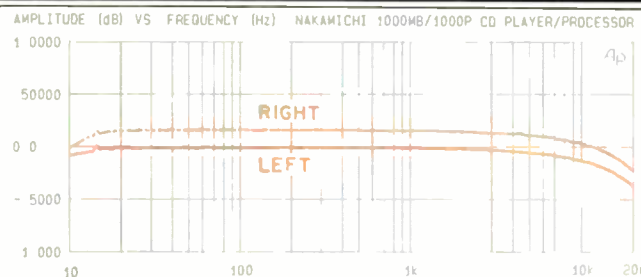


Fig. 1—Combined frequency response of transport and processor.

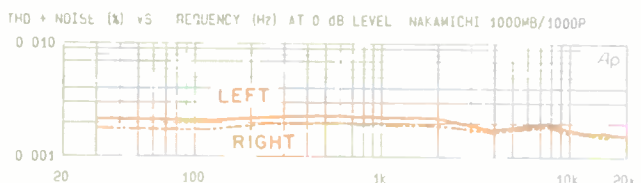


Fig. 2—THD + N vs. frequency at 0-dB recorded level.

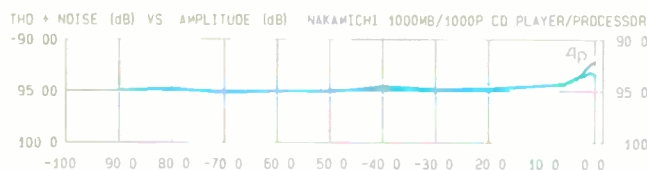


Fig. 3—THD + N vs. recorded level for 1-kHz signal.

ed—and all seven CDs can be quickly accessed for programmed or random play.

Other features include random play of all discs or a single disc, disc scan, recording synchronization (with compatible Nakamichi analog or digital recorders), a System Remote link to other Nakamichi components, Time Data memory (which stores the track numbers and timings of all seven discs), repeat play, and memory play. Both optical and gold-plated coaxial digital outputs are provided. The rather large, full-function wireless remote control (similar in size and appearance to the 1000 DAT recorder's) handles all operating functions of the transport. Rather surprisingly, however, neither the front panel nor the remote offers access to index points on discs containing index coding.

I'm not going to go into a great deal of detail about the 1000p digital processor since its functions, inputs, and outputs are identical to those of the unit described in my report on the Nakamichi 1000 DAT recorder. What is new is the DA-111p upgrade board developed as a replacement for the processor's original D/A converter, the DA-101p. Like the earlier board, the DA-111p uses Nakamichi's calibration-ROM, 20-bit D/A conversion technique, which the company feels is superior to the recently popularized one-bit

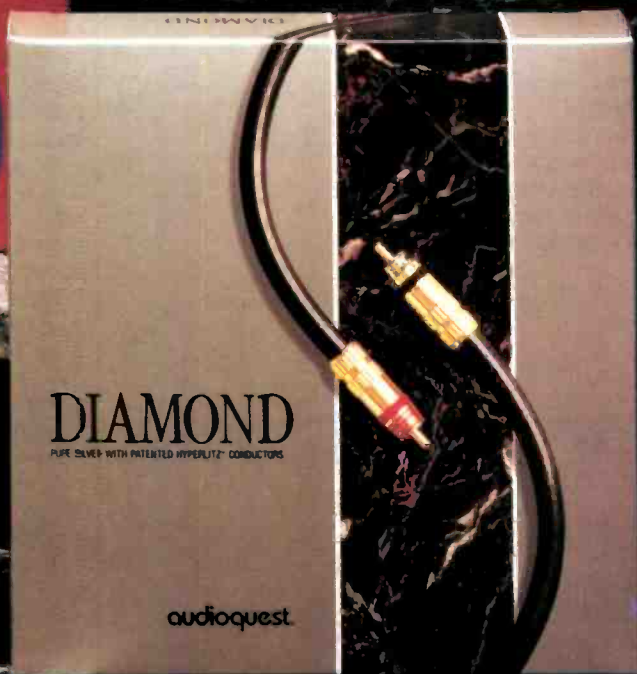
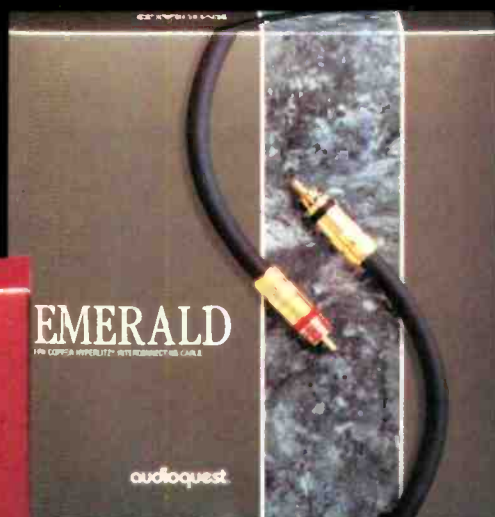
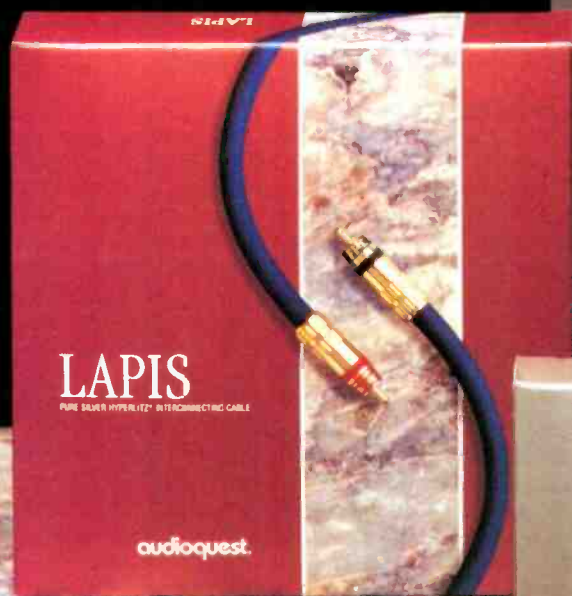
noise-shaping designs. In the Nakamichi system, D/A conversion errors are compensated with the aid of read-only memory (ROM) chips preprogrammed with error data for the individual D/A converter chips used. The outputs of the main signal converter and the compensation converter are digitally summed. Music's information density being as high as it is, this computation must be performed at extremely high speed, which required approximately 30 ICs in the digital summation stage of the original D/A board! This created difficulties with "real estate" and power consumption, and risked generating excessive digital noise. Nakamichi solved this problem in the DA-111p by using a new programmable LSI chip to replace the 30-odd ICs. This design, intended to eliminate the digital noise at its source, also reduced by a factor of four the area occupied by the digital circuitry. The extra space is used for an analog output stage of discrete components rather than IC op-amps.

Control Layout

On the 1000mb's front panel, the "Power" pushbutton and "Eject/Load" button are to the left of the disc door. A two-section display to the right shows disc number and track in one window and time and memory number in the other. The displays are static matrix types, which are non-pulsating and do not generate switching noise. A row of five buttons beneath the displays handles disc selection, forward and reverse track skipping, and storing of multiple discs. Three larger buttons below these are for "Stop," "Play," and "Pause."

All additional user functions are handled via the remote control, including programming, direct track access, random and repeat play, disc scanning, and direct selection of disc numbers when in the multiple-disc mode. A "Time/T. Edit" button, when pressed successively, alters the display from elapsed disc time to remaining playing time, total number of tracks and playing time, and elapsed track time. Another button on the remote, "Time Data," calls up a display of the number of tracks and total playing time of each of the discs loaded in the player. This display operates only when the transport is in "Stop" mode. The Time Edit function can be set to play only those tracks that will fit a given tape length. It also works in conjunction with the Synchro Recording feature when the transport's "Sync. Rec" jack is linked with that on a Nakamichi analog or digital tape deck. This jack, the "System Remote" jack, and the coaxial and optical digital outputs are on the rear panel.

The front panel of the Nakamichi 1000p digital processor remains as it was when I tested it as part of Nakamichi's 1000 DAT recording system. One or two DAT recorders plus the new CD transport can be hooked up to this processor, which sports peak-level meters with switchable peak hold, a headphone jack and its level control, an "Output Level" control, an "Analog/Digital" input selector, and buttons for selecting which input you want to monitor. While there are other controls on the panel, they relate to recording with a connected DAT recorder/transport rather than to the processor's use as a D/A converter. Optical and coaxial inputs and outputs for two DAT transports, plus optical and coaxial inputs for a CD transport, are mounted directly on the rear panel of the processor. One pair each of balanced and



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This is the first CD player I've ever measured whose THD + N, instead of rising with higher frequencies, actually went down a bit.

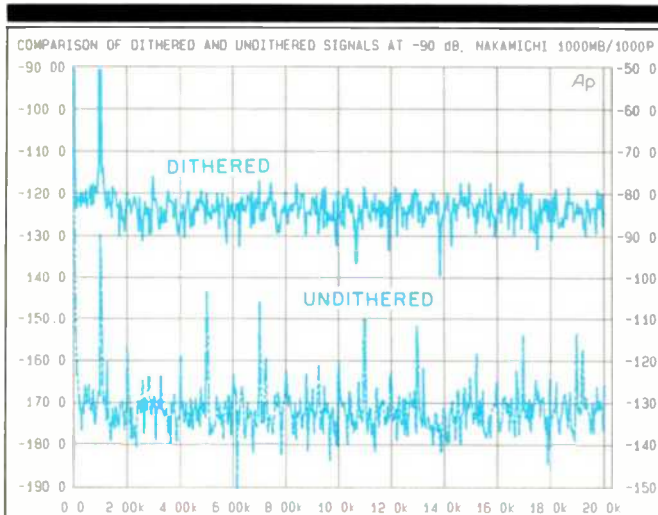


Fig. 4—Spectrum analysis of 1-kHz signals at -90 dB recorded level. Use left-hand scale for dithered signals, right-hand scale for undithered signals.

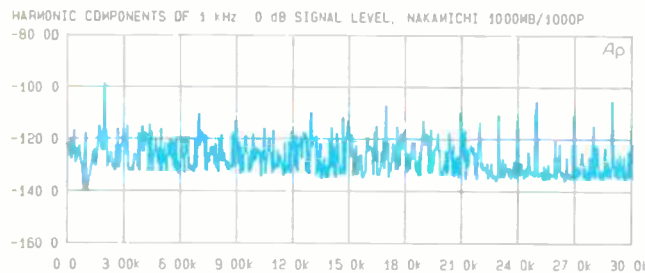


Fig. 5—Spectrum analysis of harmonics from 1-kHz signal at maximum recorded level.

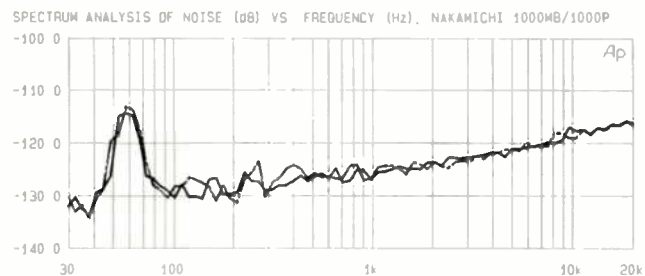


Fig. 6—Spectrum analysis of residual noise when playing "no-signal" track of CD-1 test disc; left channel is solid curve, right channel is dashed.

unbalanced inputs are on the A/D converter board, and the D/A board carries fixed- and variable-level unbalanced outputs plus balanced outputs that are switchable for fixed or variable operation. There is also a pair of unswitched a.c. outlets on the rear panel, one of which can be used for the power cord of the 1000mb CD transport.

Measurements

Most of my tests of this two-component system were the same ones I would have conducted with a one-piece player. In my first measurements, I was unable to detect any difference between the system's performance with a coaxial cable and with an optical link; I elected to use the optical hookup for the remaining tests. Figure 1 shows the combination's frequency response, using the swept-frequency track of my CBS CD-1 test disc. Channel imbalance amounts to no more than 0.2 dB, and response at 20 kHz is down a bit more than 0.3 dB.

Figure 2 shows how THD + N varied with frequency, for a signal recorded at maximum level. This is the first CD player I've ever tested whose THD + N, rather than rising at higher treble frequencies, actually diminished somewhat! Over most of the frequency spectrum, THD + N at 0 dB is approximately 0.002%, with little difference between left and right channels. At all but the highest recorded levels, the reading for THD + N at 1 kHz proves to be even lower, about 0.0018% (-95 dB), as shown by the plot in Fig. 3.

Figure 4 shows what the output looked like when I played signals recorded at -90 dB. In the lower curve, the signals were undithered, and while the noise floor hovers around the -130 dB level, harmonic and other spurious components are visible at many frequencies. Using dithered signals at the same low level, the overall noise floor rises somewhat (to around -120 or -125 dB), but the only trace of a true distortion component is the third harmonic, 3 kHz, which is 115 dB below maximum recorded level and hardly worth worrying about.

To separate the actual harmonic distortion from any residual noise for high-level (0-dB) signals, I ran a spectrum-analysis sweep up to 30 kHz for a 1-kHz test signal (Fig. 5). The only significant in-band distortion component is at 2 kHz (the second harmonic of the 1-kHz test signal). It is more than 98 dB below maximum recorded level, corresponding to an actual harmonic distortion figure of 0.00126%.

Signal-to-noise ratio for the combination of components measured 108 dB for the left channel and 107.9 dB for the right channel. A spectrum analysis of the noise content, using a third-octave bandwidth filter (Fig. 6), reveals that even the power-supply hum component, at 60 Hz, is at least 113 dB below maximum recorded level. Separation at 1 kHz is nearly 107 dB from the left channel to the right and nearly 106 dB from the right channel to the left. At 16 kHz, separation is still 82.5 and 84 dB for the left-to-right and right-to-left directions, respectively (Fig. 7).

Linearity is excellent, deviation from perfect linearity is negligible from 0 dB down to 80 dB below maximum recorded level, and deviation is just over 1 dB at -90 dB (Fig. 8). In order to explore behavior for even lower level signals, I used dithered signals from -70 to -100 dB, and deviation from perfect linearity is no more than 1.5 dB for either

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After literally banging on the transport while it played a CD, I agree with Nakamichi's claims about resistance to vibration.

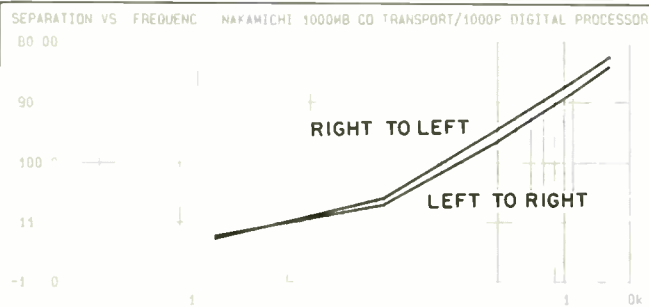


Fig. 7—Separation vs. frequency.

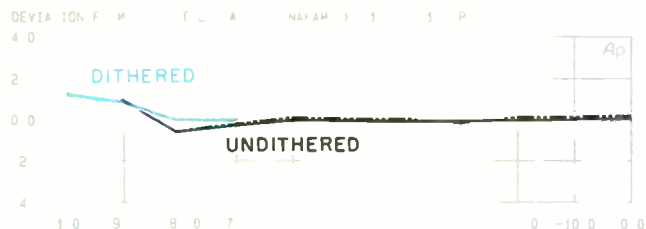


Fig. 8—Deviation from perfect linearity.

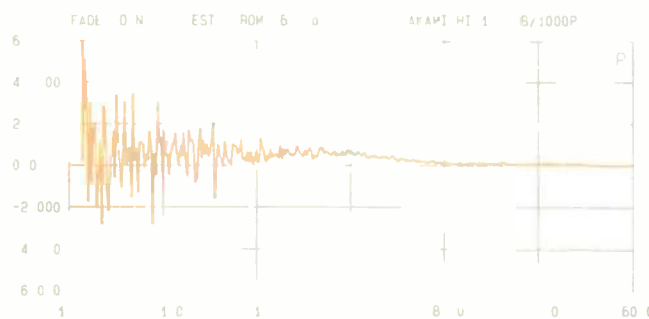


Fig. 9—Fade-to-noise test for dithered signal.

channel, as shown. Finally, I conducted the usual fade-to-noise test for a further evaluation of the linearity of this CD player combination. These results (Fig. 9) also enable me to derive the EIA dynamic range of the system, which was approximately 105 dB. Using the EIAJ method for calculating dynamic range, I came up with 99.3 dB for the left channel and 99.7 dB for the right, marginally short of the 100 dB claimed by the manufacturer. Frequency accuracy of the system was within 0.0049%, so even musicians or others endowed with perfect pitch would not be likely to detect any deviation from perfect pitch when listening to CDs played on this combination.

Since I was dealing with this combination as a CD player, I saw no reason to explore the A/D capabilities of the digital processor, particularly since those capabilities were covered in my earlier report on the Nakamichi 1000 DAT recorder system. Furthermore, the A/D section of the 1000p processor has not been changed; only the D/A circuitry has been upgraded since the introduction of that component in 1989. I did feel it would be interesting to check out the D/A converter section's frequency response, distortion, and linearity to see if the CD transport contributed anything but perfect transfer of digital data to the system.

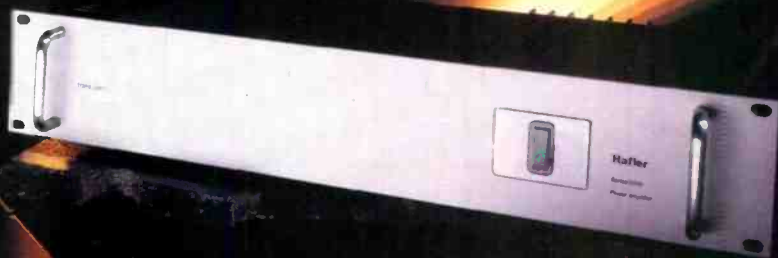
Figure 10, therefore, is a plot of frequency response obtained when the D/A converter was fed digital signals generated by my Audio Precision system rather than by a test CD. If you compare these results with those in Fig. 1, you'll see that they are virtually the same. By the same token, if you compare Fig. 2 with Fig. 11, you will see that the plots of THD + N versus frequency are virtually the same; even the slight difference between the channels' performance remains the same for both. As for linearity, it is hard to compare the results shown in Fig. 8 (deviation from perfect linearity) with those in Fig. 12 (output versus input), because my test system is not yet programmed to plot this test the same way for CD and self-generated signals. In Fig. 12's plot of equivalent digital input versus analog output, both in dB, perfect linearity would be indicated by a perfectly straight diagonal line. In fact, the line is almost perfectly straight down to -100 dB, at which point the deviation measures only 0.79 and 0.91 dB for the left and right channels, respectively; this is better than the results from CD. Below -100 dB, you can see some deviation as the output becomes buried in the noise floor. I should mention that for Figs. 10, 11, and 12, the sampling rate for the digital signals produced by the test equipment was 44.1 kHz, the standard sampling rate for CDs.

When I compared the DA-111p D/A converter to the board that it replaced, I found that audible improvements were hardly discernible but did note some measurable improvement. For example, in Fig. 11, THD + N remains virtually constant, even at high frequencies, whereas in the earlier version (Fig. 4A, November 1989), THD + N rose at the treble end. The new board's linearity was also just a shade better than the earlier converter's. Surprisingly, however, though S/N was excellent and met the published claim for the new upgrade, it was somewhat short of the 113.4 and 114 dB measured for the earlier version.

Use and Listening Tests

To show off the avowed benefits of this, the most expensive CD player I had ever tested and auditioned, I chose a recording of Howard Hanson's Symphony No. 4 (Delos DE 3105), with Gerard Schwarz leading the Seattle Symphony. (I have always respected the engineering work of my good friend John Eargle, who oversees all Delos recordings.) The sound was as good as I've heard from any CD player of late, but therein lies the problem. If there was a minute improvement in musicality over the better CD players I've heard in recent times, was that improvement worth the additional several thousand dollars that you would have to pay for the Nakamichi 1000 combination?

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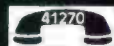
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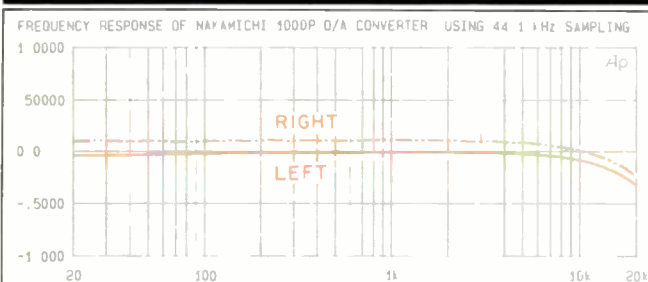


Fig. 10—Frequency response of 1000p processor with DA-111p D/A converter board, using optical digital input from test generator.

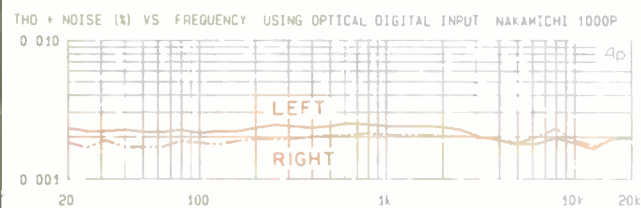


Fig. 11—THD + N vs. frequency, 1000p processor with DA-111p.

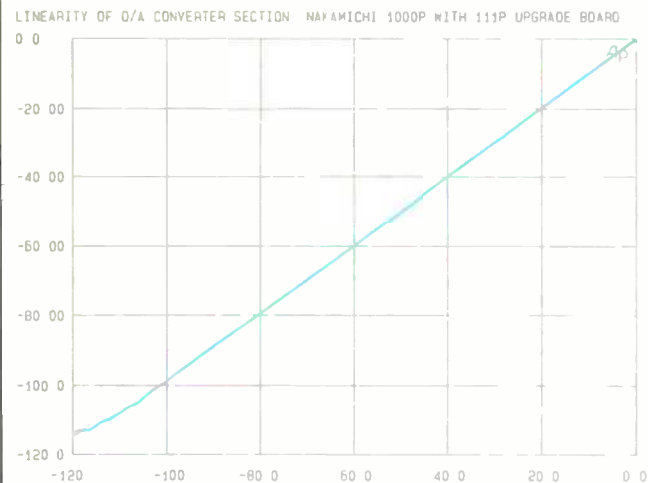


Fig. 12—Output vs. linearity at 500 Hz of 1000p processor with DA-111p; see text.

