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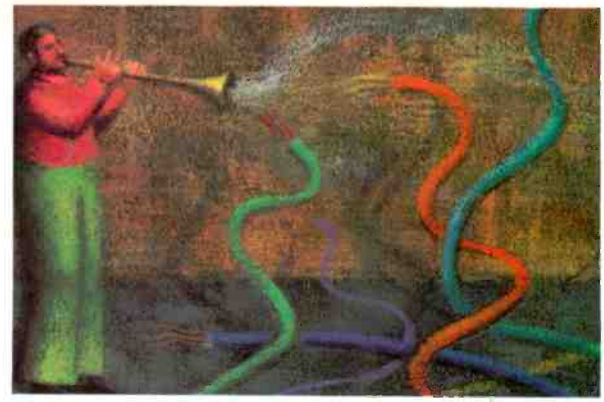

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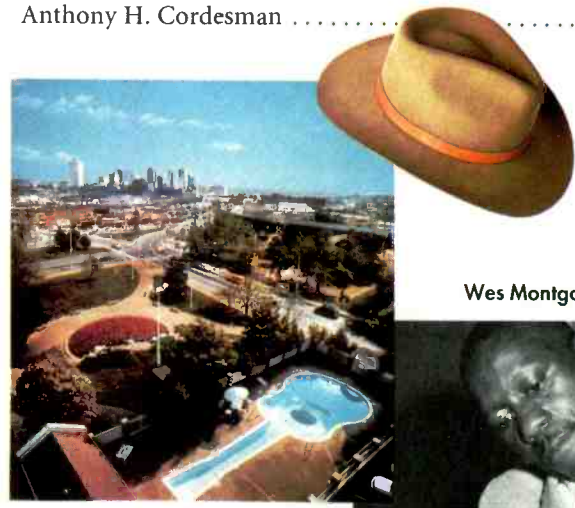

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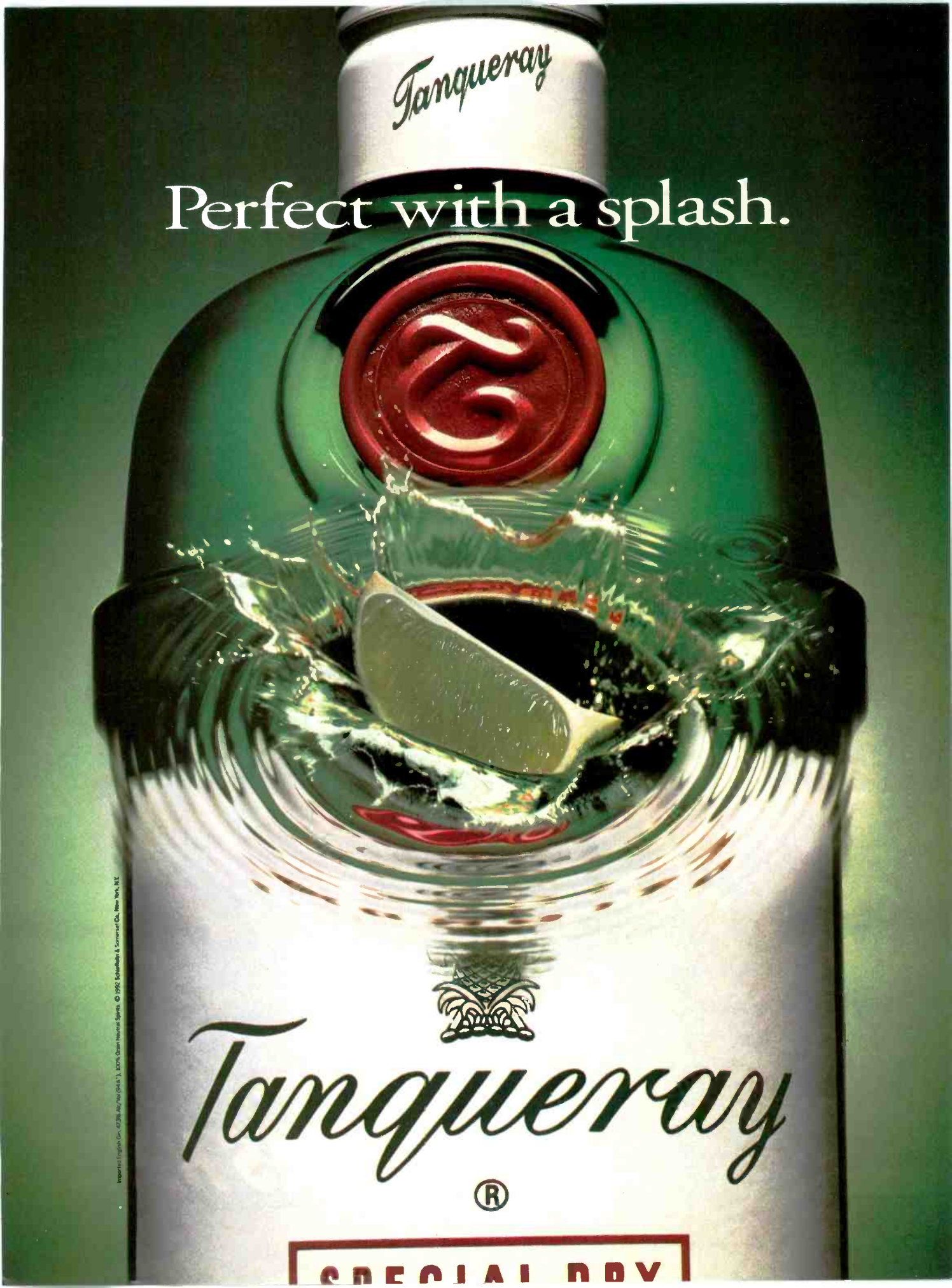
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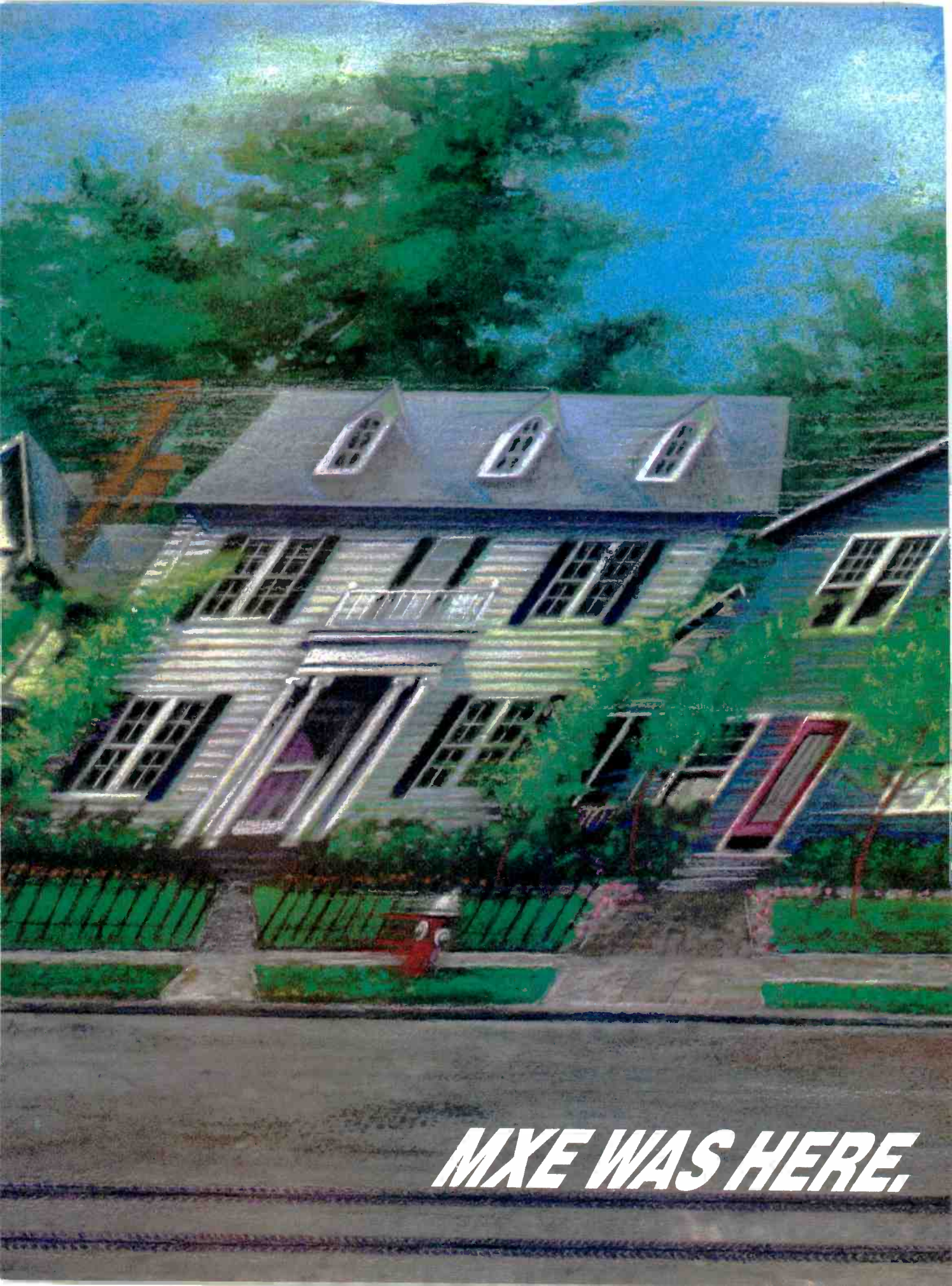
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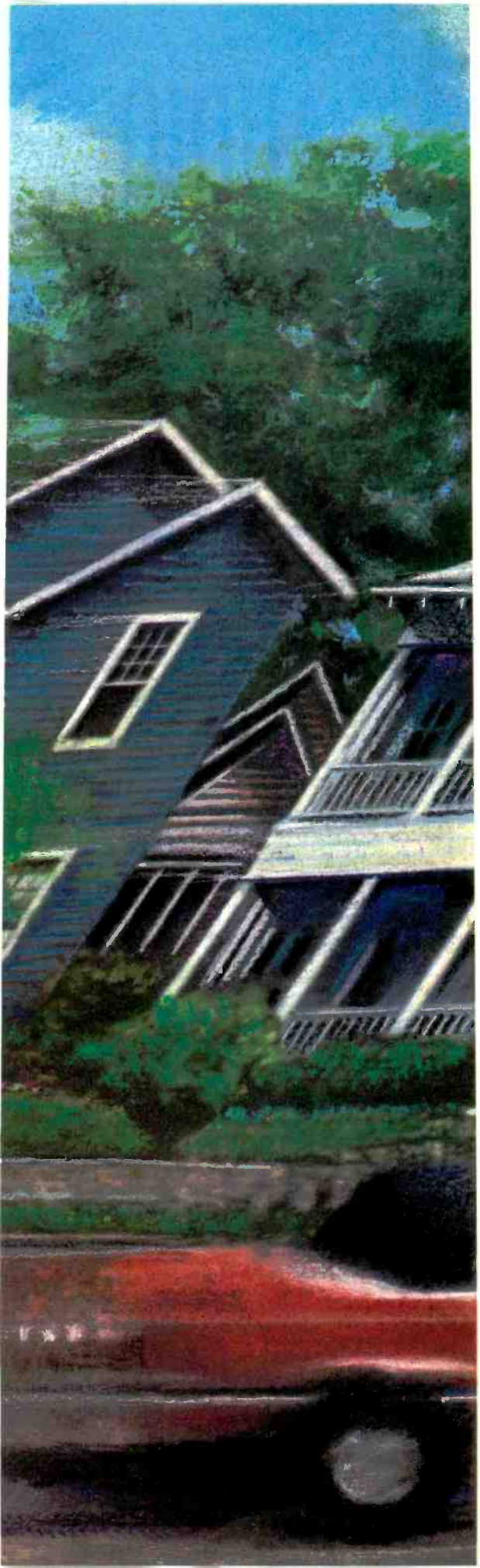

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FAST FORE-WORD

Last weekend, I went down to one of the hi-fi stores in my suburban New York City town. I was bored with my present collection of equipment, and it wasn't time for the Summer Consumer Electronics Show yet. So my wife, who knows me too well, told me to get out of the house, as she usually does when she sees me moping around like that. I went to one of my favorites, Hi-Fi Circus—The FUN Electronics Store. I like them better than Magic Movie & Music or General Light and Sound, mostly because they concentrate on things that fiddle with my hearing rather than items that play tricks on my eyes.

Also, Hi-Fi Circus has the Rules of Selling posted on their wall, and I'm told that they will dock a salesman part of his commission if they find him breaking the rules. After I found out about how the rules worked, some of the salesmen suggested that they would split the commission with me if I wanted to get a really great deal. The catch was that I would have to buy more than one item of the most expensive brand in the place and that I could never tell the owner. It was a sneaky way to get an extra sale. So, what are the rules?

The first is don't sell using bait and switch. Which simply means that if a customer knows enough to know what he wants, sell it to him and go on to the next customer. The next rule is don't sell magic features. That is, don't attempt to get a customer to buy a product that has no benefits, either in this world or the next. There is a corollary to this rule: Don't attempt to sell a product that works on a principle not previously known to science, that is, science as it is practiced in this universe rather than in some other alternative or parallel space.

There are a few other rules, but I can remember only two of them. Don't charge for putting the store warranty into force, because it's free, and because charging for it makes the customer think he's getting gray goods, ones not obtained through "maker encouraged" channels. (I got a lot of office equipment like that, from a guy who was having a "Truckload Sale" in a gas station that had gone out of business.) The last rule I can remember is don't sell using crazy numbers, i.e., harmonic distortion that's two decimal places beyond the threshold of audibility.

My wife lets me go to Circus Hi-Fi pretty well any time I like, so long as I leave our credit cards and checkbook at home. She and the owner have a pretty good relationship; she gets to send back any equipment I come home with if she can't tell what's been improved within 30 minutes of my plugging it in. Since I have to carry any such equipment back in my arms, rather than using the car, this has cut down on purchases I don't truly *need* to make.

I don't feel electronically disadvantaged with this arrangement. After all, I do get to hear all this great new gear—just go down to Circus Hi-Fi and wait until the real customers are gone. And most of the time I don't even get my nose bloodied for insisting that the "New and Improved" actually have *audible* improvements or, at least, do something I can touch or feel.

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Fond of Pfeiffer

Dear Editor:

Many thanks for Susan Elliott's excellent interview with Jack Pfeiffer (November 1992). This article brought back many pleasant memories for me.

As a former engineer with the RCA Chicago recording studios, I had the pleasure of working with Jack, Richard Mohr, and Lewis Layton in the late '50s and early '60s when they used to come to Chicago to record the Chicago Symphony, Heifetz, Rubinstein, Gilels, and others. Jack was always held in high regard by the RCA engineering staff. Not only is he well educated in the disciplines of music and audio engineering, but he possesses the personality—with that contagious grin of his—that endears him to all, even the most finicky artist. No one could be more well suited for his work.

What ever happened to Dick Mohr? He, too, was a gifted producer and a marvelous person.

Let's have more articles like this one and fewer "Equipment Profiles."

Willis Connor
Chicago, Ill.

Mr. Pfeiffer's Reply: I recall your contribution to our Chicago session very clearly and hasten to assure you that Dick Mohr is very much alive and kicking. He has been the producer of the Metropolitan Opera Broadcast intermission features for the past 12 years, and just retired in April.

Pfeiffer on Toscanini . . .

Dear Editor:

In your entertaining interview with Jack Pfeiffer, he says the stereo recordings he made of Toscanini's last two concerts with the NBC Symphony have never been released on CD. At least the last one—an all-Wagner concert at Carnegie Hall on April 4, 1954—exists on CD. The label is the Arturo Toscanini Recordings Association; the CD was pressed by Denon in 1984. The labelling and notes are all in English.

Unfortunately, the performances show possible reasons why the Maestro's family has refused to approve reissues of these recordings. They are surprisingly moderate in tempo, and could even be called slow and fussy in spots. The orchestra does not always seem sure of Toscanini's beat, and ensemble occasionally slips.

Nevertheless, the recording is fascinating. To hear Toscanini in stereo seems akin to seeing Mathew Brady photographs in color. The recording is close-up, the soundstage broad. The sound is bass-shy, buzzy in climaxes, and dynamically compressed—delightfully antique compared to the Pfeiffer/Reiner *Heldenleben*, recorded a month before. Perhaps the CD wasn't made with the prime tapes; certainly the sound was not restored or improved in the ways now feasible for reissues. Was Mr. Pfeiffer really unaware of this CD?

I hope you can find more industry veterans like Henry Kloss (February 1992) and Jack Pfeiffer to talk to. Their stories are the most unique and interesting part of *Audio*'s editorial mix.

William J. Murphy
Sacramento, Cal.

Mr. Pfeiffer's Reply: I'm well aware of the pirated CD of Maestro Toscanini's last concert on April 4, 1954. Although it is not of the stereo tape that I made, it sounds truly stereo, and I suspect it might be a synthetic processing of the mono broadcast. The section where the NBC engineers cut over to a recording of the Brahms First Symphony for a few moments is not on this pirated CD, so the whole thing is a bit of a mystery, but not enough to get excited about!

. . . and Stokowski

Dear Editor:

As one who has bought a number of recordings because Jack Pfeiffer was involved in their production, I'd like to pose a question about Stokowski's recordings of Sibelius' Symphony No. 1 and Schumann's Symphony No. 2 with, as I recall, "his" orchestra, back in the early 1950s. I owned the LPs. No longer. Not only did the re-

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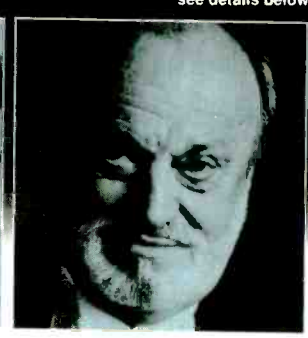

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"Phantom Of The Opera" Highlights (Orig. London Cast) (Polydor) 424•333

I Love A Parade. John Williams, Boston Pops. (Sony Classical) 422•717

Best Of The Canadian Brass. (CBS) 401•596

Bernstein Songbook. From *"West Side Story";* more. (CBS) 371•088

Walt Disney's "Fantasia" (new digital sndtrk)(Buena Vista 318•659/398•651

Various Artists—Heavy Classix (Angel) 457•325

Kiri Te Kanawa Sings Kern. (Angel) 457•317

The Baltimore Consort And Merry Companions—The Art Of The Bawdy Song (Dorian) 456•087

Canadian Brass—English Renaissance Music (CBS Master.) 403•402

Handel: *Water Music.* Marriner, Academy.... (EMI Classics) 401•638

Liszt: *Hungarian Rhapsodies.* Mehta, Israel Phil. (CBS Master.) 386•607

Mozart: *Violin Con. 2;* more. Cho-Liang Lin (Sony Class.) 410•373

Itzhak Perlman, Daniel Barenboim—Brahms: *The 3 Violin Sonatas.* (Sony Class.) 409•367

Tchaikovsky: *Piano Concs.1 & 3.* Vladimir Feltsman (Sony Class.) 409•227

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Schubert: *Piano Sonatas D.845 & D.850.* Richard Goode (Elektra/Nonesuch) 455•725

Stephen Hough, piano—Liszt: An Italian Recital (Virgin Classics) 455•717

Mozart: *Violin Concertos Nos. 3&5;* more. Chase, Goodman, Hanover Band (Cala) 455•402/395•400

Mendelssohn: *Sym. Nos 1, 2 & 3.* Dennis R. Davies cond. (Musicmasters) 455•394/395•392

An Enchanted Evening With Jose Carreras (Sony Classical) 454•785

Mozart, Mendelssohn, Beethoven: *Violin Sonatas.* Maxim Vengerov, violin (Teldec) 453•969

Mozart: *Horn Concertos K417; Divertimento K334.* Aubrey & Dennis Brain (EMI Classics) 451•112

The King's Singers—La Dolce Vita With Tragicomedia (EMI Classics) 450•510

Mozart: *Symphony No.39; Sinfonia Concertante.* Giulini, Berlin Philharm. (Sony Classical) 449•207

Mahler: *Symphony No 4.* Barbara Hendricks, soprano; Salonen, cond. (Sony Classical) 449•116

Leonard Bernstein—Ballet Dances And Opera For Orch. (Sony Class.) 448•738/398•735

Hanson: *Symphonies Nos. 5&7; Piano Concerto;* more. Rosenberger, piano; Schwarz, cond.(Delos) 448•621

Brahms: *Sextets, Op.18 & 36;* Stern, Lin, Robinson, Ma, Laredo, Tree (Sony Classical)446•559/396•556

Portraits Of Freedom—James Earl Jones, speaker; Schwarz (Delos) 446•476

Paganini: *24 Caprices.* Eliot Fisk, guitar (Musicmasters) 444•307

Tchaikovsky: *Symphony No. 1;* more. Abbado cond. (Sony Classical) 443•341

Wagner: *"Rienzi" Overture;* etc. Mehta, NY Phil. (Sony Classical) 443•226

Orff: *Carmina Burana.* Tilson Thomas cond. (CBS Mast.) 376•913

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cordings have stunning sound, they were great examples of this great man's art. They should be on CD.

Also, though he was not connected, I think, I'd like to ask Mr. Pfeiffer why Stokowski's recording of Mahler's Symphony No. 2, "Resurrection," which was on the RCA label, is not on CD. It has a modern, superlative sound and performance—and with the London Symphony, a fine Mahler orchestra.

I can't begin to tell you how much I'd appreciate this information.

William W. Weaver
Louisville, Ky.

Mr. Pfeiffer's Reply: I certainly agree that the Stokowski recordings of the Sibelius First and Schumann Second Symphonies should be transferred to CD. They were early Manhattan Center recordings of the highest monaural quality. The Mahler Second is certainly entitled to CD status, but it has an awkward length—too long for one CD, too short for two. We could couple it with his Brahms Fourth from the same era, and I've made that recommendation, but the marketing people are still dragging their feet! I'll keep pushing on all of these issues.

Here's the "Perfect Pitch"

Dear Editor:

Concerning Bert Whyte's comments on absolute pitch and pitch memory ("Behind the Scenes," February), I have found that although I do not have "perfect pitch," I can whistle A=440 any time I want, since as a musician I often have need of that note for tuning purposes. Rather than being due purely to memory, I think this also has to do with physically practicing that note—both *thinking* it and *forming* it in my throat. It seems that whenever I think a melody, the muscles in my throat and vocal cords move along with my thoughts. I imagine that there is a specific position they all take for A=440. I use a small tuning fork—and I suppose that if it were a middle C fork, I would have learned to whistle middle C.

After one year back with *Audio*, I am happy enough to renew my subscription. Good job! Your equipment articles are great, and your interviews are wonderfully diverse and informative; I especially liked the ones with Peter Asher (December 1992), Henry Z. Steinway (January), and Eddie Kramer (February). Keep up the good work!

John R. Peterson
Pleasant Grove, Utah

Behind the Mechanics of Concert Hall Sound

Dear Editor:

I thoroughly enjoyed reading Rick Howland's "Mechanics Hall: Meetinghouse for Music" (January). I was part of a chorus that performed the Verdi Requiem there 10 years ago; the hall's potential as a studio was particularly apparent during the Dies Irae. The article reminded me of my own work in another hall with a "special sound," a hall with a similar history and one also enjoying a renaissance, the Troy Savings Bank Music Hall in Troy, N.Y.

There are some points Mr. Howland makes regarding the sound of a hall and its reverberation that deserve comment.

One might conclude that Elbridge Boyden and other architects of the period were not versed in acoustics but simply copied halls that worked. To quote the article: "Whether [the sound] was intentional...or not, we will likely never know." Though acoustics did not exist as a formal science until Wallace C. Sabine's work at Harvard, architects like Boyden, George Post (Troy Music Hall), the firm of McKim, Mead, and White (Boston Symphony Hall), and others were all versed in basic acoustic principles—principles dating back to the time of the ancient Greeks—that indeed allowed orators to be heard at the back of the hall. Concert hall design had in fact risen to a well-understood and highly developed level before the turn of the century, both in this country and in Europe. Among classic halls still in use are Amsterdam's Concertgebouw (1888), Vienna's Musikvereinssaal (1870), and Zurich's Tonhalle (1895).

Halls in Worcester, Troy, and Seattle and other undiscovered gems in remote places like Geneseo, N.Y., all have the "classic proportions" and materials mentioned in the article but, more important, possess a box-within-a-box construction derived from the Leipzig tradition of concert hall design. The original Leipzig Gewandhaus, made famous by Mendelssohn's tenure as music director, was the first to employ this principle. If all of this is not well-thought-out science in formal terms, it is a kind of architectural engineering that today's designers would do well to review.

It is common practice to use a single value to characterize a hall's reverberation time, but a misleading one and valid only in a statistical or "diffuse" sense. Sound decays in a hall in each of three mutually perpendicular directions. This reverberation signature can be recorded using proper microphone choice and placement, but only if bidirectional or gradient transducers are used.

The potential use of a Soundfield microphone or two stereo microphones to transmit the "sound of a hall" is what makes the rediscovery of Mechanics Hall so exciting, bringing its distinctive acoustics, as well as live performances, to new audiences via a listening experience in their homes and cars. Also, those who have championed such hall restorations have shown that orchestral ensembles, both large and small, could market their own sound to solve the problem of declining ticket sales—using neither a National Public Radio sound, a Telarc sound, a Sony sound, nor a Teldec sound, but instead the hall's sound. The restoration in Worcester, as in Troy, can therefore help audiences return to the concert hall. " 'Preservation Hall' of another kind" is quite the understatement.

James Mastracco
Washington, D.C.

The Trouble with the Industry

Dear Editor:

You recently discussed the current problem facing the home audio industry ("Fast Fore-Word," September and December 1992). It is very difficult to feel any remorse for an industry that could make a product where there is a demand but simply won't do it. That product is a reasonably priced open-reel tape deck with emphasis on playback and not recording.

When one has a large investment in tapes and no way to enjoy them, why would one invest in another system that could be discontinued tomorrow?

If the audio industry is looking for customers such as myself, it might try merchandising a product that has a built-in market.

Robert L. Wojcik
Addison, Ill.

TAPE GUIDE

HERMAN BURSTEIN

Taping Tips

Q. *I have a collection of 700 LPs and would like to tape some of them. To help me, I wonder if you could refer me to some good books, magazine articles, etc.*—Ralph Corbett, Fullerton, Cal.

A. I doubt that you need a book on tape recording to enable you to get the best out of your cassette deck. If you carefully follow the instructions in your owner's manual, the results should be as good as your deck permits.

Still, there is no harm in reading additional material. Accordingly, I suggest two articles: E. Brad Meyer's "How To Make Great Tapes from CDs," *Stereo Review*, December 1991, and Edward J. Foster's "Mass Tape Test: 51 Cassettes," *Audio*, June 1993. Meyer's article concentrates on getting the best out of a deck, and it applies as much to copying LPs as it does to CDs; Foster discusses tape selection.

Before you go heavily into transferring your LPs to tape, experiment with cassette selection. Try both Type I and Type II tapes, and try a couple of brands of each. Roberson's article can be helpful as a guide. The objectives are to discover what tape goes well with your deck and to find how high a recording level you can put on the tape before distortion and treble loss become noticeable. If you were into live recording, I would suggest that you try Type IV tapes (metal).

Leaders: To What End?

Q. *I have often wondered why audio cassettes have leaders. And if there is a good reason for having a leader at the beginning of side 1, why is there another at the end? Those of us who favor auto reverse must contend with a bit more silence at the "turnaround."*—Theodore E. Gagliano, Georgetown, S.D.

A. One reason for having a leader is to ensure smooth tape travel at the beginning of the tape. The tape pack is less than perfectly round at the outset, which affects tape motion and may produce an effect akin to wow, particularly on less expensive decks. The departure from roundness occurs where the tape or leader is attached to the cassette hub. The relative deviation from roundness is greatest at the beginning of the tape pack. Use of a leader helps overcome the problem where it is most severe. Another reason for the leader, which is ordinarily transparent, is that it serves to activate the reversing mechanism in some decks.

Similarly, it is necessary to have a leader at the end of the tape. When the cassette is turned around, what started out as the end of the tape becomes the beginning.

Open-Reel Oldies

On several occasions I have read or heard discussions on the life expectancy of taped music. Early this month I came across some open-reel tapes recorded at 7½ and 3¾ ips between 1958 and 1962. They were stored on edge in a bookcase in our dining room. The tape is Audiotape Type 1861 made by now-defunct Audio Devices. The quality of these recordings is excellent, with crisp, clean highs and lower noise level than I would have thought possible for that time—and darn good even for today. There is no discernible print-through on high-level passages. Apparently tape doesn't have to be in the care of the Smithsonian Institution to survive in good shape.—Martin E. Clark, Tavares, Fla.

Mr. Clark's experience with old open-reel tapes corresponds with mine. I have a substantial number, recorded from the early '50s into the '60s. Many were commercial, prerecorded, tapes; I recorded the rest, often on Audiotape 1861. They all play quite well. (The fact that they are monophonic doesn't distress me; when listening to them, I simply pretend that I am sitting farther back in the auditorium, where imaging disappears.)

Level Imbalances

Q. *I own two three-head cassette decks of the same make and model, purchased about two months apart and now about four years old. Both are in excellent condition except for several problems with level. Deck 1 displays higher record and playback levels for the right channel, while deck 2 displays higher levels for the left channel. Also, deck 2 plays back louder than does deck 1. I have fed a mono signal, via a Y-connector, to both channels of deck 1 to verify that the meters are off; I have done the same for deck 2. Is there any adjustment I can make to correct these problems? While under warranty, both decks were in a service shop for these problems. One was there for two weeks, and the other for a month. They were returned in the same condition except for some scratches. The technician told me that the decks had been cleaned and demagnetized by the shop. When I told him that I did this regularly, he turned color and got very upset. Also, I was told that the shop was waiting for a service manual for my decks.*—James Rodriguez, Bronx, N.Y.

A. In a quality cassette deck, as most three-head decks tend to be, there are often internal controls for matching playback and recording level between channels and ensuring correspondence between these levels and the deck's meters. I do not know whether your decks have all these controls. A service manual, if you can obtain one, would tell you, and it would identify these controls and instruct you how to adjust them. If you cannot locate a manual, open the deck and examine the circuit boards; the controls you are looking for may be identified there.

While magnetized and/or dirty heads may cause some treble loss, these factors could not account for your observed differences in level. It seems that your service shop was putting you on.