In trying to answer that tough question about the Law of Diminishing Returns as Applied to Hi-Fi, I reminded myself that, after all, the 1000p digital processor, at a suggested price of \$6,000, has several additional applications, including use as the heart of a DAT recording system and potential future use as a decoder of digital broadcasts by satellite, if and when such service arrives in this country. (Forget about using it for whatever non-satellite digital audio broadcast system this country elects to use—that system is almost surely going to use severe data reduction or compression to reduce spectrum requirements.) Still, this leaves another \$6,000 for what is certainly a superbly designed CD transport, albeit one that, for all its high price, cannot directly access an index point on a CD.

As usual, during my listening tests I used the pair of Pierre Verany "defects" discs to check out error-correction and tracking ability of CD players. I agree with everything Nakamichi claims concerning the transport's resistance to external vibration. You can just about bang on any surface of this player with a clenched fist without dislodging the optical pickup assembly from its "appointed track" on a CD. However, when I played the test tracks containing data gaps of increasing lengths, the unit began to exhibit one audible glitch per revolution for a track in which a 1.25-mm length of data had been made opaque on the disc's surface. In the past, I have encountered CD players in which error correction (or interpolation) was maintained even with 2.5 mm or more of data made unreadable. I don't know whether this limitation applies to the particular sample I tested (it had come all the way from Japan and was a preproduction unit, I suspect) or whether it can be expected on production units. To be perfectly fair, the CD Standards require only that a data gap 0.2 mm long be corrected, but most modern players (including, of course, this one) do much better. It's just that I would have expected a unit that has been engineered so beautifully in all other respects would be among those with the greatest error-correction and interpolation capabilities.

With all due respect to my friends at Telarc, they have been accused by some of turning out recordings that are a bit too bright at the treble end of the spectrum. I wanted to see if this quality would be present when a recently released CD of Meredith Willson's *The Music Man* was played on the Nakamichi 1000 CD components. The recording (Telarc CD-80276) contains the entire score of the musical, with Erich Kunzel conducting the Cincinnati Pops Orchestra. It took only the overture to convince me that the bright sound attributed to Telarc discs was still there, but wonder of wonders, it now was not the least bit irritating or harsh! In fact, for this type of musical, with its many vocalists and sound effects, the brightness provides a liveness that closely approximates the sonic experience I enjoyed when I saw *The Music Man* on Broadway.

On the question of cost versus performance, consider an automotive analogy: While a \$10,000 car will certainly get you from here to there, some folks cheerfully spend upwards of \$100,000 for a Ferrari or a Lamborghini. Somehow, there's a certain engineering elegance about Nakamichi components that renders price a secondary consideration!

Leonard Feldman

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—Robert Harley
Stereophile, Vol. 14, No. 11
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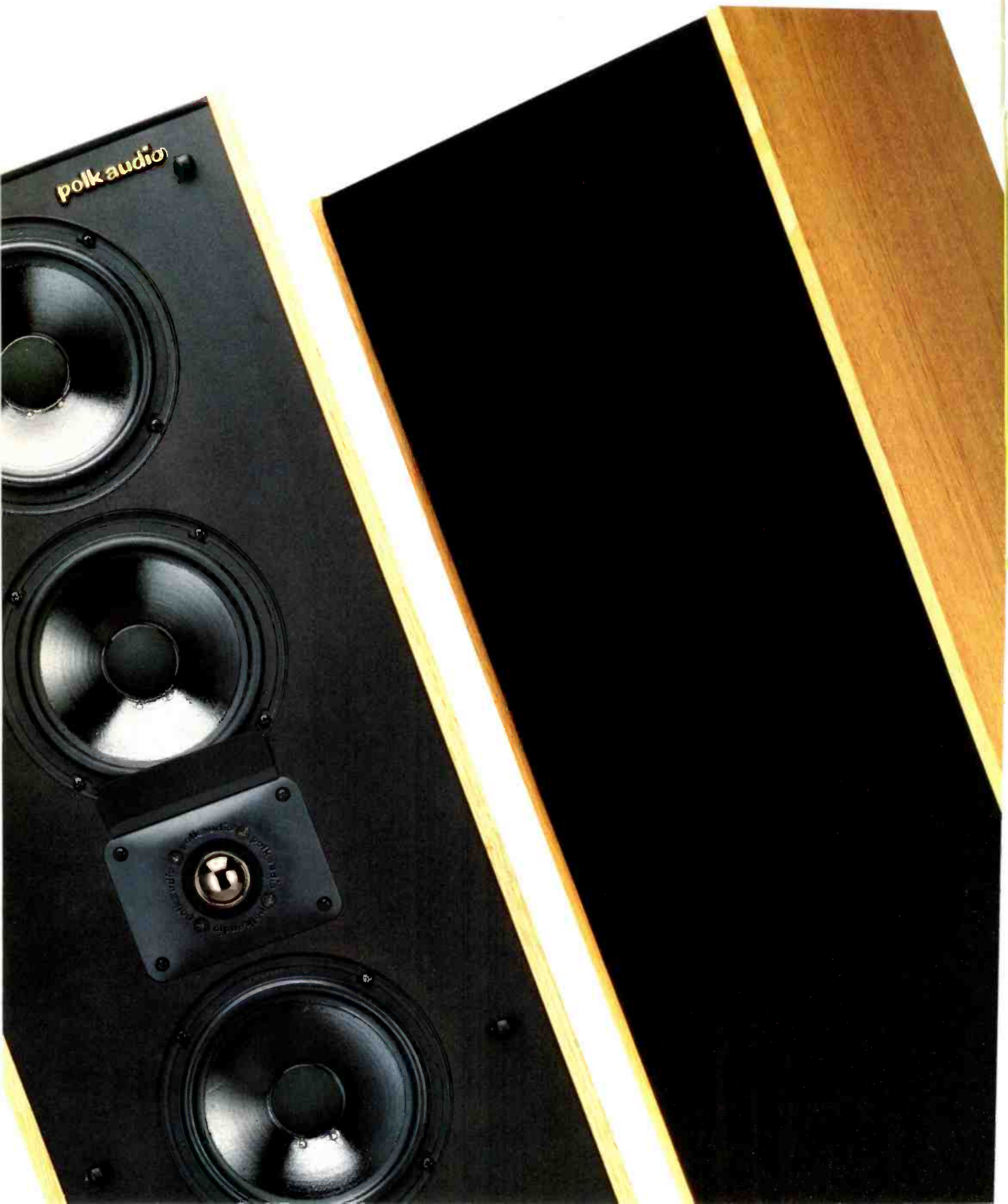
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AR
M1 SPEAKER**Manufacturer's Specifications**

System Type: Two-way, acoustic-suspension system.

Drivers: 6-in. cone woofer and ¾-in. soft-dome tweeter.

Frequency Response: 65 Hz to 20 kHz, +0, -3 dB.

Sensitivity: 88 dB at 1 meter with 2.83 V rms applied.

Crossover Frequency: 3.6 kHz.

Impedance: 8 ohms nominal, 5 ohms minimum.

Recommended Amplifier Power: 10 to 100 watts per channel.

Dimensions: 10⅝ in. H × 7¾ in. W × 11¼ in. D (27 cm × 19.7 cm × 28.6 cm); footprint, 7¾ in. × 8¼ in. (19.7 cm × 21 cm).

Finish: Charcoal-gray vinyl wrap.

Weight: 24 lbs. (11 kg) per pair.

Price: \$269 per pair; 28-in.-high stands, \$70 per pair.

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Since late 1989, Acoustic Research has been operating under the International Jensen umbrella, along with several other companies including Advent, Phase Linear, Now Hear This (NHT), and of course Jensen. From 1967 to 1989 Acoustic Research was owned by Teledyne, Inc. Recently

AR formed an alliance with the high-end audio equipment manufacturer Cello to market an affordably priced line of systems with near high-end performance. This came about due to Cello's founder Mark Levinson being very impressed with the sound of the M1 when driven by his Cello amps.

The M1 is the smallest member of AR's Holographic Imaging series of home systems. The series consists of six systems, ranging from the small, two-way M1 up to the three-way, floor-standing M6. All of these systems share the distinctive feature of having a midrange/woofer mounted on a slanted-back baffle, with a tweeter mounted below, offset to one side of the cabinet. All have narrow baffles that minimize diffraction and broaden coverage.

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The cabinet's unusual shape gives extra strength, and its nonparallel walls minimize internal standing waves.

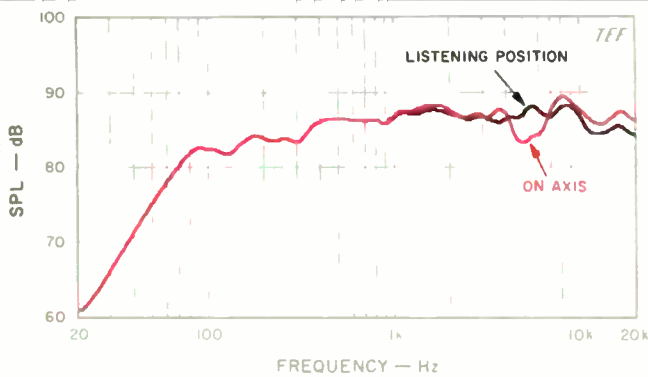


Fig. 1—One-meter, anechoic frequency response, taken on axis and 20° inside the horizontal axis, for an input of 1 watt into 8 ohms (2.83 V rms).

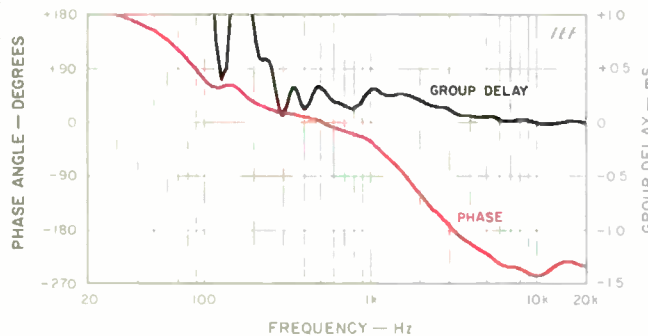


Fig. 2—On-axis phase response and group delay, corrected for tweeter arrival time.

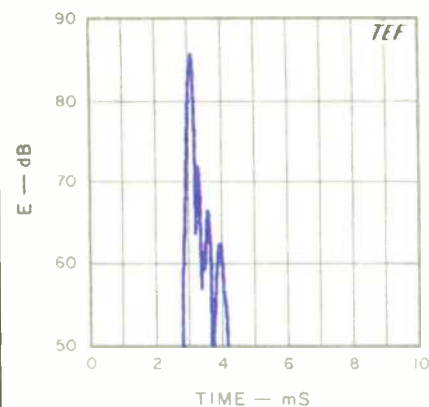


Fig. 3—One-meter, on-axis, energy/time curve.

Their rear panels and tweeter baffles are angled backward at 15° from vertical. The woofer baffle is tilted back even more, by 10°, making a total of 25°. A side view of the system emphasizes these striking features. The speakers' sloping rear and front panels make them look as if they might fall over backwards!

All the systems in the line are finished in a somewhat industrial (but good-looking) charcoal-gray vinyl wrapped around medium-density fiberboard. The fit and finish of the reviewed M1 samples were excellent. The tweeter is mounted to one side below the woofer, on a molded plastic bezel. The bezel acts both as a mount for the tweeter and as an attractive louvered protective cover, precluding the need for a separate tweeter grille. Because the tweeter is mounted asymmetrically on the bottom front of the cabinet, the systems are supplied in mirror-imaged pairs. A removable, black fabric-covered plastic frame is used to cover the woofer. A good-looking black molded plastic mounting ring covers the woofer frame. The systems looked quite good even with the woofer grille removed.

The odd shape of the box strengthens the assembly, minimizing potential panel resonances. In addition, the non-parallel cabinet walls reduce internal standing waves. The system's small size minimizes these two problems as well.

The M1's long-excursion, vented-pole woofer uses a polypropylene cone filled with carbon and mica, mounted by a butyl-rubber surround in a stamped-frame basket. The 3/4-inch, wide-dispersion tweeter has a soft fiber dome and Ferrofluid cooling. The crossover is a simple high-pass network; instead of a low-pass network, the system takes advantage of the woofer's upper roll-off. This is done to "reduce power loss and ensure the smoothest sound," according to AR.

AR states that the systems should be set up with their tweeters on the outside and that they should face straight ahead rather than being toed in toward centrally seated listeners. With this orientation, the listener is actually 15° to 20° off each system's horizontal axis. The gentle 25° upward woofer angle tends to project the upper midrange frequencies toward the ceiling. According to AR, this "projects smooth, flat sound at the critical crossover point directly toward your ear and ample hall-simulating midrange reverberation throughout the reflected sound." The company also states that "the asymmetrical offset of the tweeter on its baffle improves imaging over a wider listening angle." Read on to find out how well the speaker delivered on each of these promises.

Measurements

Figure 1 shows the anechoic, equivalent 1-meter frequency response, smoothed with a 10th-octave filter, for 2.83 V rms input (1 watt into the rated 8 ohms). The curves were taken with the microphone even with the top of the cabinet. This height roughly corresponds to the ear height of a seated listener when the systems are placed on the manufacturer's optional stands. Both free-space and ground-plane measurement techniques were used.

The manufacturer's literature was somewhat unclear on the mounting height. The owner's manual stated that the tweeter should be "at around" ear height, which is higher

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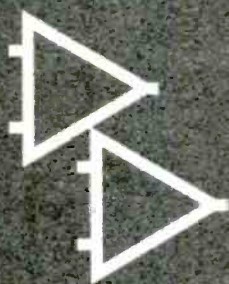
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The woofer had a healthy linear excursion capability, with no dynamic offset, and overloaded gracefully at high levels.

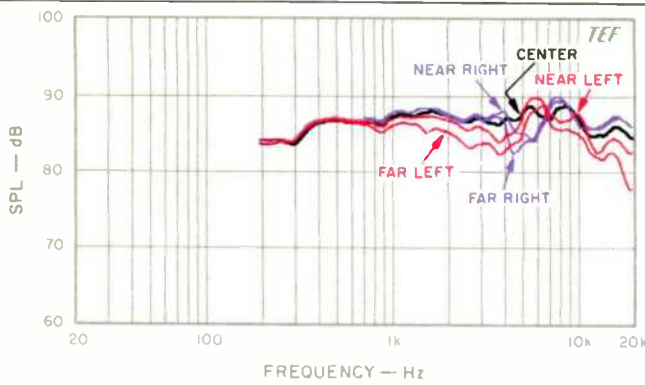


Fig. 4—Frequency response for right channel at five listening positions in horizontal plane, in 10° increments from 40° off axis ("Far Left"), through 20° off axis ("Center"), to on-axis ("Far Right").

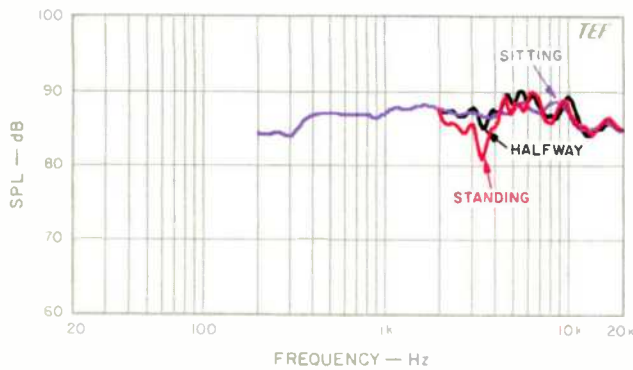


Fig. 5—Frequency response for three listening positions in the vertical plane.

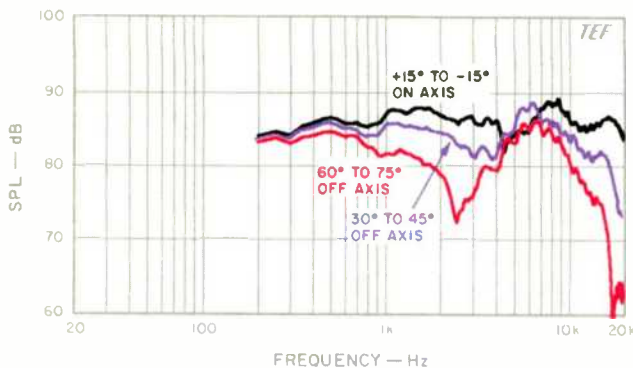


Fig. 6—Mean horizontal responses.

than the systems' position when placed on the optional 28-inch stands (not pictured). I opted to test them at the stand-mounted height.

Two curves are shown, one with the microphone directly in front of the box, and the other with the microphone 20° off the horizontal axis in the direction away from the tweeter. This latter position corresponds approximately to that of a centered listener when the systems are aimed straight ahead, as AR recommends.

The grille, which covers the woofer only, affected the woofer's response in the upper range by less than ± 1 dB (not shown). All measurements were taken with the woofer's grille removed.

The on-axis curve exhibits some roughness above 4 kHz, chiefly a dip from 5 to 6 kHz and a peak at 8 kHz. In contrast, the curve for the listening position is significantly smoother and fits within a fairly tight window of ± 2.3 dB from 160 Hz to 20 kHz. Both curves exhibit a gently rising characteristic between 80 Hz and 2 kHz and a 12-dB/octave roll-off below 80 Hz. Averaging the response over the range from 250 Hz to 4 kHz yielded a sensitivity of 86.6 dB, which was slightly lower than the manufacturer's 88-dB rating. The two systems were closely matched, within ± 0.75 dB from 200 Hz to 20 kHz.

Figure 2 shows the axial phase and group-delay measurements of the system, corrected for the tweeter's arrival. The phase response exhibits a fairly low 230° phase rotation between 1 and 20 kHz. The group-delay curve indicates that the woofer lags the tweeter by about 0.23 mS, which is about 0.8 wavelength at the 3.6-kHz crossover. This delay is due partly to physical offset between the acoustic centers of the woofer and tweeter and partly to delays generated by the crossover network.

Figure 3 shows the energy/time curve (ETC) of the M1. The main arrival, at 3 mS, is quite compact, broadening only below 72 dB SPL, with two lower level peaks at 66 and 62 dB SPL. A perfect ETC would appear as a single sharp spike centered at 3 mS, with a width of about 1 mS at the base (50-dB line) and tapering to a rounded point at the top.

Removing the woofer revealed a close-fitting, well-constructed box made of 5/8-inch-thick medium-density fiberboard. No braces are used for internal strengthening, as the small size and non-right-angle construction of the enclosure minimizes the need for them. The inside of the box was completely stuffed with cotton batting.

A high-level sine-wave sweep revealed moderate side-wall resonances of the top, sides, and back in the range from 330 to 360 Hz. Commendably, the woofer did not exhibit any dynamic offset effects. The woofer's linear excursion capability was a healthy 0.25 inch peak to peak, with an excursion limit of about 0.55 inch peak to peak. The woofer overloaded quite gracefully at high levels, with no objectionable noises.

The M1's minimalist crossover consists only of a second-order high-pass filter on the tweeter. The filter network, which is wired directly to the input terminals, consists of a ferrite-core inductor and a high-quality, 100-V capacitor of metallized polyester film. Short lengths of stranded 20-gauge hookup wire, attached to the drivers with clips, make up the internal driver connections.

At first, their shape made the M1s seem just different, but I soon began to think of them as unique and notable.

Because of the M1's asymmetrical horizontal and vertical coverage, I have chosen to present response curves at significant points in the listening area rather than my usual "3-D" off-axis response curves. These points correspond to locations spread out horizontally and vertically in the normal listening region.

Figure 4 shows the horizontal coverage of the M1 at angles corresponding to five lateral positions about equally spaced across the normal listening area and corresponding to seating positions on an imaginary couch, 10 feet from the speakers, whose width is equal to the distance between the speakers. It is assumed that only the right-channel system is operating, that its tweeter is on the side away from the center of the listening area, and that it's aimed directly ahead with no inward angling. The measurement points represent listening locations directly in front of the right-channel system ("Far Right"), about 10° off axis ("Near Right"), at the center of the couch ("Center"—about 20° off axis), about 30° off axis ("Near Left"), and extending 40° off axis to a point directly in front of the left-channel speaker ("Far Left").

The curves in Fig. 4 show that the smoothest response is, properly, at the center listening position. At points to the right, closer to the driven speaker's axis, the response shows the dip between 5 and 6 kHz and the 8-kHz peak seen in Fig. 1. To the left of the center position, farther off the driven speaker's axis, the response shows a depression between 1 and 5 kHz and a 6-kHz peak, then rolls off above 10 kHz.

Figure 5 shows response curves at three vertical angles—corresponding to sitting, halfway up, and standing—at a location midway between the systems (center of the imaginary couch). These angles correspond roughly to elevations of 0°, 6.5°, and 13° (heights of 36, 50, and 64 inches, at the 10-foot listening distance). In general, these curves are fairly well behaved, except for a 3.5-kHz dip at crossover at the standing position.

Figures 6 and 7 show the NRC-style mean horizontal and vertical on- and off-axis response curves of the M1. In contrast to the previous two figures, which emphasized the M1's operation when aimed straight ahead and heard from 20° off axis, these curves illustrate the system's output within ±15° of the axis (the standard measurement angle) and at greater off-axis angles.

The tweeter's off-center mounting creates interference patterns in the horizontal plane very similar to those found in the vertical plane of most systems. As a result, the mean axial (±15°) horizontal response curve in Fig. 6 shows the M1's by-now familiar dip at about 5 kHz and rise between 5.5 and 9 kHz. The 30° to 45° response exhibits greater high-frequency attenuation coupled with a broader dip between 2 and 5 kHz. The 60° to 75° off-axis response has a very significant dip at 2.5 kHz along with a rapid roll-off above 8 kHz.

Figure 7 shows the mean vertical responses of the M1. The mean axial curve (±15°) fits within a fairly tight window of ±2.3 dB from 200 Hz to 20 kHz, with three peaks and two dips. The 30° to 45° response shows a substantial dip at 2.5 kHz coupled with high-frequency roll-off above 10 kHz. The 60° to 75° response exhibits a broad depression between

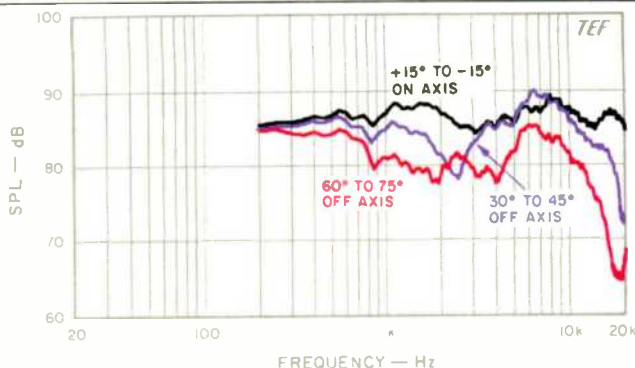


Fig. 7—Mean vertical responses.

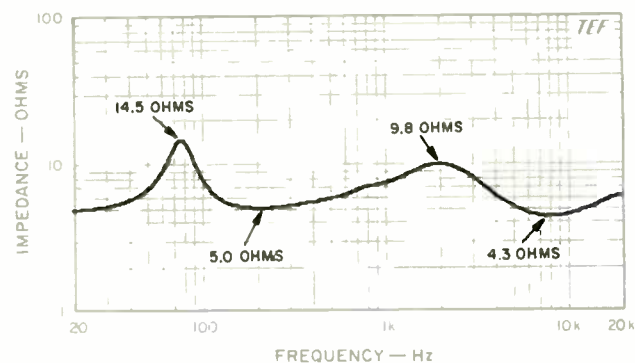


Fig. 8—Impedance.

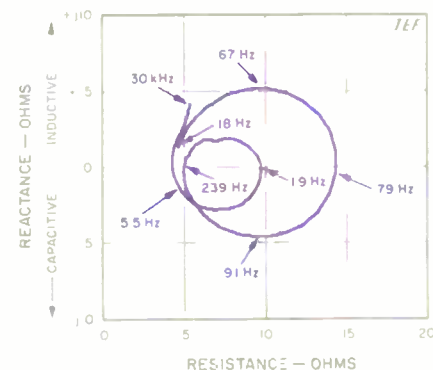


Fig. 9—Complex impedance, showing reactance and resistance vs. frequency.

The M1's bass was clean and very satisfying, and high bass levels did not affect the sound of the upper bass or the midrange.

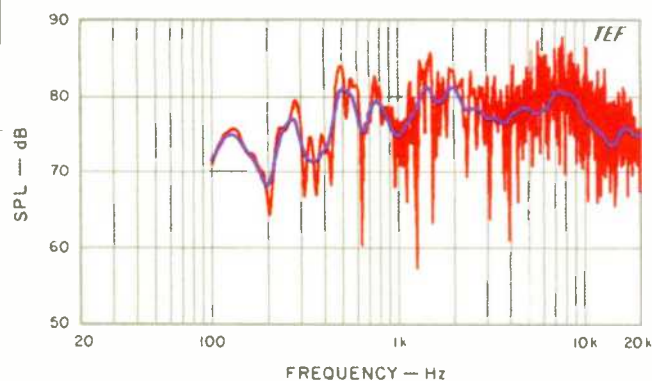


Fig. 10—Three-meter room response, showing both raw and smoothed data.

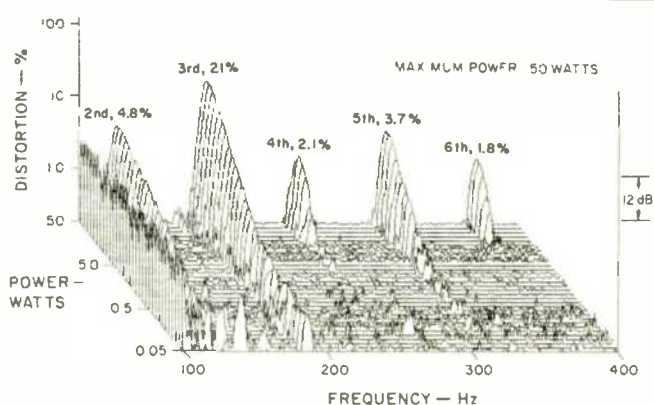


Fig. 11—Harmonic distortion products for the musical tone B₁ (61.7 Hz).

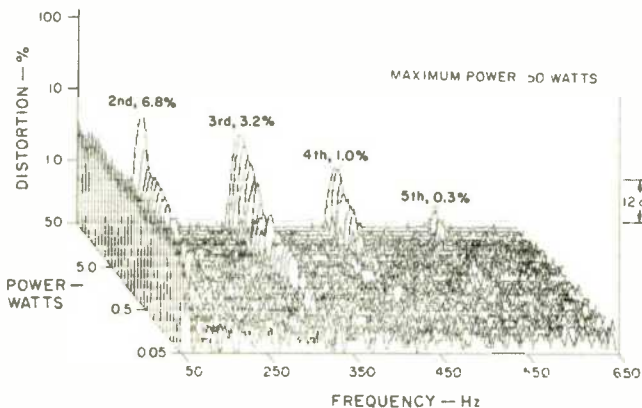


Fig. 12—Harmonic distortion products for the musical tone A₂ (110 Hz).

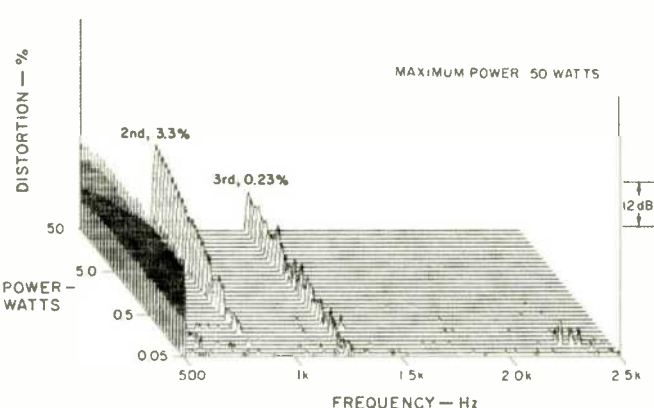


Fig. 13—Harmonic distortion products for the musical tone A₄ (440 Hz).

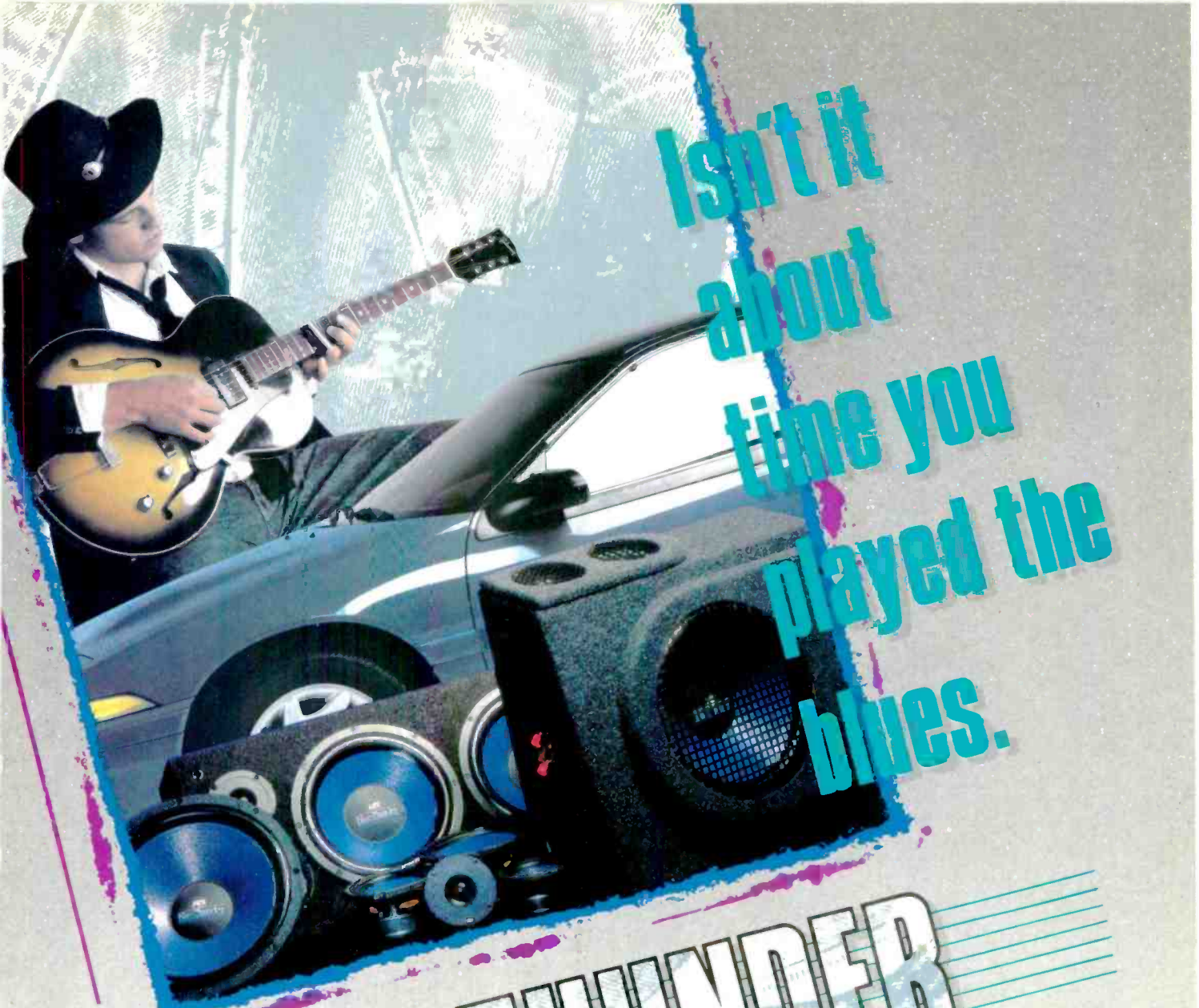
800 Hz and 5 kHz and even greater high-frequency roll-off above 10 kHz.

The M1's impedance is shown in Fig. 8. The curve is quite typical for a closed-box, two-way system and shows no particular problems. The minimum impedance of 4.3 ohms at 8 kHz will not be a problem for any amplifier. The 14.5-ohm peak at 79 Hz indicates the resonant frequency of the closed-box system design, below which the response rolls off at 12 dB/octave. The reasonably low minimum impedance, and the fairly low minimum/maximum impedance ratio of 3.4, make the M1s only somewhat sensitive to cable resistance. To keep cable-drop effects from causing re-

sponse peaks and dips greater than 0.1 dB, total cable series resistance should be limited to a maximum of about 71 milliohms. This means that cable no smaller than about 16 AWG should be used for a typical 10-foot run.

Figure 9 shows the complex impedance of the M1. No problems are evident. The impedance phase angle (not shown) reached a maximum of only +32° at 60 Hz and a minimum of -29° at 100 Hz, both symmetrical about the closed-box system's low-frequency resonance.

Figure 10 shows the 3-meter room curve of the system, including both raw and sixth-octave smoothed responses. The M1 was located in the right-hand stereo position with



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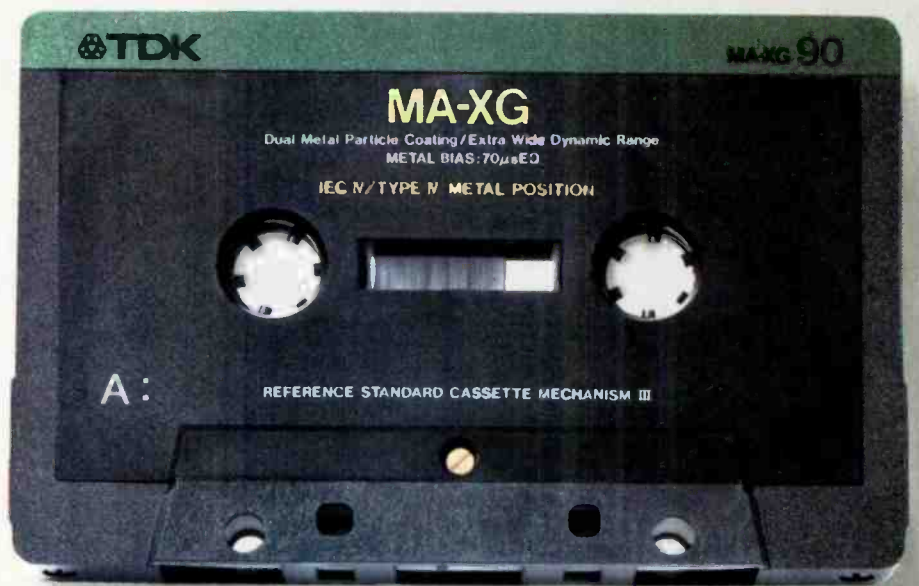
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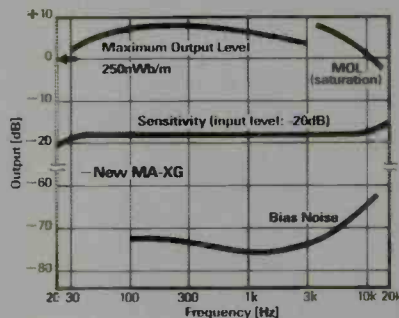
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The sound of the M1 was very airy, with well-defined high-frequency transients and impressive smoothness and definition in the bass.

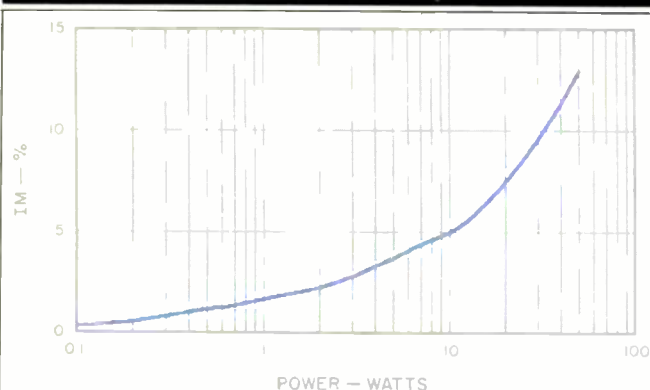


Fig. 14—IM distortion on 440 Hz (A₄) produced by 61.7 Hz (B₁), mixed in one-to-one proportion.

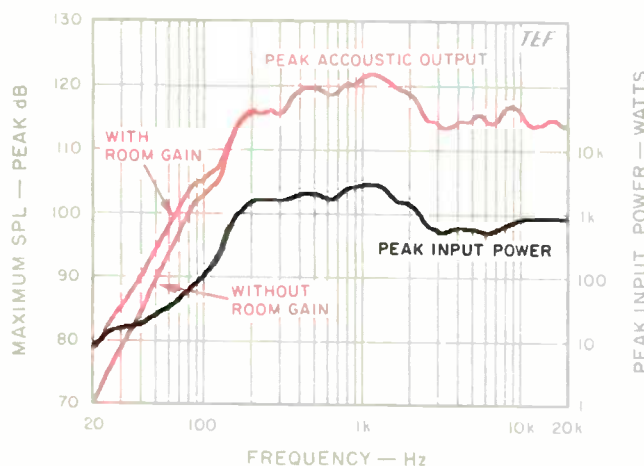


Fig. 15—Maximum peak input power and maximum peak sound output vs. frequency at 1 meter on axis.

the tweeter on the outside, aimed directly ahead (axis parallel to side wall). The test microphone was placed at ear height (36 inches), at the central listening position on the sofa. The system was swept from 100 Hz to 20 kHz with a sine-wave signal of 2.83 V rms. The parameters of the test sweep were chosen to include the direct sound plus 13 mS of the room's reverberation. The smoothed curve is somewhat rough but does fit within a relatively close envelope of about ± 3 dB from 450 Hz to 20 kHz. The curve exhibits a high-frequency rise between 7 and 9 kHz, followed by a moderate roll-off at higher frequencies. The usual room-effect response roughness is evident below 1.5 kHz.

Harmonic distortion measurements of the musical notes B₁ (61.7 Hz), A₂ (110 Hz), and A₄ (440 Hz) with increasing power level are shown in Figs. 11, 12, and 13. Figure 11 shows the harmonic distortion data for 61.7 Hz (B₁). This tone was used instead of the usual 41.2-Hz (E₁) tone because that frequency was below the system's cutoff, as a quick check of E₁ distortion revealed—50% third harmonic for 50 watts input. Distortion at full power was less than 5% for all harmonics but the third, for which distortion reached a significant 21%. At this test frequency, 50 watts generates a moderately loud 96 dB SPL at 1 meter. Figure 12 displays the A₂ (110-Hz) harmonic data. At full power, the second harmonic reached only 6.8%, with the remaining harmonics all at lower levels. Distortion was below 3% for all but the two highest power levels, 40 and 50 watts. With full power at 110 Hz, the system generates a loud 99.5 dB SPL at one meter. The A₄ (440-Hz) harmonic data is shown in Fig. 13. The second-harmonic distortion only reached 3.3% at full power; the third harmonic was much lower, at 0.23%. All higher harmonics were below the measuring floor of the test setup.

Figure 14 shows the IM on a 440-Hz tone (A₄) created by a 61.7-Hz tone (B₁) of equal input power. At full power, IM reached a moderate 12.6%.

The M1's peak power capabilities for tone bursts are shown in Fig. 15. The lower curve shows the maximum peak electrical input power-handling capacity, calculated by assuming the measured peak voltage was applied across the rated 8-ohm impedance; at frequencies where the M1's impedance is below 8 ohms, the actual power is higher than indicated. From 20 to 200 Hz, the input power is limited by the woofer's excursion capability, rising smoothly from 8 watts at 20 Hz to a plateau of about 1.5 to 3 kW between 200 and about 1,500 Hz. Between 3 and 7 kHz, the power falls to about 600 watts, then rises to about 900 watts above 10 kHz. Above 2 kHz, the input power is limited primarily by the tweeter. In this range, the system sounded harsh at power levels above those shown; at even higher levels, the sound began to "snap," as though the driver was hitting some mechanical limit. Although the maximum input power above 2 kHz is lower than I have measured on some other systems, it's still higher than will be delivered by most power amplifiers that are likely to be used with the M1s.

The upper curve in Fig. 15 shows the maximum peak sound pressure levels the M1 can generate at a distance of 1 meter on axis for the power levels shown in the lower curve. Also shown on the upper curve is the "room gain" of a typical listening room at low frequencies. This adds about 3 dB to the response at 80 Hz and 9 dB at 20 Hz. Above 150 Hz, the M1 can generate loud peak levels in excess of 115 dB SPL. Though the maximum output below 150 Hz rolls off quite rapidly, the M1's low-frequency output is still quite usable. Even when overloaded by the low-frequency tone-burst test signal, the system did not sound particularly stressed. Of course, in a standard listening setup, with the systems close to room boundaries, two systems will generate even higher low-frequency peak levels than shown.

Use and Listening Tests

After so many traditional, right-angled, box-like speaker enclosures, I found the M1's shape, in a word, different.

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N° 23.5

Analytic and detailed but still open, the ARs had accurate imaging that created a very believable, lifelike sonic presentation.

After several weeks with the M1, however, I began to think of these Acoustic Research speakers as distinctive, unique, and notable.

Curiously, the owner's manual was not very specific on aiming and placement of the M1s, other than stating that the systems should be placed about 8 to 10 feet apart along the wall opposite the listening area, and a general mention about the effect of room boundaries on low-frequency response. Even mounting height was not made clear, and nowhere in the published information given to me did AR mention that the systems should be aimed straight ahead rather than being toed in. Only in a cover letter was this specified. However, in several places in the published information, a figure depicting the listening area from an overhead viewpoint fortunately does show the speakers aimed straight ahead. Because the straight-ahead aiming of the systems is so crucial to proper operation, I hope that users will follow this configuration.

As with other small systems I have reviewed, I set up the M1s about 9 feet away from the sofa where I do my primary listening. The systems were aimed straight ahead, with no toeing in. They were placed far away from reflecting boundaries, on stands 26 inches high (2 inches shorter than AR's optional stands) that raised them so the top of each enclosure was approximately at ear height. This mounting location does not provide much low-frequency augmentation but was chosen to maximize smoothness, accuracy, and imaging in the upper range—characteristics I consider to be more important for serious, critical listening than for casual use.

Connection to the M1 is through a pair of standard, five-way binding posts spaced $\frac{3}{4}$ inch apart for use with double-banana plugs and mounted in a circular recess at the bottom rear of the enclosure. The small, $1\frac{1}{8}$ -inch diameter of this recess made it fairly hard to turn the connector tops with my fingers to achieve firm contact. The wire-capture holes in the connectors are generously large and can handle wire as big as 10-gauge.

I first listened to the M1s with a new CD set of Handel's *Messiah* (Harmonia Mundi HMU 907050.52). The vocal bass solo from the section "The Trumpet Shall Sound" was reproduced with much realism and presence and created a very palpable vocal center image. The massed choral sections were delivered with minimal strain and a very detailed soundstage.

As expected, the M1s' low end was lightweight when compared to that of my much more expensive reference systems (B & W 801 Matrix Series 2). However, on material with significant bass levels, such as Jean Guillou's organ performance of Mussorgsky's "Pictures at an Exhibition" (Dorian DOR-90117), the M1s made a good account of themselves, with a low end that was clean and very satisfying, if not room-shaking. More important, the systems handled these high bass levels with minimal effect on their reproduction of upper bass and midrange material at all but very high excursion levels.

The systems did not produce gut-thumping kick drums on rock but did do quite well on jazz acoustic bass, where their smoothness and bass definition were quite impressive. Moving the systems back to the rear wall did increase the

systems' low-frequency output, as expected, but at the expense of smoothness and imaging in the upper frequencies.

On most well-recorded material, the AR systems presented a very open, airy sound with good definition of high-frequency transients. This was demonstrated very well on the Robert Hohner Percussion Ensemble's CD, *Different Strokes*, especially track 7, "Bonham" (dmp CD-485). However, on some pop vocal material, the systems exhibited a very bright, spitty character on sibilants. The M1's top end was significantly brighter and crisper than that of my reference systems. This was evident both on vocals and with material having significant high-frequency information, such as cymbals, tambourines, wind chimes, etc. The M1s' accentuated high end did a good job in revealing any high-frequency harshness or graininess in a recording. Recordings with clean high ends were rendered very well but with raised high-frequency levels.