The difference in playback levels of the two decks may be due to missetting of controls referred to above. If deck 2 is the one that was manufactured later in time, as you can tell by the serial numbers, possibly there was a change in playback circuitry to overcome complaints of inadequate playback signal. If deck 1 was made later, perhaps there was a reduction in gain to overcome an overloading and distortion problem internally. A

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

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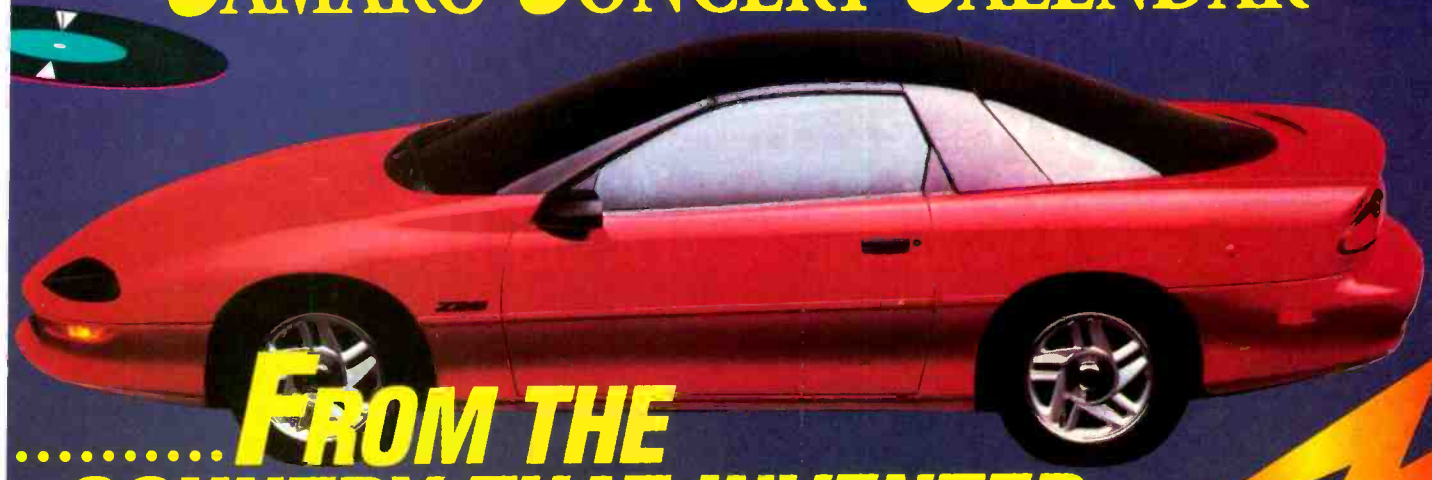


FROM THE COUNTRY THAT INVENTED ROCK 'N ROLL

JULY

AEROSMITH
- 7/1 - Columbus,OH Buckeye Lake
- 7/2 - Burgettstown, PA Star Lake Amph.
- 7/4 - East Troy, WI Alpine Valley

ALBERT COLLINS & THE ICEBREAKERS
- 7/25 - Philadelphia, PA River Blues
- 7/30 - Snowbird, UT Jazz & Blues Fest
- 7/31 - Telluride, CO Koto Concert Series

STEVE MILLER
- 7/1 - 2 - Wantagh, NY Jones Beach
- 7/3 - Saratoga Springs, NY Perf. Arts Center
- 7/6 - 7 - Holmdel, NJ Garden State
- 7/9 - 10 - New York, NY Paramount
- 7/14 - Atlanta, GA Lakewood
- 7/15 - Nashville, TN Starwood Amph.
- 7/16 - St. Louis, MO Riverport Amph.
- 7/17 - Kansas City, MO Sandstone Amph.
- 7/20 - 21 - Denver, CO Red Rocks
- 7/23 - Oklahoma City, OK Zoo Amph.
- 7/24 - Dallas, TX Starplex Amph.
- 7/25 - Woodlands, TX Woodlands
- 7/29 - Los Angeles, CA Greek Theatre

MOODY BLUES
- 7/2 - Saratoga, NY Performing Arts Ctr.
- 7/6 - 7 - Vienna, VA Wolf Trap
- 7/10 - Burgettstown, PA Starlake Amph.
- 7/12 - Holmdel, NJ Garden State Arts Ctr.
- 7/16 - Stowe, VT Performing Arts Ctr.
- 7/17 - Wantagh, NY Jones Beach
- 7/18 - Mansfield, MA Great Woods
- 7/21 - Toronto, ONT Ontario Place
- 7/25 - St. Louis, MO Riverport Amph.
- 7/26 - Cincinnati, OH Riverbend Amph.

POISON
- 7/2 - Bakersfield, CA Kern County Fair
- 7/3 - Laguna Hills, CA Irvine Meadows Amph.
- 7/4 - San Bernadino, CA Glen Helen Pav.
- 7/12 - Portland, OR Portland Coliseum
- 7/13 - Seattle, WA Seattle Center Coliseum
- 7/15 - Mountain View, CA Shoreline Amph.
- 7/16 - Sacramento, CA Cal. Expo Amph.
- 7/18 - Park City, UT Park West Amph.
- 7/20 - Englewood, CO Fiddler's Green Amph.
- 7/22 - Wichita, KS Kansas Coliseum
- 7/23 - Bonner Springs, KS Sandstone Amph.
- 7/24 - St. Louis., MO Riverport Amph.

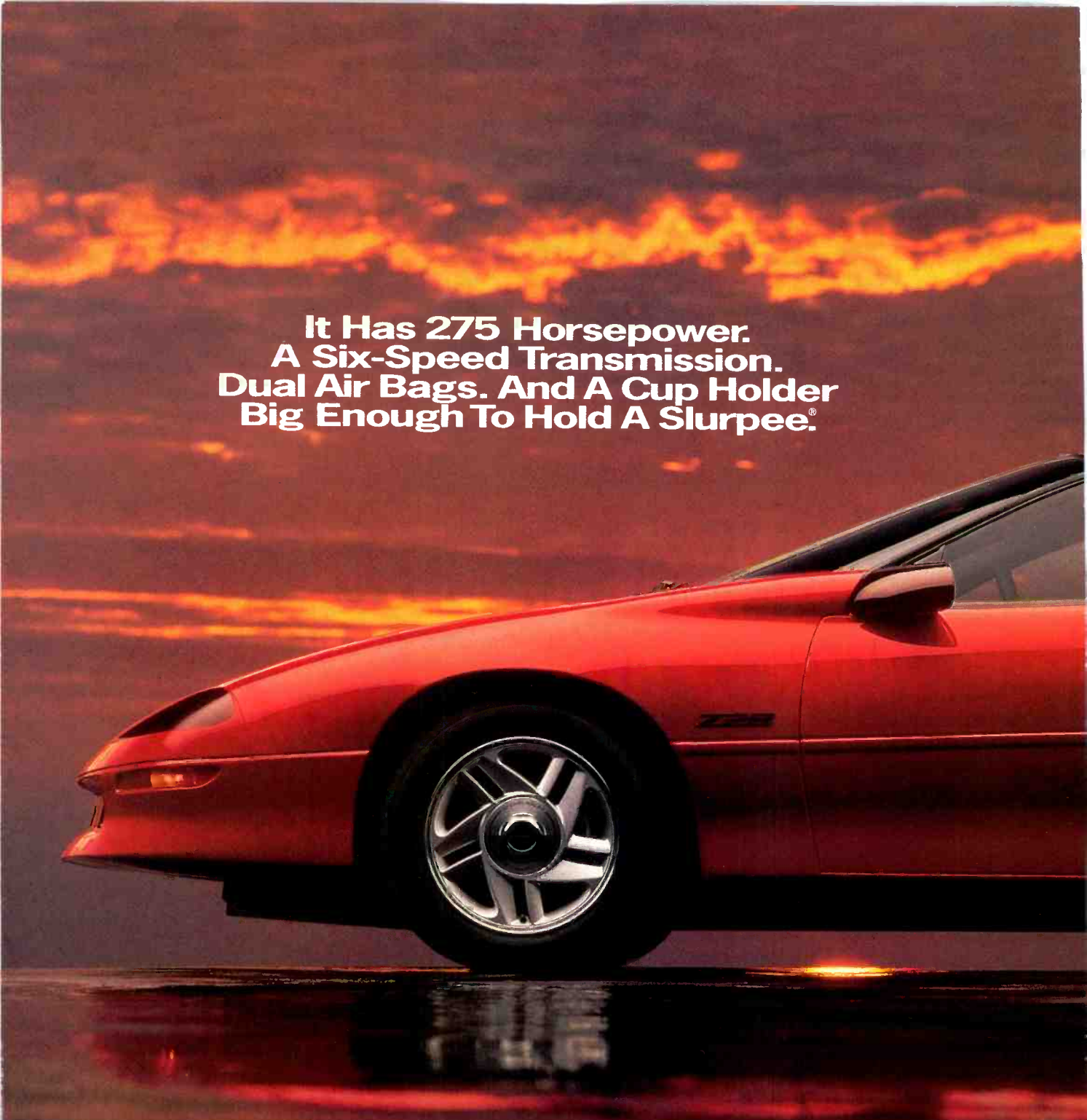
SPIN DOCTORS
- 7/1 - Milwaukee, WI Marcus Amph.
- 7/8 - Stanhope, NJ Waterloo Village
- 7/9 - Wantagh, NY Jones Beach
- 7/10 - Holmdel, NJ Garden State Arts Ctr.
- 7/11 - Philadelphia, PA Mann Music Center
- 7/13 - Mansfield, MA Great Woods
- 7/14 - New Haven, CT Coliseum
- 7/15 - Middletown, NY Orange Cty. Fairgrounds
- 7/16 - Hershey, PA Hershey Pk. Stadium
- 7/18 - Buffalo, NY Darien Lake Amph.
- 7/19 - Maple, ONT Kingswood
- 7/20 - Cuyahoga Falls, OH Blossom
- 7/21 - Clarkston, MI Pine Knob
- 7/24 - Noblesville, IN Deer Creek
- 7/25 - Tinley Park, IL World Music Theater
- 7/26 - Minneapolis, MN Northrup Audit.
- 7/27 - Omaha, NE Civic Audit.
- 7/29 - Cinncinnati, OH Riverbend Amph.
- 7/30 - St. Louis, MO Riverport Amph.
- 7/31 - Bonner Springs, KS Sandstone Amph.

TINA TURNER
- 7/4 - Montreal, Canada Forum
- 7/5 - Ottawa, Canada Civic Center
- 7/8 - Burgettstown, PA Starlake Amph.
- 7/10 - Buffalo, NY Darien Lake Amph.
- 7/12 - 14 - New York, NY Radio City Music Hall
- 7/16 - 17 - New York, NY Radio City Music Hall

AUGUST

ALBERT COLLINS & THE ICEBREAKERS
- 8/1 - Winter Park, CO Winter Park Jazz Fest
- 8/6 - Gresham, OR Mt. Hood Jazz Fest
- 8/7 - Seattle, WA - Backstage

SPIN DOCTORS
- 8/1 - Oklahoma City, OK Zoo Amph.
- 8/3 - New Orleans, LA Municipal Audit.
- 8/7 - Dallas, TX Starplex Amph.
- 8/17 - Vancouver, B.C. Pacific Coliseum
- 8/21 - Berkeley, CA Greek Theater
- 8/26 - San Diego, CA Open Air Theater
- 8/28 - Los Angeles, CA Greek Theatre



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AUDIO CLINIC

JOSEPH GIOVANELLI

4-Ohm Speaker on a 4-Ohm Tap

Q. *I own a pair of 4-ohm loudspeakers and am considering the purchase of a tube power amplifier. This amp has a tap for use with 4-ohm loads. I have learned from your column that 4-ohm loads draw more current from the amplifier than loudspeakers of higher impedance do. With the added heat generated, would this shorten tube life?*—Basil Avdelis, Brooklyn, N.Y.

A. The extra current load from 4-ohm speakers can cause problems for some solid-state amps, because their naturally low output impedance lets the low-impedance speakers draw more current from the output transistors. But tubes have such high impedances that a transformer is needed to match them to a speaker's low impedance. At the 4-ohm tap, the amplifier delivers more current but less voltage than it does at the 8-ohm tap, which is why a tube amp is usually rated the same for output at either impedance. (Solid-state amps are usually rated to deliver more power into 4-ohm loads than into 8-ohm loads.) The load seen by the output tubes will be the same for 4- or 8-ohm loads, assuming the proper transformer taps are used. Tube life and sonic quality should not be affected.

In any case, you can usually presume that an amplifier is designed to handle any load for which it has a specific output.

Longevity of DAT Cassettes

Q. *My friends have told me that, like videotapes, the quality of DAT recordings declines after about 40 plays, and that the number of errors encountered while "reading" the tapes becomes high enough so that sound quality audibly suffers. Is this true? If so, how can it be avoided?*—Jeremy Rassen, Cambridge, Mass.

A. Although my experience with DAT machines is very limited, I have not noticed any degradation of performance with repeated plays or play/record cycles. It is my understanding that, because of the very extensive system of rewriting data and of error-correcting codes, tapes should stand up well over time and many plays.

Recording studios are using the DAT format for archival purposes. Obviously, long life of tapes is very important for this. The other side of the coin is that archived material is not run very often.

Digital Audio Tape has not been with us long enough to provide a history to fall back on. Given your concerns, make copies of your important tapes and play the copies rather than the masters. If you can make digital copies, that is best. The SCMS copy-protection scheme prevents us from making more than one or two digital copy generations from any given tape, however.

Setting Amp Input Levels

Q. *I'm a parttime musician and, as a consequence, occasionally need to listen to music at realistic sound levels. I have killed a couple of power amplifiers. Can I extend the life of my amplifiers by keeping their input level controls set low? Is my amplifier working harder if my CD player's output is set to medium output rather than to its maximum? What about the settings on my preamplifier?*—Joseph P. Foley, Jamaica, N.Y.

A. A power amplifier works harder when it is asked to produce more output power. It will produce more output power when the signal fed to its inputs increases. This increase can be the result of turning up the volume on the amplifier, preamplifier, or CD player, or it can be the result of natural increase in loudness of the music being played. Therefore, if you turn down the volume of your CD player and turn up the volume of the preamplifier to compensate, the net signal to the inputs of the power amplifier will be unchanged.

You don't want a situation in which the power amplifier produces so much power that it blows out your loudspeakers. If your loudspeakers can handle more power than can be supplied by your power amplifier, and if this amount of power does not produce sufficient listening level, you need more powerful amplifiers or you need loudspeakers that can produce higher listening levels than your present ones can from the same amount of amplifier power.

You must not turn your power amplifier's input level controls down so low that you overload your preamplifier in order to drive the power amplifier sufficiently. Also, you don't want the input controls set so high that you hear background noise from your loudspeakers even with the preamplifier's volume controls all the way down. Some preamplifiers have audio stages ahead of their volume controls. Be sure to keep your CD player's signal level sufficiently low enough so that you don't overload those early preamp stages.

Setting a CD Player's Output Level

Q. *I'm unsure how I should use my CD player's output level control. Should I turn my preamp's volume up full and set overall volume with the control on my player? Would it be best to keep the CD player's volume up almost all the way and control volume from the preamp? Or should I use the preamp's volume control for the basic setting and then make minor adjustments with the control on the player? With the preamp's volume control all the way up and the CD player's control down, I seem to be hearing more hiss.*—Peter Paciariello, Tucson, Ariz.

A. First, set your preamp's volume control to the point that's normal for most of your other program sources. Then use your CD player's output level control to make the volume from CD match, more or less, the volume from your other program sources. After that, adjust volume from the preamplifier. This is certainly the most convenient setting, since it lets you switch between sources without drastically readjusting volume.

It's also advisable for sonic reasons. When you set the preamp's volume control full up, you amplify the noise from all the preamp's circuits that come before the volume control. Since one of the major benefits of CD is low noise level, you won't want to add noise from your electronics. And I think you will find that when that noise is absent, the music takes on an openness that is hard to imagine until you've heard it. A

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

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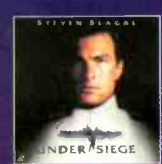

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The M & K S-80 satellite, from Miller & Kreisel Sound, is a two-way speaker with a 1-inch tweeter and 5¼-inch woofer. The angles of its trapezoidal cabinet were optimized using computer time-domain measurements. The asymmetric plate surrounding the tweeter is designed to control directivity, to improve imaging and reduce diffraction. Power-handling capacity of the 10-pound speaker is 200 watts. A shielded version is available, using extra driver magnets that also reduce distortion and increase efficiency. Prices: $550 per pair unshielded, $595 per pair shielded.
For literature, circle No. 100

Gemini Antenna

The Gemini G2000 amplified indoor antenna picks up FM radio and the VHF and UHF TV bands. Gain is 25 dB for FM, and it is independently adjustable up to 45 dB for VHF and up to 30 dB for UHF.
Price: $69.95.
For literature, circle No. 102

Dynasound CD Storage

The CD Magic Quick Retrieval System, which holds 24 CDs in their jewel boxes, not only pops those boxes out when desired but pops them open, for easy access to any CD and its booklet. Units are stackable. Price: $39.95.
For literature, circle No. 101

CWD Cabinets

Traditionally designed, the Rialto entertainment center from Custom Woodwork & Design is built of birch and finished in CWD cherry, natural cherry, or mahogany. The system shown consists of two column units for audio components plus a center unit with space for a TV up to 35 inches in screen size. Prices: Columns, $1,495 each; center unit, $1,995; optional finishes, 5% additional.
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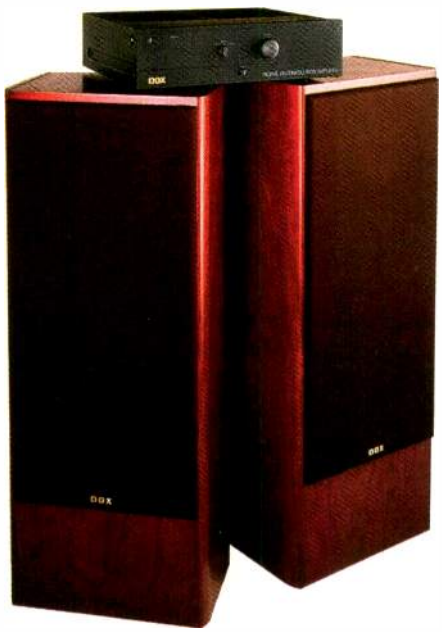


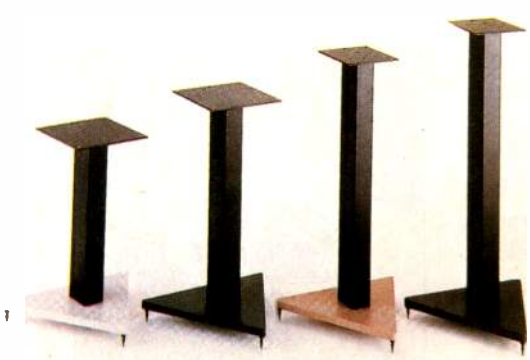
a pair of DDL-1 speakers plus a DDA-1 amplifier that incorporates a DSP unit designed to counteract coloration in the speakers. The DDA-1, with rated output of 140 watts into 4 ohms at 0.01% THD and 0.16% IM, has inputs for analog and for optical and coaxial digital signals. The DDL-1 speakers are three-way bass-reflex systems with 12-inch woofers, and are available in a wood-grain vinyl or rosewood veneer finish. Prices: $1,995 in wood vinyl, $2,195 in rosewood.
For literature, circle No. 104

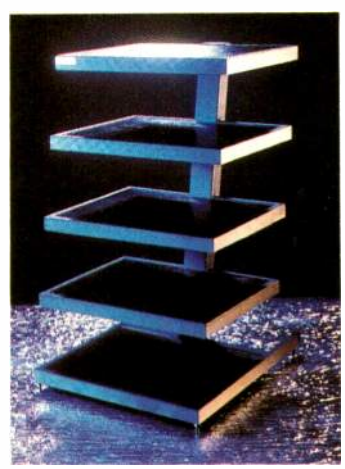
NAD THX Amplifier

The Monitor Series 2700THX from NAD is a THX-certified stereo power amplifier delivering 150 watts per channel. Designed for high headroom, the unit can deliver as much as 600 watts per channel IHF dynamic power into 4 ohms. A rear-panel switch optimizes the amp for speaker impedances of 2 to 4 ohms or for impedances of 8 ohms and up. Both normal and THX inputs are provided; the former incorporate filters to eliminate noise above and below the audio band, for reduced IM; the THX inputs are unfiltered. Price: $829.
For literature, circle No. 106

Sanus Systems Speaker Stands

The triangular bases of the Sanus Reference Foundation speaker stands are constructed of an acoustically inert material made to resemble marble, available in gray, emerald, sand, and rose. The steel top plates are damped with isolation strips. All models may be filled with sand or shot, and they incorporate nonconductive paths for speaker wires. Adjustable spikes are available for the tops and bases. Models 12, 16, 20, 24, and 28 inches tall are available. Prices: $169.99 to $179.99.
For literature, circle No. 105





Standesign Equipment Rack

Supported by a slanted central spine instead of a side frame, the Standesign Design 5 rack can hold components of virtually any width. That spine also contains a channel to keep power cords and signal cables out of sight. The rack stands 34 in. H × 20 in. W × 16 in. D; lower, four- and three-shelf versions are also available. Price: $399.
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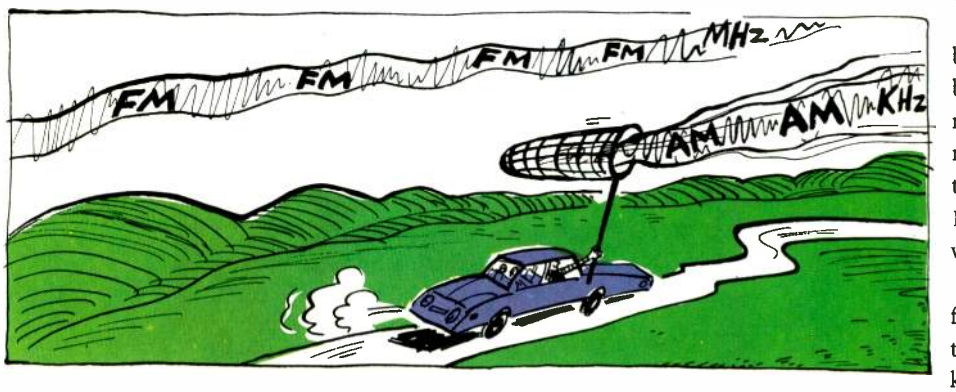
ROAD SIGNS

IVAN BERGER

A NEW MORNING FOR AM?

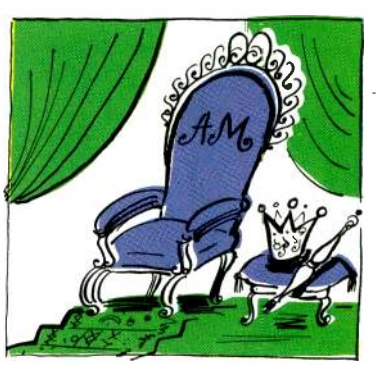


No matter how much money we spend on fancy car stereo, many of us still spend part of our mobile listening time tuned in to good old AM. It brings us instant news of traffic jams and weather, fills our cars with other people's voices on lonely drives, comes in where FM stations aren't available, and sometimes lets us keep listening without retuning as we drive through county after county. But we listen most to FM, the upstart that dethroned AM from king of radio to being, at best, a duke.

There are hopeful signs for AM broadcasters, but the band has a lot to recover from. Everybody knows by now of FM's greater fidelity. Radios that receive FM have long been only a little more expensive than AM-only models. And interference on the AM band has grown, due to overcrowding and the use of more and more electrical and electronic devices.

What really shifted the balance was stereo. A single standard for FM stereo was set soon after stereo records hit the market. It took another 20 years or so for AM stereo to arrive. And then the FCC approved not one but several AM stereo systems, leaving the marketplace to decide which would win, so stations and receiver makers were unsure which format to espouse. Most took a wait-and-see attitude and held it for a decade. The field soon narrowed down to Motorola's C-QUAM and the Kahn (ISB) system. But Motorola, with the capacity to make C-QUAM receiver ICs, gained the upper hand. According to *Radio World*, an industry newspaper, there are now 24 million C-QUAM receivers in circulation, and C-QUAM is used by 591 U.S. stations; six other countries (Australia, Brazil, Canada, Mexico, Japan, and South Africa) have adopted it as their standard. Fewer than 20 U.S. stations use the Kahn system, and there's not much equipment to receive it.

Now there are moves afoot to bind AM's wounds. On the stereo side, Congress has finally ordered the FCC to pick a single system. It seems likely that C-QUAM will be picked. However, seven out of every eight U.S. AM broadcasters use no stereo system as yet, and some engineers feel C-QUAM has unresolved technical problems, so it's no shoo-in.



To deal with interference between stations, the AM band has been expanded by 100 kHz. As more and more new radios are made that can receive stations on the new frequencies (1,605 to 1,705 kHz), more and more stations will migrate to those frequencies.

The AMAX certification system for high-quality AM radios has led to only one home product that I know of, Denon's TU-680NAB tuner (see *Audio*, April), but lots of AMAX-certified Delco car stereos are now on the road. And even the non-AMAX AM tuners in car radios are often far, far, better than those in home equipment.

The Radio Data System won't do as much for AM as for FM. The RDS radios won't be able to show the name of the song an AM station's playing, since only FM stations can transmit the needed data (at least for now). But the system will help travellers identify and locate the stations they pick up and help them find the kind of programming they want, for AM and FM alike.

One cloud on AM's horizon is the possibility of digital broadcasting, but that cloud may be silver-lined. If transmitted by satellite, digital signals would blanket most of the country, surpassing the reach of even clear-channel AM stations. But there's also talk of going digital on both the AM and FM broadcast bands. Presumably, the audio quality would be the same for digital transmission via either band—and AM digital signals would maintain their greater reach. That might even put AM back on its long-lost throne. A

Illustrations: Beata Szpura

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EDWARD TATNALL CANBY

ORCHESTRATING A FUTURE

Illustration: Tom Lulevitch

Sometimes a mirror image, two opposites like the two sides of a coin—or two immense events, alike but different—can lead to fascinating perspectives on our special scene, audio. Big-time conventions, for example, ours and somebody else's, just as big, right next door. Two monster week-long aggregations of thousands of people, new ideas, innovative products, seminars, luncheons, workshops, lectures, demos, receptions, forums, banquets, all in the good old American way, outwardly as alike as two peas. Or maybe two galaxies? One is *us*. The other isn't.

Well, if it's audio people and dentists, there isn't much to learn. Reminds me of my oft-told story of a Manhattan press luncheon, where I got off at the wrong elevator stop, ate my way through the hors d'oeuvres, and only then discovered I was with the dentists, not audio. One floor up, please. But the two conventions I have in mind aren't that way at all. They have much subject matter in common—though you'd never know it, reading each group's prospectus.

Ours, as most readers know, is the Audio Engineering Society (AES) Convention, which reaches mid-Big Apple every couple of years, an automatic-weapon shot away from the *Audio* office. (We could almost shoot holes in the nearest loudspeaker.) The other is the annual Conference (read, Convention) of the American Symphony Orchestra League, held in 1993 a mere stone's throw away from the very same area.

Now we in audio are rather familiar with the symphony orchestra in America, not to mention other orchestras around the world. So too are all of us, from the professionals who record the sound of it to the people who sell the sound, and of course the consumers who now inhabit home theaters of our making (which double very nicely as home symphony concert halls). In every part of the audio world the symphony orchestra is familiar, perhaps not quite the equal of the pop video scene but nevertheless very much a vital cog in our machinery, and it always has been. After all, don't we produce thousands, even millions of recordings of American symphony orchestras? Can any group be more familiar, indeed, with the workings and the product of such an orchestra than we are?

I would not be surprised if some industrious statistician were to announce that 10.47 times as many people listen to *recorded* symphony (whether with both ears or half an ear) as listen to the same "live," in the musical flesh (also occasionally with half an ear—or none while asleep). Maybe a hundred times as many? Could be. We do have a common denominator, live and recorded. So do our Conventions. Or do they?

Therefore, I opened up the handsome Conference prospectus of the American Symphony Orchestra League with interest. Hail, brothers, and well met, as Shakespeare probably did not say.

Enormous is the word, at least in variety. For some five days of multiple activities (not unlike the AES Convention) there were listed nearly *200* separate events, each lasting from an hour to three or more. (Some were listed several times under different categories.) But as I perused the numerous pages, decked out in three colors—red events, black ones, and green ones—it began to be clear that something was missing. Audio was missing.

LET AUDIO WEEP FOR THE SYMPHONY, THOUGH THEY SHED NO TEARS FOR US.

In all this mammoth Convention there was simply no reference to the symphony orchestra *via any form of audio*, except one, at the tail end: A three-hour special post-Conference seminar (extra cost, $55) entitled "Producing Your First Recording." Presumably for those symphony people who had not yet heard about cassette and CD. Even this one seminar

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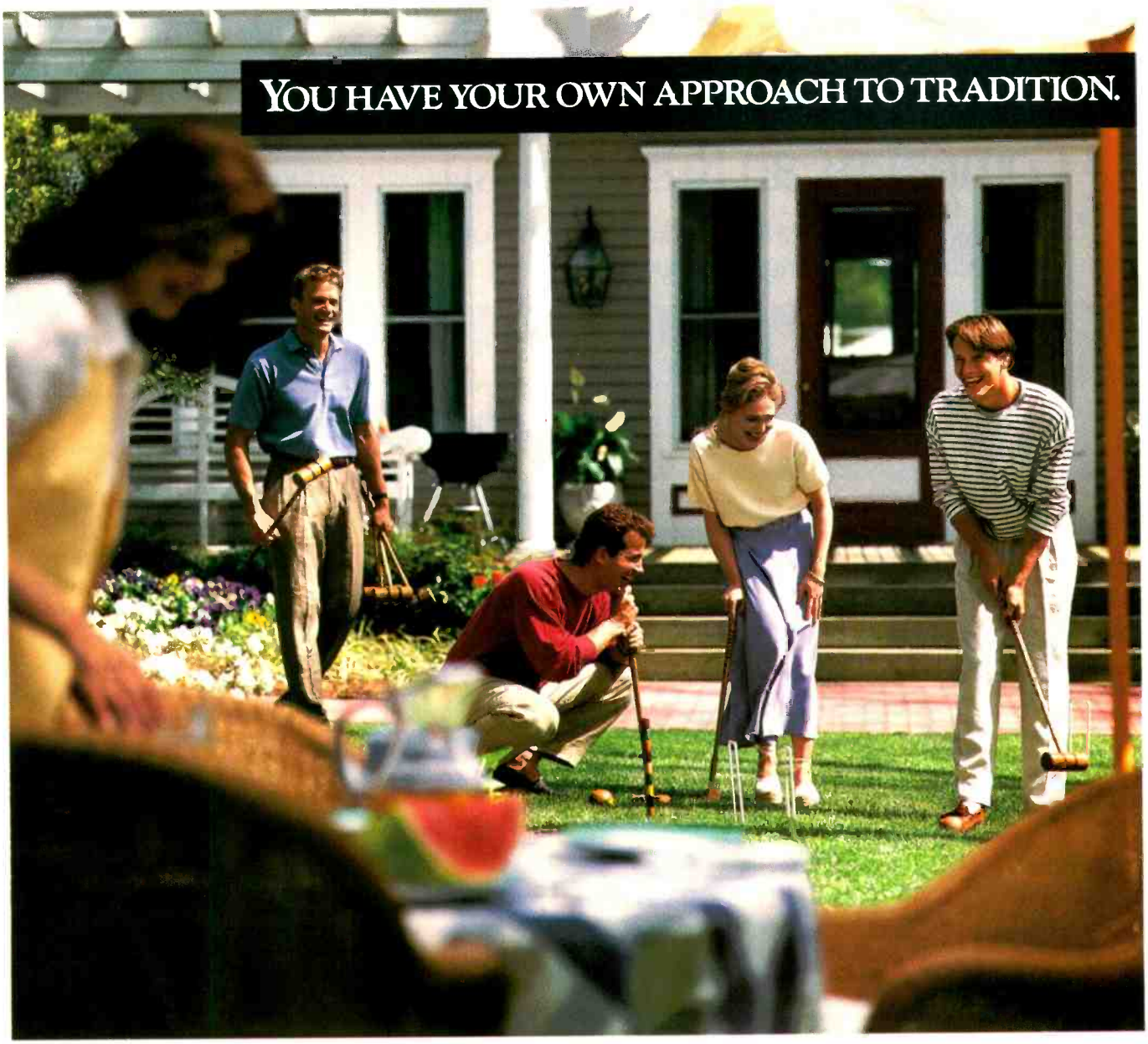

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was competitive with no fewer than three others simultaneously, diluting its impact.

Is this all the influence we have on the American symphony orchestra in its largest get-together of the year? If you cut out a few lines of that really opulent prospectus, we are not there at all. Except as part of the furniture, mikes and speakers along with tables, chairs, and rostrums. Is *this* the other side of the coin?

Factually, it is. But I am not offering these words as a criticism—be calm, you musician readers! Rather, an observation. Things as they actually are, and surely for compelling reasons.

The intense, exclusively nonaudio emphasis of this assembly of American music-makers is absolutely justifiable from an inside point of view. This is an "industry" (they call it that) in peril, precarious to the point of utter disaster yet, still, very much alive. An industry so full of technical anachronisms that, when you begin to think about it, the whole business seems preposterous. Music composed for the royal court of King So-and-so centuries ago, now performed in vast concert halls for democratic audiences, everybody from ragged students in shorts to wealthy dowagers and their husbands (who are the ones who go to sleep). Such an incongruity! Such an inspired and worthwhile incongruity!