On pink noise, the M1s' were not as smooth as my reference systems; the noise took on a moderate tonality, which indicated that certain parts of the spectrum were being emphasized over others. The pink noise clearly showed the M1s' high-frequency emphasis and reduced low end as compared to my reference systems. The AR systems passed the stand-up/sit-down test with only moderate tonality changes in the upper midrange when I stood up fully. However, there were also moderate tonality changes when I shifted my listening position from side to side. In sensitivity, the M1s were quite a close match to my reference speakers.

In band-limited third-octave pink noise, the M1s were clearly audible at 32 Hz, provided increased level with each higher third-octave step, and were as sensitive as my references between 80 and 100 Hz. Even when driven hard below 32 Hz, the M1s did not generate any objectionable sounds, but only low-order harmonic distortion.

Regardless of the statements in AR's literature, I felt that the M1s' ability to maintain a stable soundstage with lateral shifts in listening position was only marginally better than that of conventional systems. The measurements presented in Fig. 4 partially explain why this is so. Between 1 and 5 kHz, the level actually drops as the listener moves beyond the center position away from the source speaker, as shown by the "Near Left" and "Far Left" curves, which were taken, respectively, 30° and 40° off the horizontal axis. To overcome lateral image shift, the level should actually stay the same or increase as you move toward the opposite speaker, so as to counteract the decreasing delay in the arrival of that speaker's sound.

At only \$269 per pair, the M1s provide a very good combination of performance attributes coupled with very distinctive styling. Their bass output and extension better the performance of other systems in their size class, though the bass is still a bit lean when compared to full-sized systems'. The M1s' accentuated high-frequency range gives a very analytic sound that produces an airy, quite detailed presentation on well-recorded material. The systems also rate quite well in accurate imaging and in creation of very believable, lifelike sonic presentations.

D. B. Keele, Jr.

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3

WELL TEMPERED RECORD PLAYER AND VAN DEN HUL MM-1 CARTRIDGE

Manufacturer's Specifications

Turntable and Tonearm

Drive System: Belt.

Motor Type: 24-pole synchronous.

Speeds: 33 $\frac{1}{3}$ and 45 rpm.

Wow and Flutter: 0.01%.

Rumble: -84 dB.

Speed Accuracy: Within 0.001%.

Arm Type: Pivoted, viscous-damped, with fixed cartridge mount and anti-skating.

Pivot-to-Stylus Distance: 9 in. (22.9 cm).

Overall Length: 11 $\frac{3}{8}$ in. (28.9 cm).

Effective Mass: 95 grams.

Cartridge Weight Range: 4 to 15 grams.

Dimensions: 19 in. W x 15 in. D x 7 in. H (48.3 cm x 38.1 cm x 17.8 cm) including optional dust cover.

Weight: 34 lbs. (15.5 kg).

Price: \$1,195; dust cover, \$100.

Company Address: c/o Transparent Audio Marketing, Route 202, Box 117, Hollis, Maine 04042.

For literature, circle No. 92

Cartridge

Type: Moving magnet.

Stylus: Van den Hul Type II; radii, 5 x 75 microns.

Cantilever: Solid boron rod, 0.3 mm diameter.

Moving Mass: 0.42 mg.

Output: 5 mV at 5.6 cm/S.

Tracking Force: 1.0 gram recommended, 1.25 grams maximum.

Mass: 6.5 grams.

Recommended Arm Mass: 4 to 8 grams.

Vertical Tracking Angle: 20° to 25°.

Coil Inductance: Approximately 425 mH.

Maximum Load Capacitance: 400 pF including tonearm, cable, and preamp input.

Frequency Range: 10 Hz to 22 kHz.

10-kHz Burst Distortion: Less than 0.5%.

Channel Separation: Greater than 26 dB at 1 kHz, greater than 20 dB at 10 kHz.

Price: \$350.

Company Address: c/o Rockport Technologies, R.F.D. 1, Box 1113A, West Rockport, Maine 04865.

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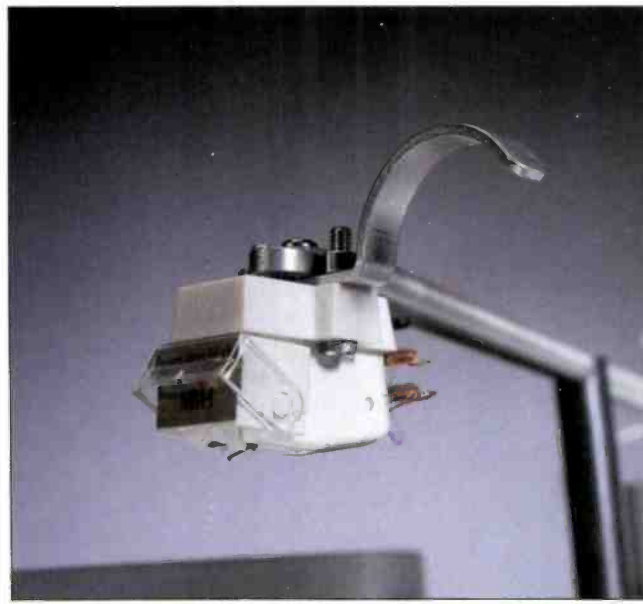
The Well Tempered Record Player consists of a turntable and tonearm combination based on the separate Well Tempered turntable and Well Tempered tonearm (now called the Well Tempered Classic arm) that I reported on in the July 1988 issue. It is sold as a lower cost version based on the unique features of the original turntable and tonearm. Bill Firebaugh, the designer, came up with some interesting, if unorthodox, ideas for his first tonearm and turntable that resulted in very good sound.

The tonearm of the Well Tempered Record Player has the same basic design as the original arm but does not have all of its features. For example, the caliper adjustment for anti-skating and the vertical tracking angle knob are absent from this version; the VTA can be set manually by moving the main tonearm post up or down in its base mounting collar, while the anti-skating is not adjustable. The turntable of the Well Tempered Record Player is more like the original model. It has a less expensive base and lighter motor mounting, but it does use the same turntable platter and a very similar main bearing. In 1988, I tested the original Well Tempered tonearm with a van den Hul MC-One moving-coil cartridge; for this report, I used the lower cost van den Hul MM-1 moving-magnet model.

The turntable of the Well Tempered Record Player is very similar in appearance to the more expensive Well Tempered turntable. The tonearm is finished in natural aluminum and is much simpler than the Well Tempered tonearm. The tonearm is basically a unipivot design, with the pivot suspended by two nylon strings so that it sits in a cup of viscous fluid. The fluid damps any rapid motion of the tonearm and causes it to be "well tempered." A bracket at the end of the

tonearm makes mounting the cartridge and adjusting the offset angle fairly easy.

The motor fits down in an oversized hole cut through three layers, each $\frac{3}{4}$ inch thick, of the turntable base; it sits on the same shelf, or platform, on which the turntable is placed. Besides the drive belt, this shelf or platform is the only mechanical connection between the motor and the turntable. This means that you can increase the isolation between





them by placing them on a foam pad. However, I didn't find this necessary; the isolation is already very good. The Well Tempered Record Player is lighter than the original setup, due to the lighter base, but appears solid and well built.

The turntable base is 19 inches wide, 13 $\frac{3}{8}$ inches deep, and 2 $\frac{5}{8}$ inches high. This height includes the rubber feet, which allow clearance for the turntable's main bearing well that protrudes from the bottom of the base. The tonearm tower is 3 $\frac{1}{8}$ inches high, making the total height 6 inches. The base of my sample was finished in black vinyl and consisted of three particleboard layers, each $\frac{3}{4}$ inch thick. (In current production, the layers are of medium-density fiberboard, and the finish is Vitricor, a clear acrylic with a

black inner surface.) The layers are fastened together by a viscous adhesive that also provides mechanical damping to this sandwich construction.

The motor, which sits in an opening 4 inches in diameter in the left side of the turntable base, has a pulley for the thin, flat drive belt that also wraps around the platter. The stepped pulley has two diameters to allow both 33 $\frac{1}{3}$ - and 45-rpm speeds. Speed change is accomplished by manually moving the belt to the appropriate pulley. The platter is made of a clear acrylic and has a recess in the center to allow for the record label's extra thickness. The record spindle is highly polished and has a tapped hole in the center. The record clamp is 1 $\frac{1}{16}$ inches in diameter and $\frac{15}{16}$ inch high; a screw in the center allows the clamp to be rotated down to lock a record against the surface of the platter. This allows any mechanical vibrations within a record to be absorbed into the platter. Acrylic was chosen for the platter because it has a mechanical impedance close to that of the plastic used to make records.

The record spindle and turntable shaft are made as a single piece. The top of the shaft is machined with a ledge, and the platter has a hole for the shaft and a matching cutout for the ledge. This design allows the platter to sit

Bill Firebaugh's interesting but unorthodox ideas on arm and turntable design result in good sound.

MEASURED DATA

Well Tempered Record Player

PARAMETER	MEASURED	COMMENT
Speed Stability	±0.20%	Very good
Wow, DIN Unwtd.	0.23%	Very good
Wow, DIN Wtd.	0.12%	Good
Flutter, DIN Unwtd.	0.09%	Excellent
Flutter, DIN Wtd.	0.02%	Excellent
Wow & Flutter, Unwtd.	0.25%	Very good
Wow & Flutter, DIN Wtd.	0.13%	Good
Long-Term Drift	0.12%	Very good
Rumble, Unwtd.	53.3 dB	Good
Rumble, Wtd.	73.4 dB	Good
Suspension Resonance	N/A	

Tonearm

Pivot-to-Stylus Distance: $9\frac{3}{16}$ in. (233 mm).
 Pivot-to-Rear-of-Arm Distance: $2\frac{13}{16}$ in. (71.4 mm).
 Tracking-Force Adjustment: Sliding counterweight.
 Tracking-Force Calibration: None.
 Cartridge Weight Range: 6 to 17 grams.
 Counterweights: 67.5 and 20.9 grams.
 Counterweight Mounting: Locked to rear of tonearm with nylon screw.
 Sidethrust Correction: Built-in as part of pivot design.
 Pivot Damping: Viscous fluid in pivot cup.
 Lifting Device: Finger lift on headshell.
 Headshell Offset: Adjustable.
 Overhang Adjustment: Slot in armtube insert.
 Bearing Type: Hanging threads; see text.
 Bearing Alignment: See text.
 Bearing Friction: Very low; see text.
 Lead Torque: Very low.
 Arm Lead Capacity: 37 pF, left and right.
 Arm Lead Resistance: 1.2 ohms, left and right.
 External Leads: None.
 Mounting: Aluminum insert in base.

van den Hul MM-1 Cartridge

Coil Inductance: Left, 458 mH; right, 450 mH.
 Coil Resistance: Left, 1,093 ohms; right, 1,100 ohms.
 Output Voltage: Left, 0.67 mV/cm/S; right, 0.64 mV/cm/S.
 Tracking Force: 1.6 grams.
 Cartridge Mass: 6.65 grams.
 Microphony: Extremely low.
 Hum Rejection: Very good.
 High-Frequency Resonance: 24.7 kHz.
 Rise-Time: 23 μ S.
 Low-Frequency Resonance: 9.5 Hz.
 Low-Frequency Q: 2.5.
 Recommended Load Resistance: 47 kilohms or higher.
 Recommended Load Capacitance: 250 pF.
 Polarity: Negative.

snugly on the shaft without rocking. The bottom of the shaft sits on a Delrin bearing plate at the bottom of the bearing well. What makes Bill Firebaugh's Well Tempered turntable designs unique is that he places the two upper bearings close together on one side of the well, toward the motor, and another set of two bearings on the opposite side of the well at the bottom; he relies on the tension of the belt to pull the shaft against these bearings. The bearing well is filled with viscous fluid, which provides lubrication, vibration damping, and speed stability.

The tonearm is a simplified version of the original Well Tempered design. It uses the hanging-thread idea of the original arm with an adjustment for azimuth provided by a knob on the top of the main tonearm pillar. This knob is attached to the end of one of the threads from which the tonearm is suspended. A plastic disc, with two large holes through it, is attached to an aluminum rod. This rod has a collar at the top through which the main armtube passes. The extremely fine lead wires exit the armtube at a point directly in front of this collar. These leads are attached to the gold-plated phono sockets and a five-way binding-post ground terminal. The phono sockets and ground terminal are mounted on a black-anodized aluminum bracket that is fastened toward the rear of the turntable base by two screws. The tonearm rest, a 2-inch-long plastic rod with a groove at one end, is fitted into a hole in the turntable base.

In keeping with the lower cost philosophy, I installed a van den Hul MM-1 moving-magnet cartridge to test the Well Tempered Record Player. This cartridge features the same famous van den Hul stylus used in the more expensive MC-One moving-coil cartridge. The shape of this stylus is closer to that used to cut the original record groove than most other stylus shapes. The van den Hul MM-1 is the first cartridge for which I have ever measured a negative absolute polarity. (The EIA Standard calls for a positive output when the stylus moves out toward the record's edge.) However, van den Hul says its cartridges always have positive polarity for outward stylus motion, so it's possible that the arm was miswired or some other mishap occurred.

Measurements and Listening Tests

Figure 1 shows the frequency response and crosstalk for the van den Hul MM-1 cartridge mounted in the Well Tempered Record Player tonearm. The frequencies above 12 kHz are rolled off, correlating with comments by the listening panel that the sound was "more subdued and recessed" and "smoother and more mellow, yet clear" compared to the reference system. The crosstalk in the left channel was greater than that in the right, which seemed to affect the sense of spaciousness. Comments such as "not as open-sounding" may be attributed to this crosstalk. Usually, the high-frequency resonance of most cartridges can be seen in the rise in crosstalk, but for the van den Hul MM-1, this resonance, which I measured at 24.7 kHz using another technique, is not very apparent. However, the fact that the crosstalk doesn't increase at high frequencies, as is the case for most cartridges, can be correlated with the high rating given to the MM-1 for image stability by panel members and to a comment by one of them that the "cymbals are very precise."

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The listening panel gave the MM-1 high marks for image stability, perhaps because its crosstalk doesn't rise with frequency.

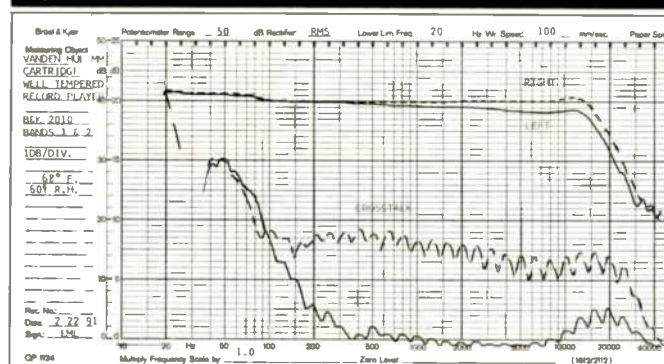


Fig. 1—Frequency response and interchannel crosstalk of the van den Hul MM-1 cartridge in Well Tempered Record Player tonearm. (The crosstalk increase at very low frequencies is an artifact of the B & K 2010 test record.)

Fig. 2—Slow-sweep check (5 to 20 Hz) for low-frequency arm/cartridge resonance. The resonance is at 9.5 Hz with a Q of 2.5.

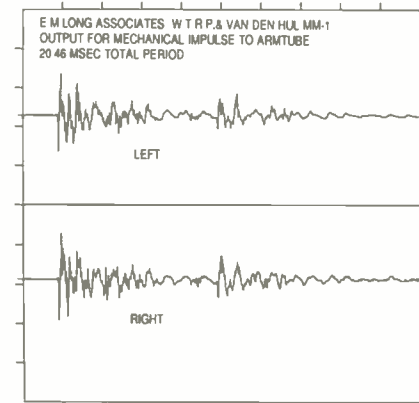
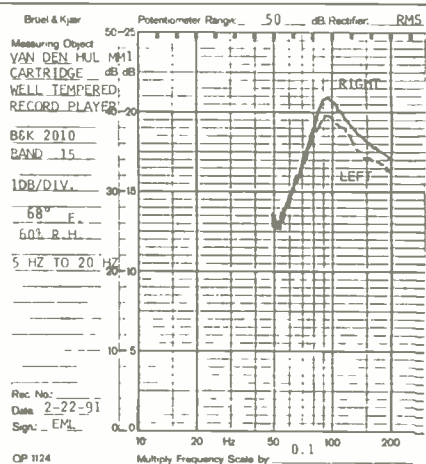


Fig. 3—Output vs. time of arm and cartridge for a mechanical impulse applied to the armtube.

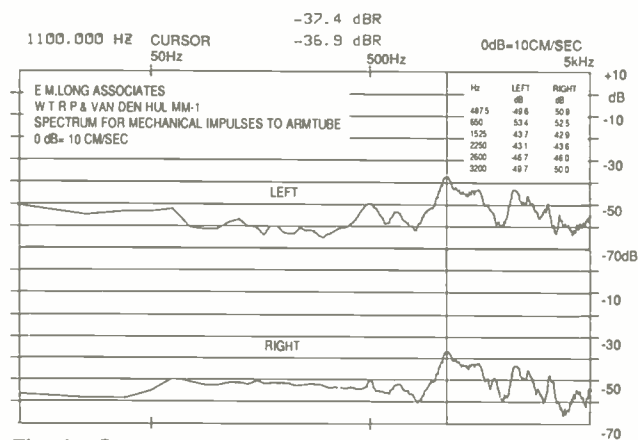


Fig. 4—Output spectrum of arm and cartridge from 16 mechanical impulses applied to armtube and averaged.

The low-frequency response from 5 to 20 Hz, shown in Fig. 2, indicates that the damping for this tonearm is not as great as that for the original Well Tempered tonearm but is still very acceptable. Comments that the bass was "thuddy" and "not as deep as the reference" may correlate with a glitch that was seen at about 140 Hz when a slow sweep was taken from 20 to 1,000 Hz (not shown). This glitch indicated a mechanical discontinuity or anti-resonance in the tonearm system, which could cause the bass to have a "thuddy" characteristic and also can be correlated with a comment about piano sound having a "slight woodiness and coloration."

The vertical and lateral responses of the tonearm and cartridge combination indicated that the effective mass was very similar in both planes, which is a good characteristic.

Figure 3 shows the output versus time for a mechanical impulse applied to the tonearm near the cartridge. Each division is about 2 mS, and it is apparent that there is reflection of energy inside the tonearm delayed from the original signal by a little less than 8 mS. This would correspond roughly to the glitch at 140 Hz in the frequency response. The delayed energy can be correlated to the comment about the bass being "thuddy" when listening to tightly miked drums, and to comments such as "slight lack of coherence" and "more ringing" in orchestral works.

The spectrum of the output due to a mechanical impulse to the armtube is shown in Fig. 4. The peak at 1,100 Hz, and quite a bit of output up to about 3,200 Hz, could account for comments about the sound of strings being "sharp" and brass being "bright and ringy."

The lack of high-frequency crosstalk seen in Fig. 1, and the good interchannel phase response indicated by Fig. 5, contribute to the ability of the cartridge and tonearm combination to reproduce individual instruments with excellent placement. It is very likely the reason why one panel member commented that the Well Tempered Record Player "does a good job on recordings with ambience."



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Distortion is still relatively low at 25 cm/S, a groove velocity that many arm and cartridge combinations can't even track.



Fig. 5—Interchannel phase difference, using pink noise from B & K 2011 test record, band 7.

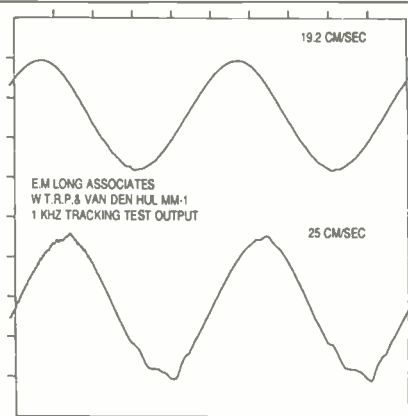


Fig. 6—Arm/cartridge tracking with 1-kHz test tone from B & K 2010 at 19.2 and 25 cm/S.

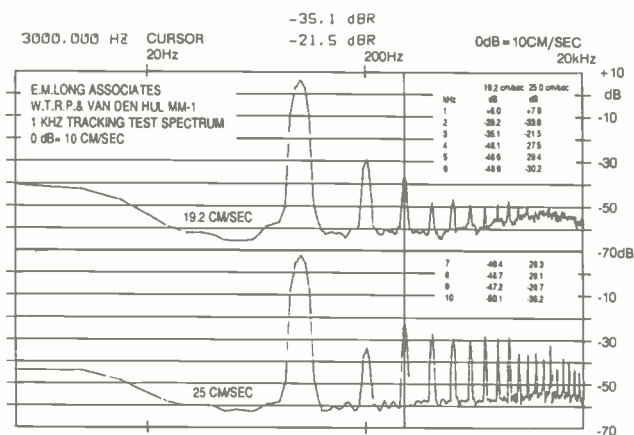


Fig. 7—Spectrum analysis of output when reproducing the test signals of Fig. 6. The third harmonic (at the cursor position) is 1.7% for the 19.2-cm/S tone and 8.4% for the 25-cm/S signal. Note the increase in the odd harmonics at the higher level.

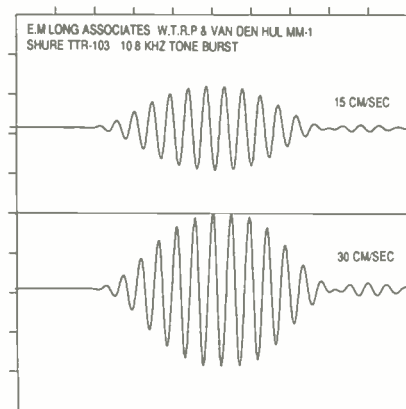


Fig. 8—Output with 15- and 30-cm/S, 10.8-kHz pulse tests from Shure TTR-103 test record.

Figure 6 shows the output of the van den Hul MM-1 cartridge for the two highest level bands on the B & K 2010 test record. The 1-kHz signal looks reasonably good at 19.2 cm/S, but at the 25-cm/S level, distortion of the waveform is apparent. Many cartridge and tonearm combinations have difficulty even staying in the groove at the 25-cm/S velocity, so the van den Hul and Well Tempered combination is very good in this respect. The distortion spectra of these test signals are shown in Fig. 7. The distortion is reasonably low at the 19.2-cm/S level. At the 25-cm/S level, the distortion is still relatively low, but the output from the third to ninth harmonics will add some brightness to the sound of strings and brass during high-level passages. Sorting out the comments from the listening panel was a little difficult because some of them seemed contradictory. In comparisons with the reference system, comments that the sound was "more

subdued and recessed" and "smoother and more mellow, yet clear" don't seem to jibe with comments about the sound of strings being "sharp" and brass being "bright and ringy." There are different and conflicting things at work here that cause these apparently contradictory comments. The rolled-off high-frequency response of the cartridge can make the sound be perceived as "mellow" for low and average level sounds, while the delayed energy and the increase in harmonics in the tonearm can make the sound "bright" at higher levels.

Figure 8 shows the response of the tonearm and cartridge for the 15- and 30-cm/S tone bursts on the Shure TTR-103 test record. There is a slight amount of asymmetry in the 30-cm/S output, but it compares well with other cartridges I have tested. The distortion (not shown) was comparatively low even at the 30-cm/S level. Figure 9 shows the square-

The platter absorbs energy from the record very well, which helps to improve the clarity of the sound.

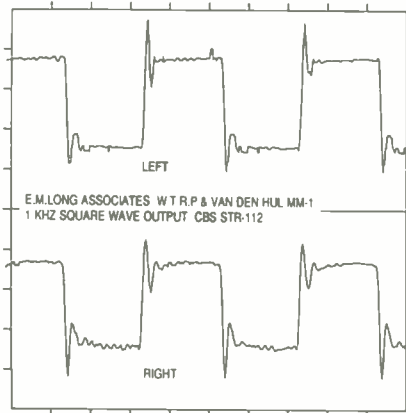


Fig. 9—Arm/cartridge output for 1-kHz square wave, CBS STR-112 test record.

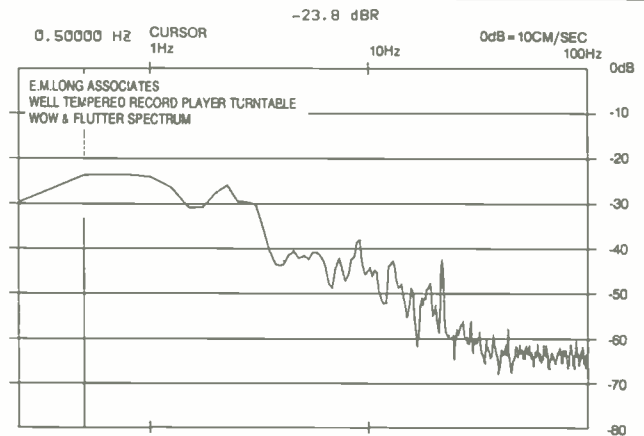


Fig. 10—Turntable's wow and flutter spectrum, from 0 to 100 Hz, at 33 1/3 rpm. The peak at about 10 Hz is due to the arm/cartridge resonance.

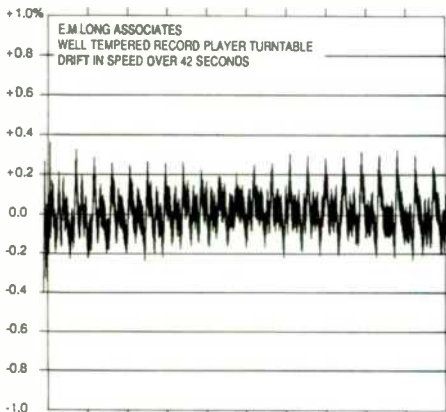


Fig. 11—Speed drift over a 42-S period. Cyclic variations at 1.8 S, or 0.56 Hz, are related to the rotational speed of 33 1/3 rpm.

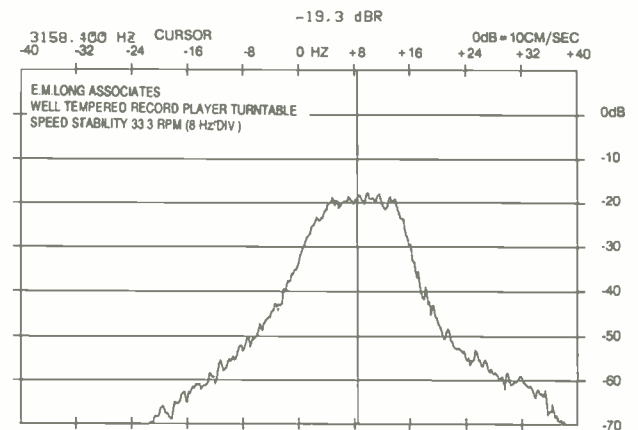


Fig. 12—Speed stability at 33 1/3 rpm; 0 Hz is referenced to the 3,150-Hz tone on the B & K test record. The cursor is at 3,158.4 Hz, which means that either the test record's tone is slightly high or the turntable is running 0.27% fast. Stability is $\pm 0.17\%$.

wave output, and the overshoot seen here can be correlated with the "bright" and "sharp" comments about brass and strings, respectively. The spectrum of the square wave (not shown) revealed another aspect of this van den Hul cartridge and Well Tempered tonearm combination that helps explain the apparent contradiction between the "bright" and "mellow" comments. The output levels of the odd-order harmonics were greater than those of a perfect square wave, which was perceived as adding brightness to the complex sound of brass and strings. The output levels of the even-order harmonics were very much greater than they should have been, and this, combined with the high-frequency roll-off, causes the sound to be perceived as "mellow."

The spectrum of the wow and flutter of the Well Tempered Record Player turntable is shown in Fig. 10. The signature of this spectrum is very close to that of the original Well Tempered turntable and indicates very good performance. The drift in speed over 42 S is shown in Fig. 11. The peaks are greater than the original turntable's but are still well within a high-performance envelope. The variation in speed is very low and produces a very controlled spectral pattern, as Fig. 12 demonstrates. The spectrum of the rumble not only was very low in output but was concentrated at around 8 to 10 Hz. The tonearm/cartridge resonance at 9.5 Hz accentuated the output.

Figures 13 and 14 show, respectively, the output versus time and the spectrum of the output caused by a mechani-

"Krell... Threshold... Madrigal...

Rowland Research... Coda...

Parasound. What !!!

Parasound?

How does Parasound manage a mention with the above said heavy hitters of the transistor amplifier world? Easy. The new 2200 power amplifier from Parasound has the type of power and performance that would be expected from the big guys, were they to build an amplifier at the two grand mark. The fact that the 2200 only costs \$1,585 certainly sweetens the deal, making it a ridiculously great bargain.

But why Parasound?

Actually, this is the amplifier that I had been expecting to see from PS Audio, Superphon or Aragon; a real high calibre audio product that reeks of power, engineering savvy, and bang for the buck. Instead, **a small firm from northern California had the sense to recruit one of the best minds in the business - John Curl - to design for them a product capable of superior performance without a typically prohibitive price tag** to go along with it. John brought with him a full suitcase of engineering and design experience that few others in the industry could match or even dream of. Remember the "JC" designation on some of the Mark Levinson designs of the 1970's - that's John Curl. More recently, John has enjoyed great critical success with his Vendetta phono section electronics, it being declared "State of the Art" by several of the glossy mags. Then, add to the formula the Parasound company, whose reputation has been built on the value-oriented sector of the market. Parasound has put together a method of product development and marketing which emphasizes in-house design and overseas construction. Years of close work with their Taiwan manufacturing facility has resulted in a relationship where both parties know what the other needs in order to produce **a finely crafted product; a product that's basically untouchable by the competition.**

THE AMP. The 2200 weighs in at 58 lbs., that's 6 lbs. more than the Krell KST-100 (\$2,700), and only 2 lbs. less than the Madrigal No. 29 (\$2,800). It's 19" wide, 8" tall and 19" deep if you include the fore and aft handles. It has balanced and single ended inputs (XLR & RCA), with a switch to convert to mono operation. The rear of the amp also has two sets of speaker terminals for those who

RAVE REVIEW

HCA-2200

Designed by John Curl

desire to bi-wire or just want to hook up more than one pair of loudspeakers. Unlike Parasound designs of the past, the 2200 lacks the two attenuator pots on the front panel and the speaker terminals are honest-to-goodness 5-way binding posts. Both sides of the amp are flanked by an impressive array of "Rowland-like" heatsinks that run quite hot in order to dissipate the considerable heat generated by the 12 high-bias (over 6 wpc in pure class A) bi-polar output devices per channel. Considering that nearly all listening is done at one or two watts per channel, **the 2200 delivers a lot of class A-biased power.** Inside you'll find two 1.2 kVA toroidal transformers (one per channel) and 100,000 mfd of filtered power storage. A nice touch is the way all large capacitors are bypassed by smaller film caps for improved performance. This is the first amplifier I have seen in a long time that goes so far as to even bypass the larger filter caps in the power supply (a favored trick by many modifiers). Parts quality throughout is good... **the transformers, filtering caps, chassis, output devices and resistors are just about as good as you can get.**

I have operated this amplifier under grueling and strenuous conditions for almost three months without so much as a hint of trouble or breakdown. As said previously, this amp does tend to heat up a room if given the opportunity, running at about the same temperature at idle as it does wide open - a sign of proper high-bias or class A operation and certainly nothing to worry about.

THE SOUND. It sounds balanced. No aspect of its operation unduly draws attention to itself. The highs aren't grainy or smeared; the bass isn't bloated; the midrange isn't recessed, or forward for that matter; the stage isn't cramped; and, dynamics aren't compressed. **What we have here is an amplifier that flat out refuses to do much wrong, while doing almost everything right.** Is it a wonderful amplifier in the manner of the Allegro Cantata? You bet it is, but for different reasons (if this amp were not a wonderful product this review would have been written two months from now, or whenever I got to it).

The 2200 is one of the most powerful amplifiers you will ever come across, controlling loudspeakers with such aplomb so as to seem effortless. Transients with the 2200 can be awesome and are certainly on par with the mono Cantatas or anything else making 200 or more wpc. A mistake will take out woofers with a lethal ease, take my word for it. Without seeming forward (remember the balance referred to), the 2200 extends

Ultra High Current Power Amplifier

into the bass region with incredible authority... enough to loosen the neighbors fillings and send the dog running for cover under one of the kids beds.

Clarity and the sense of space on a three dimensional stage were very good. Without effort I could pick out the location of instruments and vocals. Saxophone on "Jazz at the Pawnshop" had an excellent sense of presence, the sax standing clearly apart from the other instruments on the stage. Drums at right rear had perfect placement, and there was a nice feeling of left and right, up and down, as the drummer worked his way around the drum kit.

This amp has some pretty remarkable abilities when it comes to reproducing the feeling of a live event in the listening room. Resolution of inner detail was natural and very revealing, without seeming hyped or exaggerated. Images at the back of the stage were crisp and easy to locate. As a final point let me say that the 2200, after several months of use, continues to improve in its sonic capabilities.

CONCLUSION. When I first listened to the Parasound 2200 I got a funny feeling inside, a queasiness, if you will, regarding how to evaluate it. I'm sitting here with the Allegro Cantata and the Krell KST-100 thinking how *they* defined high-end performance at prices that were starting to be accessible to "Blue Collar Audiophiles", even if it was still a stretch dollar-wise. The Kaye amplifiers have always been a favorite and the Muse amps will forever represent good sounds, solid build, quality and value. How then do I tell you that there is another amplifier that **deserves nothing short of a rave review**, without BFS appearing to belong to the amp of the month club? Is it possible that there exists more than one exceptional amplifier out there? How do I maintain a sense of credibility with readers when I know for a fact that many of you will go into certain audio retailers only to be told that Krell stinks, Coda is a dog, Kaye is a looney or that Parasound is strictly mid-fi?

Due to space and time limitations we will not be devoting extensive editorial space to products that do not deserve it. For example, I have at my disposal a pair of B&K mono-blocks just like those raved about by Sam Tellig (Tom Gillette) of Stereophile. I have never cared for the sound of the amps and would put them somewhere above the AVA Fet-Valves, and below the Parasound 1200 or Soundcraftsmen Pro Power One (a true sleeper). I will not be reviewing the M-200

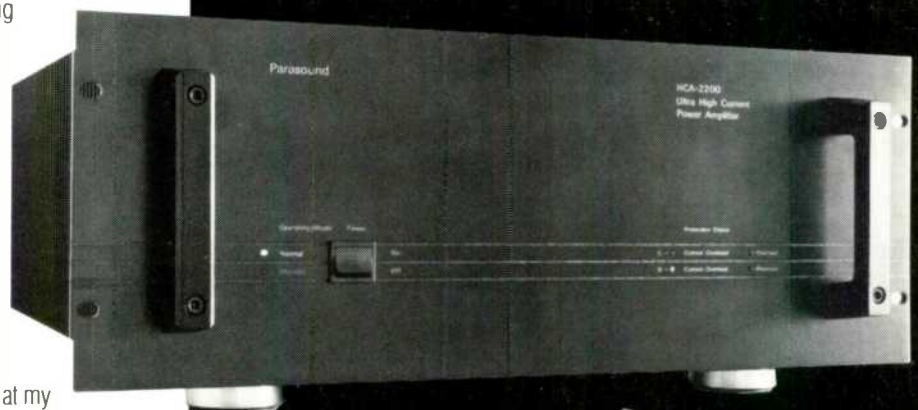
from B&K. If they come up with a new product that seems to me to be of value, I will look at it or have one of the other contributors look at it. Adcom has only made one good product in my opinion, that being the 535, no need to review the rest. A friend has the Aragon 4004, but it sounds soft and too laid back to be accurate. Yes, we look at quite a few products from Counterpoint, Parasound, Muse, Krell and mas, but that's for a reason - these products consistently sound ACCURATE while providing a value; not because they advertise, or give us things for free. I make a conscientious effort to print reviews of products that offer something to you, the reader's. I prefer talking about Parasound and Fried products over Apogee loudspeakers and Air Tight tube amps because the Parasound and Fried are **not aimed at people with more money than brains.**

So this is how I'm going to approach the review of the Parasound 2200 power amplifier. **I want you to add it to the list of truly fine products that have something special to offer in terms of value regardless of what it's compared to or what anyone else says about it. It stands on its own in terms of build and performance, being basically as good (accurate) as any amplifier that I am aware of, and better (more accurate) than most."**

-- Martin DeWulf--

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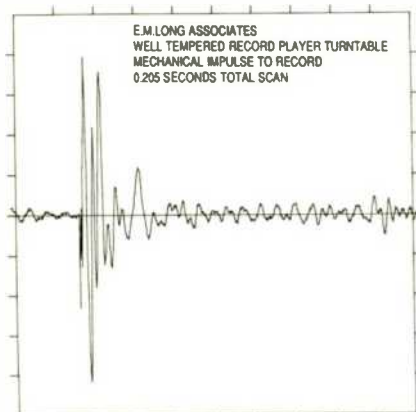


Fig. 13—Output vs. time for a mechanical impulse applied to the edge of a stationary record, with stylus resting in groove.

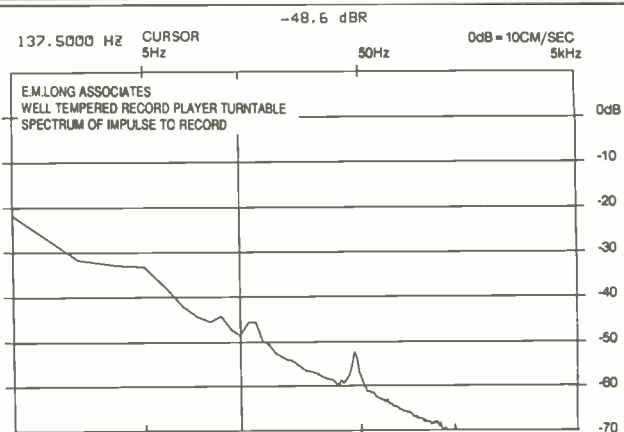


Fig. 14—Spectrum to 5 kHz of output from mechanical impulse applied to the edge of a stationary record, with stylus resting in groove.

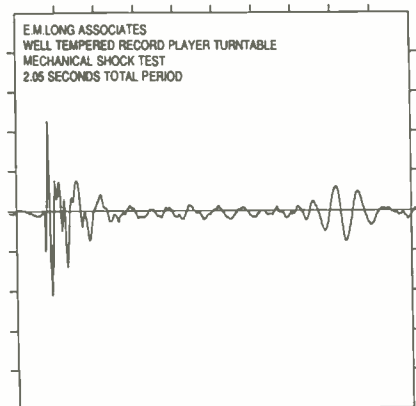


Fig. 15—Output vs. time for a mechanical shock applied to the platform on which the turntable rested.

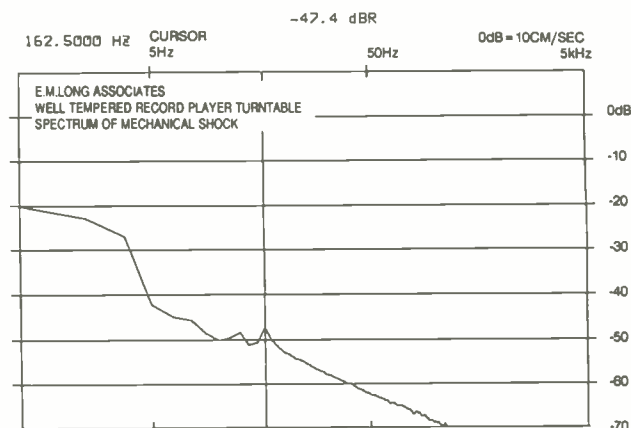


Fig. 16—Spectrum to 5 kHz of the output caused by mechanical shock applied to the platform.

cal impulse applied to the edge of a stationary record. These figures indicate that the absorption of energy from the record by the turntable platter is very good, which helps to improve the clarity of the sound. The output versus time for a mechanical shock applied to the platform on which the Well Tempered Record Player was resting is presented in Fig. 15. The delayed output, shown in the trace, is at the tonearm/cartridge resonance but is very low, considering the fact that the turntable is not suspended by springs and rests directly on the platform. The spectrum of the output shown in Fig. 16 also indicates that outside mechanical vibrations should not be a problem for the Well Tempered Record Player. The energy is concentrated in the lower range, where the good damping of the tonearm keeps the vibrations under control.

Conclusions

The Well Tempered Record Player succeeds in the goal of providing a level of performance close to that of the original Well Tempered turntable and tonearm combination at a reduced cost. The van den Hul MM-1 cartridge is priced well below the MC-One, reducing the total cost even further. The listening panel's rating for this combination indicates that it provides good performance compared to the much more expensive reference system. The sound was recessed and more muted in the upper frequencies due to the MM-1 cartridge, but upgrading to the MC-One would help this. The Well Tempered Record Player is well positioned as far as cost and performance are concerned and should fulfill the requirements of many audiophiles who have a limited budget.

Edward M. Long



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4

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Grounding: Star grounding for hum and r.f. rejection; switchable connection to chassis ground.

Dimensions: 13 in. W x 3½ in. H x 5¼ in. D (33 cm x 8.9 cm x 13.3 cm).

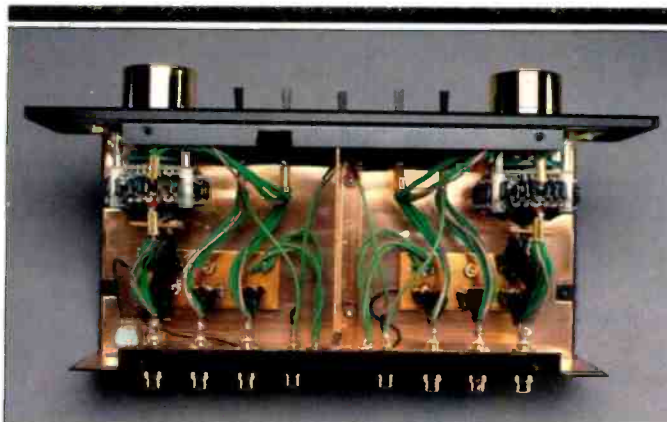
Weight: 9½ lbs. (4.3 kg).

Price: \$2,195.

Company Address: 833 Southwest Sunset Blvd., Suite L57, Renton, Wash. 98055.

For literature, circle No. 94





Now here is a device after my own heart: A passive preamp/control center using switched attenuators. I have been using a similar unit, although one not nearly as carefully thought-out and crafted, for a number of years as my reference. I have reviewed various active preamps and line-level stages over the years, and even though apparent detail and resolution have been improved over my passive reference in a number of cases, I have always preferred the overall musicality of my reference. Apparently, I am not the only person who thinks this way, as witness the component being reviewed here.

First Sound's Reference II (to shorten its formal title) functions like a standard preamplifier in providing input signal selection and control of volume and balance. Unlike a standard preamp, it doesn't have an active line-level stage for driving the cable to the power amp. Further, it does not have a phono preamp stage. The Reference II provides for three signal inputs and for two outputs, main and tape out. For a simpler and purer signal path, there is no balance control per se, but rather two individual volume controls with big, gorgeous golden knobs. Balance is accomplished by setting the individual volume controls appropriately. This is a pain in the butt at first yet is fairly easy to get used to. Other controls on the front panel are five toggle switches. The two outside switches select input "1" or "2," and the pair just inside of them switches between the "Main" input, muting, or the signal selected by the previous switch pair. The switch in the center, "Normal/Record," enables or disables the tape output jacks. The input selector switches are separate for each channel, and the center switch is the only common physical point between the otherwise separated and shielded channels.

On the rear panel are the signal input/output connectors. Of these, the jacks for the "Main" signal input and output, and for input "1," on my sample were WBT phono connectors, while the jacks for input "2" and output "2" (tape) appeared to be Tiffany brand; current units, however, use Cardas jacks throughout. According to the manufacturer, the "Main" inputs are the purest or least "unhindered," so they should be used for your most favored source instead of input "1" or "2." A toggle switch on the lower right-hand corner connects or isolates the chassis ground and the grounds of both signal channels.

The Reference II's enclosure is made up of two U-shaped pieces. One piece is bent to form the front subpanel, bot-

tom, and rear of the unit, while the other forms the top and sides. A 1/4-inch-thick front panel completes the physical picture. The chassis is aluminum and lined with copper for maximum shielding against r.f. interference.