Symphonic music lives, but how? I mean, live music, on the spot, heard as it is actually played, warts and all. (In concert, mistakes are not corrected until total breakdown, which *never* happens. It can't be allowed to happen!)

And look at the tools of the trade. "Modern" instruments? Yes, if the first streetcar, following a horse, is modern, or the original Daimler and Benz automobiles of the 1890s. But then again, if the musical instruments of the orchestra are mainly frozen, so to speak, in the forms they had a century and much more ago, that is merely because the sophisticated art of instrument building reached its high point early, before the Industrial Revolution got underway. Very simply, people sometimes know when it is wise to stop. Good thing! For new instruments—electronic, perhaps—a new music. For new music, new instruments. It works both ways.

So the symphony orchestra—in all its human aliveness as an institution, a pro-

ducer of music, an industry—when you come down to it is 99% *heritage*. Good heritage. Not a thing we want to abandon too quickly, however precarious its operation. And however obsolete the mechanical sound-makers.

Alas, inevitably, the symphonic musicians are unresponsive to many musical trends that can keep other types of "classical" music alive and expanding and far more practical. Smaller ensembles. *We* like them. So do music listeners. Music revived from other times and *not* for symphony orchestra. We have had a veritable revolution here, within my own musical lifetime. It merely makes life more difficult for the symphony orchestra. And now, to polish it off, the "period" instrument! Increasingly popular with listeners, if not with symphony men.

As far back as the 1930s, our big orchestras sometimes allowed a harpsichord to appear on stage where appropriate. Totally inaudible, of course, but "correct" for Bach, Handel, Vivaldi, even Haydn symphonies. Later, the recorder, the old, old wooden "flute," appeared (at least in Europe) in music composed for it. That is all. Years ago. Do you find recorders in symphony orchestras today? Special order, maybe. Anything else that is "period" for symphonies? Rarely.

THE REASONABLE AND SENSITIVE MUSICIAN WAXES PASSIONATE WHEN HE FINDS HIS TRADITION IS CHALLENGED.

The performing reflects the same, the symphony orchestra locked in its own exalted heritage. How many big-symphony horn players, doing miracles with those incredible twisted tangles of brass tubing, transposing at sight one key to another, choosing among overtones, hand in the bell, working the little valves (and I might add, pouring saliva out on the floor. . .), how many of these practitioners can play a simple, older, valveless horn with concert quality? How many symphony oboists have tried the old sort with only a key or two, "period," for all sorts of older music? How many symphony clarinetists could do a concert on a Beethoven or Mozart clarinet?

It's a matter of attitude. In the symphonic tradition, out of the 18th century but primarily surviving in 19th- and 20th-century form, these earlier mechanical music machines are not thought useful. You can play the music "better" on a "modern" instrument, also mechanical. And also obsolete, even if there are no successors. In this sense the symphony orchestra is narrowly, literally conservative inside its own sense of musical values.

When that tradition is challenged, especially by the dire threat of extinction, your reasonable and sensible musician waxes passionate. Who wouldn't? Life is at stake.

So let us return to that pair of Conventions. I think all of us can understand that audio in music is not the immediate interest of those who join together in the Symphony League Convention! Audio will take care of itself, thanks, very nicely. Other problems exist of much, *much* greater import. This League airs those problems and struggles mightily towards the upbeat, trying to bring solace, comfort, and new ideas to the ranks. What else? In enormous profusion, days on end, and worth every dollar (this Convention strikes me as expensive...) for the attendees.

I will not bore you with more than a few titles from the innumerable events at this other Convention: "The Best Future for Your Orchestra," "Board Members and Fundraising," "Life As an Orchestra Musician," "Leadership Colloquy I," "Business/Orchestra Alliances," "Selecting a Youth Orchestra Conductor," "Conflict Resolution: Can We All Get Along?" And plenty more—also concerts, needless to say. None of this is audio. But we inherit the results.

I think Dan Roth, president of the Oregon Symphony, sums it up: "The Conference provides an essential opportunity to address with our fellow managers, board members, musicians, volunteers, and staff the critical issues we face today." A bit pompous, perhaps, but if you ask me, beneath that statement, and in the entire Conference, is a cry for help and for courage such as we in audio—lucky we—have never had to express in any of our Conventions. Is an audio tear or two of sympathy in order? I think so. We have a stake in the symphony, too. A

BERT WHYTE

HALLS FOR ALL

Symphony Hall, in Birmingham, England, has variable acoustics designed in America by Russell Johnson.

Photograph: R. Johnson/Artec

Nowadays, engineers who record classical music employ a formidable array of high-tech equipment to capture the multiple sonorities of symphony orchestras. One of the most important links, however, is the acoustic space—the concert hall. It is apparent that no matter how sophisticated the recording equipment or how highly skilled the engineer, if the venue has poor acoustics, the chances of making a good recording therein are greatly diminished.

Thus, engineers are forever on a quest for good recording halls. Everyone knows the exemplars—Boston Symphony Hall, the Concertgebouw, the Musikvereinssaal in Vienna, etc. The important factor is the desirable acoustic qualities of the space involved, which may be a structure never intended for performing or recording music.

I have made recordings in Walthamstow and Watford "Assembly" halls in London, and while they are two of the most famous and busiest recording venues in England, their original purpose was as Town Halls, which housed the administrative activities of their respective boroughs. Their use for recording was sheer happenstance. This is also the case with a number of churches throughout the world, such as St. Eustache in Montreal, where Decca records the Montreal Symphony Orchestra, and All Saints, Tooting, London, frequently used by Chandos. New York City has a paucity of good recording halls; such places as the ballroom of the St. George Hotel in Brooklyn (now gone) and the ballroom in the Great Northern Hotel in New York City (also gone) have been used.

UNTIL RECENTLY, HALLS WITH VARIABLE ACOUSTIC CONTROL WERE SHEER FANTASY.

Concert halls built in recent years have purportedly had the benefit of modern acoustical science and design. The result has been a mixed bag. The principal goal was to provide halls with an acoustic ambience that optimizes the performance and auditioning of classical music. Even though a number of halls meet these criteria, it does not automatically follow that they are also good recording venues. However, sometimes the reverse is true—a hall can be good for recording but might be less than satisfactory for concert presentation. With the great majority of spaces used for classical music recording, what you see and hear is what you get. Their acoustic characteristics are known quantities, and little can be done to appreciably modify them. These halls are what might be termed static acoustic environments.

Even in halls considered desirable for recording, the results can vary quite a bit, depending on the recording engineer's philosophies and skills. Another factor that must be considered is the nature of the music. Haydn and Mozart symphonies are vastly different in scoring from those of Bruckner or Mahler, and thus require different recording approaches. Piano and violin concertos impose their own special conditions, and large-scale choral works can be the most daunting of all to record. It is also true that certain halls are preferable for specific kinds of music. For example, the quite reverberant acoustics of All Saints Church, Tooting, would be appropriate for the Brahms German Requiem, but I wouldn't want to record Stravinsky's *Rite of Spring* there.

In the best of all possible worlds, a recording engineer's dream hall would allow the entire classical music repertoire to be optimally recorded. This obviously requires a hall with variable acoustic control, in essence a dynamic acoustic environ-

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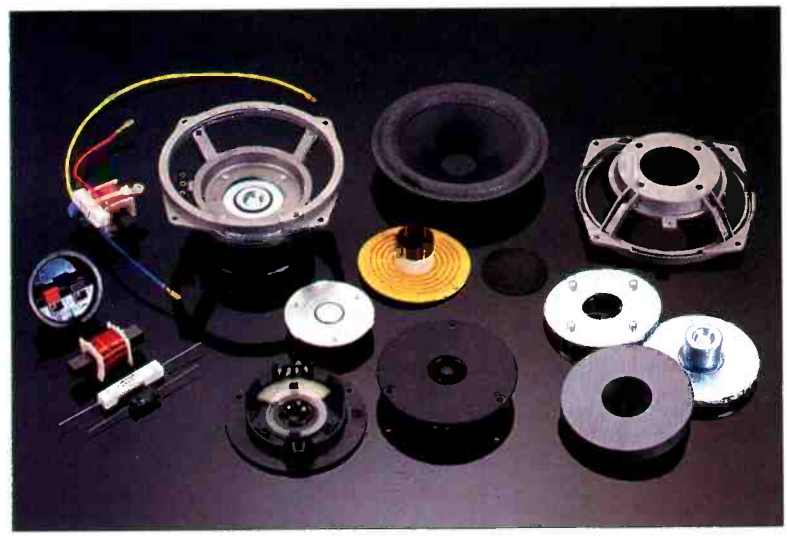

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The ATOM is a 2-driver, 2-way bass reflex systems with critically tuned resistive port on the back to maintain correct bass balance even when placed near a wall.

- The high-frequency drive unit uses a polyamide dome which has low mass and high internal damping for balanced wide-band frequency response. A high-temperature voice-coil, aluminum former and ferro-fluid cooling/damping further reduces distortion and ensures long service life. Beware of inexpensive cone-type tweeters found in virtually all loudspeakers in this price range. Their performance capabilities are substantially inferior.
- The high-frequency drive unit is mounted in a specially designed front baffle. This ensures uniform and smooth total energy output for a natural tonal balance and a superb three-dimensional soundstage.
- The ultra-compact 5¼" PARADIGM built bass/midrange drive unit features a polypropylene cone for smooth response, extended bass performance, and greater freedom from unwanted resonances and distortions. A multi-layer voice-coil, kapton former and oversized magnet structure ensures musical accuracy and long term reliability. Most remarkable however, is the use of a high-pressure diecast aluminum chassis to minimize mechanical vibration, ringing and flexing. Although common in expensive speakers, a diecast chassis at this price level is completely unprecedented!
- The dividing network uses close tolerance, high power components in time-corrected quasi-Butterworth configurations for maximally flat frequency response.
- Enclosures use inert high-density hardboard to limit unwanted panel resonances.

ATOM speakers with an SB Series subwoofer makes an outstanding three piece system

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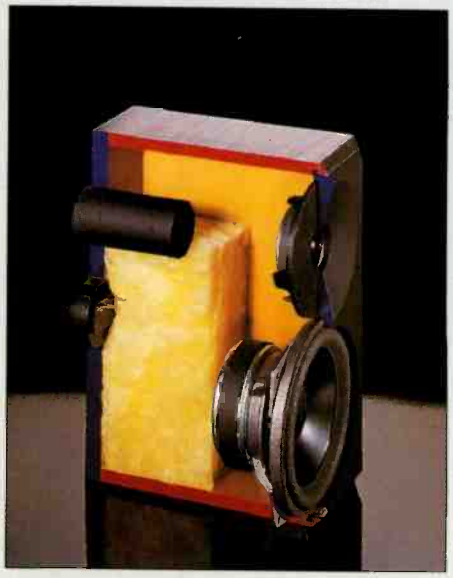
Based on the vast body of speaker research conducted by the world-renowned National Research Council of Canada and utilizing extensive in-house R&D facilities, PARADIGM engineers evaluate many generations of prototypes before a design is put into production. The goal of this enormous commitment to research and development is to deliver performance/value that is second to none! Sophisticated manufacturing and strict quality control procedures ensure superior musical performance for years to come. The ATOM is completely natural and true to live music, and it offers amazing value... **the ATOM is not just a best buy, *it's a steal!***



ATOM enclosure

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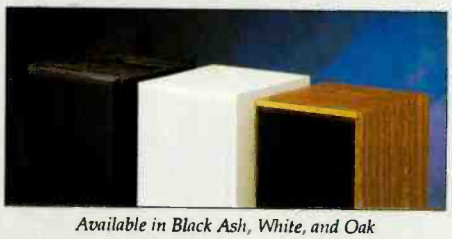

Available in Black Ash, White, and Oak

SPECIFICATIONS

Design	2-driver, 2-way bass reflex. Quasi 3rd order resistive port.
Crossover	2nd order electro/accoustic at 3.0kHz. Frequency- and phase-corrected.
High Frequency Driver	19mm(¾") polyamide dome with aluminum former, ferro-fluid cooled and damped.
Bass/Midrange Driver	135mm(5½") high-pressure diecast aluminum chassis, polypropylene cone, high compliance suspension and kapton voice-coil former. Barrium ferrite magnet.
*Low Frequency Extension**	60Hz (DIN)*
Freqeuncy Response	
On Axis (0°)	±2dB from 90Hz-20kHz
Off Axsis (30°)	±2dB from 90Hz-15kHz
Sensitivity - Room/Anechoic	89dB/86dB
Suitable Amplifier Power Range	15-80 watts
Maximum Input Power†	50 watts†
Nominal/Minimum Impedance	8ohms/4ohms
Recommended Placement	Premier™ s-70 speaker stand or bookshelf.
Height, Width, Depth	26cm x 17cm x 19cm / 10in x 6½in x 7½in
Weight	8kg/18lbs per pair

* DIN 45 500. Listening rooms reinforce bass. Thus, in most listening rooms, this reasonably indicates the audible (approximately -3dB) low frequency performance that can be achieved.
† Maximum input power indicated is with typical program source, providing the amplifier is clipping no more than 10% of the time.

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ment. Until recently, such a hall was largely fantasy. However, acoustician Russell Johnson, of Artec Consultants in New York City, has brought the dream hall much closer to reality by incorporating some of his variable acoustics techniques in two new halls—the Eugene McDermott Hall in the Morton H. Meyerson Symphony Center in Dallas and the City of Birmingham Symphony Hall in England.

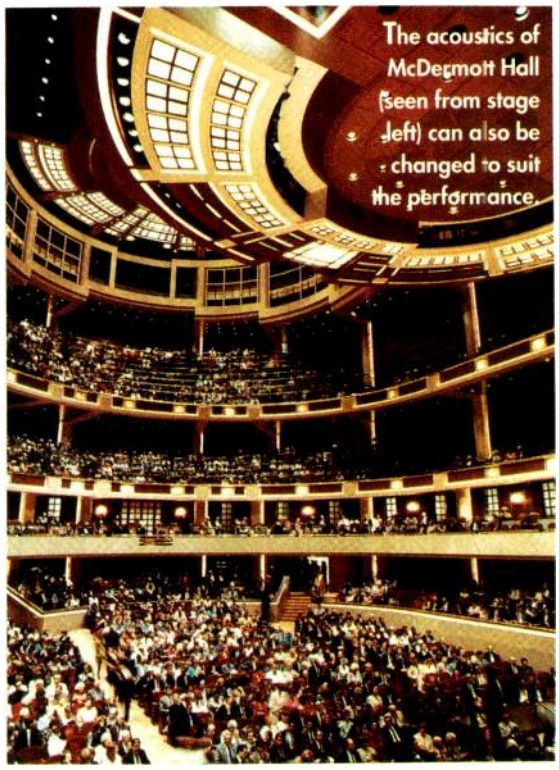
For some years, I have carried on a dialog with Johnson on many aspects of his designs. I felt that many of the innovative features in Johnson's halls with dynamic acoustic environments would be of great value in recording but wondered if financial considerations would permit full implementation of his ideas. Thus, it is particularly gratifying that these halls were constructed with close adherence to his design principles.

Both halls are loosely based on the traditional rectangular shoe-box design—i.e., long and narrow, with high ceilings and encircling galleries or balconies (as exemplified by Boston Symphony Hall). The Dallas and Birmingham halls use similar variable acoustic control methods but differ in construction and materials.

As you might know, the Eugene McDermott Hall is home to the Dallas Symphony Orchestra and conductor Eduardo Mata (soon to be succeeded by Andrew Litton). It is also used by the Dallas Wind Symphony. Since the inaugural concerts by the Dallas Symphony Orchestra in September 1989, this hall has been lavishly praised by music critics for its fabulous acoustics.

A HALL MAY BE GOOD FOR RECORDING BUT NOT SATISFACTORY FOR CONCERT PRESENTATION.

The Eugene McDermott Hall has been used by Reference Recordings to record the Dallas Wind Symphony with conductors Howard Dunn and the redoubtable Frederick Fennell, of Mercury Records fame. The always adventuresome Craig Dory, cofounder and chief engineer of Dorian Recordings, has been recording the Dallas Symphony in McDermott Hall. Dory is always ready to embrace worthwhile new technology, and I discussed several of his ideas with him after carefully auditioning his initial four recordings in the new hall. Dory also had extensive conversations with Russell Johnson on the various aspects of this unusual hall. In the CD booklet for its first recording here, Stravinsky's *Rite of Spring* and Prokofiev's "Scythian Suite" (DOR-90156), Dorian furnishes a very concise but well-detailed description of McDermott Hall's special features:



Photograph: R. Johnson/Artec

> The hall's variable acoustics are achieved in three ways. The ceiling's perimeter consists of 72 hinged concrete panels, concealed by a grille cloth, which can be closed and opened, altering the effective volume of the hall and the degree of reverberation. A comprehensive system of motor-operated, multi-layered cloth curtains can be extended to cover most of the wall surfaces, reducing reverberance, or retracted into concealed storage pockets, allowing the sound-reflective wood and masonry walls to function. The third variable acoustical feature is a system of four vertically adjustable sound-reflecting canopies above the concert stage. The canopy system provides the ability to adjust early reflections to achieve acoustical characteristics most complimentary to the repertoire being performed, and allows the musicians on stage to hear themselves and one another accurately. A 4,500-pipe organ built by Fisk [was] completed in 1992.

The Birmingham Symphony Hall has similar features for variable acoustics—including a huge reflecting canopy that can be raised or lowered over the stage area. Massive panels of wood bonded on concrete, located on each side of the organ chamber, can be adjusted from fully open to completely closed. When open, they add considerable internal volume to the hall. Fabric-covered acoustic panels can be adjusted in conjunction with the concrete panels to change the acoustic character, and adjustable panels can be moved behind the orchestra to provide more projection. All of the aforementioned can be precisely adjusted to reflect or to absorb, and all are built with particular emphasis on solidity to preserve bass response. Russell Johnson suggests that of the sound reaching the listener's ears, about 10% is direct sound and 90% reflected from the various surfaces and boundaries.

In both the McDermott and Birmingham halls, the adjustable acoustic elements can be used to reduce the reverberance of the hall (make it sound "drier") or, conversely, to open up the sound by increasing the reverberation time. The proper utilization of these variable devices depends on such things as the size and layout of the performing ensemble and the type of music being recorded. The adjustable canopy plays a vital role in providing early-arrival reflections to achieve an appropriate balance between clarity and reverberance.

These two Artec-designed halls provide very good control of acoustics. However, the recording engineer needs a thorough understanding of how the various systems work and what their effects are—which, of course, only comes with experience. Both Reference Recordings and Dorian in Dal-

las, and EMI Records in Birmingham, have therefore been on a learning curve, and this is reflected in their initial recordings. Although Reference Recordings' *Fiesta!* (RR-38) and *Holst* (RR-39) have many impressive sounds, hall/orchestral perspectives are a bit recessed (except for a larger-than-life bass drum, which rather overwhelms the balances). *Fennell Favorites!* (RR-43) is a decided improvement, with better projection of the brasses and woodwinds of the Dallas Wind Symphony, better balance between orchestral choirs, and wider dynamic range. On the recent Frederick Fennell *Trittico* (RR-52), recorded with High Definition Compatible Digital (HDCD) technology, engineer Keith O. Johnson scores an impressive sonic bulls-eye! Familiarity with the variable acoustics has paid off in a stunning recording of the Dallas Wind Symphony's sonorities. The ensemble has just the right degree of detail and definition, enrobed in a lovely natural ambience. The dynamic climaxes in Albeniz' "Feast Day in Seville" are startling in their impact; the bass drum is rock-solid, tam-tam and cymbals scintillate with vast energy, and the huge declamatory brass is eminently thrilling.

Dorian's first recording in McDermott Hall of the Dallas Symphony, the aforementioned Stravinsky/Prokofiev CD, has many good moments, but the general perspective is, for me, a bit recessed and short on presence. Shostakovich's Symphony No. 7 (on DOR-90161) is very clean, with better detail and wider dynamics, but I find Craig Dory's effort still short on forward projection, the "launch" into the hall.

In these Russell Johnson halls, I have a feeling that there may be an initial tendency to try to achieve that almost mythical concert hall "bloom"—a detailed yet warm, rich sound that relates to what one hears at a live concert in one of the great halls. This may be particularly true for engineers partial to purist mike techniques. Although it's a nice goal, it's difficult to achieve, with the ever-present risk of recessed and unfocused perspectives.

Dorian's next disc, *An American Panorama* (DOR-90170), features Leonard Bernstein's *On the Waterfront* suite, Roy Harris' Symphony No. 3, and Aaron Copland's *Billy the Kid* suite. Dory had become more comfortable with the variable acoustics adjustments, which is reflected in a well-detailed recording that has reasonable launch and a very flattering ambience. The dynamic range is impressively wide, and percussion, especially in the *Billy the Kid* gun battle, is ultra-clean and has great impact.

Finally, Dorian's recent CD (DOR-90169) pairs Prokofiev's *Alexander Nevsky* with Shostakovich's Symphony No. 9. Dory must have pushed all the right buttons, because this disc fully exploits all of the wonderful acoustic control provided by McDermott Hall. In the *Nevsky*, Dory hits just the right balance between chorus and orchestra. The launch and perspective are right on, with that elusive combination of

HAVING UNPRECEDENTED ACOUSTIC CONTROL REQUIRES KNOWLEDGE OF THE SYSTEMS AND THEIR EFFECTS.

orchestral definition and rich ambience affording a sound of outstanding presence. The dynamic range is awesome and a challenge to the very best playback systems. The impact and sonorities achieved in the "Battle on Ice" section are simply overwhelming. You couldn't ask for a better demonstration of the benefits of Russell Johnson's pioneering ideas on variable hall acoustics. And, of course, a tip of the hat to Craig Dory for being a quick study in successfully exploiting McDermott Hall's wondrous facilities.

EMI made a live recording of Mahler's First Symphony with Simon Rattle and the City of Birmingham Symphony Orchestra (EMI Classics CDC-54647) in the new Symphony Hall. I eagerly await the arrival of Prokofiev's Fifth Symphony, made by Rattle in Symphony Hall in traditional recording sessions, which will enable me to evaluate how the EMI engineers handle the hall's variable acoustics.

Russell Johnson also sent me much interesting design information and diagrams on his proposed hall for the Philadelphia Orchestra. Sadly, the funding for this hall is nowhere near what is required, so unless some Main Line multimillionaire comes forth, it may never be built. A

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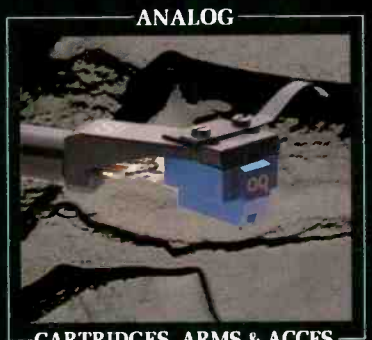

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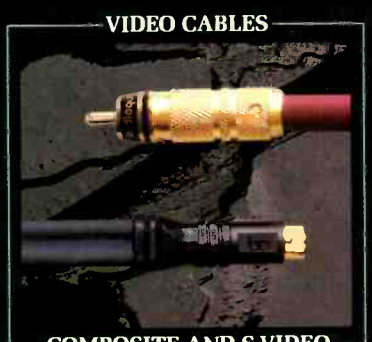

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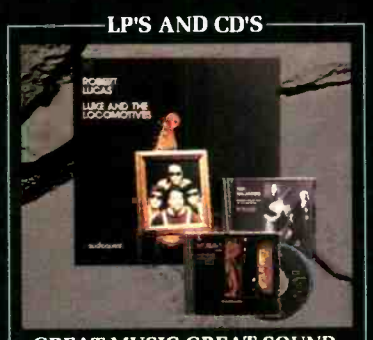

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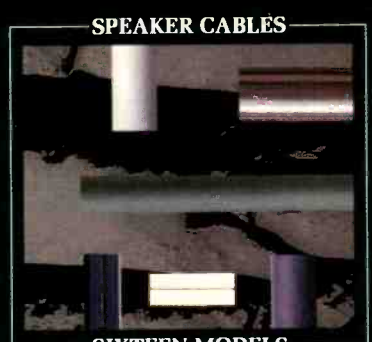

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BASCOM H. KING

I LEFT MY ART IN SAN FRANCISCO

I was invited to attend the San Francisco *Stereophile* Hi-Fi show, and I gladly accepted. I have attended some of these hi-fi shows before and generally found them to be interesting, an opportunity to see and hear new equipment, and a good source of new information. To my knowledge, there haven't been any public hi-fi shows in the western U.S. since the old shows at the Ambassador Hotel in Los Angeles ceased many years ago, so the *Stereophile* show fills a sorely needed gap.

I'D HAVE LIKED THE A/V DEMOS EVEN BETTER IF THEY HADN'T BEEN SO DARN LOUD!

This show, held March 12 to 14 at the Marriott Hotel in San Francisco, was the best one I have attended. It offered a number of "fringe events," which consisted of live performances and panel discussions on various audio subjects. I attended one of the "Meet the Designers" sessions as well as performances by the Water Lily Gospel Trio and singer Sara K. accompanied by guitarist Bruce Dunlap. I was blown away by the dynamic range, tonal beauty, and harmony of the Water Lily Gospel Trio! No hi-fi I've heard comes close to capturing that sound and beauty. What is always interesting is how soft and pure classical guitar and voice sound—no artificial brightness or irritation, as found in so much audio system reproduction. I also attended a live performance by Arturo Delmoni, a violinist with great technical mastery and emotional communication in his playing. Delmoni's music-making and engaging personal style made for a very successful event.

Equipment was on display on the Golden Gate Hall level and on floors four through seven of the Marriott. The Hall exhibit was arranged so that a number of small companies had display booths lined up in rows. A rich variety of CD and vinyl recordings from specialty sources like Reference Recordings, Sheffield Labs, Water Lily Acoustics, Chesky, and others was available for sale. One especially interesting display was by an old equipment club from San Francisco, Tube Audio Enthusiasts. They had a number of older electronics pieces on display along with a row of vacuum tubes once used for audio—what memories!

In many of the major listening room demonstrations, several manufacturers and/or dealers exhibited products jointly in rooms on the fourth through seventh floors of the Marriott. Clearly, the marriage of audio and video is increasingly common, and I saw a lot of audio/video setups. Among the more impressive of these were the demonstration in the Cello Music and Film Systems room and a combined demonstration in another suite of a Runco projector, speakers by Sonus Faber, Thiel, and Velodyne Acoustics, and with electronics by Theta Digital, Lexicon, and Classé Audio. Audio Excellence, a dealer in San Francisco, put this together. I was really impressed with the video quality in both demonstrations, although the sound was usually too darn loud—I had to put my hands over my ears to protect them for the really delicate audio demonstrations.

On the Golden Gate level was a co-exhibit of Mirage speakers and PS Audio. A pair of larger Mirage speakers and PS Audio electronics were making very nice sounds. On another floor, I spent some time listening to MBL's 101 omnidirectional loudspeakers, which have received some very favorable reviews. I must say that certain sounds were very convincing, and I didn't have to sit in a sweet spot to get this effect. However, low-frequency extension

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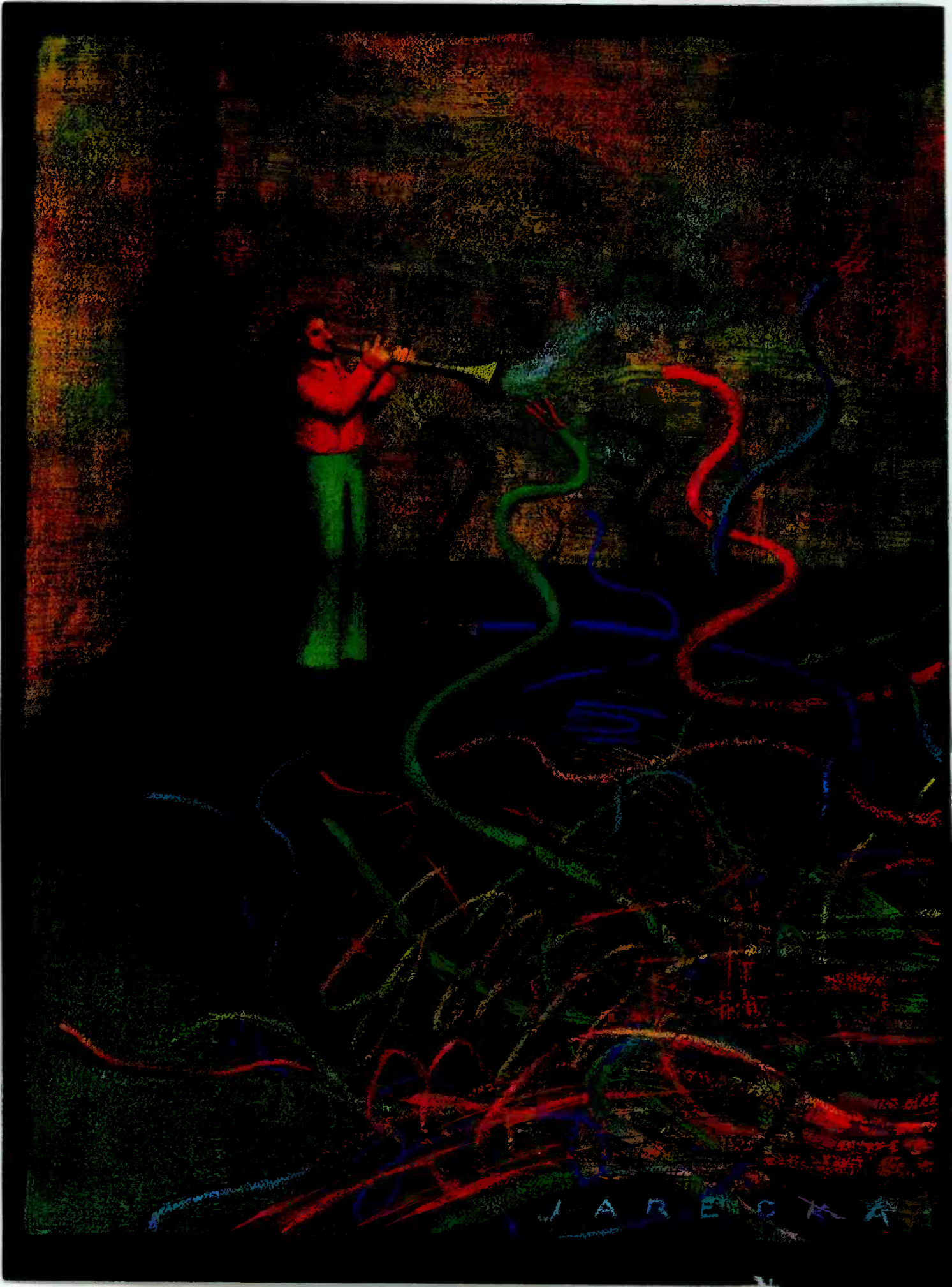
wasn't that good; the speakers really needed subwoofers. Tony DiChiro conducted a great-sounding demo in the Kinergetics Research room, pointing out what to listen for in a prepared program of well-selected music. I had a surprise at the Audible Illusions room. This company, which has so far made all-tube gear, displayed a new solid-state power amp. In the Parasound room, I found a number of interesting new products, including a handsome and great-sounding CD transport and a subwoofer utilizing a new magnetic structure by Aura Systems that allows much greater linear excursion compared to conventional structures. Excellent sound was happening in the NHT room. Their new Model 3.3 speaker is designed to effectively use the floor/wall boundary to get more uniform bass response in the room. Its unusual shape allows the woofer to be near the floor/wall boundary and yet get the low-mid/mid/tweeter array out in the room with a low-diffraction, minimum-sized baffle. Great selection of music too.

Very natural sound was to be heard in the Vandersteen Audio room, where Richard Vandersteen's first foray into recording was being played on vinyl when I went in. In a discussion with him, I learned that some very interesting new speaker designs are near release. Valve Amplification Company co-exhibited with Scientific Fidelity, whose new Joule speakers driven by the VAC electronics produced great sound with especially impressive bass. Jadis and Oracle Audio teamed up in a room featuring Jadis tube electronics and the Oracle Helicon speaker system. This setup sounded very good. Also impressive for its price and size was a little two-way speaker sold as a kit by A&S Speakers of San Francisco. SigTech, maker of the first-to-market DSP speaker and room-acoustic correction system, exhibited in a deliberately untreated room. You could switch their correction in and out with the remote control. A pair of small B & W speakers was used with the system; bass and lower midrange quality were much improved with the correction switched in.

This report highlights things that stood out and caught my attention. Other exhibits not mentioned also produced some fine and some not-so-fine sound. I had a good time and enjoyed the show. A



Fred E. Davis

SPEAKER TESTING FOR AUDIBILITY CABLES

The function of a speaker cable seems intuitively obvious: Simply transmit the output of an amplifier to the speaker without alteration. This might appear to be a trivial task, yet there are nearly endless cable styles, sizes, conductor and insulation materials, strand winding techniques, etc. All promise the same result, even though they may incorporate opposing electrical characteristics. Does connecting a speaker to an amplifier require such complexity? Can changing cables really make dramatic improvements in system sound, or are perhaps fraudulent marketing tactics preying on an unknowing, nontechnical public?

Speaker cable seems to be one of those issues that leave very few standing on middle ground. People are either strong supporters of esoteric cables or steadfast skeptics. Everyone seems to have an opinion, but how many of those opinions are based on fact rather than assumption?

Only two reports have appeared in engineering journals in this country [1, 2]. These present objective analyses of cable behavior at audio frequencies from an engineering perspective. Over the years, numerous articles have appeared in popular audio magazines, hi-fi newsletters, and engineering trade journals [3 to 18]. Some are quite good, but others are mere repetitions of advertising claims. There are even articles and debates on computer networks [19]. Several manufacturers have published "white papers" to extol the benefits of their cable's design [20 to 23]. I note, with some skepticism, that little is sacred to marketing, including the laws of physics. Some papers do present interesting data but draw conclusions from elsewhere.

About the time audio enthusiasts discovered that 18 AWG (American Wire Gauge) lamp cord worked better than the common 22 AWG "speaker wire," very heavy specialty cables were introduced. Every three steps of AWG indicate a change of twice or half the cross-sectional area. For example,

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Illustration: Danuta Jarecka

an 18 AWG wire has twice the area of 21 AWG, and 12 AWG has four times the area of 18 AWG.

At that point in time, more complex views of cables emerged, suggesting that speaker cables performed better if they had less capacitance or more inductance; that skin effect (frequency-dependent variation in the signal's penetration of the conductor), phase shift, and dispersion were veiling high frequencies, or that cables behaved like transmission lines. Other concepts included the need for vibration damping to isolate the cables, the use of directional arrows (so the alternating current would know which direction sounds best), and the need to "burn in" speaker cables to attain peak performance. In his papers [2 to 5], R. A. Greiner writes that speaker cables are not transmission lines (audio frequency wavelengths are much too long compared to the length of the cables), that phase shift and dispersion effects are too small to be audible (typically less than 0.1° per foot at 20 kHz, and differences of less than 0.006 μS per foot for most cables between 100 Hz and 10 kHz), and that the skin effect has only a small effect on heavy conductors (skin depth in copper at 20 kHz is 0.020 inch).

It is no secret that speaker systems present a complex load to the amplifier [24, 25]. While an isolated speaker driver is predominantly inductive (except around resonance), the complex impedance of most speaker systems, which have multiple drivers and passive crossovers, exhibits negative and positive phase angles within the audible range, indicating capacitive reactance as well as inductive reactance. Complex impedance is the combined effect of resistance and capacitive and/or inductive reactance. (Some issues of *Audio* that contain interesting Nyquist or polar-impedance plots of speakers' complex impedances are November 1990, page 100, and August 1990, page 95. Also see sidebar, "Speaker Impedance and Reactance.") Otala and Huttunen [25] show that given complex waveforms, some commercial speakers require up to 6.6 times more current than an 8-ohm resistor for the same signal, suggesting a dynamic impedance as low as 1.2 ohms.

The ideal speaker cable should transfer all audio frequencies into any loudspeaker load with flat response. Real cables will always show some loss due to resistance, but better cables will minimize this loss and still transfer all frequencies unscathed. One frequently overlooked concept is that the amplifier, cable, and loudspeaker form one electrical network. Too often, the amplifier, loudspeaker, and cable are considered as if they were separate components, when in fact they are closely coupled in a single system.

There are two primary mechanisms for a speaker cable to alter the signal to the speaker. One is that the electrical properties of the cable (especially frequency-dependent reactive properties) will directly alter the signal reaching the speaker. The other occurs when the cable either causes or allows the amplifier to generate spurious signals or distortions [14]. For example, if an amplifier that cannot drive capacitive loads has a highly capacitive cable attached to it, then the amplifier will oscillate. Another example: An amplifier sensitive to reactive loads is connected to a reactive speaker with a low-resistance, low-reactance cable. The amplifier will see a load it cannot handle and become unstable. These are faults of the amplifier design and will not be much addressed here. They are, however, far from uncommon.

I will primarily address the electrical properties and effects of cables. The main reason is that electrical measurements are not subject to the vagaries of our ears, either tin or golden.

Every cable possesses a combination of the fundamental electrical properties of resistance, inductance, and capacitance. The measured characteristics of 12 cables will be discussed, as will some basic electronics

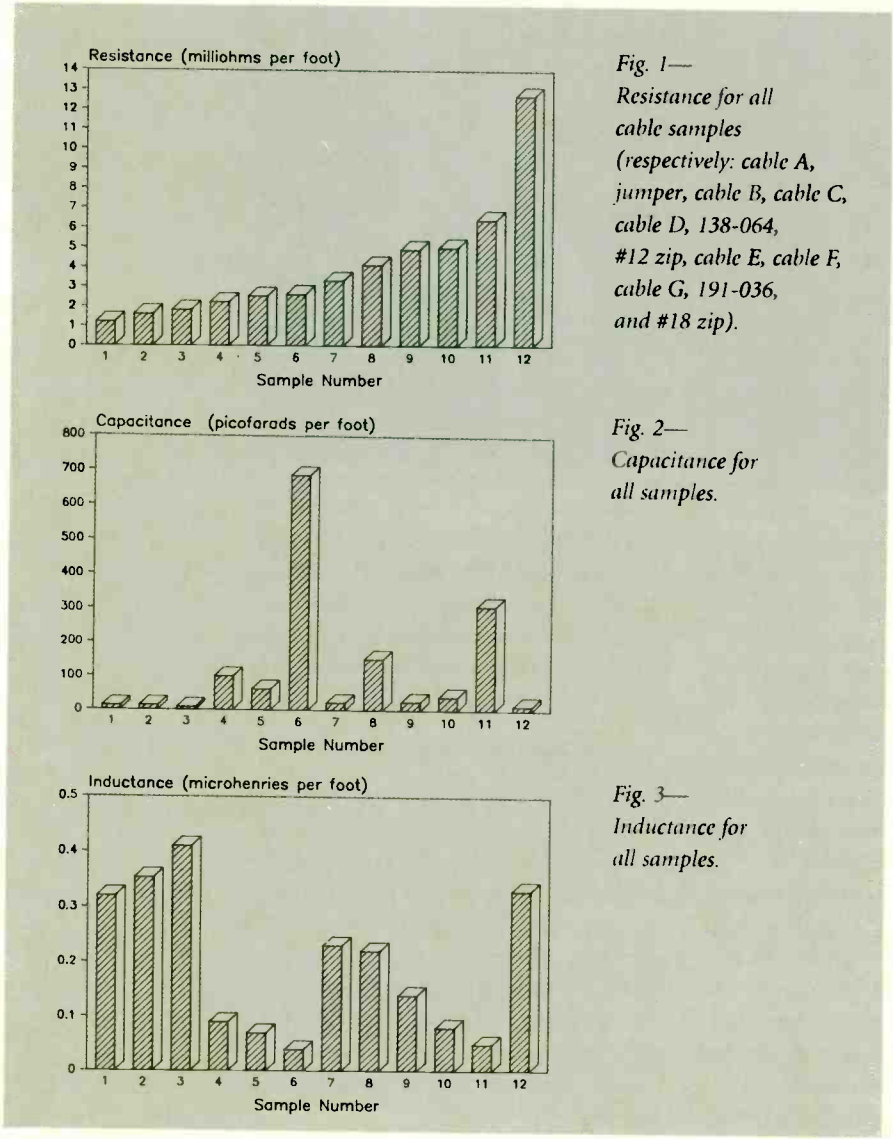


Fig. 1— Resistance for all cable samples (respectively: cable A, jumper, cable B, cable C, cable D, 138-064, #12 zip, cable E, cable F, cable G, 191-036, and #18 zip).

Fig. 2— Capacitance for all samples.

Fig. 3— Inductance for all samples.

relating to cables and audio. The performance of the cables with real speakers will be examined first, and then two amplifiers will be included to present the electrical response of the complete systems.

I tested a variety of commonly and uncommonly available wire. Most of the samples were 10 feet in length. Some are very expensive (not the most expensive available, but still over $130 per foot), others are cheap (about 24¢ per foot), and some are not sold as speaker cables at all. This is not an exhaustive examination of every speaker cable available, but it does represent a wide variety of styles. A brief description of each cable follows, presented in order of ascending resistance. When known, the organization of the strands is shown in parentheses as "(quantity × gauge)." Unspecified gauges were estimated from conductor diameter and resistance. Brand names and models of some cables have been abbreviated; others have been deleted in the interests of not adversely affecting the business of any manufacturer, whatever the merits of the design.

(1) Cable A. Thousands of bare copper strands (39 AWG) in two parallel conductors, each about 0.25 inch in diameter and spaced about 0.5 inch between centers of the conductors. Approximately 5 AWG. Extremely flexible for such a heavy conductor. This is an older cable but is typical of the very-heavy-conductor style.

(2) Jumper. Automotive jumper cables from the garage. Two parallel 0.375-inch-diameter conductors of approximately 7 AWG (19 × 20). They are great for starting the car and come with handy, attached alligator clips, but how well will they work with speakers?

(3) Cable B. Independent conductors, about 0.625 inch in diameter each, with complex layer construction. Inside a very thick layer of insulation is a 0.189-inch-diameter conductor. This conductor is composed of several groups of tightly twisted, very thin (about 39 AWG) enamelled wires wound in helices around a heavier (about 20 AWG) enamelled wire. (A similar construction is used by at least two other brands.) All conductors are soldered together at each end, terminated with large, crimped lugs. Approximately 8 AWG.

(4) Cable C. Six conductors (each approximately 13 AWG) composed of many small (approximately 30 AWG) enamelled copper wires, lightly twisted over a stranded plastic core, altogether about 0.5 inch diameter. Equivalent to about 9 AWG.

(5) Cable D. Sixteen independent wires, woven together in a flat cable. Teflon insulation. Each individual wire is equivalent to 19 AWG and is composed of seven strands, varying in size from 31 to 24 AWG. Equivalent to approximately 10 AWG.

(6) 138-064. (Full name: Spectra-Strip 843-138-2601-064 ribbon cable, manufactured by Amphenol.) Made of 32 twisted pairs of 26 AWG wire (7 × 34), arranged in a flat ribbon. Intended for high-speed transmission of digital data. For these tests, each conductor was made of 32 wires, one wire from each pair. Equivalent to about 11 AWG.

(7) #12 zip. (Full name: Belden 9718.) Belden's 12 AWG (65 × 30) speaker wire with clear PVC insulation and parallel construction like zip (lamp) cord (sample 12). Electrically, it is very similar to jacketed, twisted-pair cables—such as Manhattan 35059 and Belden 8477—which are commonly used in professional sound reinforcement.

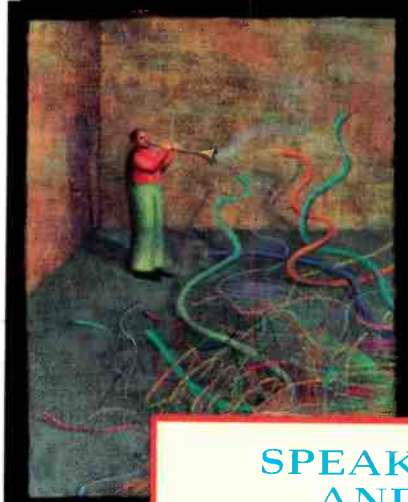
(8) Cable E. A large, 0.7-inch-diameter cable using a construction technique of multiple conductors of different gauge and length, like sample 3. The manufacturer claims this will permit "all frequencies to travel through a given length of . . . cable at exactly the same rate of speed." Each main conductor is composed of three groups of multiple gauges, with a coaxial cable connected in an unknown fashion (hidden by potting compound) inside a proprietary coupler at the amplifier end. At $130 per foot, the most expensive cable tested. Approximately equivalent to 12 AWG.

(9) Cable F. Very similar to sample 5, except eight independent wires, woven in a flat cable. Teflon insulation. Each individual wire is equivalent to just over 19 AWG and is composed of seven strands of variable gauge, from 31 to 24 AWG. Approximately equivalent to 13 AWG.

(10) Cable G. An unusual cable made from eight independent wires of 23 AWG (7 × 31) braided together. PVC insulation. Equivalent to 14 AWG.

(11) 191-036. (Full name: Spectra-Strip 843-191-2811-036 ribbon cable, manufactured by Amphenol.) Made of 36 wires of

The ideal speaker cable should transfer all audio frequencies into any speaker load, with flat response.



28 AWG (7 × 36), arranged in a flat ribbon. Intended for digital interconnections (such as floppy disk drives). For these tests, 18 alternate wires were connected for each conductor. Equivalent to about 15 AWG.

(12) #18 zip. (Full name: Belden 19123.) An 18 AWG (41 × 34) zip (lamp) cord. Brown PVC insulation, and parallel construction.

Resistance

Measured cable resistance, in milliohms per foot, is shown in Fig. 1; note that this includes the resistance of both conductors. Conventional wisdom would indicate that since a speaker's impedance is low (often 4 ohms, sometimes less), the cable's resistance should be much lower. In the pursuit of lower resistance, some practical limits are frequently exceeded at the expense of performance, due to added inductance.

The skin effect is a frequency-dependent change in resistance. The depth through which most of the current flows will be lower with lower frequencies and closer to the surface at higher frequencies. In copper at 20 kHz, this depth is about 0.020 inch. Therefore, conductors thicker than 0.040 inch in diameter (larger than about 20 AWG) will begin to show an increasing resistance at 20 kHz. Cable A (sample 1, 5 AWG) has a 342% increase in resistance between 20 Hz and 20 kHz. At first this seems quite astounding, but compared to an 8 ohm-load it represents a change of only 0.36%, which is not readily audible (especially given our lack of hearing sensitivity at 20 kHz). The skin effect, although quite real and measurable, will have insignificant audible effect.

Capacitance

In parallel with the amplifier and speaker, capacitance is the second most commonly discussed cable parameter. Yet, paradoxically, it has the least direct effect. The capacitance of most cables is very small (usually about 1/10,000 of the inductance) and will have little direct effect on the signal. Figure 2 shows measured cable capacitance, in picofarads per foot.

Inductance

Figure 3 shows cable inductance, in microhenries per foot. Inductance is rarely mentioned in discussions of speaker cables, yet its audible effect often exceeds that of resistance. Like resistance, it is in series between the amplifier and speaker. Inductive reactance will cause an inductor to oppose the flow of an alternating current, much like a resistor. Inductive reactance is directly proportional to frequency, so the higher the frequency, the higher the inductive reactance. For example, cable A (sample 1, 5 AWG) has an inductive reactance of 0.4 ohm at 20 kHz. Notice that this is about 10 times greater than the a.c. resistance including the skin effect (0.041 ohm). When 8-ohm loads are driven at 20 kHz through 10 feet of this cable, the combined inductive reactance and skin effects would produce a drop of 0.43 dB.

Impedance

The combination of a cable's resistance, capacitance, and inductance will determine the equivalent series impedance of the cable across the audio spectrum. Simply speaking, better cables will have a low im-

SPEAKER IMPEDANCE AND REACTANCE

If the phase angle or polar-impedance (Nyquist) plot for a loudspeaker is not available, you can still get a reasonable idea of how reactive that speaker is by examining a plot of its impedance amplitude. The manufacturer should be able to supply you with your speaker's impedance curve if it is not in your owner's manual. Another potential source is a magazine review; check your local library. (Note that in the plots of speaker phase angle published in *Stereophile* magazine prior to November 1991 with an "Ap" symbol in the upper right corner, the true phase angle is inverted.) You can also easily measure your speaker's impedance. (See "Quick-Build a Speaker Impedance Checker" by M. J. Salvati, *Audio*, August 1979.)

A rising impedance amplitude with increasing frequency is a result of inductive reactance with a positive phase angle. A falling impedance with increasing frequency is a result of capacitive reactance with a negative phase angle. The amplitude of the reactive component is proportional to the slope of the impedance magnitude. A very steep slope indicates a large reactive component; a gentle slope indicates a small reactive component. Note that the same interpretations can be made for speaker cables by using their impedance plots (Figs. 4 and 5). Those cables that have the largest change in impedance will be the most reactive and have the greatest phase shift.

pedance at all audible frequencies; this, in turn, permits flatter transmission of signals from amp to speaker.

The measured impedances of the sample cables are shown in Figs. 4 and 5. Those cables with the most constant impedance were the flat, or ribbon, types with higher capacitance and lower inductance (Fig. 4, 138-064; Fig. 5, 191-036). Other multiconductor cables, such as cables C and D (Fig. 4) and the lighter cables F and G (Fig. 5), display a small impedance rise. Of the simple two-conductor cables tested, the #12 zip (Fig. 5) performed the best, since both heavier and lighter gauges showed greater high-frequency impedance. The low resistance of the heavy, two-conductor cable A and the jumper (Fig. 4) are little help at 20 kHz, where inductive reactance has raised the impedance beyond the impedance level of even much lighter gauges. Cable F, which has a complex layer construction, duplicates almost exactly the impedance characteristics of #12 zip (Fig. 5).

Cables with the greatest change in impedance will also show the greatest phase shift. (See sidebar, "Speaker Impedance and Reactance.") The heavy, two-conductor cables will have approximately 3° of phase shift at 20 kHz, an amount that is inaudible and thus not a problem [26, 27].

Higher cable capacitance will tend to reduce the combined reactive component of a cable, thus lowering the cable's impedance at high frequencies and improving the high-frequency response. This effect is contrary to the popular belief that high frequencies will be attenuated more with higher cable capacitance [18, 21]. Erroneous conclusions are usually drawn from a mathematical model of cable performance that comprises series resistance and shunt capacitance but omits series inductance. Increasing capacitance counters the inductive effects from the cable and amplifier. Sample 6, 138-064, showed the highest capacitance, lowest inductance, and flattest impedance. Well-designed amplifiers are not affected by this amount of cable capacitance, but some amplifiers, especially older designs, may become unstable.

Cable/Speaker Interactions

The speakers I used for these tests, designated A and B, have fairly typical impedance and phase characteristics, as can be seen in Figs. 6 and 7. I took measurements at the same frequencies that I used in the tests of cable impedance. (Please note that the lines connecting the data points in these two graphs are intended to simplify reading the plot and do not reflect valid data between the sample frequencies.) Speaker A, an AR Model LST/2, is a three-way design with an acoustic-suspension woofer, three dome midranges, and three dome tweeters. It exhibits mostly capacitive reactance (negative phase angle) at the frequencies sampled between 127 Hz and 12 kHz; its lowest impedance, 4.8 ohms, occurs above 8 kHz. Speaker B, a Burhoe Model Green, is a two-way system with a bass-reflex enclosure and dome tweeter. It shows much more inductive reactance (positive phase angle) around 1 kHz than speaker A, and its capacitive reactance peaks at around 8 kHz. Its lowest impedance is 5.8 ohms, around 500 Hz.

Obviously, a loudspeaker can only perform up to the quality level of the electrical input to its terminals, so the best cable will have the flattest frequency transmission despite loudspeaker impedance or phase angle. Cable electrical response was measured using these two commercial loudspeakers as loads; results are shown in Figs. 8 and 9 with speaker A and in Fig. 10 with speaker B.

The low-inductance, multiconductor cables show the most linear response (cable

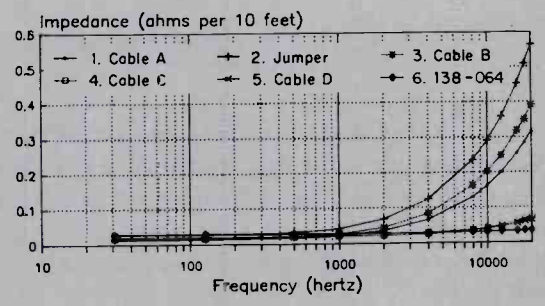


Fig. 4— Impedance of samples 1 through 6.

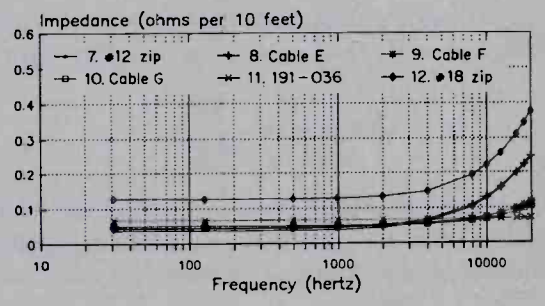


Fig. 5— Impedance of samples 7 through 12.

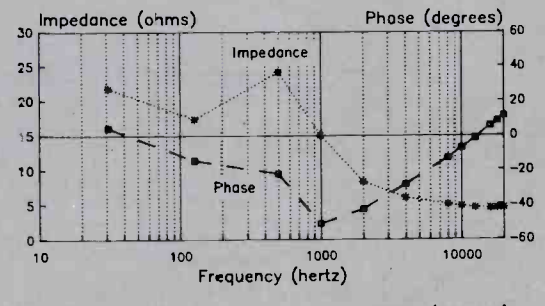


Fig. 6— Impedance and phase response of speaker A. (Note: Here and in Fig. 7, lines connecting data points do not reflect valid data; see text.)

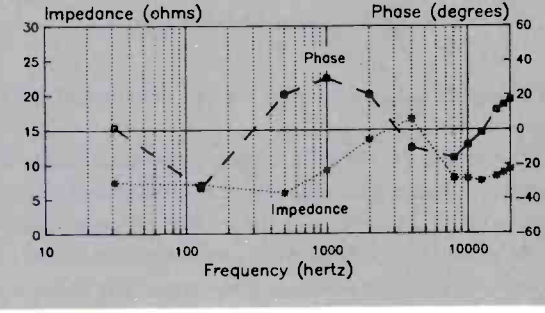


Fig. 7— Impedance and phase response of speaker B.

SPEAKER CABLE MODELS

The cable and speaker should be treated as lumped circuit elements in electrical models. The cable response model presented here is simple and is based on the ratio of the vector sum of the speaker's resistive and reactive components to the vector sum of both speaker and cable resistive and reactive components together. The cable is modelled at each frequency as a resistance in series with an inductive reactance, using the measured values of resistance and inductance. The skin effect was calculated and applied to the resistance where appropriate. The capacitive component of the cables modelled is too small to have much influence at audible frequencies, and is thus omitted from the model. The speaker is modelled at each frequency as a resistance in series with a reactance that can be either inductive or capacitive. The expression for the cable response at the speaker terminals for a given frequency is:

$$V_s(f) = V_a(f) \times \frac{\sqrt{(R_s^2 + X_s^2)}}{\sqrt{(R_w + R_s)^2 + (X_w \pm X_s)^2}}$$

where $V_s(f)$ is the voltage at speaker terminals at frequency f; $V_a(f)$ is the voltage at amplifier output at frequency f; R_w is the cable resistance, including skin effect, at frequency f; X_w is the cable inductive reactance at frequency f; R_s is the speaker resistance, and X_s is the speaker reactance at frequency f, either inductive (+) or capacitive (–).

Response, in dB, was found by taking the logarithm of the ratio of the response at a test frequency and the 1-kHz response:

$$V_s(f) = 20 \log \frac{V_s(f)}{V_s(1\ kHz)}$$

Three different styles of cables are modelled and compared to measured values in Fig. B1. The model gives a very good approximation to the actual measured responses. The results are for the full 10 feet of cable, since they are not directly scalable to other lengths.

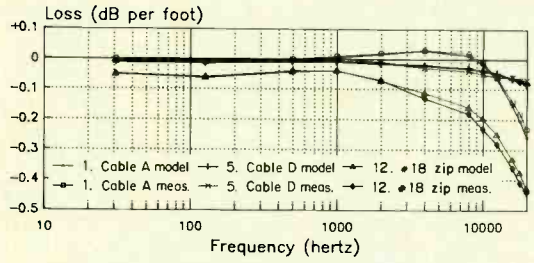


Fig. B1—Modelled and measured responses of samples 1, 5, and 12 with speaker A.

The rise above 0 dB in the measured responses occurs when the combined magnitude of impedance of speaker and cable (as seen by the amplifier) is lower than the speaker's impedance alone. This results when the reactance of the speaker is capacitive and subtracts from the cable's inductive reactance. The result is a lower total reactive component, which reduces the magnitude of the impedance seen by the amplifier. The current through the cable and speaker is higher than the speaker's impedance alone would require. This higher current results in a voltage across the speaker terminals that is higher than the amplifier's output. Low-inductance cables will provide a more ideal response, since cables whose inductive reactance is much less than the speaker's capacitive reactance will reduce this "hump" effect and add only a little more than the speaker's complex impedance to what the amplifier sees as a load. When the effective impedance of cable and speaker is lower, it should not prove difficult for a well-designed amplifier because the effect is small with short cables (approximately 0.6% for the worst case in these tests, sample 2, jumper cable). The lowest impedance seen by the amplifier and the greatest rise in speaker voltage as a result of this effect occurs at resonance, when the inductive reactance of the cable is equal to the capacitive reactance of the speaker. The impedance will then be limited by the resistive components of both cable and speaker. For example, speaker A would require just over 40 feet of sample 7, #12 zip, to provide enough inductance to achieve resonance at 10 kHz, where the resistance seen by the amplifier would be about 4.84 ohms.

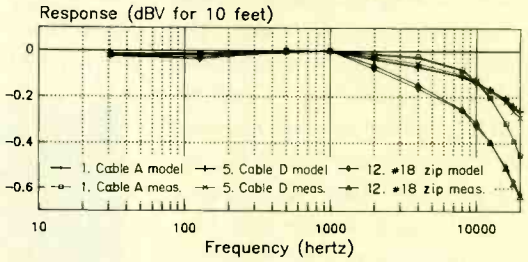


Fig. B2—Modelled and measured system response for amp B with speaker A, samples 1, 5, and 12.

The effect of the amplifier can be added to the cable response model by including the additional resistance and reactance of the amplifier's output:

$$V_s'(f) = V_a'(f) \times \frac{\sqrt{(R_s^2 + X_s^2)}}{\sqrt{(R_a + R_w + R_s)^2 + (X_a + X_w \pm X_s)^2}}$$

where $V_s'(f)$ is the voltage at speaker terminals at frequency f, $V_a'(f)$ is the internal amplifier voltage at frequency f, R_a is the amplifier output resistance, and X_a is the amplifier output inductive reactance at frequency f.

Figure B2 illustrates the results of this model, using amp B's voltage response with speaker A's impedance and phase (converted to dB relative to the 1-kHz response, as before). The model fits extremely well with the measured data. Because the model is very simple and amplifier dynamic responses are more complex, it will not fit as closely with all amplifiers. The model infers that, overall, the flattest response will occur by keeping the reactance of the amplifier and cable as low as possible.

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C, cable D, and 138-064 in Fig. 8; cable F, cable G, and 191-036 in Fig. 9, and 138-064 in Fig. 10). Also note the relatively flat response of the 12 AWG cable with both speakers (#12 zip in Figs. 9 and 10) when compared to other two-wire cables (cables A and B in Figs. 8 and 10). These graphs also show another common effect, the high-frequency loss with the higher inductance two-conductor cables.

The interaction of a cable's inductive reactance with the speaker's capacitive reactance can be seen in Figs. 8 and 10. Notice where the response rises above 0 dB (Fig. 8, between 1 and 9 kHz; Fig. 10, between 3 and 12 kHz). At this point, the speaker's terminal voltage has exceeded the amplifier's output. (See sidebar, "Speaker Cable Models," for an explanation of this effect.)

Amplifier Effects

The frequency response and damping factor of the two test amplifiers are shown in Fig. 11. Damping factor is a measure of the amplifier's ability to deliver a given voltage without being affected by the load impedance. It is inversely proportional to the amplifier's output impedance. A damping factor that falls (i.e., rising output impedance) with increasing frequency is usually due to inductive reactance. For amp A, a Mark Levinson ML-11, the frequency response falls off at each end of the spectrum, and it has a drop in damping factor above 1 kHz. Amp B, a Nikko Alpha 230, has a flat frequency response and a high, almost linear damping factor.

Now let's look at the effects of amplifiers and cables. We've already seen how added cable inductance will cause deviations in frequency response due to interactions with the speaker's reactive components. Therefore, it would be desirable to minimize reactive effects from the amplifier as well. But why would an amplifier's output be reactive? Amplifier design theory is beyond the scope of this article. In short, most designers add inductance (typically 0.5 to 10 μH) between the output of the amp's last stage and its output terminals to isolate it from capacitive loads that could cause instability. This inductance is always in series with the cable's inductance, and in some amps can exceed the cable's inductance. (Amps A and B include such a network.) The greater the inductance, the greater the increase in output impedance (and the lower the damping factor) with increasing frequency. The damping factor of an amp can also shape the frequency response [7, 10, 14]. The response of the system becomes more sensitive to the speaker's impedance with increasing output impedance of the amplifier.

Matching the source and load impedances at radio frequencies is important to reduce reflections of the signal. But this is not a problem at audio frequencies, because the rise-time of the amplifier (which is much faster than the musical content of the signal) is far slower than the propagation time of the audio signals in the cable.

The response of every cable was tested with the same speaker load but two different amplifiers. Figures 12 and 13 present the response of all 12 cables with speaker A and amp A, while Figs. 14 and 15 present the response of all 12 cables using speaker A and amp B. Note that the "dBV" scale is different from the scale in the cable response plots in order to accommodate the increased range. These graphs illustrate the combined response of speaker, cable, and amplifier. Immediately obvious is that the response of amp A overwhelms the individual cable effects (Figs. 12 and 13). Damping factor for amp A and the impedance of speaker A are both low in the same frequency range, which makes the net re-

Fig. 8— Frequency response of samples 1 through 6 with speaker A.

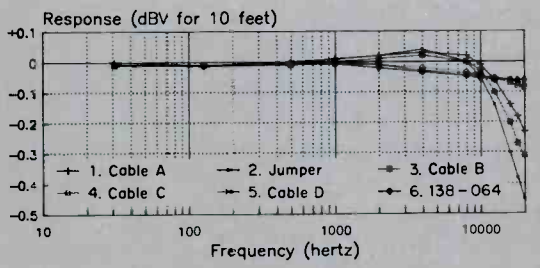


Fig. 9— Frequency response of samples 7 through 12 with speaker A.

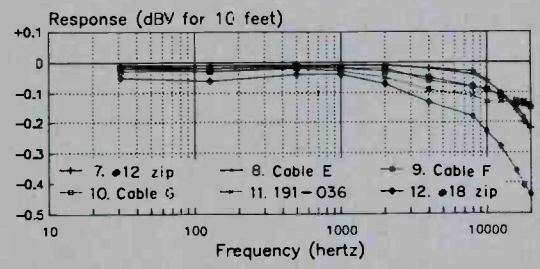


Fig. 10— Frequency response of samples 1, 3, 6, and 7 with speaker B.