Circuit Description

I can hear it now: Circuit description? How can he talk about a circuit without amplifying devices? Well, let me tell you, if manufacturers of active electronics paid as much attention to the passive circuitry of their products as was lavished on the Reference II, their products could sound considerably better. Of the many elements that make up the Reference II, I'll start with the selection of the volume-control attenuators. These are Shallcross step rotary switches that comply with MIL-S3786/40 Standard and are specifically designed to endure vibration and both physical and thermal shock. These switches have a contact rating of 10 amperes continuous at 115 V—most likely the highest contact rating ever used in the hi-fi industry for an attenuator. Solid silver-alloy contacts are used in both the fixed and movable parts of the switch; the movable parts are double-leaf wiper arms. This means that there is no plating to wear off, giving consistent contact quality over the life of the switch. These switches are really superior and quite costly. (I can attest to their high price, for I use a similar Shallcross switch in my own reference signal selector/switched attenuator. A number of years ago, I bought several switches for, I believe, \$40 to \$50 each.)

The topology of the attenuator circuit is interesting and unusual. Instead of being a tapped voltage divider with as many resistors as attenuation positions, all in series, the attenuator is a ladder type that switches in individual pairs of resistors for each position. (I must say I also use this topology in my own reference unit, an idea originated not by me but by an associate, Tom Baldwin.) Two resistors in a circuit at a time is logically better than, say, 30 resistors, and the mechanical and solder connections to wire them, all in series. These resistors are made by Holco and use no steel or ferrous material in their construction. According to First Sound, they are superior to the "industry standard" Rodenstein Resista units. The 20-gauge copper leads of the wires are looped twice through the solder lugs of the switch contacts to ensure mechanical contact integrity before soldering. In addition, WBT crimping sleeves are used on the



Active electronics might sound better if their makers paid as much attention to circuitry as this maker of passive gear does.

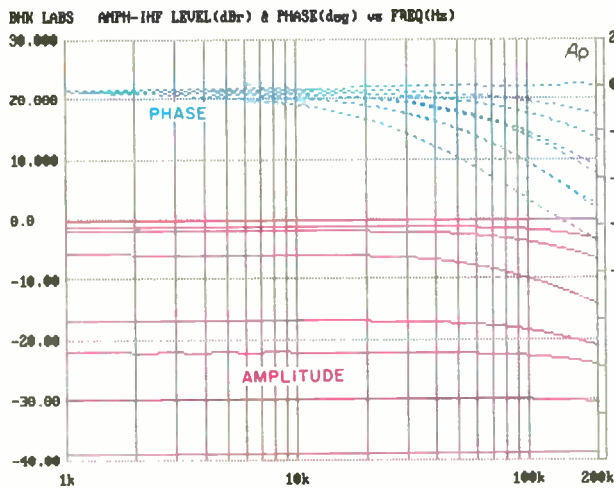


Fig. 1A—Phase and frequency response for volume settings from 0 to -28, for instrument loading; see text. Frequency response curves, from top to bottom, are for volume settings of 0, -1, -2, -6, -17, -22, -25, and -28. Phase response curves, from top to bottom, are for settings of 0, -28, -25, -1 and -22, -2 and -17, and -6.

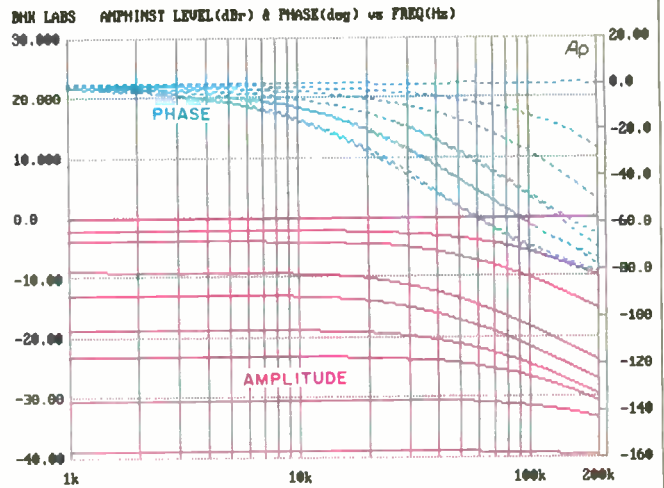


Fig. 1B—Same as Fig. 1A but for IHF loading. Frequency response curves, from top to bottom, are for volume settings of 0, -1, -2, -6, -10, -17, -22, -25, and -28. Attenuation settings for phase response curves are same as for Fig. 1A except that bottom curve is for both -6 and -10.

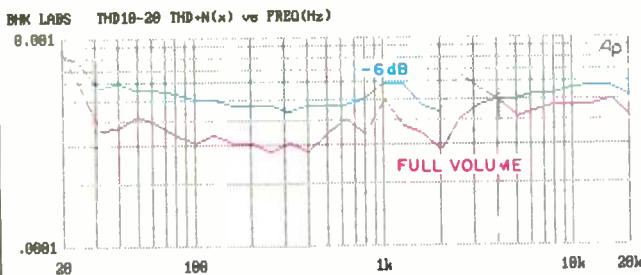


Fig. 2—THD + N vs. frequency, for attenuation settings of 0 (full volume) and -6; see text.

toggle switches and the attenuator input and output joints to further ensure a stable positive mechanical contact for the joints. Copper solder is then applied to these joints.

A variety of Cardas Cable is used for the internal wiring. Each interconnection uses a number of these wires, some as large as 6-gauge, in parallel. First Sound felt that this wire's design, which is said to minimize internal signal-induced vibration, was a factor in minimizing sonic degradation. The internal wiring topology, developed after much listening, includes such interesting touches as orienting the direction of each internal cable for best sound. Two types of solder are used for the various internal joints, a special copper type and Wonder solder.

First Sound makes a point in their technical description of paying as much attention to the ground side of the circuit as to the hot side. The signal common leads can be connected to the chassis, or isolated from it, by setting a rear-panel switch; the designers say that isolated operation is preferred, perhaps for better rejection of external fields, but that grounded operation may yield lower hum in some installations. The common point for all of the ground connections in each channel is a large, thick ground-bus plate, made of oxygen-free copper, at the bottom of the enclosure. These plates are electrically isolated from the chassis by insulated standoffs and are connected to each circuit point by a number of individual Cardas wires in parallel.



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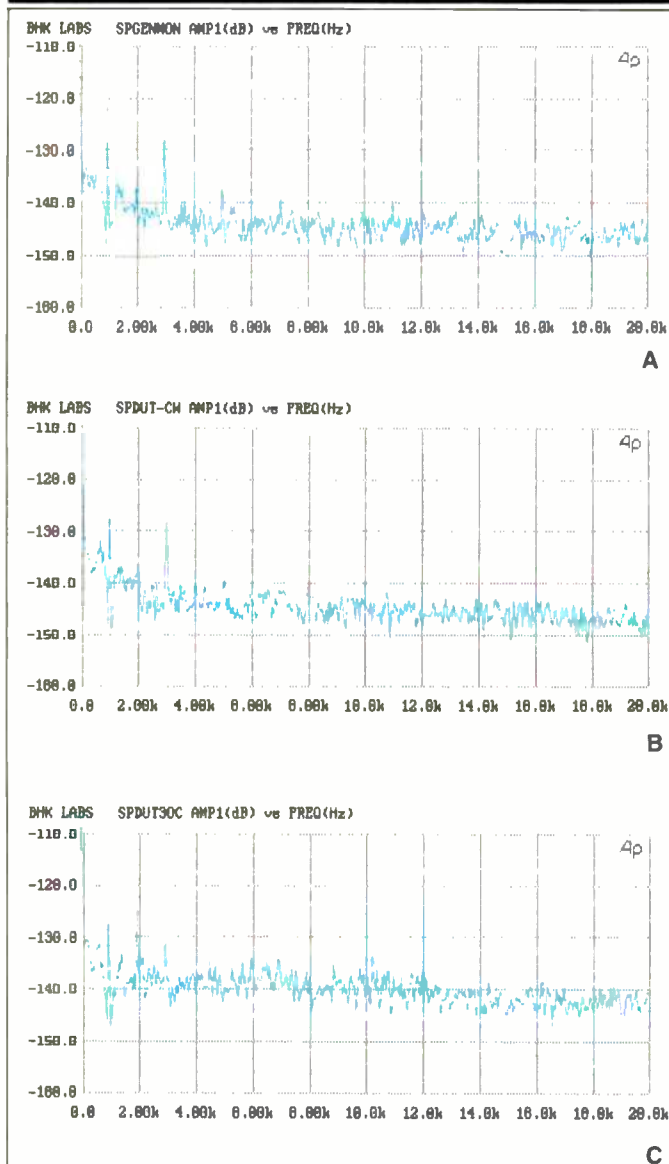


Fig. 3—Distortion spectra for test system generator output (A), Reference II with volume control at maximum (B), and Reference II with volume control at -6 (C). See text.

The descriptive literature for the Reference II states that just the right kind and amount of vibration damping has been applied, again determined by listening tests. Unwanted vibrations are handled by special damping material applied wherever First Sound considered it appropriate. The feet of the unit are cone-shaped, mounted to the bottom

of the chassis with large bolts but isolated with Navcom damping material.

The owner's manual and other descriptive literature supplied with the Reference II were very informative and make a good case for the techniques used in the unit's construction.

Measurements

Again, I can hear the muttering out there: What's to measure on something with no amplifying devices? One very measurable thing is the Reference II's effect on frequency response delivered to the power amplifier as a function of interconnect cable capacitance and volume-control position. I also thought it would be interesting to see if the great resolution of my Audio Precision test gear could reveal any distortion added by this passive circuitry.

Figure 1 shows the effect on frequency and phase response of the Reference II, with two different loads, as a function of attenuation. In both figures, the knob positions used to produce the curves are the same except that an extra curve, for position 10, has been added to Fig. 1B. In Fig. 1A, the total capacitance is on the order of 400 pF, which includes my measurement cables plus the input capacitance of the Audio Precision analyzer. For Fig. 1B, the IHF load has been added. The effect of this load's extra capacitance in reducing high-frequency response is somewhat diminished by the load's 10 kilohms of resistance, which helps to lower the attenuator's effective series resistance at its highest output resistance points.

The curves in Fig. 1A show pretty reasonable high-frequency response and are more or less representative of what you would get with a pair of 1-meter interconnects used between the Reference II and a power amplifier. The response in Fig. 1B is obviously worse but, as a point of reference, is better than that of any CD player. (Note that the frequency scale here ends at 200 kHz.) In my opinion, this is a small price to pay for the otherwise superior sound possible with a passive preamp like the Reference II.

Total harmonic distortion plus noise was measured as a function of frequency at full volume and at approximately 6 dB down, using an input level of 10 V rms (Fig. 2). The plot is essentially that of the System One's residual noise level, as the results looked the same when not going through the Reference II. The top curve, for an attenuation setting of approximately -6 dB, appears to show more distortion because the relative input S/N ratio of the System One is not as good with the input level reduced.

Next, a series of spectra was taken using a 1-kHz frequency and, again, a 10-V input. Figure 3A, the output of the Audio Precision System One's generator, is provided for reference. Figure 3B is the output of the Reference II with the volume fully clockwise. As can be seen, the distortion spectra of Figs. 3A and 3B are essentially identical regarding the amplitudes of the second and third harmonics, the only significant distortion products. In Fig. 3C, the volume is reduced about 6 dB. The noise level is higher, as in Fig. 2, and the second and third harmonics' amplitudes are different than in Figs. 3A and 3B. This difference may or may not be from the Reference II; it could be the System One's behavior with a 5-kilohm source. In any case, it's important to note that we're talking about one part per million here!

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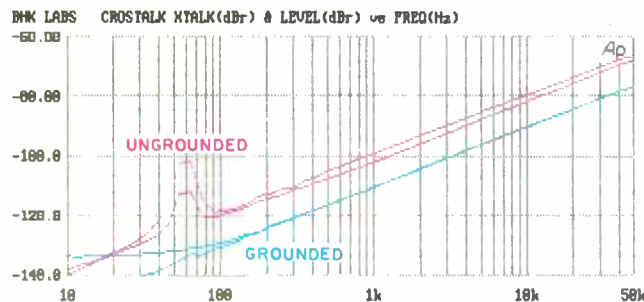


Fig. 4—Crosstalk vs. frequency, at full volume setting, with signal commons grounded to chassis and ungrounded.

Table I—Volume-control attenuation and tracking vs. position, with instrument load.

Volume Setting	Attenuation, dB		Volume Setting	Attenuation, dB	
	LEFT	RIGHT		LEFT	RIGHT
0	0	0	16	-15.80	-15.79
1	-0.87	-0.87	17	-16.76	-16.76
2	-1.77	-1.77	18	-17.80	-17.80
3	-2.71	-2.70	19	-18.83	-18.82
4	-3.63	-3.63	20	-19.82	-19.82
5	-4.61	-4.60	21	-20.88	-20.89
6	-5.62	-5.62	22	-21.95	-21.95
7	-6.59	-6.59	23	-23.91	-23.89
8	-7.60	-7.61	24	-26.93	-26.93
9	-8.61	-8.61	25	-29.92	-29.95
10	-9.63	-9.64	26	-32.99	-33.00
11	-10.64	-10.64	27	-36.00	-35.99
12	-11.68	-11.66	28	-39.00	-39.01
13	-12.70	-12.69	29	-42.03	-42.03
14	-13.73	-13.74	30	-45.00	-45.00
15	-14.74	-14.74			

Crosstalk as a function of frequency is plotted in Fig. 4. The curves showing greater crosstalk, and a bit of 60-Hz hum, are with the chassis enclosure not grounded to signal common; the lower curves are with the chassis grounded to signal common. The performance here is quite good. Further, and this is not usual, the crosstalk shown for 0-dB attenuation with the enclosure grounded did not increase when the controls were set at about -6 dB.

Table I shows both channels' tracking and actual attenuation values with a 100-kilohm load. Maximum tracking error is 0.03 dB. Is this accurate or what?!

Use and Listening Tests

Signal sources used to review the First Sound Reference II included an Oracle turntable fitted with a Well Tempered Arm and Spectral Audio MCR-1 Select cartridge fed to the Reference II through a Vendetta Research SCP-2B phono preamp. Magnavox's CDB-560 CD player, used as a trans-

port, and Krell's MD-1 CD transport were paired with both Wadia 2000 and Krell SBP-64X decoding units. The remaining program sources were a Nakamichi 250 cassette recorder, a Technics 1500 open-reel recorder, and a Nakamichi ST-7 tuner. I hooked up and used the Reference II just as I do my own signal selector and switched attenuator unit—or any active preamplifier, for that matter. High-level sources, including the output of the Vendetta Research phono preamp, were connected to the inputs; the outputs drove the interconnect cables that went to the power amplifiers. These power amplifiers included a pair of Carver Silver Sevens, a pair of Luxman MB3045s modified to use EL-34 output tubes, a Jeff Rowland Model 1, a McIntosh MC2600, and a prototype 50-watt/channel switching amplifier designed by a friend of mine. Speakers used were the Spica Angelus, the Martin-Logan Monolith III, and an experimental pair of two-way systems that were loaned to me by Arnold Nudell.

When I first received the Reference II, I immediately put it in my system. First impressions were that it sounded just about like my own reference signal selector/switched attenuator. I then loaned it to a friend who has a great-sounding system consisting of a pair of Apogee Divas driven with EAR 549 200-watt tube amps. This friend has a phono preamp like my reference tube preamp and a signal selector/switched attenuator like my own but with different kinds of attenuator and signal-selector switches. After using the Reference II for a while, he thought that it sounded about like his normal unit.

After measuring the Reference II, I set it back up in my system. Again, I thought it sounded about like my own unit but with a trace more openness due, perhaps in part, to its higher cutoff frequency when driving my interconnect cable. I think the Reference II sounds absolutely outstanding and takes the passive preamp/control approach about as far as I can reasonably think of its going. There are some engineers who think driving an interconnect to the power amp with a passive volume control is just not right. They correctly cite variable frequency response (demonstrated by the figures here) and claim that you can't have high fidelity with a cutoff frequency that is so low and variable. I have heard good-sounding line sections with low output impedance that bring a bit more detail and resolution to the music, but I generally have been happier with a setup using something like the Reference II. However, I am going to research this situation further with a tube preamp I recently heard that has the above-mentioned effect on the reproduction.

When I used the Reference II, the only objection I could think of was that the knobs are a bit hard to turn. I would have opted for softer switch detents for easier turning. The manual does say that the knobs will loosen up with use, although I haven't seen much change so far. The piece is somewhat front-heavy when not hooked up, but that works in favor of its not tipping backwards when the cable load weights it down from the rear.

In conclusion, I think that First Sound's Reference II is about as good as a passive volume-control system gets. If the prospective purchaser's tastes are at all similar to my hopefully clear biases, I would enthusiastically recommend this unit.

Bascom H. King



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AKG K280 EARPHONES

Manufacturer's Specifications

Transducer Design: Dynamic.

Coupling to the Ear: Circumaural.

D.c. Resistance: Left, 76.3 ohms; right, 77.0 ohms.

Absolute Polarity: Negative.

Cord: 9 feet long from left earcup, with ¼-inch stereo phone plug.

Adjustments: Headband slides in bail; self-adjusting with elastic tension band.

Weight: 10½ oz.

Price: \$199.

Company Address: 1525 Alvarado St., San Leandro, Cal. 94577.

For literature, circle No. 95

AKG is an Austrian company that specializes in making high-quality audio transducers such as microphones, phono cartridges, and earphones. Over the years, they have spent a considerable amount of time researching the problems associated with the design of earphones. Their goal is to produce earphones that give the same impression one would have when listening to the original sound in a natural, diffuse-field environment.

The AKG K280 earphones are well made, with good finish. The attention to detail is very evident, from the easy adjustment of the comfortable headband and the stitching around the foam-filled vinyl ear cushions, to the "L" and "R" embossed on the bail spacer that indicate left and right channels. I especially like the idea of having "open-air" type earphones with cushions that fit around the ears rather than sit on them, as is the case with some other earphones that use the open-air acoustical design concept. There is very little pressure against the ears, and although the K280 earphones weigh 10½ ounces, they feel much lighter and it's easy to forget you are wearing them. Ordinarily, the lack of tight seal around the ears would impair bass output, but the K280 earphones are designed to allow for this; their bass output has been increased accordingly. AKG uses two identical dynamic transducer elements mount-



ed in the same earcup, both covering the entire frequency range. They are placed one above the other and canted at about 15° toward the ear. This provides the ability to deliver higher acoustic output than a single element could at the same distortion level, as

well as a better sensitivity match between the left and right earphones because two elements average out any difference in sensitivity.

The subjective sound qualities of the AKG K280 earphones were rated by members of a listening panel, some of

EARPHONE EVALUATION

PARAMETER	RATING	COMMENTS
Overall Sound	Good	
Bass	Very good	"Boomy" and "Bass-heavy"
Midrange	Good	"Bright upper range" and "Sharp"
Treble	Good	"Slightly smeared"
Overall Isolation	Poor	
Bass	Poor	"No low-frequency isolation"
Midrange	Poor	"It's easy to hear normal outside conversation"
Treble	Fair	"Highs from outside are muted"
Comfort	Very good	"Very good for long-term listening"
Value	Very good	

GENERAL COMMENTS: Very comfortable; good adjustments; good bass; distant perspective; some coloration but very pleasant for long-term listening.

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The AKG K280s deliver high sound levels from low power and are comfortable for long-term listening.

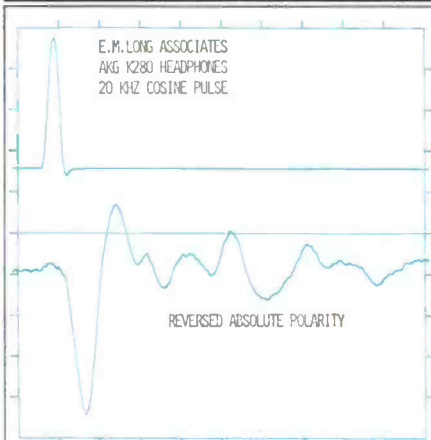


Fig. 1—Output vs. time (bottom) for 20-kHz cosine pulse (top); see text.

whom years of experience evaluating high-quality audio components. They were asked to listen to various selections and write down their comments. Remarks about the bass being "boomy" and "bassy" correlate well with measurements that I made, which showed an increase in output in the lower range that reached a maximum at 125 Hz. Comments about the perspective being "distant" and "recessed" may be correlated with the range between 2 and 5 kHz, where the output was lower than it should be.

Comments from the listening panel about the mid- and high-frequency ranges (shown in the Evaluation Table) can be correlated with the way the K280 earphones reproduced the spectrum of a 500-Hz square wave. The output at the ninth, 11th, 13th, and 21st harmonics (4.5, 5.5, 6.5, and 10.5 kHz, respectively) were higher than they should have been. This correlates with the comment regarding "bright upper range," while the level of the seventh harmonic (3.5 kHz) was low, resulting in "distant" perspective. The levels of the 17th harmonic (8.5 kHz) and 23rd harmonic (11.5 kHz) were also lower than they should have been, correlating with other measurements that I made which showed reduced output above about 12.5 kHz.

Figure 1 is the output of the AKG K280 earphones for a 20-kHz cosine input. The input pulse is shown at the top; the output from the AKG K280

earphones is below. The output after the input has stopped correlates with a comment that the sound was "slightly smeared." The output also shows a negative absolute polarity, which may account for the comments made about the articulation of voices ("lacks clarity" and "not as clear as the reference earphones"). Although I didn't give the panel members the option of changing the absolute polarity, I did do it myself. The articulation and realism of the voices, on some recordings, were better when I reversed the polarity.

I also measured output versus frequency with a Fast Fourier Transform analyzer. I made two measurements, one directly in front of one transducer element and the other between the two elements. The response between elements showed good output up to 12.5 kHz, where it dropped off sharply. The response directly in front of one element was higher above 9 kHz. This shows that slight changes in position of the earphones can affect the output in the upper range. Although this isn't a major problem, you should be aware that the sound quality of the K280 is slightly position-dependent. Since I measured the earphones before the listening sessions, I asked each panel member to adjust the position to get the best sound, especially in the upper range. Some response irregularities that I found may have been due to reflections from the plastic side walls of the earcup to which the dynamic transducers are mounted. Comments such as "nasal sound" and "coloration" can be correlated with this type of problem. I measured the phase transfer function, and the results indicated that it also is affected by the K280's position.

The AKG K280 earphones have the advantage of being able to produce very high sound levels with relatively little input power. They are very comfortable for long-term listening, and it is easy to forget that you are wearing them. Despite what might appear to be a rather negative tone to some of the comments made by members of the listening panel, they gave the AKG K280 overall ratings of "good" and "very good" for sonic qualities and "very good" to "excellent" for physical attributes. Give them a listen if you are thinking of buying high-quality earphones.
Edward M. Long

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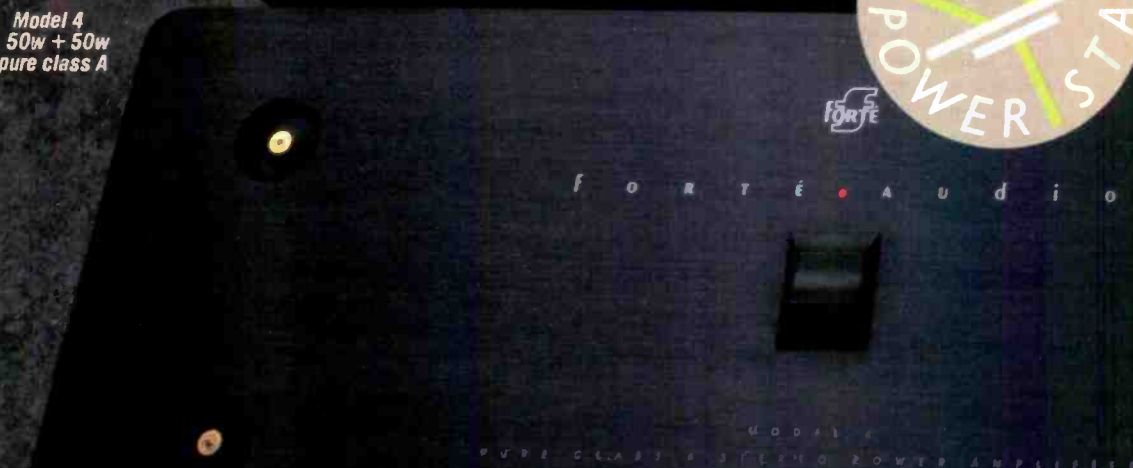
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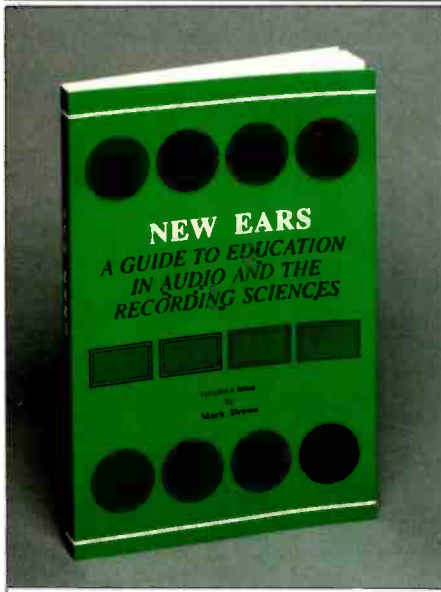
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New Ears: A Guide to Education in Audio and the Recording Sciences, compiled and edited by Mark Drews. New Ear Productions, softcover, 208 pp., \$11.95. (Available from New Ear Productions, 1033 Euclid Ave., Syracuse, N.Y. 13210.)

Your clock radio turns on at 6:00 a.m. like, well, like clockwork, playing a medley of early Beatles tunes—not a bad way to start a morning. While heating up a bagel, there's just enough time to catch the TV news, with sound bites from Washington, New York, and the Persian Gulf. Traffic's not too bad today, but your CD changer is still a comfort, with your eclectic collection of driving music. They are paging you even as you walk into the office, and your phone doesn't stop ringing all day. Fortunately you've got two tickets to *Die Walküre* tonight—that should be a welcome relief.

Clearly, the benefits and distractions of audio technology are all around us, from clock radios to car stereos, from telephones to opera house acoustics. All are examples of a profession that combines art and engineering to bring us everything from the commerce of voice to the joy of music. More specifically, all of that exists thanks to the thousands of audio professionals practicing their craft in broadcasting studios, recording studios, manufacturing plants, consulting firms, and even editorial offices.

Yet most of these professionals have come to audio by a circuitous route, through electrical engineering colleges, electronics trade schools, military training, music performance, or even from an entirely unrelated field of study. Until recently, there were no education programs specifically designed to train audio professionals. That has changed, as a wide variety of academic and trade school curricula have been developed to meet the growing need for skilled personnel in audio professions.

In fact, the large number of programs, and their diversity, has made it difficult for prospective students to find the program best suited to their backgrounds and aspirations. Recognizing this problem, Mark Drews has compiled a directory of audio education programs and published it as *New Ears: A Guide to Education in Audio and the Recording Sciences*. In its 208 pages, it profiles over 80 programs and provides a master list of more than 320 audio-related programs at universities, trade schools, and education workshops in North America and worldwide, ranging from short courses to graduate study.

A wealth of information is provided on the profiled programs, including degrees offered, program length, tuition, class size, financial aid, admissions policy, and specific course offerings. Using this consistently presented database, it is easy to compare programs and identify their strengths and focus. In this way, prospective students can quickly find the program best suited to their needs. The master directory of programs is given alphabetically by state and country. This is convenient for locating programs in a specific geographical area and in identifying programs not profiled. The book also contains directories of audio publishers, magazines and journals, professional industry associations, and suggested books, plus a useful bibliography and even some words of wisdom based on the author's own experiences as a music engineering student at the University of Miami.

Of course, any book grows obsolete after it is published, and *New Ears* is no exception. Since it was published in 1989, changes have taken place in the field of audio education. Fortunately,

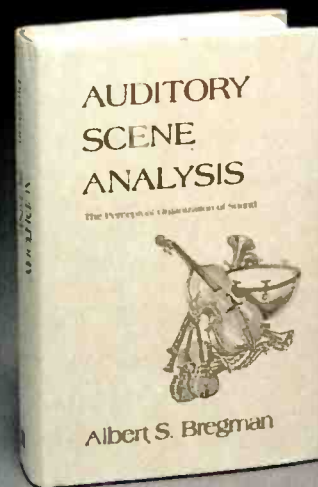
with the many phone numbers and addresses supplied, it would be an easy matter for a prospective student to contact a listed institution for the latest information.

Anyone interested in pursuing a career in audio engineering, music recording, or a related field should start a search for appropriate education with *New Ears*. It will save you many hours of do-it-yourself research and provide a concise, consistent summary that makes comparison shopping easy. Given the high cost of education, and the low cost of this comprehensive book, it may be the smartest decision you'll make.

Ken C. Pohlmann

Auditory Scene Analysis: The Perceptual Organization of Sound by Albert S. Bregman. A Bradford Book, The MIT Press, hardcover, 773 pp., \$55.00.

The study of hearing, long the province of researchers absorbed in the plotting of sensory thresholds, discrimination functions, scaling functions, and the like, is broadening into a new and exciting area of research, made possible by recent developments in audio technology. Armed with the ability to synthesize virtually any time-varying sound signal that can be imagined, to digitize naturally produced sounds, store them in computer memory, and analyze and transform them in numerous ways, researchers





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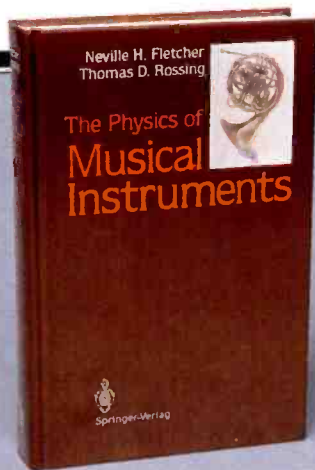
The Physics of Musical Instruments presents a fine balance among mathematical rigor, graphical detail, and verbal description.

are at last coming to grips with the difficult yet central problems of sound perception.

For example, suppose that you are listening to a symphony in a concert hall. The mixture of sounds that reaches your ears is produced by many instruments playing simultaneously. What principles does the hearing mechanism use to sort out this mixture of sounds, so that we identify the violins as playing one melodic line, the cellos another, and the flutes another? We do this with such apparent ease that one might assume the perceptual task to be a simple one. Yet there is no computer system in existence that can perform such an analysis reliably.

To take another example, you pick up the telephone and immediately recognize a friend's voice at the other end of the line. Yet this is the first time you have ever heard this particular sound spectrum. What are the cues that enable us to recognize a specific sound quality such as this, even in the face of considerable signal distortion? This task also appears deceptively simple, yet at present we do not know how it is accomplished.

Albert S. Bregman's *Auditory Scene Analysis* provides an up-to-date and comprehensive account of research and theory in this field. It focuses primarily on Bregman's own very interesting work, but also draws on that of other psychologists and related work by computer scientists and musicians. The book contains over 700 pages, which are packed with information concerning details of lab experiments, debates over their interpretation, and theoretical speculations. There are lengthy explorations of the primitive grouping principles by which we link together components of the ongoing acoustic spectrum—frequency proximity, temporal proximity, spatial location, similarity of timbre, and so on. Then there are explorations of what psychologists call "top-down" or "schema-driven" processes in auditory perception—the uses made by the hearing mechanism of past experience with sounds. Other sections of the book deal with the applications of these principles to the perception of particular classes of sound, for example those of speech and music.



This book is not for casual reading. The arguments are so synthesized and intermixed that you really have to read it from beginning to end in order to develop a clear understanding of Bregman's view. But for those prepared to devote the time, *Auditory Scene Analysis* contains much valuable information and food for thought.

Diana Deutsch

The Physics of Musical Instruments by Neville H. Fletcher and Thomas D. Rossing. Springer-Verlag, hardcover, 620 pp., \$69.00.

While Neville Fletcher may be a new name to most of us, Thomas Rossing is well known in the United States for his excellent textbook, *The Science of Sound*, and for his contribution to the *Auditory Demonstrations* CD, which is distributed by the Acoustical Society of America.

Fletcher and Rossing state that their new book is addressed to a reader "with a reasonable grasp of physics and who is not frightened by a little mathematics." A further aim has been to bridge the gap between the many books that treat musical instruments largely in a graphical and historical way and the body of detailed quantitative analysis normally found in scientific journals. The book certainly succeeds in this regard.

The authors lay a rigorous foundation on which to understand the particulars of musical instruments. The first section deals with vibrating systems (in one and two dimensions), coupled systems, and nonlinear systems. These are, of course, the basic mechanisms for generating and sustaining

sounds mechanically and for radiation via sounding boards.

The next section deals with plane and spherical sound waves, level and intensity, and the nature of sound reflection, diffraction, and absorption. Sound radiation is discussed basically in terms of ideal point, line, and plane sources. Air columns and horns are discussed as a prelude to the discussion of wind instruments.

With the fundamentals covered, the authors move on to string instruments, and the reader who has done his homework, so to speak, is now able to move more or less freely between detailed physical descriptions of instruments and the pertinent mathematical equations. In the third section, both plucked and bowed instruments are discussed in terms of their history, construction, lore, and modes of playing. Physical descriptions include detailed spectral and directional characteristics of many of the instruments.

Keyboard string instruments are discussed in terms of construction, details of action, tuning, various inharmonicities, unique decay characteristics, and directional properties. Rarely have I seen such detail in descriptions of sounding-board nodal structure and output spectra.

The next major section deals with wind instruments and includes the three orchestral classes of lip reeds (brass), flutes, and woodwind reeds. As in earlier sections, the descriptions of instrumental output spectra and directional properties are richly detailed. The pipe organ is given special treatment here.

In the percussion section, instruments are divided into the categories of drums (membranophones), mallet instruments (tuned xylophones and metallophones), cymbals, gongs, plates and steel drums (untuned metallophones), and bells.

All in all, the book presents a fine balance between mathematical rigor, graphical detail, and verbal description. The book can function as a specialized text at the upperclassman or graduate level, but the intuitive clarity of so many of the graphs and descriptions recommends this work as a broad source of information for the reader who may, in fact, be frightened by a little mathematics! John Eargle



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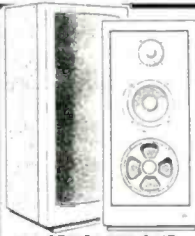
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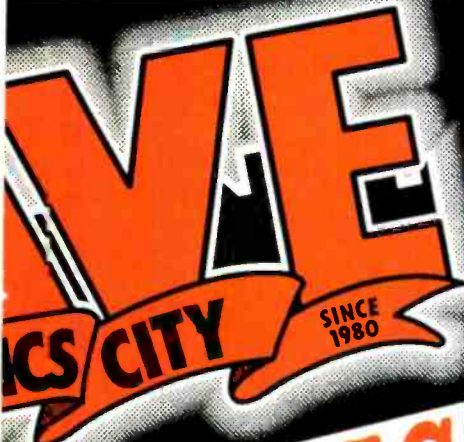
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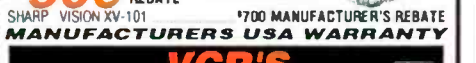


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THOROUGHLY MODERN MOZART



hesitant. Not bad, just marginally noticeable. Was it not enough rehearsal? (The strings do the major work in such music.) Didn't the players connect with Barenboim's conducting signals? (They're used to a conductor up on the podium.) Or was it perhaps a "live" performance, with no alternative takes available? No audience is apparent, nor mentioned. Don't worry. It's still the best Mozart around.

Edward Tatnall Canby

Au Jardin des Aveux: Songs and Duets of Saint-Saëns, Chausson, Gounod, Faure, and Messiaen. Ann Murray, soprano; Philip Langridge, tenor; Roger Vignoles, piano.

Virgin Classics VC 7 91179-2, CD; DDD; 66:50.

The degree to which you think this recording falls short of being superb will depend largely on your tolerance for squally singing. Wonderful as they are elsewhere (which is most of the disc), both singers repeatedly lose focus and even control on the climaxes, which are raucous and forced as a result. What a pity! Otherwise, this would have been a CD to recommend without the slightest reservation.

Its layout is not unique, but it works extraordinarily well. Each composer is afforded a group of four or five numbers (though Messiaen gets only one) that has a beginning, a middle, and an end and is varied between duets and solos for one singer or the other. This gives each group variety and yet a sense of going somewhere that is lacking in most recitals of individual songs (as opposed to cycles). And they are wonderful songs. From the familiar (the Gounod "Sérénade," for instance) to the farcical (a virtuoso vocal duet version of the Saint-Saëns "Danse Macabre"), the recording is musically beguiling throughout.

If it is axiomatic that Spanish singers can't trill, I have always assumed a corollary to be that British singers can't pronounce French. Wrong! Both Ann Murray and Philip Langridge are astonishingly idiomatic in both diction and musical phrasing; the lapses are both minor and infrequent. I wish most American singers (whom I generally consider far superior in this respect) could do as well.

Mozart: Piano Concertos Nos. 20-27. Daniel Barenboim, pianist and conductor; Berlin Philharmonic. Teldec 9031-72024-2, four CDs; DDD; 4:04:00.

Four CDs, two of the memorable late concertos on each, and this recording is as near to impeccable perfection as I've ever heard. The pianist is mature, thoughtful, utterly aware of every note and phrase in the music, a miracle of cool yet profound understanding. The conductor also—he is the same man, Daniel Barenboim. Just as Mozart himself conducted these works from his own early piano.

Barenboim was a child genius of an in-between generation, born in South America of exiled parents, an Israeli at age 10 and a world figure in his early touring years. He arrived at a time when the new Israelis were a bit daunting, musically—so much force and intensity! I remember him just that way. Now, young-middle-aged, he has lived through difficult times but clearly has never ceased studying, expanding. If a pianist who conducted Wagner's *Parsifal* at Bayreuth can play Mozart so superbly, he is indeed an expanded prodigy—for he is now much more than a Mozart specialist.

Barenboim somehow avoids the mannerisms of a couple of generations, for a synthesis in the playing of these works that is exactly right for our time. It is not the old, precious pointillist Mozart of the earlier century, played almost with disdain on the tips of fingers used to Rachmaninoff and Chopin. Nor the slightly naive romantic playing that puts Mozart in the manner of Sibelius, from too many new, young pianists who will learn better. Not a note is out of place. Every musical phrase has its shaping and direction, including the Mozart "runs," those cascades of fast notes that *always* have direction and shape, as too many pianists do not understand. In other words, for a while it is Mozart as he has to be. Serious when the music is profound but not ostentatiously so, letting the music speak. Humorous but never shallow or undignified.

One curious minor fault. The smallish modern-type orchestra is right, but though the winds and percussion are models of precision, the strings are oddly inaccurate in many tiny details of pitch and entrance—while playing, even so, in a warm and highly musical fashion. No complaint there! Positively Viennese.

One or two of these minor flaws are downright clumsy. Some are merely

Illustration: Rick Tulka

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At any age, an artist with Evgeny Kissin's playing ability would stand out; Kissin's exceptional youth makes him phenomenal.

Accompanist Roger Vignoles leaves nothing of any importance to be desired, and the engineering is bright and clean, with a good deal of reverberation but not enough to blur the detail. The recording actually was made in a church, though it doesn't convey a very specific sense of space—just a pleasant ambience that nicely matches the mood of the recital. Texts are included, together with English and German translations.

Murray and Langridge have both distinguished themselves in Hyperion's complete Schubert Edition songs series. This recording reveals yet another layer of their multifold talents. Because they have so much going for them, it's tempting to attribute the badly managed climaxes to microphone overload. Alas, I fear technology is blameless here.

Robert Long

Mozart: Symphonies Nos. 21, 23, 24, and 27. Amsterdam Baroque Orchestra, Ton Koopman.

Erato 2292-45544-2, CD; DDD; 53:05.

Not too long ago the numerous early Mozart symphonies were considered musical small potatoes and were played exactly that way, with condescension. Today, given their rightful place as sophisticated, masterful light entertainment, they can be delightful—quite aside from the weightier late symphonies. The big punch in this perceptive recording of four of these earlier



symphonies is the "authentic" orchestra, entirely composed of instruments of the sort used in Mozart's day. The players are expert enough—as if to prove it, the speeds are recklessly fast in most movements, hilariously so. But not so fast as to obscure good musicianship, good phrasing and shaping. It is exhilarating music or gently sweet in the slower movements, and thoroughly enjoyable! Only the slightly overblurring acoustic tends to hide a few musical details, not seriously.

Edward Tatnall Canby

Kissin in Tokyo. Evgeny Kissin, piano.

Sony Classical SK 45931, CD; DDD; 73:13.

Evgeny Kissin: A Musical Portrait.

Evgeny Kissin, piano; Moscow Virtuosi, Vladimir Spivakov; London Symphony Orchestra, Valery Gergiev; Moscow Philharmonic, Andrei Chistyakov.

RCA 60567-2-RC, two CDs; DDD and ADD; 2:11:43.

Not since 1958 in Moscow, when a young 6½-foot Texas stringbean won first prize for piano in the inaugural

International Tchaikovsky Competition (which I covered), can I recall a young pianist who's caused such an international furor as Evgeny Kissin, born October 10, 1971 in Moscow. Van Cliburn and Kissin (pronounced *Kis-seen*) have much in common. Nowadays one takes such transcendental technique quite for granted, but a rarer, more important aspect of their overwhelming talents deserves even more attention.

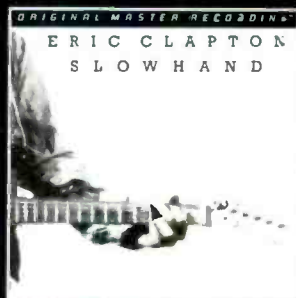
Cliburn's triumphal return to Carnegie Hall stunned the experts 33 years ago: He continued—he embodied—a Romantic approach to pianism (usually called, for lack of better words, "the grand manner") that had become virtually extinct with the deaths of such titanic pianists as Barère, Hofmann, Lhévinne, and Rachmaninoff. The abundance of recent Kissin recordings (precipitously released to exploit the sensation of his American debut) reveals that same panache and flamboyance, that innate quality a few inordinately blessed young musicians can polish but never first acquire, which moved Cliburn's impassioned auditors to shout themselves hoarse. Hearing such playing engenders, on a different

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Pianist Leslie Howard has taken a very serious view of Liszt as a composer, as witness both his playing and his booklet notes.

but related level of esthetics, the same thrill as watching a superbly endowed athlete take superhuman risks—and succeed.

This Sony Classical disc becomes even more extraordinary when you realize it offers Kissin in live performance: He gave this recital in Tokyo, which explains his rather endearing choice of three Japanese folksong encores. At any age, an artist capable of this playing would stand out; Kissin's exceptional youth makes him phenomenal. His performance of the Sonata No. 6 (in my opinion Prokofiev's best) sets a standard probably unmatched since the prime of Sviatoslav Richter, to whom the composer entrusted the world premiere. Even for one so young, Kissin has, to put it simply, virtually everything one could hope for in even a thoroughly seasoned pianist in his mature prime.

Although Kissin comes from the glorious Muscovite tradition of heaven-storming bravura virtuosity, he adapts

his articulation and tone cleanly and neatly to the pristine classicism of Haydn and Mozart. His poetic Romanticism recalls another phenomenon, Ivo Pogorelich—but with the important difference that Kissin, in contrast to the wild young Yugoslav, generally accords the printed score the respect which creative genius deserves from mere interpreters. *Paul Moor*

Liszt: At the Opera, Part 1. Leslie Howard, piano.
Hyperion CDA66371/2, two CDs; DDD; 2:35:51.

These opera-based pieces—paraphrases, transcriptions, variations, "reminiscences," fantasias, and what-not—are great fun, if nothing else, and great vehicles for a master performer (which Liszt was, of course). They are included in Volume 6 of Leslie Howard's complete traversal of Liszt's piano music for Hyperion, and at least one more set of opera pieces (includ-

ing all of the Verdi paraphrases except *Aida*) is yet to come.

Howard takes a very serious view of Liszt as a composer, as witness both his playing and his booklet notes. Those of us who find some of the master's utterance badly overblown may indulge Howard in this for the sake of Liszt's genuine inventiveness—and the need for a master pianist to overcome the fearsome difficulties Liszt set for anyone who chooses to play his music.