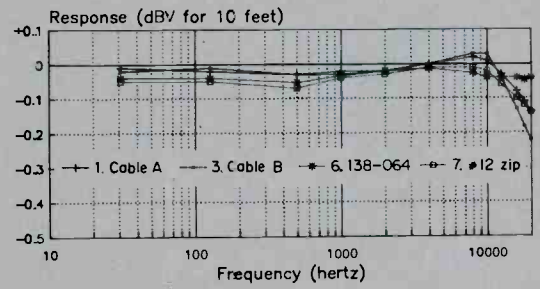
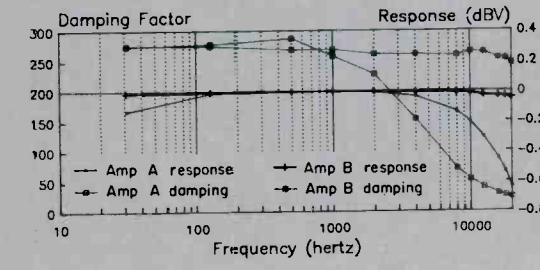


Fig. 11— Frequency response and damping factor of amps A and B.



sponse worse. The response with amp B (Figs. 14 and 15) closely resembles the response of the cable and speaker alone (Figs. 8 and 9). The high damping factor of amp B maintains better control of reactive effects with the more inductive cables and is less affected by variations in load impedance, thereby producing a flatter response (Fig. 14).

Audibility

Cable differences are measurably different, but are those differences audible? The answer is a definite maybe. It depends on many factors, some of which include: Cable type and length, frequency response and other characteristics of your system, speaker/listener placement and room characteristics, choice of musical material, and your hearing ability. Under carefully controlled listening conditions, differences of as little as 0.2 dB over an octave can be reliably detected by some listeners [28].

In informal listening tests (primarily using amp B and speaker A but also including a variety of others), I found the difference between standard, two-wire cables to be indistinguishable, even when comparing 12 AWG to 18 AWG (a 400% difference in resistance!). This was not surprising, since the cables' impedance curves are almost identical, with only an offset in resistance (Fig. 5). Comparing two-wire cables with the flat ribbon cable gave a subtle difference in the high treble. The subtlety of the difference correlates well with the measured performance of the same amplifier, cable, and speaker (Figs. 14 and 15). At no time did I ever hear (or measure) anything that approached the quantum leaps touted in some arenas.

Before you jump to premature conclusions, I urge you to try a double-blind (or even single-blind) listening test using great care to ensure that *only* cable-induced effects are being auditioned. You don't even need a switchbox; have an honest friend (a poker face helps) switch cables for you, and do not peek. The results may surprise you.

Conclusions

There are very real, measurable differences among speaker cables. However, for average systems and short cables, these differences are at the threshold of audibility. Most systems should not require more than 12 AWG, and all speaker cables should be kept as short as is practical and have clean, tight connections. For those rare systems that may require heavier gauges, be aware of the rapid increase in cable inductance with large cables and the attendant roll-off of high frequencies. Only unusual speaker loads should require special cables. More significant contributors to system sound will be speaker type and placement and, in some cases, amplifier differences. For those who consider very subtle differences to be important, the following conclusions should be noted.

If speakers were only simple resistances, then large, low-resistance cables would not be a bad idea. However, speaker systems often exhibit a frequency-dependent, complex impedance that can interact with the reactive components of amplifier and cable. In my tests, the best response was obtained with low-inductance cables and a well-designed amplifier, one whose output is of low inductance and whose damping factor is high and frequency-independent. This corresponds with standard engineering theory.

The best way to achieve adequately low resistance and inductance in a cable is by using many independently insulated wires per conductor rather than large, single conductors. Efforts to reduce the skin effect (such as litz construction, a multiplicity of individually insulated strands) will help,

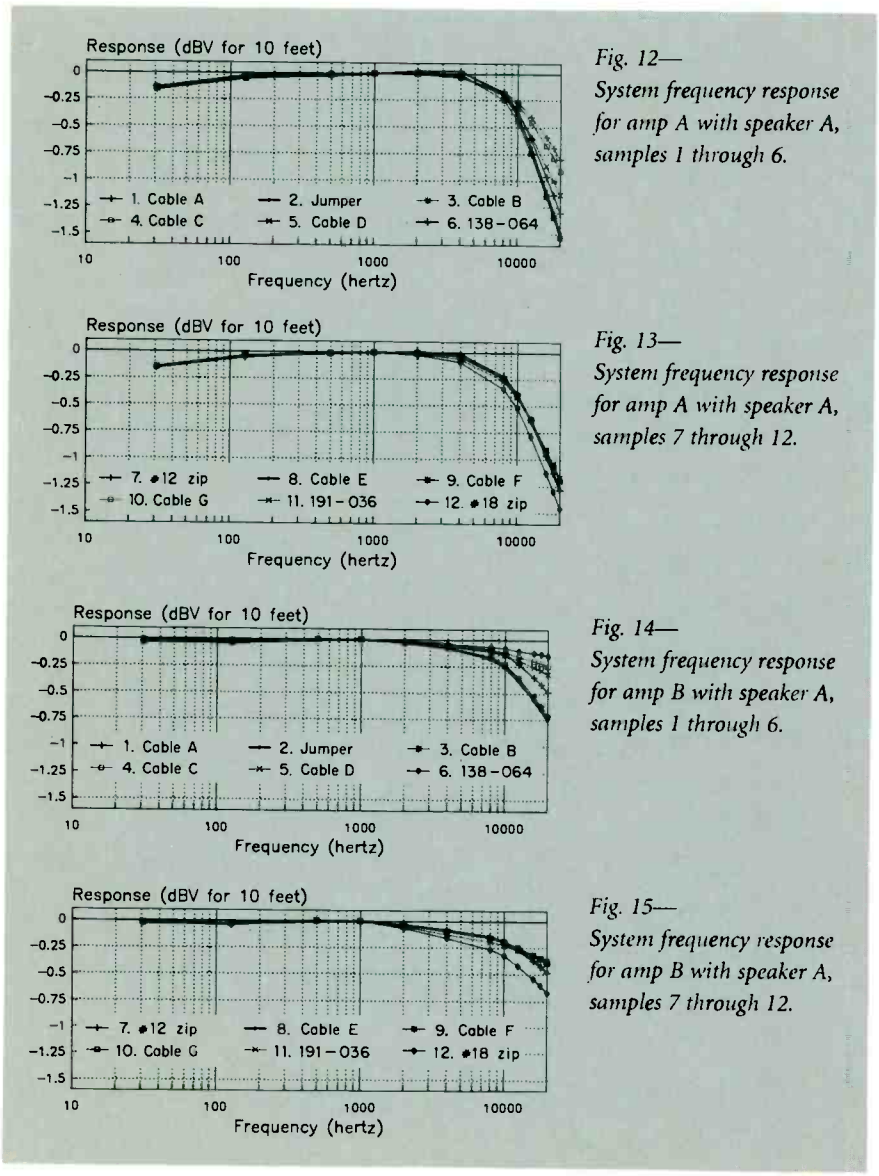


Fig. 12— System frequency response for amp A with speaker A, samples 1 through 6.

Fig. 13— System frequency response for amp A with speaker A, samples 7 through 12.

Fig. 14— System frequency response for amp B with speaker A, samples 1 through 6.

Fig. 15— System frequency response for amp B with speaker A, samples 7 through 12.

but improvements are due more to the reduction of inductance than the reduction of skin effect. Inductive reactance is more significant in large cables than skin effect. If it doesn't cause instabilities in the amplifier, larger capacitance in a cable is not significant since this component is comparatively small and reduces the effects of amplifier and cable inductive reactance. The use of exotic materials as conductor, plating, and insulation will have minimal (if any) audible effect but maximal effect on your wallet.

The best performance was measured with the low-inductance, multiconductor cables: 138-064, cable C, and cable D. Smaller multiconductor cables—such as 191-036, cable F, and cable G—also performed well.

Of the simple two-wire cables, 12 AWG provided the best performance with reactive loads, while both smaller and larger gauges (5 to 7 AWG and 18 AWG) showed greater high-frequency drop and interaction with the speaker's capacitive reactance. Only speakers with very low impedances would need a heavier cable. (For example, see D. B. Keele, Jr.'s review of the PSB Stratus Gold in *Audio*, November 1991.)

No one can deny the allure of the technology that brings us high-quality audio; the hardware is great fun and provides a pleasure all its own. But for me, it is the involvement with the music that is more important, and all the hardware is a means to that end. If you (and your bank account) feel that exotic wires the size of your wrist bring you closer to the music, enjoy! I prefer my speaker cables to have the least effect on system response, letting tone controls or a graphic equalizer perform tonal balancing only when required but otherwise leaving them switched out. By the way, keep the auto jumper cables in the garage! A

Better cables have flatter impedance curves across the audio spectrum.

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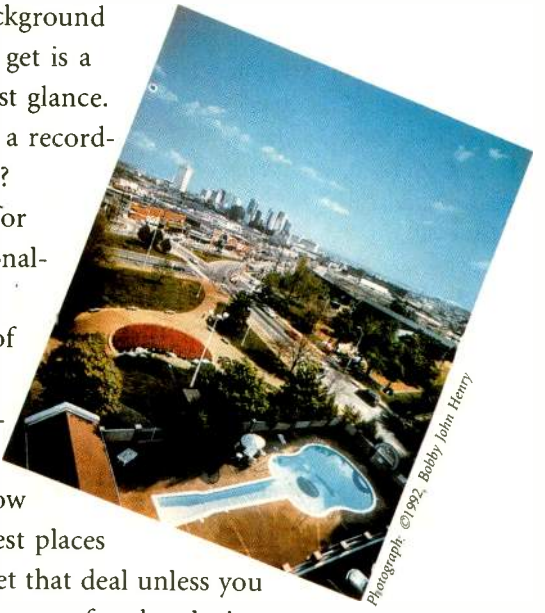
Doin' a Demo

ALLAN GIRDLER

Nashville, Saturday night at the Grand Ole Opry: Standing at the center of stage left is a blonde woman dressed like a top-selling realtor. Next to her is a man in a buckskin blazer. On his left, a sleek brunette in a short, tight, white dress. At her elbow, a tall and rumpled man with silver hair.

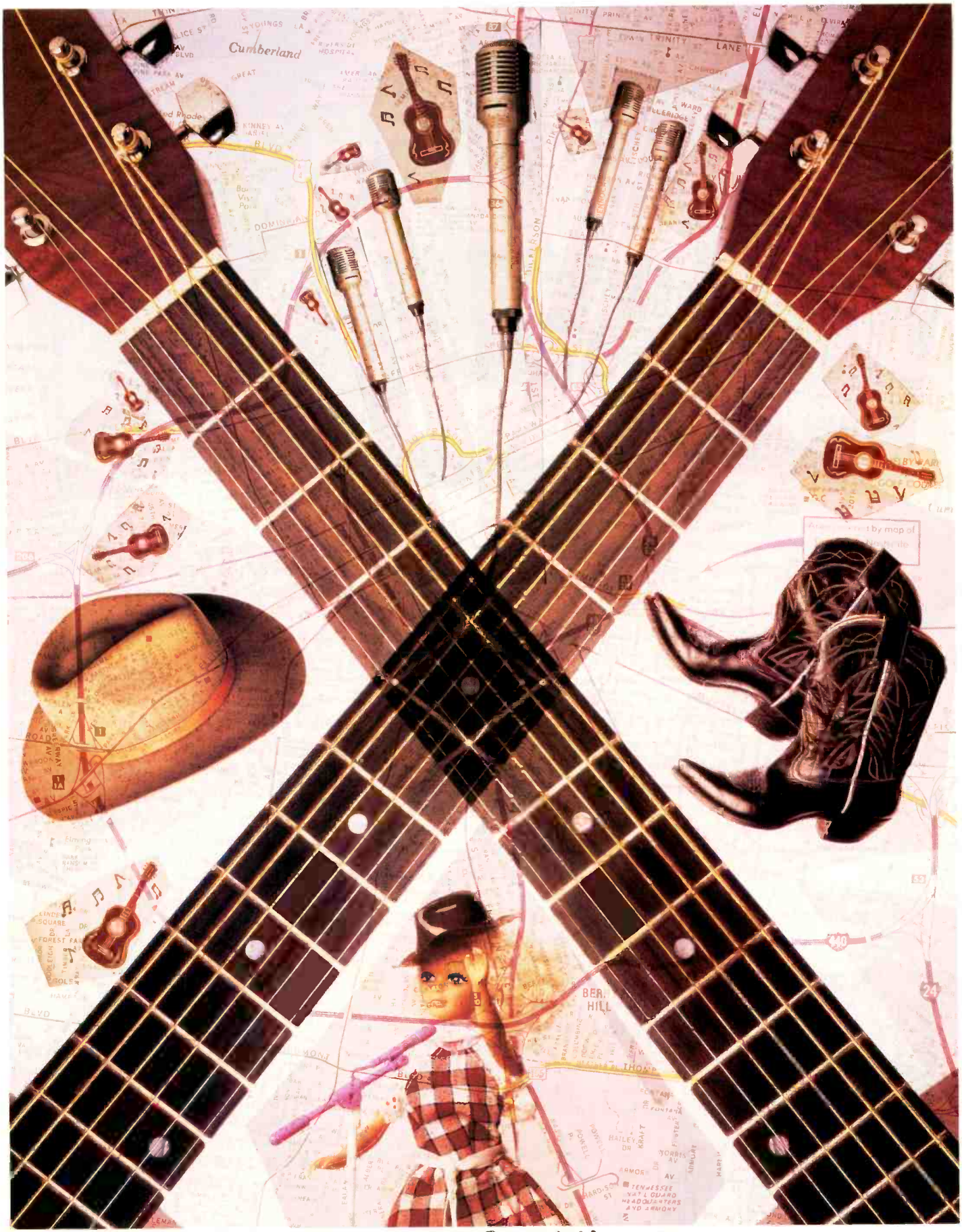
They look like they're standing at a bus stop, each waiting for a different bus. At an invisible cue the four step toward microphones and flow into song, in perfect pitch and harmony, blending flawlessly with the star belting one out before the footlights.

This is Nashville, where the four disparate standees are in fact beegees, country and western code for background singers. This is Nashville, where what you get is a whole heap more than what you see at first glance.

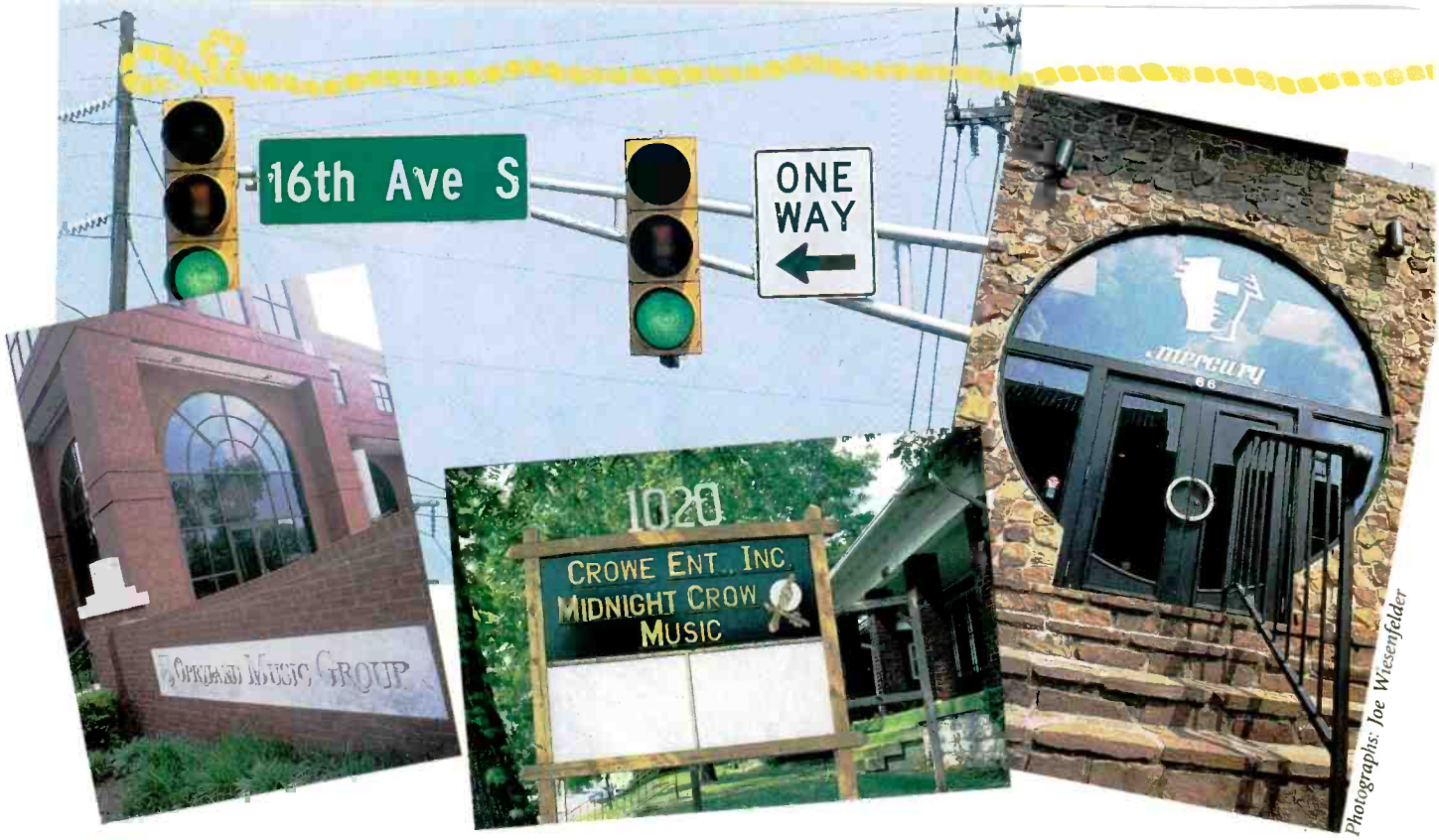

Photograph ©1992, Bobby John Henry

How I know this is, I'm just back from a recording session there. Sounds like big time, eh? In plain fact I was there to drive the bus for my wife, a singer and songwriter professionally known as Nancy Tucker—just in case you'd like to know today about the stars of tomorrow.

She has talent, charm, looks, stage presence, creativity, and energy. What she hasn't got amounts to the Catch-22 of show business: You can't get booked into the best places unless you have a record deal, you don't get that deal unless you have lots of fans, and yup, you guessed it, you get fans by playing in the best places. If you can get the booking.



Photograph: David Hamsley



Photographs: Joe Wiesenfelder

This circle should be broken, we figured. One way is a demo tape—meaning the artist does the work, pays the money, and has tapes to distribute to agents, scouts, and anybody else who'll listen.

Soon as we learned about this, we learned that in country and western, if you don't do it in Nashville you might as well not do it. We don't live in Nashville. We live in rural California, so far back the bears speak Spanish.

But. You don't have to have a plastic protector in your shirt pocket to know that Nashville is Equal Opportunity. Anybody who wants, can buy a ticket there. And rent time in a studio. And hire musicians. And make the vital demo tape. Which is exactly what we did.

With some help. We have a pal who plays bass for one of the stars and makes records in his spare time. He has a pal who's a good engineer, and between them they could get deals on time and equipment and talent. All we had to do was make reservations, buy tickets, make down payments, and borrow against our house; the demo's full cost was 15 thou and change, in case you're wondering.

At this point reality begins to improve on myth. I mentioned the background singers, because until they sang, I couldn't imagine what they were doing there. The Grand Ole Opry bills itself as a casual visit with your country cousins. But the parkway has an exit direct to the parking lot. Once in the lot you can't miss the theater, and whatever your seat, you can see. This was mid-winter, and the audience (of course we went—I mean, you visit Hershey, you eat chocolate, right?) was sparse. I expected, well, not much. So we saw Bill Monroe and Hank Snow, idols of my childhood (if not yours). I decided, these homespun folks are a lot more professional than they like letting on, like the stock car racer who blushed down to his toes when someone looked in his toolbox and found, not moonshine whiskey but aerodynamics textbooks.

So on the one hand, Nashville *is* country music, and country is big and getting bigger every day; on the other hand, you can walk through the music district in an hour or so and maybe see some stars while you do it. Nashville is on a human scale, is what I want to say.

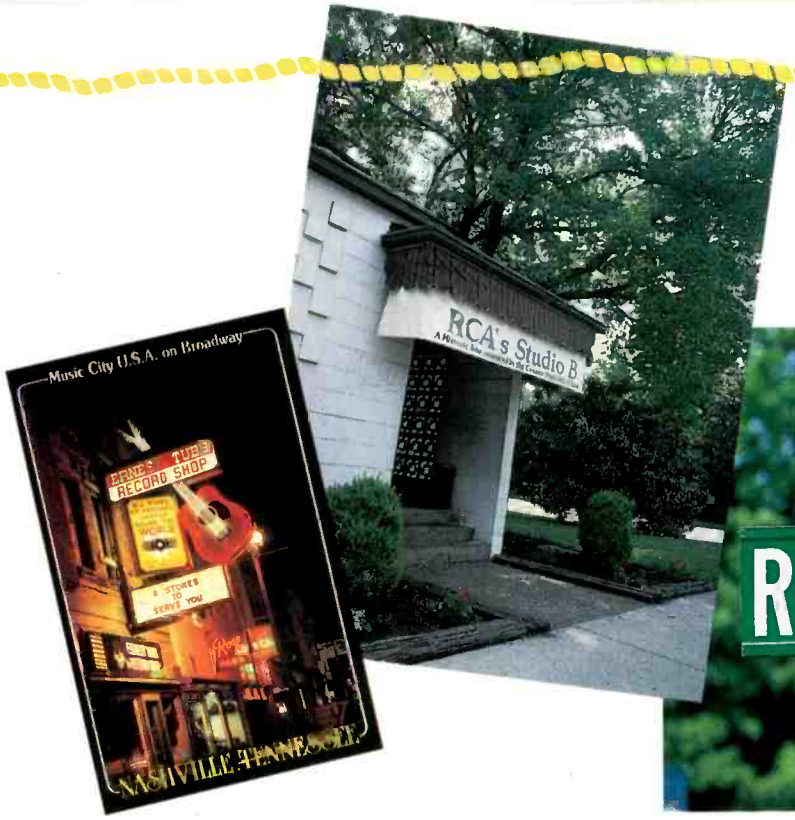
Now (finally) the technical part. Our studio was in a converted house at the edge of the district. Our relatively modest bud-

As Long As You're Under Our Roof, Young Man . . .

People who were kids in the South about the time it became known as the New South were subject to three all-year no-nos: You didn't wear overalls, you didn't listen to country and western music, and you didn't like stock car racing—not unless you wanted folks to think your family was trash.

This flashed into mind when one of the singers came into the studio, to sing C&W, remember, in overalls.

I asked him how he felt about stock car racing. Never cared for it much, he said, but his grin tipped me off. He knew what I was thinking, and he knew we both knew that two out of three still counts as breaking away. *A.G.*



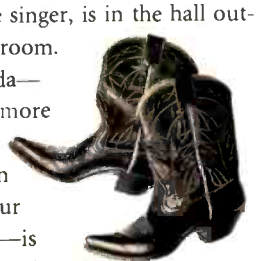
A stroll through Nashville's Music Row takes only an hour or so, but here you'll find signs of the present (the Opryland Music Group) alongside those of the past (RCA's Studio B, where important records by Elvis Presley, Chet Atkins, and others were made).

get had got us a full crew of studio musicians, full professionals who work behind—well, we got the impression that our deal was a touch better than the big acts would like to know about. Suffice it to say that you'd know the names.

As they came in the door, the instrumentalists looked more like the guys who sat next to you in college or the clerks you don't recognize outside the insurance office. No sign they knew firsthand what Dolly Parton (oops!) gave her band for Christmas. Until they warmed up. Kind of how you walk into a guitar store with a friend, and he picks up a stray Gibson and does Eric Clapton. Except these guys did Clapton, Lester Flatt, Doc Watson, Bob Johnson, Leadbelly, Andrés Segovia, Charlie Christian, and Jimi Hendrix, all while scooting their chairs back and forth and talking about basketball.

Our producer handed out arrangements. Basic arrangements. During our research we were told one reason Nashville works so well is that all the musicians speak and play the same pared-down language. They read music, as the joke goes, but not enough to interfere with their playing. And if one guy says, "Prolly otta put a couple footballs there," the others know he means whole notes.

That understood, we begin the recording sessions. The studio was a warren of large and small rooms, insulated from each other but linked to the control room and each other by the 24-track system's console. The drums are over there, in a separate room; the keyboard is in kind of a cubbyhole, next to the drums; bass, lead, and slide guitars are in the large central room, and the rhythm guitar goes in the vocalist's room while Nancy, the singer, is in the hall outside the control room.



Head Enchilada—in command of more levers, switches, and buttons than you'd find in your basic submarine—is the engineer. The players can monitor themselves and see everybody else. But the engineer can hear it all, and each instrument goes down on a separate track on the master tapes, which is the key to modern recording.

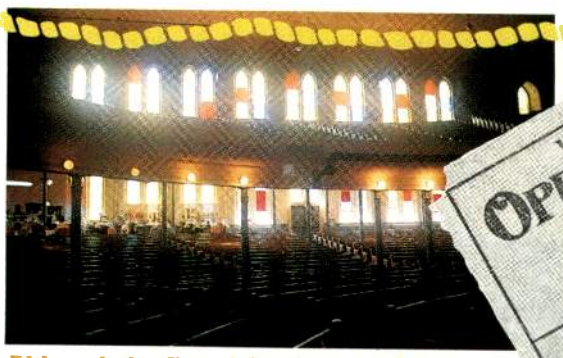
We planned to record 10 songs, some by Nancy, others by other writers. All new stuff. No point in covering, as they say when singer B does a song that's already been released and become a hit by singer A. Anything from "Achy Breaky Heart" to "The Wabash Cannon Ball" would be completely overlooked by every radio station in the field. Plus, there are by my count 2.3 talented, innovative, and hungry writers for every one such singer. And because nobody really knows how the popularity thing works, or because it's all sort of a club, if you want to sing an unpublished song, all you have to do is ask.

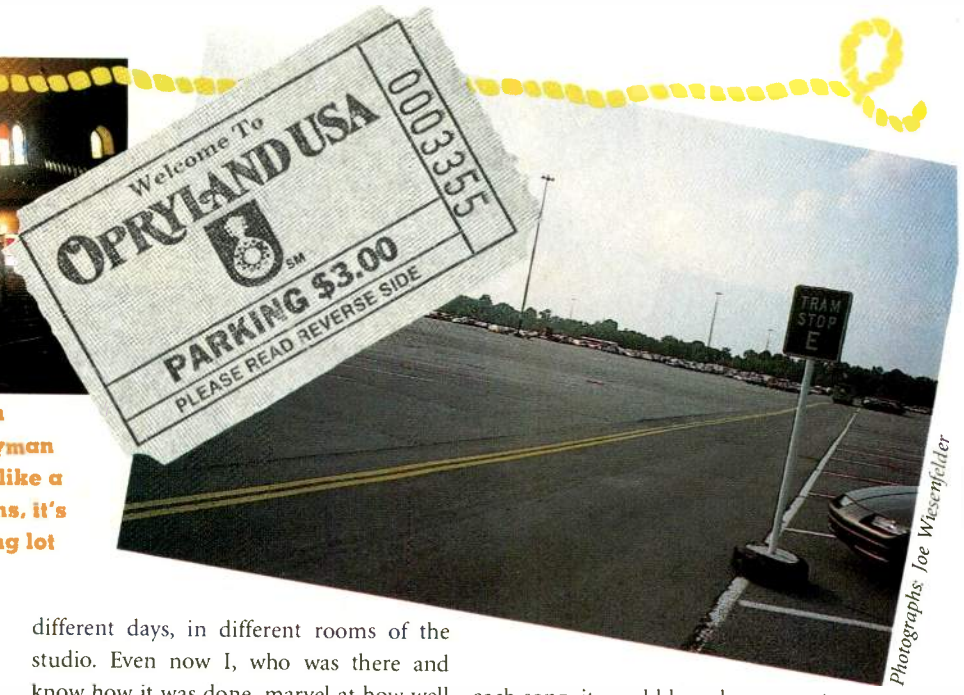
This is mentioned here because writers have demos, too. They hire singers and bands to perform the song as the writer meant it to be done. (An inside tip: If you want to sell a song to, say, Michelle Wright or Garth Brooks, hire singers who sound like those stars, so the stars will know how they'll sound before they sing it.) So first, the engineer played the writers' demo tapes and the group took notes, mental and on paper.

There was no formal hierarchy. Instead, one of the players was a natural leader. They all knew each other and how things work, so he'd say, well, we might do thus-and-so here and this-and-that someplace else, and they'd nod and mark their scores. Minutes, hours, or days later they'd all do what had been agreed on. Best staff meeting I ever saw.

Ten songs. Each runs three or so minutes. We had a family joke about how we'd have to do each one twice, so we'd work in the studio for an hour and go home.

Not! After the writers' demos were played, Nancy stood in the hall and sang, scratch, as it's known. That means she simply sings. The band plays along, seriously. The way it worked was, she was practicing, they weren't. The prime intent was, she'd get used to them, and they'd get used to her.





Photographs: Joe Wiesenfelder

Although the Grand Ole Opry, which formerly resided in the downtown Ryman Auditorium, still bills itself as being like a casual visit with your country cousins, it's hard to imagine your cousins' parking lot being this big.

The engineer was recording every run-through and every session. This went on until he had a good take of drums, keyboard, and bass—plus slide, lead, and rhythm guitars—each on its own track, for all of the 10 songs. Each good take was backed up by another take that was almost as good, on another piece of tape.

That done, most of the instrumentalists went home. The slide guitarist went home and came back with a harmonica; the lead returned with fiddle and mandolin. Happened the guitar players were the best available on the other instruments, so they sat down separately and did harmonica, fiddle, and mandolin parts for the 10 songs.

Next, the beegees. There are studio singers, just as there are studio players. My guess is, it's something to do with temperament; they have professional voices, perfect ears, and infinite patience but would rather make a good living near home than star on tour. Or so I hope.

In any case, the singers, two men and a woman, listened to the songwriter demos, Nancy's scratch tracks, and the instrument tracks. They conferred among themselves and with the producer as to when to sing parts, when to chime in on the melody, and when to lay out. No fuss, no muss. They sang, they listened, and they sang again, until everybody was satisfied.

My favorite has become the duet, an as-yet-unreleased song about a couple united in their split. Nancy sang the wife's part, one of the men sang for the husband—on different days, in different rooms of the studio. Even now I, who was there and know how it was done, marvel at how well they sing together. Science is wonderful.

We're talking full-time work, here. We got up every morning and went to the studio, where we watched, listened, and sang. Well, Nancy sang; I made coffee and ran errands (what else are husbands for?). When we fell over, we went back to the hotel, freeing the engineer and producer to do the serious work.

I don't have enough fingers to do all the math, but we had 24 tracks, so each part could be taped on its own. We had 2-inch tapes, so the tracks were wide enough for reasonable headroom, and we had three tapes, so the engineer could put part of this on the rest of that. All this with a nominal tape speed of 30 ips and a variable-speed oscillator, meaning if it was a fraction off, it could be speeded up or slowed down. This went on for a couple of nights, until the engineer and producer thought they had every part of every song sounding as good as it could get.

Then came the real work. Nancy sang. And sang, and sang, each of the 10 songs for 2½ days. As a multiple of that strain, the corrective singing is done a phrase or a bar or even one word at a time, over and over. Kind of like spending a few days flashing that impulsive and infectious grin of yours. Or kind of like making the chewing gum keep its flavor on the bedpost overnight.

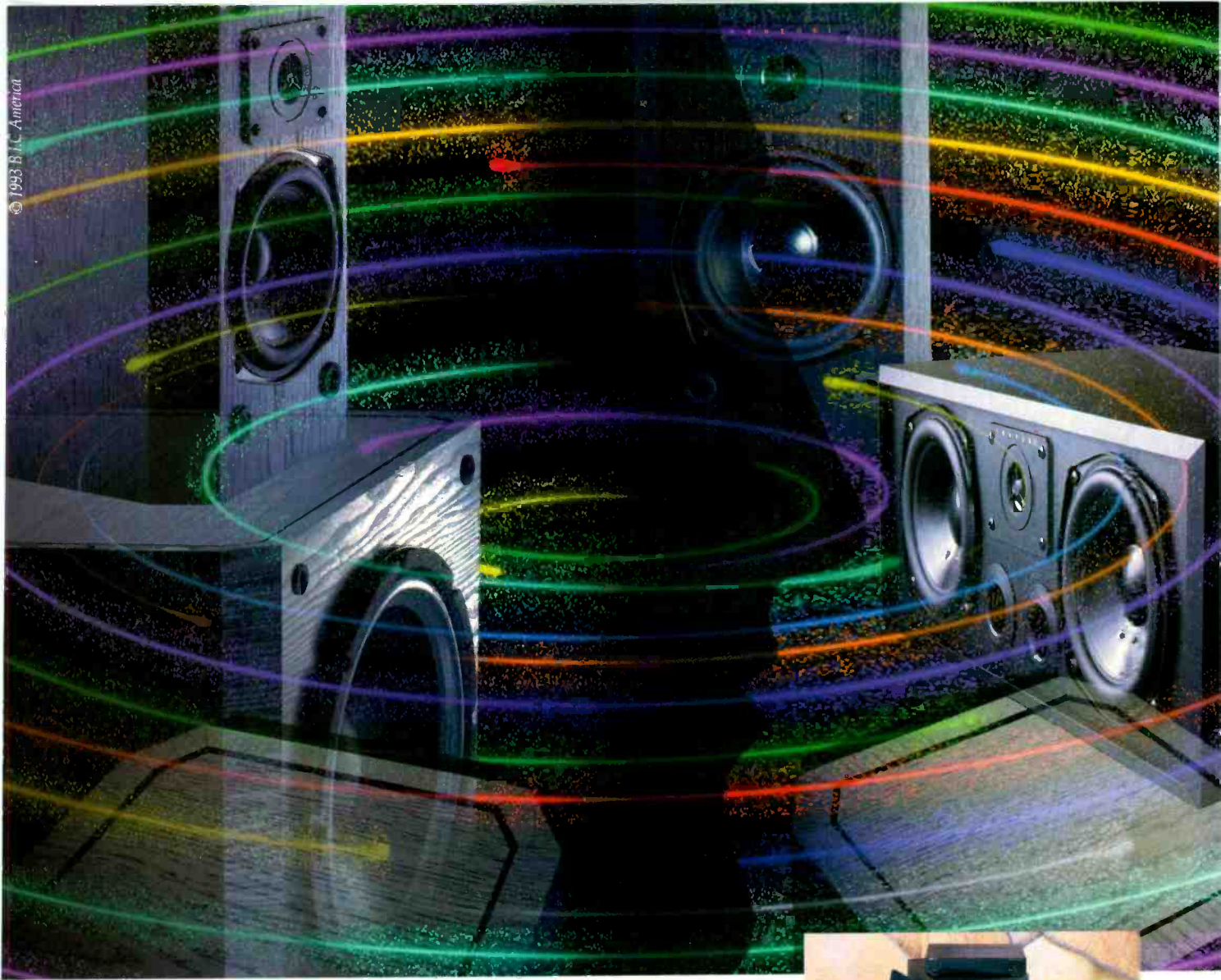
"Work" is the word here. Stardom, like genius, must be in the details.

This grind went on because once the engineer had captured a fairly good version of each song, it would have been counterproductive to do the whole thing over just because one word was slurred or an inflection wasn't quite yet where it was supposed to be.

Each correction was punched in, as they say. Nancy sang in unison with the nearly perfect tape, and at the absolutely on-time micro-moment, the improved live portions went on the tape while erasing the not-quite-there-yet portions.

The final, unimprovable note went down about 2 a.m. on the final day in the studio. We went home. Ditto the producer. The engineer went to Vancouver, where he has access to a larger studio and where he can hang aboot (I speak Canadian, eh?) as long as he likes. We considered hanging oot with him, but I remembered those signs in the repair shops, where work costs $5 if you aren't there, $10 if you watch, and $25 if you give advice.

So here we are, waiting for the record deal. Because I can't afford to give advice, I'll just tell you what I've learned. I've always admired musicians, but not until now have I appreciated how professional and skillful the technology and support have become. And when I hear the product, Nancy singing the songs I know so well, I still enjoy it. For once, science has enhanced art. Knowing how to blow smoke and move mirrors doesn't mean you can't believe in magic. A



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EQUIPMENT PROFILE

AIWA XK-S9000 CASSETTE DECK

I guess it's a sign a product genre has attained ultimate maturity when you find a model that does just about everything you've ever asked that product category to do—*and* does it very, very well. Such is the Aiwa XK-S9000, which, overlooking a few minor foibles, comes as close to being the ultimate cassette deck as any I've seen. When you total up the goodies, the options, and the things this deck does that others do not, the XK-S9000 also may rank as the ultimate bargain in cassette decks.

Needless to say, the XK-S9000 has Dolby B- and C-type noise reduction. What deck doesn't? But it also sports Dolby S NR. Although introduced some years ago, this noise-reduction system has elicited a rather limited following, possibly because a deck must meet stringent performance standards—vis-à-vis azimuth alignment, tape matching facilities, etc.—to be granted a Dolby S license. To top it off, a Dolby S chip set (in this case, manufactured by Sony) is more expensive than a simple Dolby B/C chip. But with Dolby S noise reduction and a top-grade tape, cassette dynamic range can approach that of CD or DAT, so Dolby S NR is a system devoutly to be wished for.

Like a number of today's decks, the Aiwa XK-S9000 also features Dolby HX Pro headroom extension. Unlike many of those decks, the XK-S9000 lets you *defeat* the HX Pro system if you wish. Frankly, I've seen HX Pro implemented so poorly on so many decks that I've become quite leery of the system. However, Aiwa has implemented it so well on the XK-S9000 that I found I *wanted* to use it and began complaining that HX Pro was one of the few options whose status is not indicated on the display panel and whose button has such a short throw that it was hard for me to tell whether the system was on or off. (I *must* have something to complain about!)

Have you ever wanted to do live recording on cassette? At one time, you could; most decks had microphone inputs, albeit few had adequate mike preamps. Even rudimentary inputs went bye-bye years ago, presumably as an economy measure. So it's a bit of a surprise these days to find a deck that not only has a microphone input but a decent mike preamp as well.

Aiwa to the rescue. The XK-S9000 has unbalanced (phone jack) mike inputs and two small slide switches on the rear panel. One switch selects between the line and mi-

SPECS

Tape Section

Frequency Response (±3 dB): 13 Hz to 24 kHz with Type IV tape; to 22 kHz with Type II tape and to 21 kHz with Type I tape.

S/N Ratio (With Type IV Tape, re Peak Level): 87 dB with Dolby S NR, 65 dB with NR off.

Wow & Flutter: 0.018% wtd. rms, ±0.035% wtd. peak.

D/A Section

Frequency Response: 4 Hz to 20 kHz, ±0.3 dB.

Distortion (EIAJ): 0.002% at 1 kHz.

S/N Ratio (EIAJ): 105 dB at 1 kHz.

Dynamic Range (EIAJ): 95 dB at 1 kHz.

Channel Separation (EIAJ): 100 dB at 1 kHz.

General Specifications

Input Sensitivity: Analog, 50 mV; coaxial digital, 500 mV; optical digital, –18 dBm.

Input Impedance: Analog, 47 kilohms; coaxial digital, 75 ohms.

Output Level: Line, 530 mV at 0 VU into 47 kilohms or higher; headphone, 1.5 mW into 32 ohms.

Power Consumption: 33 watts.

Dimensions: 18½ in. W × 5 15/16 in. H × 16⅜ in. D (46.9 cm × 15.1 cm × 41.5 cm).

Weight: 30.8 lbs. (14 kg).

Price: $999.

Company Address: 800 Corporate Dr., Mahwah, N.J. 07430.

For literature, circle No. 90

crophone inputs; the other adjusts mike preamp gain. In the more sensitive setting, a DIN-0 recording (that is, a flux level of 250 nWb/m at 315 Hz) can be attained with as little as 1.6 mV of output from the mike; in the less sensitive setting, 4.7 mV are required. The preamp's clipping point is 112 mV with the more sensitive setting and 330 mV when the gain is reduced. These figures compare with 85 mV needed from the line inputs for a DIN-0 recording. Input impedance on all analog inputs is perfectly adequate.

I say *analog* inputs because the Aiwa XK-S9000 also has coaxial and optical *digital* inputs and an internal digital-to-analog converter (DAC). The DAC is activated by a rear-panel slide switch adjacent to the digital inputs; you can switch it off entirely when you're not using it, thereby preventing the possibility of clock noise getting into the analog circuitry. The recording source ("Line/Mic" or "Digital") and digital input ("Optical" or "Coax") are selected by front-panel switches. The DAC automatically adapts to the data rate: 32 kHz for digital broadcasts and some DATs, 44.1 kHz for CD and prerecorded DATs, and 48 kHz for home-recorded DATs. The chip is billed as a dual-channel, 18-bit device fed by an eight-times oversampled digital filter.

THE AIWA XK-S9000 COMES AS CLOSE TO BEING THE ULTIMATE CASSETTE DECK AS ANYTHING I'VE SEEN.

Apparently a "ladder" DAC is used, because my bench tests revealed substantial low-level nonlinearity on the left channel; this usually is caused by misadjustment of the most significant bit of the ladder. An adjustment error such as this can vary from unit to unit, so another sample might not exhibit the same problem.

More about test results later. For now, let's stay with features and general performance. Most cassette decks have a headphone output; few have a headphone level control, without which it becomes a matter of luck whether the volume is satisfactory. Aiwa fills the bill with a well-designed headphone amplifier whose output impedance (54 ohms) is aimed at delivering maximum level into typical consumer headphones. (Maximum power transfer is achieved when the headphone impedance matches the source impedance.)

The XK-S9000's four-motor transport is, without question, the quietest I've experienced. When the cassette is loaded (this happens automatically when the cassette is dropped into the door slot), it is clamped against a resilient pad to damp shell vibration. To optimize torque characteristics during recording and playback and yet provide fast tape spooling, different motors drive the reels in fast-wind and in normal record/play modes. The pancake-type d.c. servo motor, which operates the dual-capstan drive, is on a floating mount to reduce transmission of vibration, and a fourth motor is activated to operate the door. This deck's speed accuracy is stellar and is independent of line voltage, fast-wind times are reasonably swift, and record/play wow and flutter is well below average.

Adding to the impression of solidity and quiet competence are the XK-S9000's resonance-deadening wooden base with oversize feet, high-gloss simulated-rosewood side panels, and twin toroidal power transformers—one for the analog circuitry, one for the digital—each extending outside the rear panel. More important from the performance standpoint is the ultra-stiff headbase casting that is mounted on three points to increase stability and reduce resonance. Finally, a head stabilizer is used to reduce vibration of the head assembly itself.

The recording and playback sections seem to be well shielded from each other. Each uses an amorphous core wound with "stress-free ultra-pure 6N" copper. The erase head is built around a double-gap Sendust core.

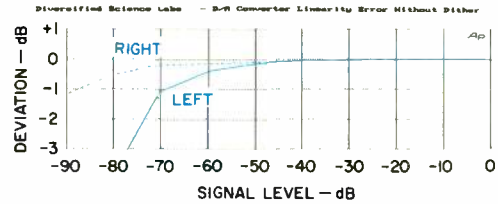


Fig. 1—D/A section deviation from linearity.

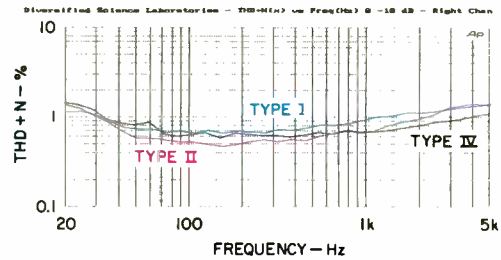


Fig. 2—Record/play THD + N vs. frequency at −10 dB.

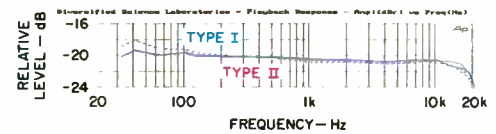


Fig. 3—Playback response.

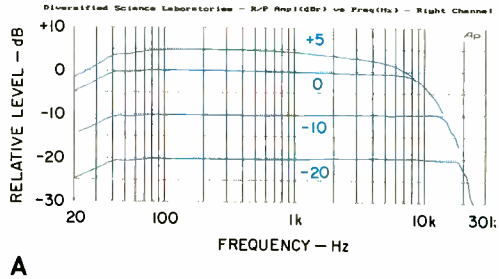
Table I—Input and output characteristics for DIN 0 recorded level.

Input	Imp., Ohms	LEVEL Sens.	LEVEL Clipping
Line	25k	85 mV	>10 V
Mike	5.35k	1.6 mV	1.12 mV
Mike, with attenuator		4.7 mV	330 mV

Output	Imp., Ohms	LEVEL Unloaded	LEVEL Loaded	Load, Ohms
Line	1,090	865 mV		
Headphone	54	5.44 V	4.75 V (37.6 mW)	600
			1.89 V (71 mW)	50

Table II—Record/play S/N ratios (re DIN 0) with CCIR/ARM and IEC A weightings.

	S/N, dB		
CCIR/ARM Wtd.	Type I	Type II	Type IV
Without NR	54.6	59.7	57.1
With Dolby B NR	64.9	69.8	67.4
With Dolby C NR	74.3	78.5	76.5
With Dolby S NR	77.5	81.7	79.6
A-Weighted			
Without NR	57.3	62.0	59.7
With Dolby B NR	66.5	70.6	68.6
With Dolby C NR	74.4	77.5	76.0
With Dolby S NR	76.7	80.3	79.2



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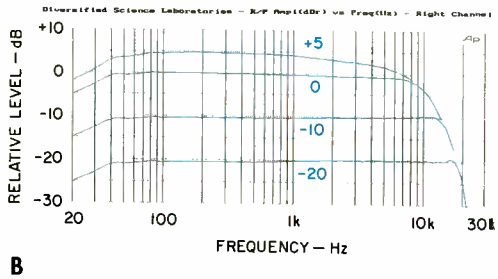

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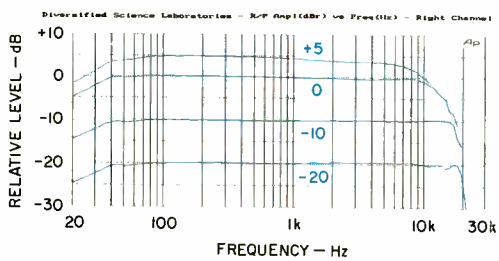

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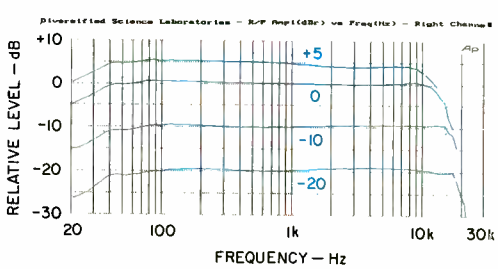

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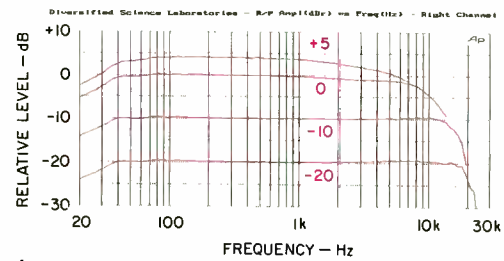
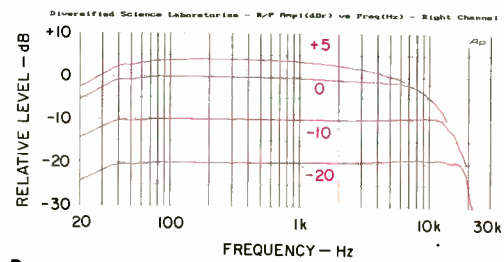
Fig. 4—Record/play responses for Type I tape without noise reduction (A), with Dolby B NR (B), with Dolby C NR (C), and with Dolby S NR (D).



A



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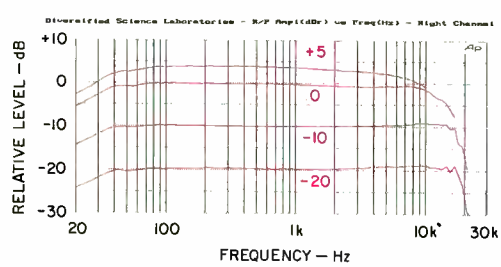

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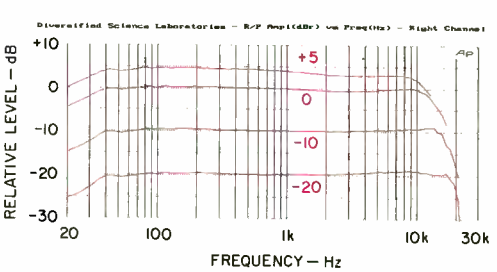


D

Fig. 5—Record/play responses for Type II tape without noise reduction (A), with Dolby B NR (B), with Dolby C NR (C), and with Dolby S NR (D).

also shows Dolby NR setting (B, C, or S) and "Monitor" position ("Source" or "Tape").

Although the XK-S9000 automatically sets bias and equalization for the generic type of tape being used, you can tweak it for the particular brand you're using. These adjustments are made with four controls arranged just under the "Record Level" pot. One knob switches the calibration system on and off and, when on, increases the indicator sensitivity to display signal level in 0.5-dB increments. A second knob adjusts bias, a third adjusts recording sensitivity to ensure proper Dolby tracking, and the fourth (more on it in a moment) adjusts recording equalization.

Aiwa uses 400-Hz and 10-kHz test tones for setup. The high-frequency signal appears on the upper (left-channel) level indicator; the 400-Hz signal appears on the lower (right-channel) level indicator. You adjust bias and record sensitivity until both level indicators hit red tick marks that appear on the display when the deck is in the calibration mode.

The fourth knob has an unusual and quite interesting function. It permits you to modify the *recording equalization* by ±2 dB at 10 kHz *prior* to adjusting bias and recording sensitivity. This means you can adjust the balance between a tape's low-frequency maximum operating level (MOL) and its high-frequency saturation operating level (SOL) to fit the characteristics of the music that you're recording *and still maintain flat frequency response.* For example, if you're recording classical music, which is likely to have substantial bass and midrange energy but relatively moderate treble levels, you can switch "Rec EQ" to "High" before adjusting bias and record sensitivity. This will give you a bit more low-frequency

The display has dual, 24-segment, peak-level indicators calibrated from −40 dB (which is always on) to +14 dB. The indicator responds very quickly (in about 0.4 mS) and without overshoot; the cursor decays in about 0.5 S, making it easy to read. A peak-hold mode can be activated to capture the maximum reading.

The deck automatically detects the type of tape via the keyways on today's cassette shells, and sets equalization and bias accordingly. Each change of tape is indicated on the display by a change of tape-type indication and of suggested maximum recording level (+6 for "Normal," +8 for "CrO_2," and +10 for "Metal"). The display

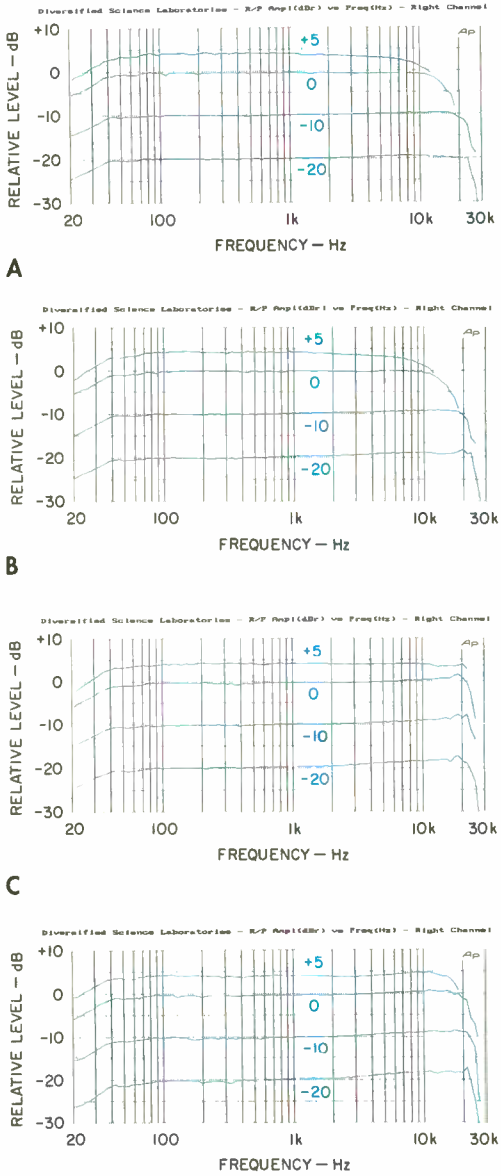


Fig. 6—Record/play responses for Type IV tape without noise reduction (A), with Dolby B NR (B), with Dolby C NR (C), and with Dolby S NR (D).

headroom at the sacrifice of a tad of high-frequency headroom. For synthesized music with a lot of surrealistic highs, you might want to switch "Rec EQ" to "Low," to augment high-frequency headroom at the expense of low. Either way, you still get flat frequency response and proper Dolby tracking, because "Bias" and "Rec Sensitivity" are set *after* the recording equalization is modified.

Another novelty on this deck is Aiwa's Blank Tape Optimized Recording (BTOR) system. There are two record buttons on the front panel, one marked "Rec" and the other "B-Rec." With "B-Rec," the erase head is deactivated since it's not needed with virgin or bulk-erased tape. Aiwa claims that the "result is well-dampened sound, sound expansion, less distortion, and clear sound reproduction." In my bench tests, I could find no statistically significant difference in background noise between the two recording modes (the factor that should be influenced most directly by erase-head performance). However, when I switched modes, matters didn't deteriorate either, and you can switch between modes without recalibrating bias and sensitivity, which suggests that Aiwa's bias supply is rock solid and insensitive to changes in loading.

On the more traditional front, the Aiwa XK-S9000 has a quasi-real-time tape counter (with memory for rewinding to counter zero) with a blinking warning when you're within 3 minutes of the end of the side, a multi-function display (all display functions active, only the tape counter active, all display functions defeated), a defeatable MPX filter, a record mute, and timer-operated record and playback with a play/repeat option. The remote control can be used to open and close the door, reset the counter, enable counter memory, toggle through the display choices, operate the transport (rewind/review, play, fast forward/cue, record [but not B-Rec], stop, and pause), and activate record mute. Aiwa's instruction manual could be improved, especially the section on calibration and the effect of the "Rec EQ" switch.

Measurements

Obviously, a deck with this many options necessitated a good bit of testing, and I generated reams of data. Because it's not feasible to present all of it here, I have cherry-picked the most significant graphs.

Let's start with the D/A converter, which was measured to the deck's line output jacks with "Monitor" in the "Source" position and the record level adjusted to produce a 2-V output. (This methodology was followed to separate converter performance from deck performance.)

THIS DECK HAS IT ALL, FROM DOLBY S NR TO A BUILT-IN D/A CONVERTER.

The low-level nonlinearity on the D/A converter's left channel, which I mentioned earlier (see Fig. 1, made with undithered signals) also showed up as increased third-, fifth-, and seventh-harmonic distortion on the –60 dB, 1-kHz tone. As a result, the left channel's EIAJ dynamic range, which is based on this test, was only 91.5 dB, while the right-channel figure was 2.6 dB better, at 94.1 dB. Aside from this, however, the converter acquitted itself reasonably well. It doesn't pretend to be the equal of a stand-alone DAC, and one can question its purpose in an analog cassette deck when every digital program source I can think of has its own DAC and could be duplicated in the analog domain. But if you view it as a freebie, how can you complain? Frequency response was within +0, –0.1 dB from 20 Hz to 20 kHz on both channels; interchannel phase error was ≤1.75° over the same band. The THD + N at 0 level was less than 0.005% from 20 Hz to beyond 3 kHz, rose to 0.01% at 6 kHz, and peaked at 0.064% at 18 kHz. Channel separation was better than 60 dB at all frequencies below 10 kHz. The deck's A-weighted noise was –100.3 dB, and its quantization noise was –89.3 dB.

For my testing of analog record/play, the tapes I used were all from TDK. Aiwa shipped the review sample with TDK AD, SA, and MA in C-46 lengths. I substituted TDK DS-X for AD (which no longer is available in this country) and used C-90 tapes for all testing.

The deck's input sensitivity, overload points, output levels, and input and output

impedances (see Table I) impressed me as being well chosen. The XK-S9000 should therefore interface readily with other normal equipment.

When recording, indicator readings for a DIN-0 level (250 nWb/m) are +3 to +4 on the scale; distortion at DIN 0, while setting no new records, was reasonably low, especially with the Type I tape: Results were 0.79% for Type I, 1.7% for Type II, and 1.2% for Type IV. Recording limits for 3% THD + N were +5.0 dB for Type I, +2.2 dB for Type II, and +4.8 dB for Type IV. Figure 2 shows THD + N versus frequency at 10 dB below DIN 0. The maxima range from 1% to 1.5%, depending on tape formulation—results which, while not outstanding in my experience, are nonetheless perfectly respectable.

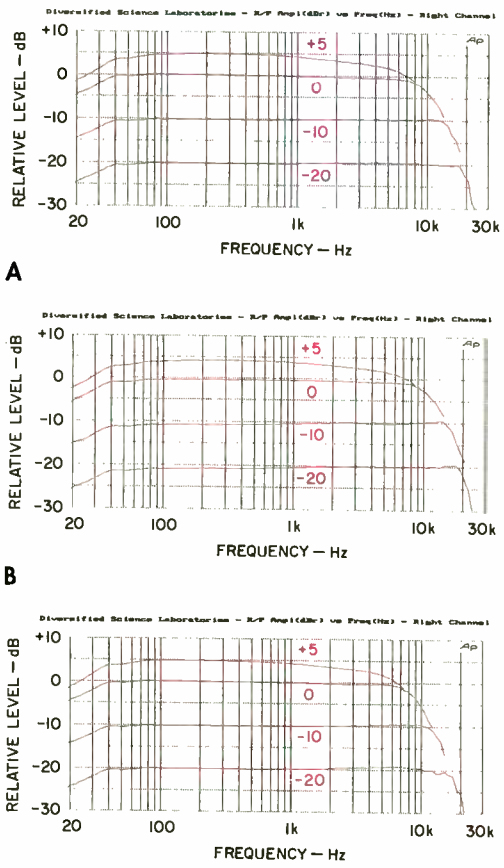


Fig. 7—Record/play responses for Type I tape, without noise reduction, at "Norm," (A), "Low" (B), and "High" (C) record equalization settings.

Record/play channel separation at 315 Hz was 46.1 dB, which is par for the course in the analog cassette world. Erasure of a high-level 100-Hz signal on Type IV tape (always the worst case) was a very impressive 73.5 dB.

Noise levels for the record/play cycle are shown in Table II. Those measured with CCIR/ARM weighting show the usual progressive 10-dB improvements when going from recordings made without Dolby NR, to those with Dolby B NR, to those with Dolby C NR. The S-type system reduces CCIR/ARM noise by another 3.25 dB, but the audible improvement was greater than this number suggests; Dolby S is the only Dolby NR system that is effective in the bass as well as in the treble; it yields a theoretical 10-dB reduction in low-frequency noise and a 24-dB improvement in high-frequency noise (4 dB greater than Dolby C NR in the treble). Using CCIR/ARM weighting shows the treble improvement but practically ignores low-frequency noise, so the difference there doesn't show up in the measurement. Using A-weighting tilts the scale even further against demonstrating the relative improvement with Dolby S noise reduction. The A-weighted figures are tabulated for comparison and because these are the ones recognized by the EIA Standard.

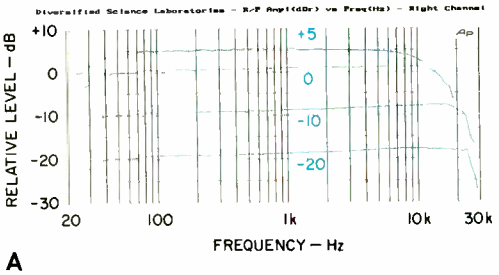
Record/play interchannel phase error (8.8°, ±5.1°) was quite low, testifying to careful *relative* alignment of the recording and playback head sections. Interchannel phase error measured when playing the BASF 70-μS calibration tape was extremely low, which testifies that Aiwa's quality control department did its job in aligning the heads to the standard tape. This shows up in playback response as well (Fig. 3). Left-channel response is down a mere 0.5 dB at 10 kHz, 1 dB at 16 kHz, 1.9 dB at 18 kHz, and 3.4 dB at 20 kHz on the Type II BASF tape; results are 0.5 dB, 1.5 dB, 2.1 dB, and 3.9 dB (respectively) on the Type I BASF tape. The right channel was generally within 0.5 dB of the left on each tape.

I measured record/play response at four levels (–20, –10, 0, and +5 dB), on each channel, with each tape, with each choice of noise reduction, and with HX Pro on and off—almost 100 curves in all. Frequently, HX Pro causes an unnatural rise in high-frequency response. That is *not* the case with the Aiwa XK-S9000, which is unusual in that it is as well behaved *with* HX Pro as without. I was so impressed, I am showing the results only *with* HX Pro and, to simplify matters further, only for the right channel (without noise reduction and with Dolby B, C, and S NR) in Figs. 4, 5, and 6.

The above curves were taken with the "Rec EQ" switch set at "Norm." Figures 7 and 8 are the response curves taken without Dolby noise reduction, on Type I and Type IV tape, at each record equalization setting. (Results for changing equalization with Type II are not shown, because they were very similar to those with Type I.) Finally, to illustrate the change in MOL and SOL that the different "Rec EQ" options effect, Fig. 9 shows SOL versus frequency, from 3 to 20 kHz, for Type I and Type IV tape at each setting. (Effects on Type II, not shown, were similar to those on Type I.) Figure 10 shows THD + N versus recorded level at 315 Hz for each EQ setting on Type I tapes; the differences were less pronounced on Type II and IV tapes and therefore are not shown. Some of the curves in Fig. 10 appear jagged because I chose to plot THD + N against *recorded* (tape playback) level rather than *recording* (input) level; variations in playback level cause the jaggedness.

WITH DOLBY S NOISE REDUCTION, CASSETTE DYNAMIC RANGE CAN APPROACH THAT OF CD OR DAT.

As to mechanical characteristics, playback speed error was only +0.1% for line voltages from 105 to 127 V, and record/play wow and flutter was +0.035%. With a C-90 tape, fast-forward time was 102 S, and rewind time was 98 S.



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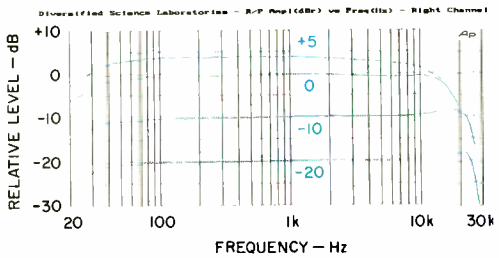

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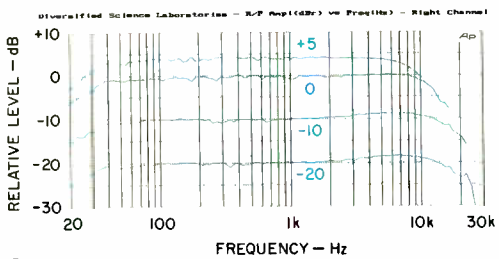

C

Fig. 8—Record/play responses for Type IV tape, without noise reduction, at "Norm," (A), "Low" (B), and "High" (C) record equalization settings.

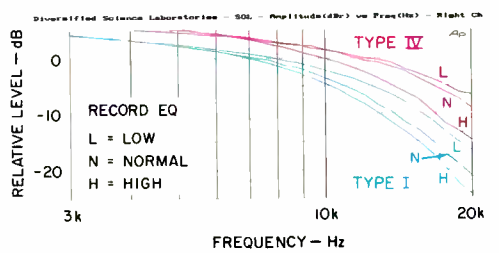

Fig. 9—Effect of record EQ on SOL for Type I and Type IV tapes.

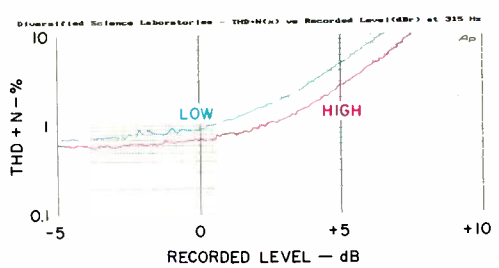

Fig. 10—Effect of record EQ on THD + N for Type I tapes; see text.