So broad and apt is the range of pianistic effects evoked in this collection that it is, overall, more rewarding than the transcriptions in Volume 5 (reviewed in the May 1991 issue). Compared to Claudio Arrau's playing of similar Liszt material on Philips LPs, Howard's approach is much "bigger," though not as rich-toned in the climaxes nor as delicate elsewhere. On balance, Howard's tendency to overstatement may be closer to the mark than Arrau's understatement, but both fall short of the ideal. *Robert Long*

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Storyville: Robbie Robertson
Geffen GEFD-24303, CD; DDD; 54:55.

Sound: B Performance: A-

Much ado has been made about Robbie Robertson's second solo album because he has returned to the source of much of his inspiration, New Orleans. At first it seemed as if it were truly about nothing, but *Storyville* can creep up on you. Not like it's gonna jump out of the bushes and grab you, because Robertson's song cycle moves much too slowly to catch one off guard, but there are constant surprises, as he makes use of vocalists such as Aaron Neville, Mardi Gras Indian chiefs Bo Dollis and Monk Boudreaux, and The Zion Harmonizers. The distant call-and-response vocals bleed into the mix like narrators who repeatedly echo and embellish the protagonist's tale of love found and love lost.

Storyville, though neither chronological nor linear in its narrative development, is a simple boy-meets-girl story with quite a few conceits attached to it. It's an imagistic work that unfolds varied perspectives almost cinemagraphic in their power. Despite veiled and not so veiled references to redemption, return, retribution, and reconciliation, Robertson manages to safely blend sentimentality, romanticism, and morality into a dreamy music. Beyond

that, like James Agee's book *Let Us Now Praise Famous Men*, this album is mysterious in that it is alternately optimistic and bleak. It's as if Robertson is walking his couple through an American landscape where hope and beauty are on the horizon just beyond the fields of frustration and failure. However, *Storyville* meanders rather than rambles, shrouded as much by slightly pretentious and clichéd poetry as it is by the dust and fog, and vague desire.

By layering voices, percussion, martial rhythms, brittle stinging guitar, organ, and keyboards around his raspy singing, Robertson creates a delicate sound that pleads for closer attention. More volume would just disturb the peace. Yet the effective intimations of something heavy to follow are part of the mirage that *Storyville* chronicles as well as becomes. Since the music is diffuse, it lacks a center of gravity, and at times this is unsettling. Plus, most songs kick along at a gentle groove even when prodded by New Orleans arranger Wardell Quezergue's punchy, parsimonious horn charts. Though Robertson doesn't include any up-tempo scorches, he rocks with a quiet energy like that of Paul Simon while threatening with the ominous fury of fire and brimstone. In the end, *Storyville* succeeds because of the atmospheric details, yet almost fails because the finery is flirtatious. *Don Palmer*

Rock On!: Del Shannon
Gone Gator/MCA MCAD-10296, CD;
AAD; 36:29.

Sound: B Performance: B+

Del Shannon, like Roy Orbison, was an old-time rocker whose recording career was being revved up again by his friends/fans Tom & Jeff (as in Petty and Lynne) when his untimely demise cut his comeback short. Del was a better writer than singer; his approach leaned toward the cornball (witness "Runaway" or "Hats off to Larry") but was more arch than operatic (the opposite of Orbison's).

These last recordings find Del produced with a sympathetic ear, and though his lyrics leave the listener wondering what decade we're in, his melodies are as strong as ever. Producers Mike Campbell and Lynne (as well as performances by Petty and most of The Heartbreakers) do manage to lighten up Del's pathos and angst, but it would have been nice if more harmonies had been added to disguise Shannon's vocal weaknesses. And they missed the boat with their choice of a cover tune ("What Kind of Fool Do You Think I Am"); the perfect song for Del is "Suspicious Minds." It's unhappily too late to change that now. . . .

Jon & Sally Tiven

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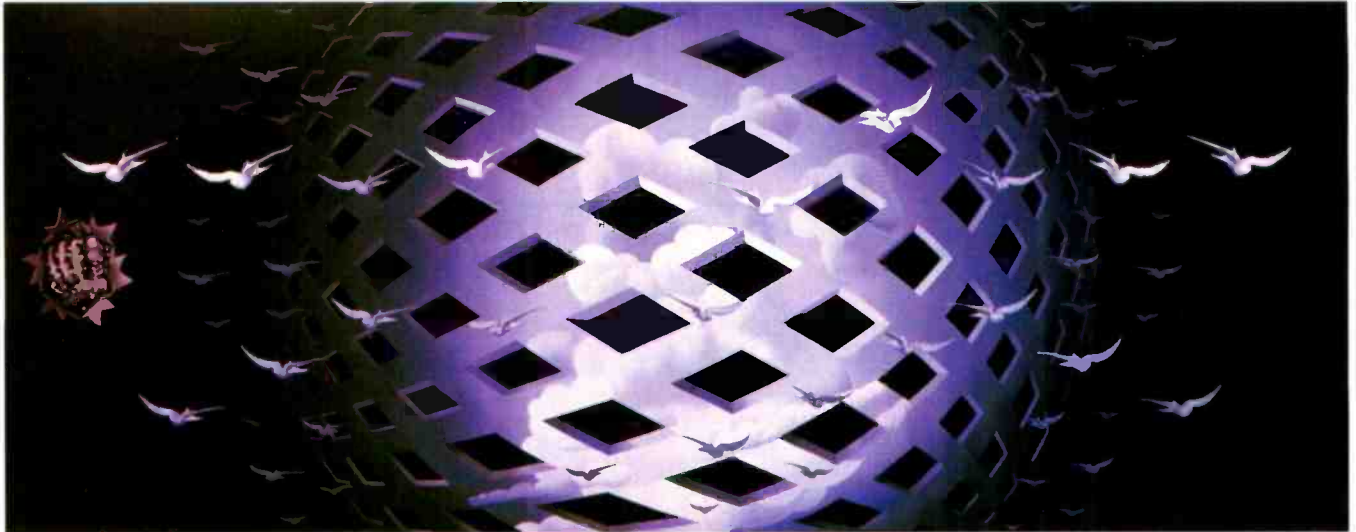
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The Groups of Wrath, which includes obscure Blondie singles and album cuts from The New York Dolls, is simply great music.



songs written, from standards to movie themes. Although this collection may be a bit overwhelming to play every day, everything in it is fitting homage not only to Bennett but to the songwriters whose work he interprets.

Michael Aldred

The Groups of Wrath: Various artists. TVT Records TVT3110-2.

The artists presented on *The Groups of Wrath* don't need an introduction—the guy who put this compilation together does. Marty Thau was an impresario during New York City's heyday as a rock and roll mecca. As the scene developed into a phenomenon and ultimately a musical genre within a genre, Thau was busy "discovering" (at least that's what it says in the liner copy) The New York Dolls, The Ramones, and other Carbona-induced zombies.

Included are Thau's self-financed demos of The Ramones (circa 1975) and The Fleshtones (1978), as well as

material from Richard Hell and The Voidoids and Suicide, which later appeared as releases on Thau's own Red Star label. Two obscure Blondie singles and album cuts from The Dolls' big finale, *In Too Much Too Soon*, are included. There are also two songs from an oddball curiosity known as The Bloodless Pharaohs, which was rockabilly parody Brian Setzer's pre-Stray Cats gig. It's got synthesizers on it too. Need I say more?

So, this compilation is recommended simply because of its great music, some of which—unless you happen to be a friend of Marty—you're not likely to hear anyplace else. *Mike Bieber*

Slowhand: Eric Clapton. **Mobile Fidelity Sound Lab UDCD 553.**

Classic Clapton, done up as an Ultradisc by Mobile Fidelity, and sounding very good, thank you. It's still listed in the Schwann/Spectrum as RSO 823276-2, but my tendency is to go with Mobile Fidelity's work here. *E.P.*

Deutsch, offers a comprehensive overview of one of America's most renowned song stylists. The earliest material dates back to April 1950 with "The Boulevard of Broken Dreams" (his first big seller), while the most recent includes two cuts from his 1990 Grammy-nominated recording, *Astoria: Portrait of the Artist*. In between is a trove of some of the best popular



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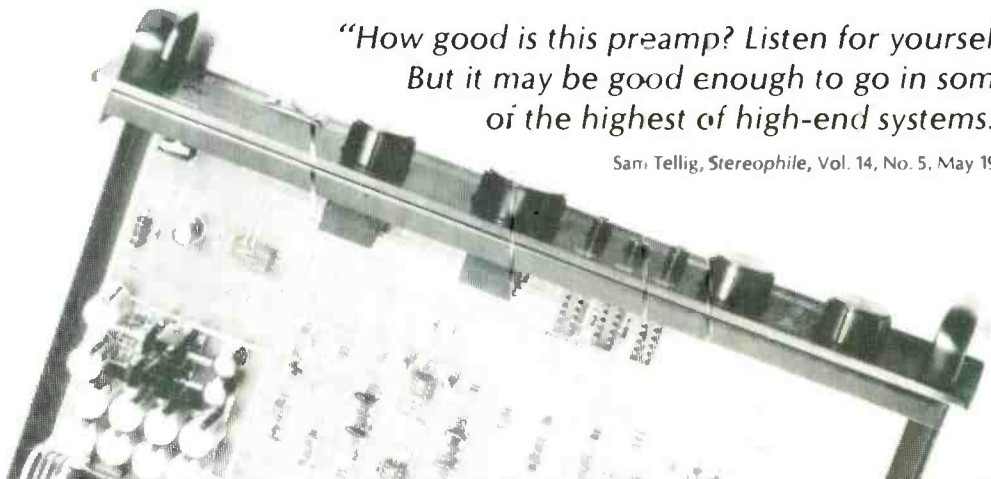
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Damn Right, I've Got the Blues: Buddy Guy

Silvertone 1462-2-J, CD; AAD; 53:59.

Sound: B+ Performance: B-

As one of the founding fathers of Chicago blues guitar, Buddy Guy and his classic '60s sides for Chess influenced a schoolhouse worth of fans, including Eric Clapton, Jimi Hendrix, Jeff Beck, and Stevie Ray Vaughan. Blues patriarch Muddy Waters anointed Guy by drafting him into his band for an extended stay.

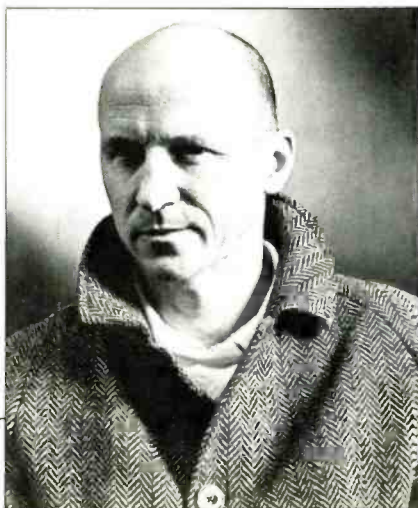
Damn Right, I've Got the Blues is Guy's first domestic album in nearly a decade. The album further documents his growing use of distortion. To get the publicity that's always escaped him, he's called upon a handful of his admirers. With as many as four guitars on a track, however, star turns by Beck, Clapton, and Mark Knopfler are little more than window dressing.

The guest appearances may explain why this uniquely Chicago bluesman was recorded in London. An interview distributed with the press package implies that the album was cut too quickly, in eight days. That may be ample time for a seasoned road band to record parts of its working repertoire, but it wasn't enough for Guy and regular bassist Greg Rzab to get comfortable with the studio band. The stock arrangements and abundance of fade-outs confirm that this album was rushed.

Guy can build a solo with the earnest dedication of a bricklayer, nursing his guitar from a humble moan to an earth-scorching roar. For this outing, however, he's tossed subtlety out the window. *Damn Right, I've Got the Blues* is blues as guitar pyrotechnics, equating volume and frenzy with passion and eloquence. It proves that Guy can be every bit as loud and tasteless as his many imitators. Worse yet, his vocals too often echo the excesses of his guitar playing.

Damn Right, I've Got the Blues should have been titled "If You Can't Beat 'Em, Join 'Em." Buddy should remember, however, that he had 'em beat eons ago. Guy remains among the most technically gifted of blues guitarists, and maybe next time he'll get the royal treatment he deserves.

Roy Greenberg



After the Requiem: Gavin Bryars
ECM 1424, CD; DDD; 66:53.

Sound: A+ Performance: A+

As long as there has been jazz, there have been classical composers trying to incorporate it into their music as well as jazz composers aspiring to the form and structural complexity of classical music. Charlie Parker begged Edgard Varèse to let him study with him shortly before Bird's death, and Aaron Copland was often listening to the rhythms of swing.

Gavin Bryars is a composer whose music is shaped by that struggle. He's a trained classical composer, but he also played bass in England's free-jazz scene in the '60s and early '70s. Those elements are all at work on *After the Requiem*, with contributions from guitarist Bill Frisell and saxophonist Evan Parker matched by members of the Balanescu String Quartet.

Bryars strives with atonality attenuated by minimalism, lyrical compositions with the contours of jazz improvisation. That struggle results in his most transcendent recording to date, a quartet of compositions that are moving in their lyrical serenity, striking in their interior edginess.

There's a somber quality to much of Bryars' writing, which in the case of the title piece makes sense, since it's based on "Cadman Requiem," a composition written for the death of a friend. Bryars frames the searing sustained guitar lines of Frisell with a trio of strings. They curve and coil around Frisell, who ably fills the role of first violin in a string quartet. Frisell's nuanced playing is heard again on "Allegro," where his sustained guitar parallels the lyrical melody played by clarinetist Roger Heaton. The musicians intertwine, sometimes each finishing a line begun by the other in seamless cross-fades, other times merging into one instrument. Together they traverse a magical landscape created by Bryars, centered by a five-note ostinato from pianist Dave Smith, with intricate details woven by vibes, marimba, and violinist Alexander Balanescu.

Whether writing for orchestral instruments or a jazz saxophone quartet with Evan Parker, Bryars balances spontaneity and feeling with poise and control,

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Robin Eubanks' *Karma*, a panoramic approach to modern sounds, engages and entertains while stretching boundaries.



sweet jazz changes mitigated by odd, multi-phonetic overtones. His *After the Requiem* is a beautiful recording, taking full advantage of the studio to create acoustic spaces and maintaining the delicate balance of instrumentation that creates a landscape in the air on a selection like "The Old Tower of Löbenicht," with Balanescu's violin caressed in a shifting wash of reeds, cymbals, vibes, and guitar. On *After the Requiem*, Gavin Bryars tends a Zen garden of details and subtle textures.

John Diliberto

Karma: Robin Eubanks
JMT 834 446-2, CD; ADD; 63:11.

Sound: A Performance: B+

With *Karma*, trombonist and M-BASE cooperative co-founder Robin Eubanks delivers a sociopolitical musical extravaganza, a panoramic approach to modern sounds designed to stretch and gray boundaries. (M-BASE is an acronym for Macro-BASIC Array of

Structured Experimentation.) It's an electric and acoustic affair that features the likes of percussionist Mino Cinelu, guitarist Kevin Eubanks (Robin's brother), bassists Dave Holland and Lonnie Plaxico, saxophonists Branford Marsalis and Greg Osby, pianists/keyboardists Renee Rosnes and Kenny Werner, drummer Marvin "Smitty" Smith, and others.

The title track, an electric jazz/funk/rap attack, initially may sound harsh to the ear and purposefully disconcerting, but it gradually softens. Ultimately, "Karma" serves more as a warning than it does as an irritant; it's a well-thought-out episode.

Eubanks employs his entourage intelligently. Taken as a whole, the disc can sound a bit uneven with regard to arrangements and segues between the 10 selections. Nonetheless, Eubanks' musical investigation is quite legitimate. The extroverted "Mino," largely an interplay between its namesake percussionist and the trombonist, rings authentically South American. By contrast, so does the calming "Maybe Next Time," in which the two Eubanks brothers, with Kevin playing nylon-string acoustic guitar, team up with Dave Holland.

Marvin "Smitty" Smith's consistency and absolute maturity continue to impress, no more so than on "Evidently" (dedicated to Thelonious Monk) and

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Eduardo del Barrio



"Pentacourse," two instances where the drummer's prowess is heard in trio with Eubanks and Holland. Another standout is "The Yearning," a nine-minute, straight-ahead sextet adventure costarring the aforementioned threesome plus Marsalis (on tenor), Rosnes (on piano), and Cinelu.

If Eubanks' intention was to demonstrate his diversity as student and his growth as a musician these past few years, then *Karma* succeeds; its variety generally entertains and engages in a program that draws from ballads, bossa, bop, and Brazilian.

Jon W. Poses

Free Play: Eduardo del Barrio. **A&M 75021 5355 2.**

On his solo debut, Argentine keyboardist Eduardo del Barrio presents a collection of improvisatory pieces that defy categorization. Del Barrio's primary instrument is the Bösendorfer SE computerized grand piano, which he uses in various contexts. Among those guesting are Charlie Haden, Peter Erskine, Dianne Reeves, and Hubert Laws. *Free Play* is a highly original synthesis of classics, pop, and jazz, and one of the most successful mixes of acoustic and synthesized instruments to date.

John Sunier

Texas Cannonball: Freddie King. **Shelter SRZ-8018.**

Many blues fans credit Freddie King as being a formidable guitarist with an ultra-soulful voice. He's also hailed as a pioneer in conquering the territory between R&B, soul, and blues. This reissue of a 1972 record reaffirms all the great things ever said about King, who's accompanied by two rhythm sections that include Leon Russell (also producing and contributing several tunes), Carl Radle and Jim Gordon (of Derek and The Dominos fame), Donald "Duck" Dunn and Al Jackson (of Booker T. & The MG's fame), and a host of others. I had fun playing this record for Robert Cray fans unfamiliar with King and watching their jaws drop. Also included is some previously unreleased material. The original cuts are better.

Mike Bieber

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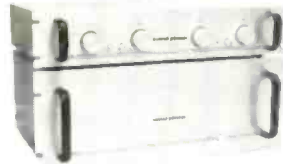
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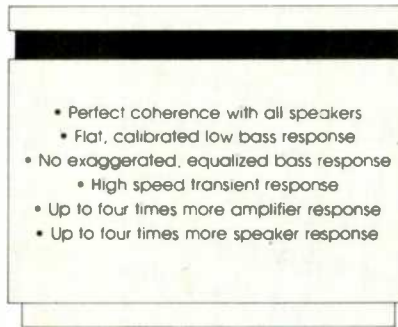
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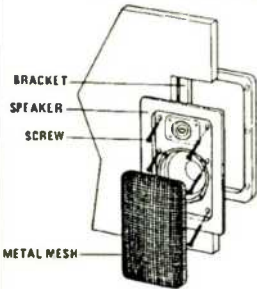
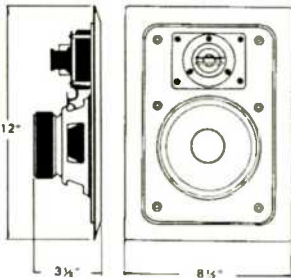
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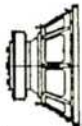
Impedance	8 ohms
Frequency Response	45 to 20K Hz
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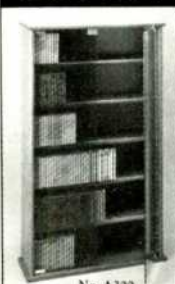
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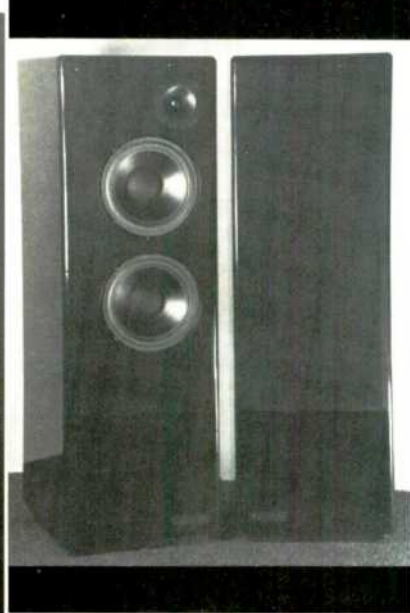
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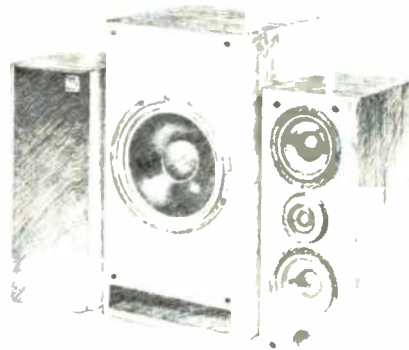
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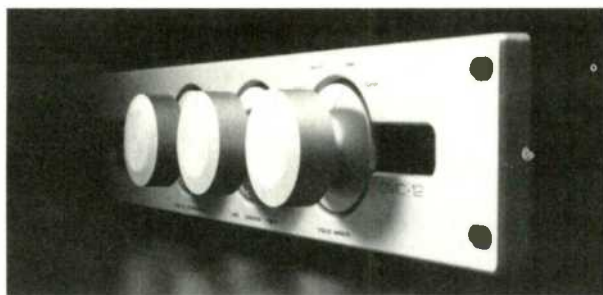
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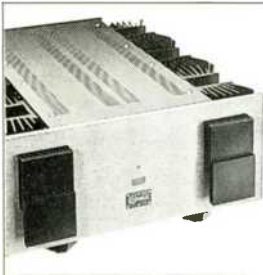
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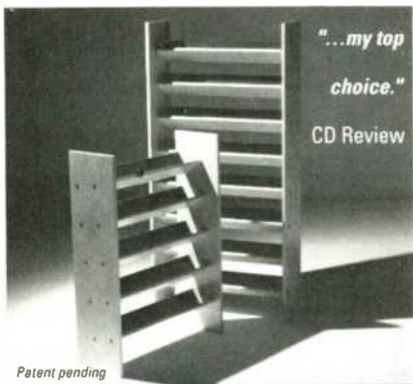


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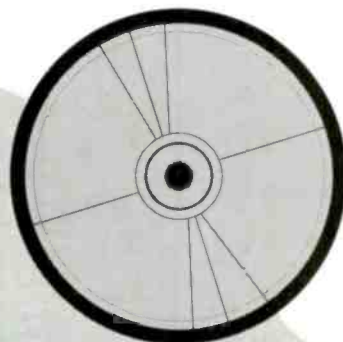
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