Use and Listening Tests

I gave the story away at the beginning of this review. The Aiwa XK-S9000 is the most "compleat" cassette deck I've seen—and one of the best performing. But that won't prevent me from nitpicking a few details, some of which are more a matter of personal preference rather than of right and wrong. For example, some people prefer to have the tape counter reset itself when the cassette is ejected; others prefer that the count be held so you can open and close the door without losing it. The Aiwa XK-S9000 adopts the latter approach.

From an ergonomic standpoint, just about every setting is shown either on the display or by illuminated dots on the transport controls. (The major exceptions are the settings for HX Pro and the MPX filter.) However, the suggested maximum recording level marks (+6 for Type I, +8 for Type II, and +10 for Type IV) are rather ambitious for the 70-μS tapes and overly conservative for the Type I (120-μS) product. Bench measurements suggest that levels 2 dB lower would be more appropriate for TDK SA and MA, while DS-X can be pushed close to +10.

When calibrating the deck, clockwise rotation of "Rec Sensitivity" increases recording level and, thereby, increases the indication on the "Low Freq" (lower) portion of the display. Rotating "Bias" clockwise increases the bias current and thereby *reduces* the indication on the "High Freq" (upper) portion of the display. Although this makes sense to the technically inclined, I think the average user would prefer to have a clockwise rotation of "Bias" *reduce* the actual bias and thereby *increase* the indication. That way, you'd always turn the knob in the direction you want the indicator to go, and both "Bias" and "Rec Sensitivity" controls would operate in a similar way.

I would have preferred to have the line outputs muted in the calibration mode. The test tones appear at the line outputs and are audible at a rather high level, so it's best not to have volume up high when calibrating this deck. Also, if you calibrate for the particular tape you're using (the whole point of the calibration system), you can't use "B-Rec" because the calibration tones will have been recorded on the tape and will need to be erased.

Nitpicking aside, the Aiwa is an extraordinary cassette deck. It comes with a Dolby S sampler from Windham Hill that has to rate as one of the finest, if not *the* finest, prerecorded cassettes I've heard.

I recorded using all tape types and every NR option. Source material included CDs and personal digital recordings chosen to expose recording flaws that typically occur on cassette. Among the rock/pop CDs were Amanda McBroom's *Dreaming* (Gecko, no catalog number) and Tracy Chapman's *Tracy Chapman* (Elektra 9 60774-2). From the classics, I used pianist Richard Goode's *Beethoven: The Late Sonatas* (Elektra/Nonesuch 9 79211-2) and harpsichordist Colin Tilney's *Scarlatti Sonatas* (Dorian DOR-90103). My recordings were of piano and harpsichord, particularly difficult to record because their transients can be easily and audibly mutilated.

I will not claim that I could hear *no* difference between source and copy using Dolby S noise reduction and a direct A/B comparison, but the differences were *very* slight; without direct comparison, I think few audiophiles would complain of the tape version if they thought it was a CD. This was especially true when using the Type I tape, whose smoothness in response and tonal character were very impressive. Dolby S NR made residual noise inaudible at normal listening and recording levels on all three tape types, so there is no reason to forgo a good Type I product with this deck. Recordings made with Dolby C NR were nearly as good on this deck (especially when using Type II tape), although Dolby S NR maintains the edge.

With DCC and MD in the wings, is Aiwa's XK-S9000 the swan song of the analog cassette genre? It's hard not to pose the question. But the Aiwa's scope is so broad and its performance so exemplary that posing it makes me sad. *Edward J. Foster*

EQUIPMENT **PROFILE**

COUNTERPOINT CLEARFIELD METROPOLITAN LOUDSPEAKER

Counterpoint has been making its Clearfield speakers only since January 1992, so the company is better known for the high-end electronics it's made since 1977. The latter include solid-state and hybrid amps and preamps, tube preamps, and solid-state D/A converters. The Clearfield line includes an $800 subwoofer and three speakers, ranging from a two-way system at $1,200 per pair up to the Metropolitan ($5,995 per pair) reviewed here.

The Metropolitan is a five-driver floor-standing system that stands 5 feet high and weighs 156 pounds. The system's front-panel width of only 10 inches, about the same as that of a small bookshelf system, should give it the latter's fairly broad, non-diffractive horizontal coverage. Spikes are provided for the system's base.

The low-frequency section is composed of two 8-inch drivers in what Counterpoint calls an aperiodic vented-box enclosure. Albert Von Schweikert, who designed the Clearfield speakers, feels that conventional vented-box systems sound somewhat boomy. To combat this, he filled the portion of the enclosure just behind the bass drivers with a lot of damping material, which sacrifices some of the bottom-octave reinforcement yielded by conventional vented boxes.

The Metro combines this damped aperiodic loading with a removable vent plug, which Counterpoint calls a Q cylinder, that lowers vent tuning along with restricting the flow of air in the vent. According to Counterpoint, the plug works by changing the port tube's ratio of diameter to length. Inserting the plug effectively lowers the Q of the system "from a theoretical value of 1, with a maximum of bass efficiency, to a

SPECS

System Type: Three-way, floor-standing, dynamic, point-source concentric array.

Enclosure Bass Loading: Critically damped fourth-order tuned air column with modified Thiele/Small alignment; damping (Q), adjustable from 0.5 to 1.0 by removing foam plug and changing stuffing.

Drivers: Two 8-in. cone woofers, two 6-in. cone midranges, and 1-in. aluminum-dome tweeter.

Frequency Response: 25 Hz to 25 kHz, ±3 dB; matching to prototype tone standard, typically within 1 dB from 35 Hz to 20 kHz.

Sensitivity: 90 dB at 1 watt/1 meter.

Crossover Frequencies: 125 Hz and 2 kHz.

Impedance: 4 ohms nominal, with conjugate circuitry to ensure impedance is stable and does not drop below 4 ohms at any frequency.

Recommended Amplifier Power: 75 to 500 watts per channel (unclipped signal).

Dimensions: 24 in. W × 60 in. H × 9 in. D (61 cm × 152.4 cm × 22.9 cm); front panel, 10 in. W (25.4 cm); base, 27 in. W × 15 in. D (68.6 cm × 38.1 cm).

Weight: 156 lbs. (70.9 kg) each.

Price: $5,995 per pair; available in cherry, walnut, black oak, or light oak.

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damped alignment with a theoretical value of 0.5, which is very tight but lower in acoustic output." The removable plug allows you to change the system's low-frequency response to suit placement near the wall or out in the room. Von Schweikert feels that the truly critical high-end listener will prefer the drier, leaner bass obtained with the plugs in place.

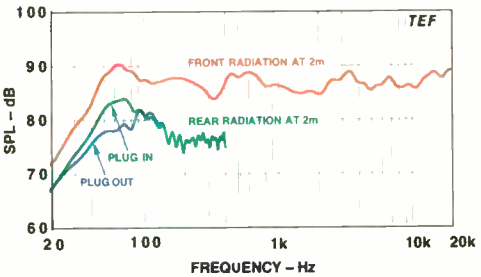

Fig. 1—Anechoic frequency response.

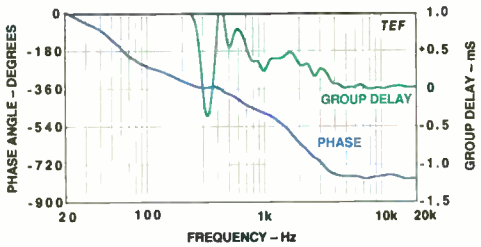

Fig. 2—Phase response and group delay.

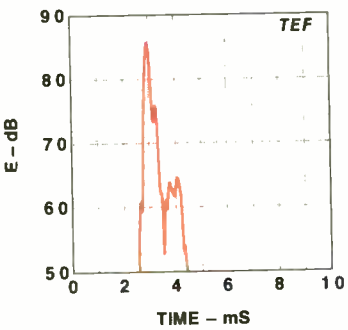

Fig. 3—Energy/time response.

Two 6-inch midrange drivers, with their own sub-enclosure within the cabinet, take over from the woofers at a lowish 125 Hz. They are spaced rather far apart, 14 inches center-to-center. A 1-inch inverted-dome tweeter is mounted midway between the two midrange drivers, offset 1¾ inches from their center line towards the inside (the side nearer the other speaker of the pair). This offset makes the Metropolitan's horizontal coverage asymmetrical. The crossover from midrange to tweeter occurs at 2 kHz. The two midrange drivers and the tweeter are mounted on a separate board, 8 × 24 inches, which protrudes by ¾ inch from the front of the cabinet. My test samples had a flocked covering on this board for acoustical absorption; future units will have an acoustically dispersive covering.

The wide spacing between the midrange drivers restricts the vertical coverage in the upper midrange, to decrease floor and ceiling reflections. This often-used arrangement of a tweeter between two midranges forms what Counterpoint calls "an effective point source," creating a single, unified wave launch so as to sound like a single transducer. Effectively, this driver arrangement provides symmetrical vertical coverage by reducing lobing.

Counterpoint states that the controlled directivity of the Clearfield Metro ensures three-dimensional, transparent imaging and allows a wide choice of room placement. The Metro's cabinet features what Counterpoint calls a Stressed Monocoque Structure with computer-optimized bracing that minimizes cabinet resonances. The front panel is 1 inch thick. The massive, cloth-covered grille frame is made from high-density fiberboard, 1 inch thick, and is 10 inches wide × 5 feet high; it weighs nearly 8 pounds all by itself! The grille frame fits around the midrange/tweeter mounting board with the grille's cloth up tight against the drivers, causing minimal acoustic effect.

The crossover is separated into two sections and mounted on the rear panel on two beefy p.c. boards behind the upper and lower woofers. Parts count includes six resistors, seven capacitors, and four inductors for a total of 17 (not counting paralleled units). The low-pass section is second-order and uses an iron-core inductor with nonpolarized electrolytics. The midrange drivers are fed from a first-order,

high-pass filter (a single capacitor in series) and a third-order, low-pass filter. (The crossover's midrange polarity is inverted, as compared to its woofer and tweeter outputs, to compensate for the offsets between the voice-coil positions of the various driver types and to produce correct *acoustical* polarity in the driver outputs. According to Counterpoint, this also reduces group delay.) The tweeter is driven by a third-order, high-pass filter with a resistive attenuator. Driver impedance compensation is used throughout. All parts are of high quality, including large Solen capacitors and heavy-gauge Monster Cable Special 1A wire for the woofer hookups.

The input connections allow single or bi-wiring, with large jumpers connecting the upper and lower crossover sections for single-wired use. All input connections are mounted on a large, easily accessible rear panel. Tweeter level can be raised or lowered in 1- or 2-dB steps by changing jumpers on this rear panel.

Measurements

Figure 1 displays the smoothed, anechoic frequency response of the Metropolitan, together with the rear bass radiation with the port plug in and out. Measurements were taken 2 meters from the tweeter, on the enclosure's axis, with 5.66 V rms applied, and referenced back to 1 meter. The front and rear responses below 400 Hz were derived from ground-plane measurements at 2 meters.

The on-axis response is quite extended, although somewhat rough. Note, however,

there are no significant peaks or dips, so that the overall response fits within a fairly tight window of 5 dB (±2.5 dB) from 42 Hz to 20 kHz, despite the bump in the bass range at 65 Hz. The vent plug hardly affected the ground-plane front response, but Fig. 1 shows a different story for the rear. With the plug in, there is a broad rise in the response between 25 and 90 Hz, with a peak boost of about 5 dB at 55 Hz in the rear bass radiation.

Averaged over the range from 250 Hz to 4 kHz, sensitivity measured 86.0 dB, 4 dB lower than Counterpoint's 90-dB rating. Right/left matching measured a fairly close ±1.4 dB from 100 Hz to 20 kHz. The deviations were about evenly distributed over the range from 100 Hz to 20 kHz. The grille caused only small effects on the response above 1 kHz, where it changed the response only about ±1.4 dB. Above 20 kHz (not shown), the response exhibited a bump at 21 kHz, followed by a sharp drop-off at higher frequencies.

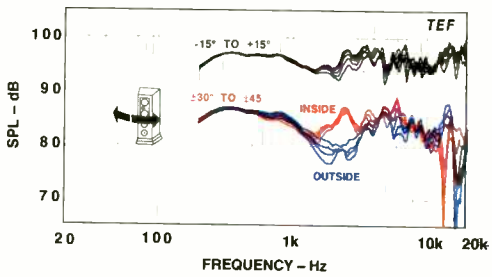

Fig. 4—Horizontal off-axis frequency responses.

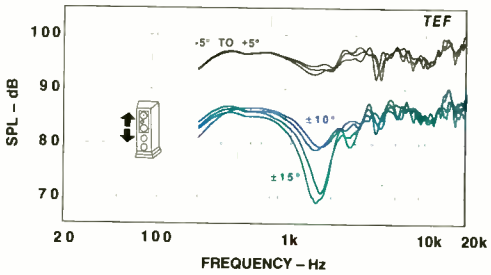

Fig. 5—Vertical off-axis frequency responses.

Figure 2 shows the phase and group-delay responses of the Metro, referenced to the tweeter's arrival time. The phase curve is well behaved but exhibits some undulations between 200 and 400 Hz. Between 1 and 20 kHz, the phase curve lags a significant 236°. This rotation is due to a combination of the crossover design and the offset between the acoustic centers of the tweeter and midranges. The group-delay curve indicates that between 1 and 3 kHz, the midrange output lags the tweeter by about 0.25 to 0.30 mS. A dip in this curve corresponds to the undulations in the phase curve between 200 and 400 Hz.

The Metro's energy/time response, shown in Fig. 3, accentuates the response from 1 to 10 kHz, which includes the upper crossover region. The main spike, at 3 mS, is fairly compact but exhibits a minor glitch at about 75 dB, about 0.3 mS after the main peak. All delayed responses are less than about 22 dB down from the main peak.

Figure 4 shows the unsmoothed sets of horizontal off-axis responses. The upper set of curves shows responses from −15° to +15° in 5° steps; the lower set shows responses from −45° to −30° and from +30° to +45°, again at 5° increments. The very close grouping in the top set indicates excellent coverage in the ±15° primary listening window. The lower set indicates response will differ in the mid-to-tweeter crossover range. Note that the response is flatter for inside orientations (the side where the tweeter is closest to the edge). On the outside, the response exhibits a broad dip between 1.5 and 3 kHz.

The unsmoothed vertical off-axis responses of the Metro are shown in Fig. 5. The top set of curves shows the responses at −5° (*below*), 0° (on axis), and +5° (*above*) the tweeter's axis. The very close grouping again indicates excellent vertical coverage in a 10° zone centered on the tweeter's axis. The lower curve set shows the responses at ±10° and ±15° around the tweeter's axis. These curves are also quite closely grouped, except for dips in the region of the 2-kHz crossover. The up/down response of the mid/tweeter array is quite symmetrical, which indicates in-phase operation with low lobing.

Figure 6 displays impedance versus frequency over the range from 20 Hz to 20 kHz, with the port plug inserted. Also shown is the impedance of just the high-frequency portion of the Metro.

The port plug causes only slight changes in the impedance curve. Removing the plug added about 1 ohm to the system impedance at 16 Hz, decreased the impedance by about 0.5 ohm at 40 Hz, and added about 0.3 ohm at 70 Hz. The overall curve exhibits a minimum impedance of 2.9 ohms at 70 Hz and a maximum of 25.5 ohms at about 1.3 kHz. I ran the impedance of the high-frequency portion separately because the crossover's high-pass filter did not seem to be rolling off low frequencies before they reached the midranges. Energizing the system with a 5-Hz signal 10 V rms revealed significant displacement of the woofers and midranges and also showed that they were not in phase with each other.

The crossover schematic showed a 160-μF capacitor in series with the midranges. Driving the overall system with +1.5 V d.c. applied to its red terminals caused a static outward displacement of the woofers and an inward displacement of the midranges, even though the 160-μF capacitor should have blocked d.c. from the midrange drivers. The midrange/tweeter impedance is about 16 ohms, rather than infinite, at low frequencies. When the mid/tweeter section is paralleled with the woofer section, the Metropolitan's overall impedance exhibits a low of 2.9 ohms rather than the manufacturer's stated minimum of 4 ohms.

Further investigation revealed that the 160-μF cap (formed by two 80-μF caps in parallel) was bypassed by two resistors in parallel, with a net resistance of about 3 ohms. These bypass resistors provided the observed low-frequency path around the caps, thus explaining the curious measurements. These resistors were not shown on the schematic, and were inserted to flatten the response of this particular Metropolitan's midrange drivers at crossover. According to the manufacturer, each Metro-

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politan's crossover is custom-tailored to its particular drivers, and records of these crossover modifications are kept, by serial number, at the factory.

From 20 Hz to 20 kHz, the max/min variation is a high 8.8 to 1 (25.5 divided by 2.9), which means that the system will be quite sensitive to cable resistance. Cable resistance should be limited to a maximum of about 0.038 ohm to keep cable-drop effects from causing response peaks and dips greater than 0.1 dB. For a typical run of about 10 feet, 12 to 14 gauge (or larger), low-inductance cable should be used to hook up the Metros.

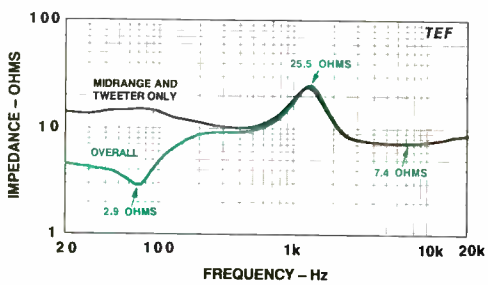

Fig. 6—Impedance; see text.

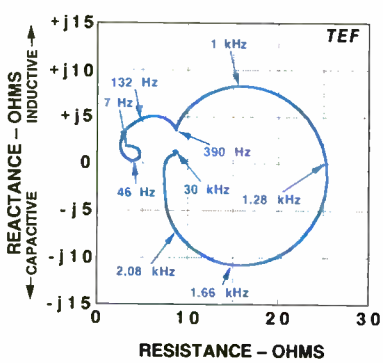

Fig. 7—Complex impedance.

Figure 7 shows the complex impedance, plotted from 7 Hz to 30 kHz; it is well behaved. The greatest changes in impedance (and phase) occur in the midrange, at about 1.3 kHz. The passband impedance phase (not shown) reached a maximum angle of +50° (inductive) at 100 Hz and a minimum angle of −41° (capacitive) at 1.9 kHz. The Metro's low 2.9-ohm impedance at 70 Hz means that it will be a fairly demanding load on a power amplifier in the bass range.

On a high-level, low-frequency sine-wave sweep, no significant cabinet resonances were noted. The woofer's linear excursion capability was about 0.4 inch, peak to peak (±0.2 inch). The woofers overloaded very gracefully and generated no bad sounds. No dynamic offset effects were noted. As noted before, however, the low-frequency sweep also generated significant displacement of the midrange drivers. Fortunately, the midrange drivers have nearly as much excursion capability as the woofers, so this did not add much additional distortion. With an input of 15 V rms at 20 Hz and the port plug removed, the woofer displacement was about 0.4 inch, peak to peak; the midrange displacement was about 0.15 inch, peak to peak, and about 90° out of phase.

Another effect was noted when driving the Metro's low- and high-frequency sections separately through the bi-wire inputs. The midrange cones would move if only the woofers were driven, and vice versa. This indicates significant acoustic leakage between the woofer and midrange enclosures.

No sharp minimum was noted in the woofer's excursion when driven by the high-level sine-wave sweep. With the port plug in, the woofer's excursion was constant between about 15 and 40 Hz and then decreased at higher frequencies. The displacement versus frequency of the woofers was very similar to that of a closed-box system. At 30 Hz and above, adding the port plug increased the woofer's displacement by about 5% between 40 and 65 Hz. Between 15 and 20 Hz, the woofers' excursion was reduced by about 25% when the port plug was inserted. Both cavities behind the woofers are completely stuffed with gray mineral wool, which greatly increases the damping of the vented system, thus reducing the port's output.

The 3-meter room response is shown in Fig. 8 with both raw and sixth-octave smoothed data. The Metro was in the right-hand stereo position, aimed at the listening position, and canted forward by about 5°; the test microphone was at ear height (38 inches), at the listener's position on the sofa. This placed the test mike on the tweeter's axis. The system was driven with a swept sine-wave signal of 2.83 V rms (corresponding to 2 watts into the rated 4-ohm load). The direct sound plus 13 mS of the room's reverberation are included. Excluding a dip at 210 Hz, the averaged curve fits a fairly narrow 10-dB (±5 dB) window from 100 Hz to 20 kHz. The general trend of the response is quite level and flat. Some midrange and high-frequency roughness is noted.

Single-frequency harmonic distortion versus power for the musical note E_1 (41.2 Hz) is shown in Fig. 9. The distortion spectra for A_2 (110 Hz) and A_4 (440 Hz) are not shown because the distortion levels were quite low and consisted of only low-order harmonics at 0.4% and below. A maximum power level of 100 watts (20 V rms into the rated system impedance of 4 ohms) was set as the upper limit. The E_1 (41.2-Hz) data shows that, at maximum power, the distortion reaches a significant 24% second, 32% third, and 11% fourth. The fifth and higher harmonics were no more than 1.6%. At 100 watts, the system generates a fairly loud 103 dB SPL at 1 meter at 41.2 Hz. Even though the 41.2-Hz distortion figures were quite high, during the listening tests the generated acoustic output did not sound distressed in any way. At higher frequencies, the distortion rapidly decreased and was essentially insignificant above 100 Hz.

COUNTERPOINT TWEAKS THE CROSSOVERS IN EACH METROPOLITAN TO MATCH ITS PARTICULAR DRIVERS.

Figure 10 displays the IM created by tones of 440 Hz (A_4) and 41.2 Hz (E_1) of equal input power. The IM distortion rises only to the low value of 4.5% at the 100-watt (full-power) level. This low level was seen even though the midranges were undergoing significant displacement due to the 41.2-Hz tone. It is fortunate that high-excursion midrange units were used in this design!

Figure 11 shows the Metro's short-term peak-power input and output capabilities, measured using a third-octave, 6.5-cycle

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tone burst. Input power was calculated by assuming that the measured peak voltage was applied to the rated 4-ohm impedance. The port plug was in for these tests.

The peak input power starts out fairly low, about 32 watts at 20 Hz, rises to 200 watts at 31 Hz, hesitates slightly, and then rises to a maximum of 8.1 kW (180 V, peak) in the range of the midrange drivers. In the tweeter's range above 2 kHz, the peak power capability falls to about 2.5 kW (100 V, peak), still a significantly high level. Between 80 and 125 Hz, the limit of the speaker was reached at about the same point that my test amplifier's limit was reached; this was due to the Metro's low impedance through this range.

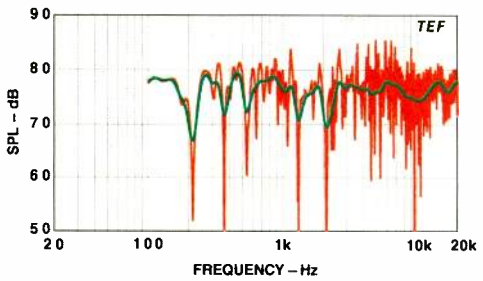


Fig. 8—Three-meter room response.

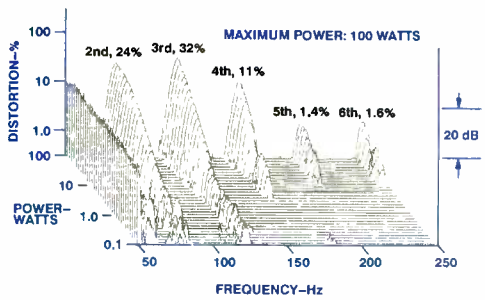


Fig. 9—Harmonic distortion for E_1 (41.2 Hz).

The upper curve in Fig. 11 shows the maximum peak sound pressure levels the Metro can generate, at 1 meter on axis, for the input levels shown in the lower curve. Also shown is the "room gain" of a typical listening room at low frequencies, which adds about 3 dB to the response at 80 Hz and 9 dB at 20 Hz.

With room gain, the peak output starts at about 97 dB at 20 Hz and rises rapidly to the mid-120s between 100 Hz and 1.5 kHz. Above 2 kHz, the output mostly maintains a still quite respectable 120 dB SPL. With room gain, levels of 110 dB and above can be generated above 40 Hz, and 120 dB and above at 55 Hz and higher. Even if the 20- and 25-Hz levels are on the low side, at 32 Hz and above the speaker generates very respectable levels. A pair of Metros can generate even higher levels. They can easily create the peak SPLs of live music, in a typical room, with a power amp that has appropriately high peak-power capability.

Use and Listening Tests

As I stated at the start of this review, the Metropolitans *are* large and heavy. When their spikes are not attached, an adult can barely move them around adequately. With their spikes attached, it is impossible for one person to move them. The Metros have separately packed wooden bases that are attached to the bottom by the user on installation. This base widens the bottom by about 2 to 4 inches and very much improves stability. With the bases attached, the systems are quite resistant to being tipped in any direction.

Counterpoint recommends toeing in the systems to aim them toward the listener, especially if the speakers are widely separated. In addition, the company recommends tilting them forward by adjusting the front and rear spikes, so the listener is on the tweeter's axis. Counterpoint calls this a Vertical Rake Adjustment, or VRA. In my situation, with my ears about 36 inches above the floor (and 3 meters away) and the tweeter about 46 inches high, the Metros needed to be tilted over about 5°. This essentially required raising the rear of each speaker about 1¼ inches higher than the front. In this configuration, they indeed look precariously tipped forward. Fortunately, the center of gravity is far to the rear of the systems, so they were very stable.

My review samples were supplied in black, including the grilles. The Metros' cabinetry and workmanship are top-rate. Because the tweeters are offset on the front of the cabinets, the systems are supplied in handed pairs. The right system has the tweeter offset to the left, and vice versa for the left system. Fortunately, the serial numbers of the right and left speakers end in "R" and "L," respectively, so it's easy to tell which is which.

As mentioned, the Metros are supplied with Counterpoint's Q cylinders, which can be inserted into the vent to change bass response and Q. These inserts are foam cylinders that decrease the diameter of the vent and increase flow resistance. Without the plugs inserted, the port is 3 inches in diameter. With the plugs inserted, the diameter is reduced to 1¾ inches. As mentioned earlier, Counterpoint states that inserting the plug lowers the overall Q of the bass response, and thus the resonant amplification due to the output from the vent, from 1 (a high-efficiency alignment) to a tighter, more heavily damped, 0.5. Yet contrary to both this statement and my own intuition, the measurements in Fig. 1 showed that rear radiation *increased* in the range from 30 to 80 Hz with the plug in, rather than the other way around. I can't completely explain this disparity, although I do know that the manufacturer based his statement on comparative readings of impedance rather than on SPL data (such as I showed in Fig. 1). Looking back at my notes for the ground-plane measurement, I see that I wrote "Yes, less output with plug out (5 dB less at 65 Hz)! Doesn't make sense!" At the time, I repeated the tests that resulted in Fig. 1 twice, to make sure. Most of my listening was done with the plugs inserted, the factory-supplied configuration. I did do some comparative listening with the plugs removed, however, and found that this made a *very* subtle difference, difficult to pin down.

THE LOW BASSS WAS OF GOOD QUALITY, WITH RESPECTABLE EXTENSION AND TIGHT SOUND.

The Metropolitans come with an *excellent* 30-page owner's manual that is packed

with useful information. Complete and in-depth information is supplied on all areas of operation, hookup, and room acoustics. These are expensive high-end systems, and one should expect this level of information; unfortunately, not all manufacturers provide it, even for speakers that cost more than $5,000 per pair.

The Metros' ability to let the user raise and lower their tweeter levels by 2 dB is useful for matching them to your acoustic environment. Making the level adjustment with jumpers is indeed the most reliable way to do this, well suited to a system of this caliber. Most of my listening was done with the factory jumper position (flat, without any boost or cut).

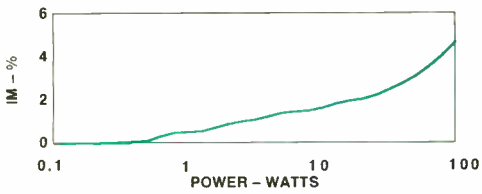


Fig. 10—IM distortion for 440 Hz (A_4) and 41.2 Hz (E_1).

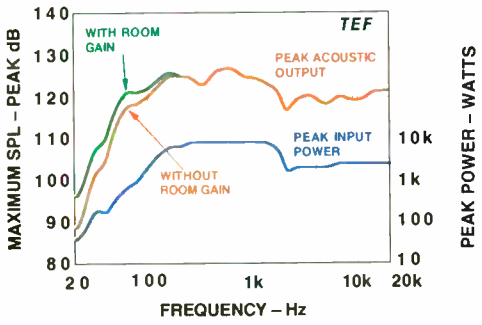


Fig. 11—Maximum peak input power and sound output.

Counterpoint states that the Metros can be placed quite close to the rear wall due to the added bass-response adjustment range that the Q cylinders provide. I could not thoroughly explore this capability because my room's rear wall is covered with bookshelves and cabinets that are 17 inches deep. With the Metros in my usual speaker positions, away from the rear wall, there was somewhat less low bass than from my reference B & W 801s (which sometimes overemphasize bass in my room). However, the Metros' low bass was of quite good quality, exhibiting respectable extension and a tight, non-boomy, sound. Listening was done both with the Metros tilted forward, to place my ears on the tweeter's axis, and without tilting them. The sensitivity of the Metros was quite close to that of the 801s, although slightly lower.

My system includes Krell electronics along with Rotel and Onkyo CD players and Straight Wire cabling. In a departure from my usual practice, most of my listening to the Metros was done with their grilles on. Very few speakers have grilles that can be left on without causing substantial response changes.

For my first listening test, my son played choir material that he'd recorded onto a portable Sony MiniDisc unit. He had recorded it directly from the console at a concert he had mixed at his college, where he's the lead audio person. (This was my first listening experience with MiniDisc, and I thought it did a great job, both sonically and operationally.) I was quite impressed with the Metropolitans' overall response, lively dynamics, and cleanliness of sound, even at concert levels—and so was my son, who had heard the live *and* mixed sound.

Further listening demonstrated that the Metros are serious high-end contenders. I particularly liked their imaging capabilities and ability to let you listen through the systems and hear subtleties in a recording. The speakers' high vertical directivity presumably contributed to what I was hearing, lessening the room's effect on the reproduced sound.

Although the Metros sounded quite different from my references, especially spatially, I liked what I heard. Tonal balance was somewhat similar to my references, although with somewhat less low bass. These speakers are not for bass freaks, but for those who value quality over quantity.

With the Metros tilted forward about 5°, which placed my ears on the tweeter's axis, the speakers flunked the pink-noise stand-up/sit-down test; I heard a prominent upper-midrange crossover suckout when standing. When sitting, however, I thought the Metros sounded super. When I returned them to level (no forward tilt), they did very well on the stand-up/sit-down test; there was essentially no tonal change between the two positions (including all the points in between). With the Metros level, my ears were about 5° below the axis when I sat and 5° above it when I stood. As Fig. 5 showed, the Metros' off-axis vertical response in the ±5° range is very uniform. I did all remaining listening with them level and not tipped forward.

I WAS IMPRESSED WITH THE OVERALL RESPONSE, LIVELY DYNAMICS, AND CLEAN SOUND.

On third-octave, band-limited pink noise, the output at 20 and 25 Hz was mostly unusable due to high values of low-order harmonic distortion. The effective output was better at 31.5 Hz and competed with my references on an equal basis from the 40-Hz band up.

On a wide variety of program material, the Metros always did very well. Only when the material required high levels of clean bass at 30 Hz and below did they stumble. As I have stated in the past, it is fortunate that our hearing is quite forgiving of high amounts of low-order harmonic distortion at low frequencies, particularly when the bass is accompanied by higher frequency sounds that help mask the distortion.

These speakers *will* play loud and clean. On the fire station sequence on *Sonic Booms 3*, recently released by Bainbridge (BCD 6289), they did incredibly, reproducing the sounds of fire engines and air horns in an extremely clean and realistic manner at ear-splitting levels. (This disc is the workout of the century for you bass freaks, with high levels down to 0.75 Hz!)

Everything considered, the Clearfield Metropolitan is a clear high-end contender. It has its own foibles and a distinct personality, but can't you say that about all high-end systems? *D. B. Keele, Jr.*

EQUIPMENT PROFILE

PHILIPS DCC-900 DCC RECORDER

One look at the Philips DCC-900 recorder and I realized that its layout and features are the same as those of the Technics RS-DC10 I reviewed for the April issue. It turns out that both were made by Philips, at the Marantz Japan plant in Sagimahara City. Interestingly, there are some differences between the two units' specs, and these differences were confirmed by my measurements.

If you are still unfamiliar with the new DCC format, the following list of features should bring you up to speed. Digital Compact Cassette machines are able to play both new DCCs and existing analog cassettes. Recorders feature full digital playback and recording, with accurate, direct track access. Prerecorded DCCs can display such text information as the artist's name and the album and track titles. The DCC format, like all digital home recording formats, incorporates the Serial Copy Management System (SCMS). This permits you to make a single copy of prerecorded MiniDiscs, DATs, or CDs but does not permit making digit-for-digit copies from that first copy.

The DCC-900 employs Philips' popular bitstream (one-bit) A/D and D/A conversion systems. A motorized tray is used for loading cassettes. Like all DCC units, the DCC-900 has auto reverse, both for digital cassettes (which only load one way and cannot be turned over) and for analog tapes. A dedicated remote control is supplied with the deck.

Control Layout

The front panel of the DCC-900 gives you access to just about every feature of the DCC format. The power switch is at the lower left of the panel. Above it is a "Timer" switch for use when an external timer has been connected.

Further up are six buttons that control the DCC marker system. At the top are buttons for automatic and manual numbering and for automatic renumbering of track-start markers. The two buttons below are used to write "next" markers (which activate playback from the beginning of the other side) and "reverse" markers (which make the machine switch tape sides without rewinding to the start of the other side). The "Mkr Erase" button is on the bottom row, by itself.

A "Dolby NR" selector comes next. For use when playing back analog cassettes, it has settings for Dolby B and C NR and an off position. Flanking the cassette drawer at the upper midsection of the panel are four tiny buttons for resetting the counter and selecting repeat play, counter display mode, and text information. (The amount of text available on a prerecorded DCC tape is determined by the software manufacturer.) Further to the right is the button to open and shut the cassette drawer. Directly below is an input selector with settings for analog, optical digital, and coaxial digital. It also offers automatic selection of whatever signal is active, with optical getting top priority and analog the last choice. At the far right are a large rotary control for recording level and a smaller control for input balance.

Along the lower edge of the front panel are a "Side A/B" button to switch tape sides and directions, followed by three logical groupings of buttons. First comes a pair of buttons for "Prev." and "Next" track skip. The next group includes the usual transport functions for record and playback. Just to the right is the recording group, comprising pause, "Append" (to find the end of a partially recorded tape or to let

THE PHILIPS DCC-900'S FRONT PANEL PROVIDES ACCESS TO JUST ABOUT EVERY FEATURE INHERENT IN THE DCC FORMAT.

you record over existing material), record, and record mute. Last in this row comes "CD Sync," to synchronize the DCC-900 with Philips 900-series CD players when copying from disc to tape. The headphone jack and its level control are at the far right. (Let me note that two of the Philips DCC-900's control features, "CD Sync" and the "Auto" input-selector system, are not on the otherwise similar Technics RS-DC10.)

The display area below the cassette drawer provides information on recording level, track number, tape position (shown as elapsed time within the tape or track, time remaining on the tape, or arbitrary counter numbers), and operating mode as well as any text that may have been included on the tape. (Track numbers appear when playing prerecorded tapes but not with home recordings unless the marker features are deliberately used.) Smaller indicator flags at the edges of the display show repeat mode, current tape side, NR setting, marker information, sampling frequency (32, 44.1, or 48 kHz), counter mode, and (when applicable) digital copy prohibition.

The remote duplicates just about all of the front panel's control functions and has numerical buttons for direct track access. Buttons to adjust output level are also provided on the remote, controlling the variable output jacks on the DCC-900's rear panel.

In addition to the variable output jacks, the rear panel has fixed-level analog output jacks, a pair of record output jacks, coaxial digital input and output jacks, and optical input and output terminals. There is also a switch to activate the front-panel infrared sensor for the remote and a pair of remote-control jacks for connecting Philips components that share the Philips Enhanced System Intelligence (ESI) control bus.

SPECS

Digital Recording/Playback
Sampling Rate: 44.1 kHz.
Frequency Response: 10 Hz to 20 kHz, ±0.2 dB.
THD: Playback, <0.003%; record/playback, <0.005%.
Dynamic Range: Playback, >95 dB; record/playback, >92 dB.
S/N: Playback, >98 dB; record/playback, >92 dB.
Channel Separation: Playback, >95 dB; record/playback, >85 dB.

Analog Playback
Frequency Response: Type II tape, 30 Hz to 16 kHz, ±3 dB.
S/N re: 250 nWb/m (Type II Tape): Without noise reduction, >50 dB; with Dolby B, >60 dB; with Dolby C, >70 dB.
Wow and Flutter: ±0.15%, CCIR wtd.

Inputs & Outputs
Analog Line Input: Unbalanced; impedance, >20 kilohms.
Fixed Analog Output Level: 2 V.
Digital Coaxial Input and Output Characteristics: 0.5 V, 75 ohms.
Headphone Frequency Response: 20 Hz to 20 kHz, ±0.5 dB.
Headphone S/N, Playback: 90 dB.
Headphone THD (Including Noise): –80 dB.
Headphone Matching Load Impedance: 8 to 600 ohms.

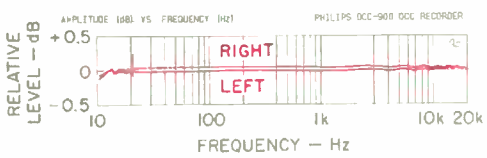
General Specifications
Dimensions: 17⅛ in. W × 5½ in. H × 11¾ in. D (43.5 cm × 14 cm × 30 cm).
Weight: 19.8 lbs. (9 kg).
Price: $799.95.
Company Address: One Philips Dr., Knoxville, Tenn. 37914.
For literature, circle No. 92

Measurements

In testing the performance of the DCC-900, I first checked record/playback frequency response. When I used the analog inputs to record a frequency sweep onto a blank DCC, response (not shown) was flat from 20 Hz to 20 kHz (drooping perhaps 0.05 dB or less at 20 kHz); there was no noticeable channel imbalance. Suffice it to say that these results were even better than the results shown in Fig. 1A, which I obtained when recording via the digital inputs. Since one of DCC's advantages is its backward compatibility with analog cassettes, I also checked response

THE WOW AND FLUTTER ON ANALOG PLAYBACK WOULD DO CREDIT TO ANY CASSETTE DECK.

when playing back a BASF Type II test tape that has spot frequencies from 31.5 Hz to 18 kHz. Response is down a bit more than 3 dB at 18 kHz (Fig. 1B), slightly more than on the Technics I'd tested previously. Still, the Philips DCC-900's response for analog playback was at least as good as that of



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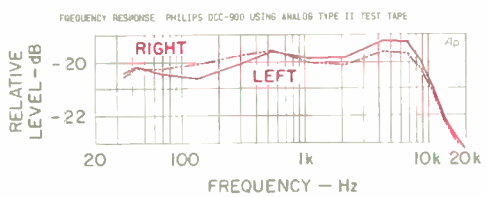


B

Fig. 1—Frequency response for DCC recording via digital inputs (A) and playback of calibrated analog cassette (B).

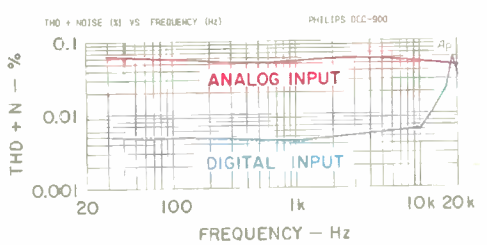
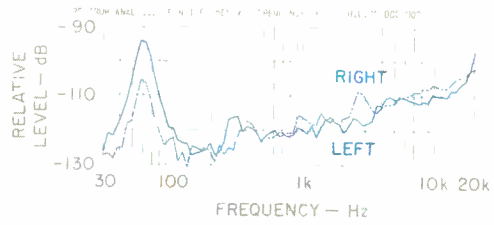


Fig. 2—THD + N vs. frequency, as percent of maximum recording level.



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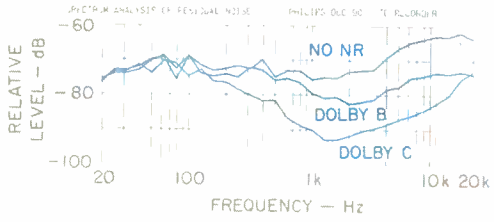

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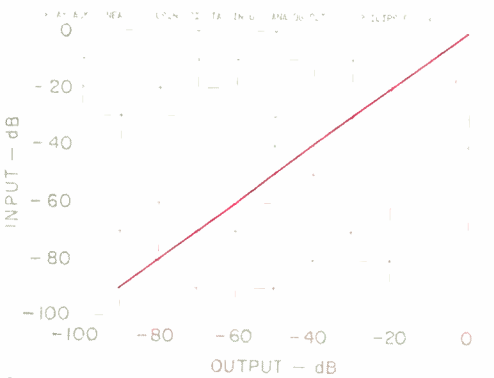
Fig. 3—Spectrum analyses of residual noise for DCC (A) and analog cassette (B).



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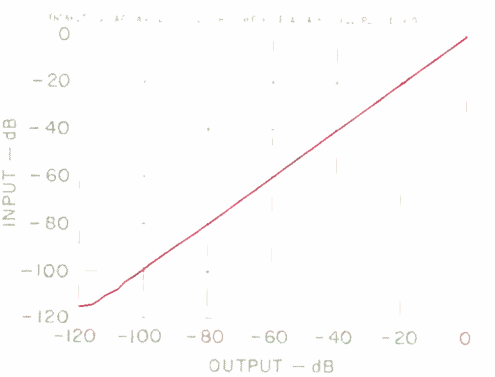


B

Fig. 4—Deviation from linearity for playback of recording made from test CD (A) and for record/play of digital signal from test generator (B).

many of the high-priced analog cassette decks.

Returning to DCC mode, I measured THD + N as a function of frequency (Fig. 2). For recordings made through the analog inputs, THD + N averages about 0.06% over much of the spectrum. As expected, results are even lower when the digital inputs are used, just under 0.005% at 1 kHz and rising to 0.007% at 10 kHz.

To isolate the harmonic distortion components from the residual noise, I conducted an FFT spectrum analysis of a 1-kHz signal. By averaging out the random noise through repeated sampling of the spectrum, I observed that the most significant actual harmonic was at 2 kHz, 90 dB below maximum recorded level; this corresponds to a THD percentage of about 0.003%, better than Philips' overall record/playback spec.

The A-weighted signal-to-noise ratio for a "digital zero" DCC recording measured –101.76 dB for the left channel and –99.31 dB for the right channel. On the analog side, the A-weighted S/N for playback of a "no-signal" Type I cassette was 55.77 and 55.80 dB, respectively, for the left and right channels without noise reduction, 64.27 and 64.15 dB with Dolby B NR, and 72.0 and 70.93 dB with Dolby C NR. Residual noise in both DCC and analog modes was subjected to spectrum analysis (Fig. 3). The major noise contribution in DCC mode is 60-Hz power-line hum (a surprise, since the Technics I'd tested had no such noise peak), but the unweighted level of even this peak is 95 dB below maximum recorded level. The analog noise curves, which have only the merest blip at 60 Hz, show the noise-reducing effects of Dolby B and C processing.

Returning once more to the DCC mode, I tested linearity by using a prerecorded tape of gradually decreasing signal amplitudes. (I had previously made a digital-to-digital transcription from my CBS CD-1 test disc.) As seen in Fig. 4A, there is virtually no deviation from perfect linearity over the range from 0 dB (maximum digital recorded level) down to –90 dB. Figure 4B shows another attempt to measure deviation from linearity, this time using my Audio Precision system to digitally generate signals all the way down to –120 dB. The DCC-900 is nearly perfect down to at least –100 dB.

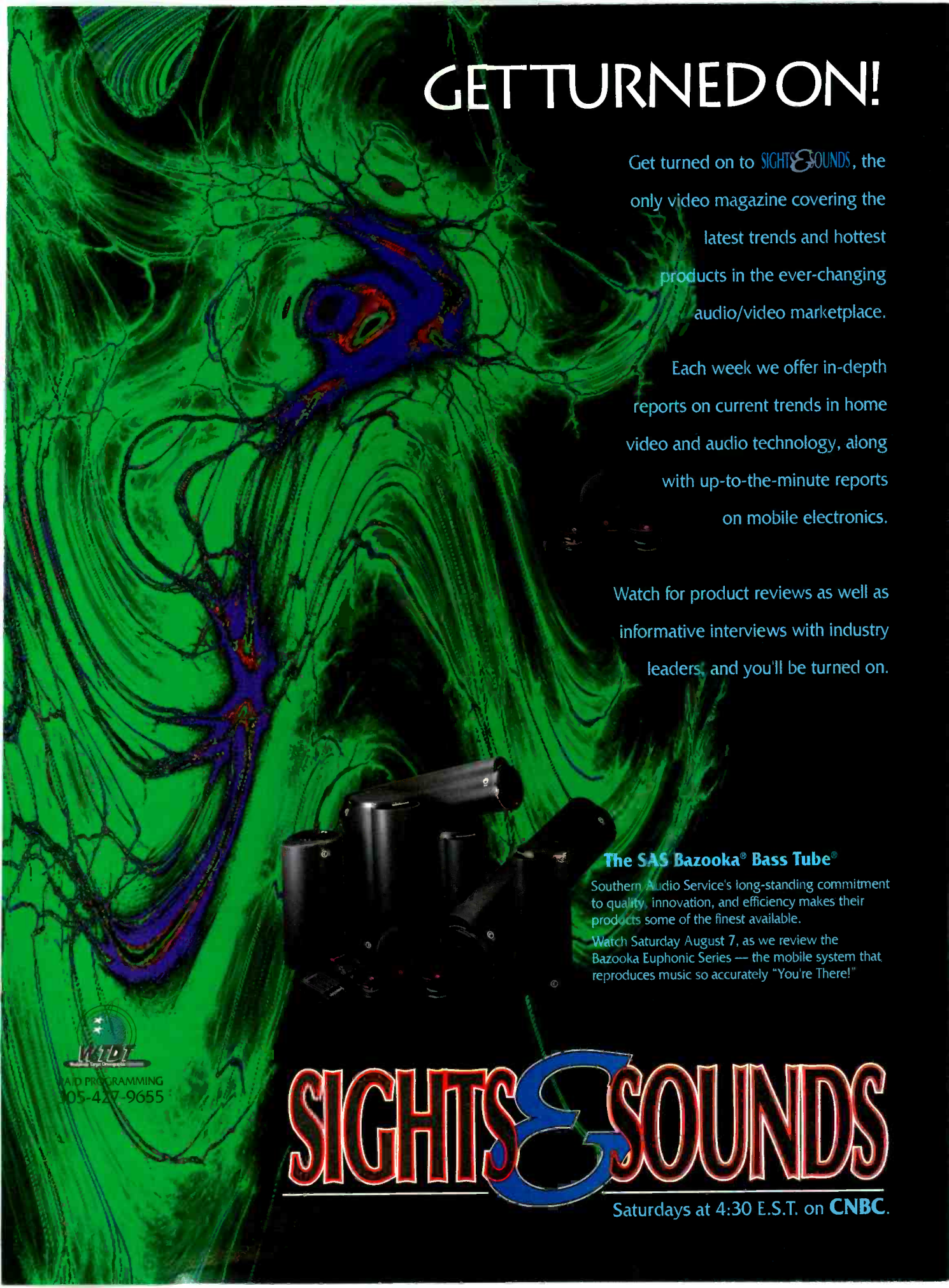
I WAS IMPRESSED BY THE CLEAN BASS, OVERALL FINE BALANCE, AND SHIMMERINGLY BRIGHT AND PLEASING SOUND.

As in previous tests of DCC recorders, I wanted to show the action of the PASC bit-rate-reduction system. Because ordinary single-tone test signals cannot illustrate this action, I use a special signal consisting of a unit pulse repeated 630 times per second. This signal is available on a Philips test CD, and I recorded it, via the digital input of the DCC-900, onto a blank DCC. An FFT spectrum analysis of the harmonics present in this complex input signal can be seen in Fig. 5A. By contrast, Fig. 5B shows what happens when the signal is recorded and played back using the PASC bit-rate-reduction system. As in previous tests, the noise floor over much of the audio spectrum increases by nearly 40 dB.

For my final bench test, I reverted to the analog domain to measure wow and flutter of the transport mechanism when playing back an analog tape. (There is no measurable wow and flutter when playing back DCC tapes.) The weighted rms reading hovers between 0.03% and 0.04%, while peak-weighted (IEC) wow and flutter ranges from about 0.06% to about 0.08% (Fig. 6). These are excellent results for any analog cassette player.

Use and Listening Tests

The layout of this recorder is superb, as is its styling. Like all DCC decks, the DCC-900 winds every DCC tape for a few seconds after you first load it, to read its table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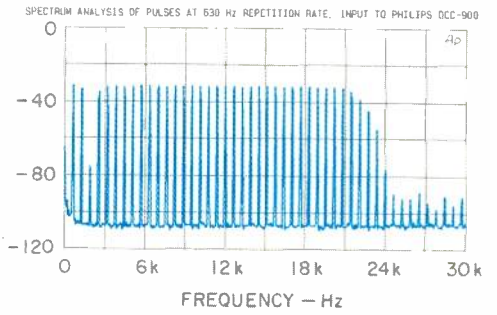
of contents. Mechanically, the Philips performed absolutely flawlessly, always arriving at the tracks that I designated. Erasing and reusing a cassette is a bit complicated, but once you learn the procedure (the unit won't start recording over existing material unless you press the "Append" button) it becomes almost routine. It is possible to add a start marker at any point on a DCC you record; if you do so, it's a good idea to press the "Renumber" button so that the readout of all track numbers will be in order. It would be nice if we could add our own text to the DCCs we record, but this feature is not available in the DCC format (it is available in MiniDisc). Still, when playing prerecorded DCCs I was impressed by the unit's excellent text display.

Since I last tested a DCC recorder, my collection of prerecorded DCCs has grown—to a total of *seven* albums! (In fact, there are well over 500 titles now available). This time I auditioned an excellent sampler featuring pianist, conductor, and arranger Peter Nero performing with the Fort Worth Symphony Pops under the direction of John Giordano. (As some of you may have guessed, this sampler was supplied by Tandy Corporation, which happens to be based in Fort Worth and is a major DCC supporter). I was particularly impressed by the clean bass and overall fine balance that I heard when playing back an arrangement of "New York, New York." Included in the sampler were several old Beatles favorites—such as "Hey Jude," "I Want To Hold Your Hand," and "Ob-La-Di, "Ob-La-Da"—all of which were reproduced by the DCC-900 with what can best be described as a shimmeringly bright and pleasing sound quality. For a demonstration of the sheer dynamic range of this medium, a good selection on this sampler was John Williams' *Superman* theme. For my classical music auditioning, I chose a PolyGram sampler, produced for and distributed by Marantz with their DCC machines. The Allegretto movement from the Shostakovich Fifth Symphony amply illustrated the unit's ability to reproduce well-recorded classical music with no audible degradation.

While I never professed to be much of a merchandising or marketing expert, my advice is, if you are considering the purchase of a top-quality DCC home deck, to check the various combinations of features offered by the Philips and Technics units. There is some difference in the prices, but there is very little difference in the measured test results, which are, in a word, superb. The Philips DCC-900 may be just what you're looking for. *Leonard Feldman*



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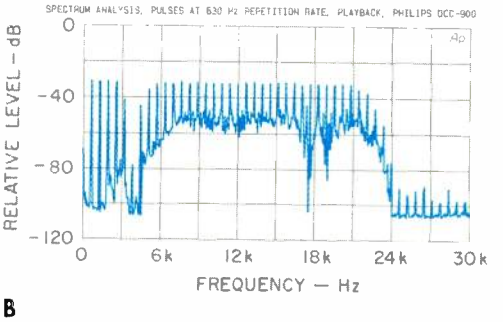

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Fig. 5—Spectrum of digital pulse signal (A) and same signal after PASC encoding and decoding (B).

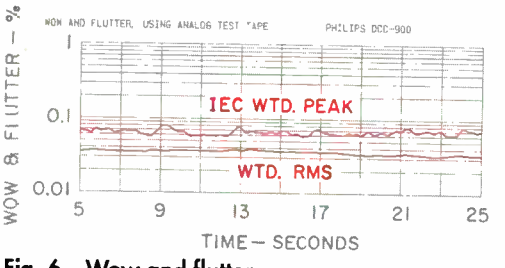

Fig. 6—Wow and flutter, analog playback.

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Thank you, Vittorio. We couldn't have said it better ourselves.

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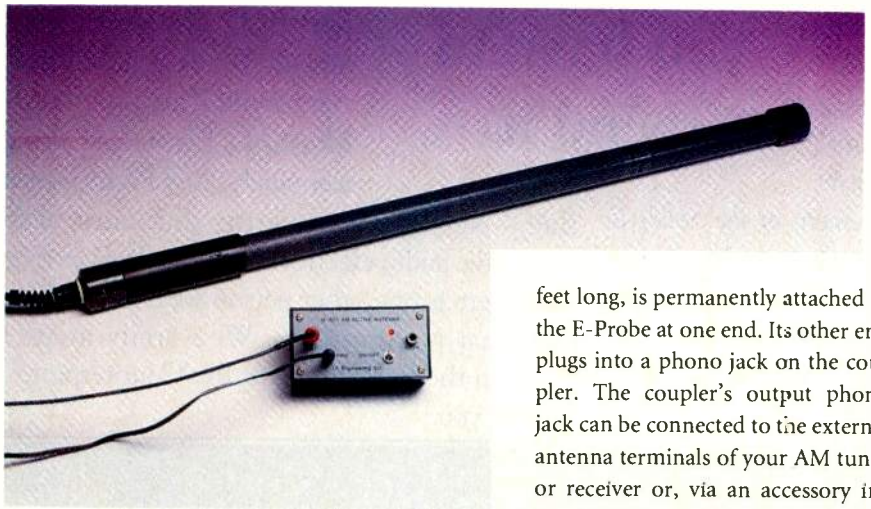
LF ENGINEERING M-601 AM ANTENNA



The M-601 is a fully sealed 26-inch-long active antenna designed for the AM broadcast band. Operating between 530 and 1,705 kHz, this high-impedance antenna contains a proprietary signal amplifier with 6 dB of voltage gain, plus a high-pass filter for reduction of lower frequency interference caused by light dimmers and power lines. According to LF Engineering, the M-601 is effective in fringe areas where a long-wire antenna of equal gain would pick up noise or would not be practical to erect.

The M-601 consists of the 26-inch E-Probe antenna and a small antenna coupler into which may be mounted a pair of 9-V batteries. Alternatively, the included a.c. adaptor can be plugged into the coupler for operation from the power line. The M-601 system consumes only 10 mA of current. A coaxial cable, 50 feet long, is permanently attached to the E-Probe at one end. Its other end plugs into a phono jack on the coupler. The coupler's output phono jack can be connected to the external antenna terminals of your AM tuner or receiver or, via an accessory inductive coupler, to the loopstick antenna of AM sets without such terminals. A stainless steel mounting clamp is included, so you can attach the E-Probe section to a mounting post to elevate it. The suggested retail price for the M-601 with E-Probe, coupler, and a.c. supply is $89; the accessory AC-600 inductive coupler is $15. Both prices are postpaid within North America.

Company Address: 17 Jeffry Rd., East Haven, Conn. 06513.
For literature, circle No. 93

LF Engineering claims that this is the first active outdoor antenna designed for AMAX radios. For those of you who haven't heard about AMAX, it is a new voluntary standard intended to improve the quality of AM radio. One of the first tuners to take full advantage of the AMAX standard is the Denon TU-680NAB (*Audio*, April). Having had an opportunity to test this remarkable tuner, it seemed appropriate to use it in combination with the M-601.

Rather than mount the M-601 on my roof, as recommended by its maker, I decided that a fairer comparison would result if I first logged the number of acceptable AM signals received with just the loop antenna supplied with the Denon tuner. Following that count, I would connect the M-601 to the tuner and see if there was a noticeable improvement in signal quality or an increase in the number of acceptably received signals. Fortunately, the TU-680NAB allows connecting an external AM antenna without having to disconnect its own loop antenna, making comparison tests extremely simple and reliable.

With only the loop antenna connected, I logged 29 signals across the AM broadcast band in my ground-level laboratory at midday. Of these, approximately a half dozen were plagued by relatively high levels of noise and interference. When I connected the M-601 and repeated the test, I received 31 signals, only two more than before. However, of the six or so that had been noise-ridden, only two still suffered from interference and noise. Furthermore, many of the signals that had failed to light up all of the tiny LEDs in the tuner's signal-strength display were now strong enough to illuminate the entire string of them. The manufacturer's claimed 23 dB of overall power gain for the M-601 system seems to be substantiated. Even the two new signals were clear enough and sufficiently noise-free to be enjoyed.

Repeating the tests at night (when AM reception generally extends for hundreds of miles), I logged only 28 usable signals without the M-601 (one of the signals that had come in clearly by day was now plagued by interference, presumably from a distant station not received during daylight hours). With the M-601, the number of usable signals increased to 33. I have no doubt that if I had taken the trouble to mount the M-601 outdoors at a somewhat higher elevation, I would have been able to pick up many more usable signals.

The LF Engineering M-601 AM broadcast antenna is a fitting addition to the Denon TU-680NAB or to any tuner or receiver whose owner wishes to explore the revitalized world of AM radio.

Leonard Feldman

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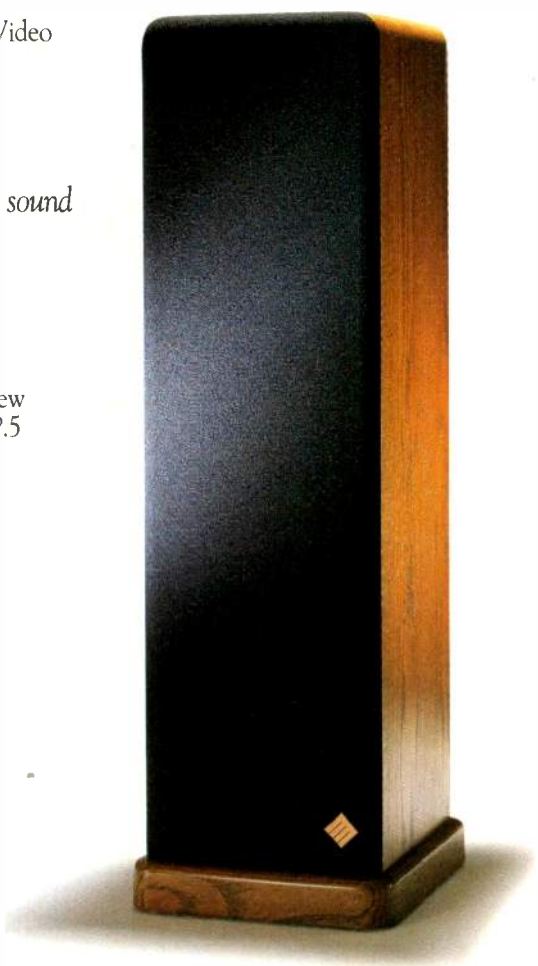

Pictured, the DIGITAL PHASE AP-1, one of five DIGITAL PHASE systems featuring the patented ACOUSTA-REED™ technology.

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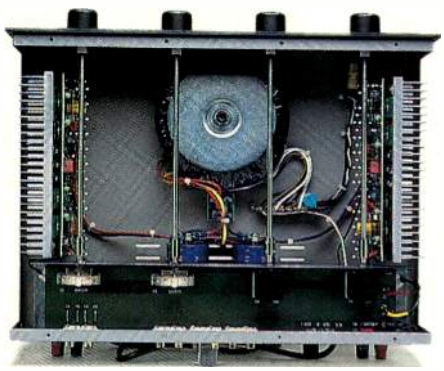

Many high-end "bargain" products promise more than they can deliver. In spite of advertising rhetoric, too often they offer marginal performance advantages over much cheaper mid-fi products. Small production runs and eccentric design add cost but may do nothing for sound quality.

Company Address: c/o Mondial, 2 Elm St., Ardsley, N.Y. 10502; (914) 693-8008.
For literature, circle No. 94

The Acurus DIA 100 Direct Input Amplifier is a very definite exception. For $995, it offers a high-quality passive line stage and a well-designed power amplifier. It delivers 100 watts per channel into 8-ohm loads, and 150 watts into 4-ohm loads, at no more than 0.09% THD from 20 Hz to 20 kHz.

The passive input section is a purist line stage, i.e., it has no active gain components or tone controls and has a minimal number of components in the signal path. Its input impedance of 10 kilohms makes it compatible with most signal sources and interconnects. Two matching high-quality switches, with silver-to-silver contacts, are used to select signals for listening and tape recording; they provide switching for four high-level inputs and two tape recorders. Two laser-trimmed precision potentiometers act as balance and volume controls. The switches and potentiometers are soldered to a high-quality, dual-sided, glass-epoxy circuit board, and construction and parts quality appeared to be excellent. The Acurus eschews the inclusion of a switch to disable the balance control, a minimalist feature that, rather than enhancing sound quality, may only discourage users from adjusting channel balance to achieve the best soundstage.

The amplifier section uses circuitry similar to that of the Acurus A250 power amplifier. The design philosophy in the power stage is to use 15 to 20 dB less feedback than many other amps do, and to individually optimize each gain stage to reduce the need for feedback. Acurus feels this produces a more tube-like sound. The output transistors are high-current bipolar transistors, and the DIA 100 has an unusually large power supply and toroidal power transformer for a unit in its price range.

The gain stages' sensitivity is 200 mV for full output, and the DIA 100 provides up to 43 dB of voltage gain. The high sensitivity allows the DIA 100 to deliver full output from its passive preamp section, even with low-output signal sources. I know of no CD player, tuner, or tape recorder that does not provide sufficient output, even with low-level recordings and signals, to drive the DIA 100 adequately.

In spite of this high gain, the DIA 100's signal-to-noise ratio is rated at 100 dB, A-weighted, and audible hum and other noise is very faint. Even demanding audiophiles are unlikely to have any problems with electrical noise or hum when listening to quiet passages. This is an important aspect of performance, given the annoying noise I have encountered with some other low-priced high-end equipment. Quite frankly, it is absurd to seek transparency in high-end electronics and then ruin it with noise.

By combining a passive preamp with an active amplifier stage, Acurus has avoided the impedance-mismatch problems that can affect some combinations of separate pas-

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sive preamps, power amps, and interconnect cables. Because the only connection between the preamp and amp sections of the DIA 100 is a short length of silver-plated, Teflon-dielectric coaxial cable, the amp section can be fed directly from the sliding contact of the volume control. Such a direct connection could present a problem with separate components if they were linked by a high-capacitance interconnect.

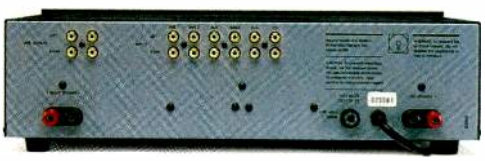
Similarly, interface problems can exist between some tape recorders and passive preamps, because these preamps lack active buffering stages to ensure suitable impedance matches. Acurus deals with this by isolating the tape outputs with resistors, and I encountered no problems with my DAT or analog cassette decks.

These design features result in a unit that has outstanding sound for the price. The DIA 100 delivers a very detailed and dynamic signal with a great deal of transparency. It performed very well in comparison to active preamp and amplifier combinations costing in excess of $1,500. It was dynamic and live without adding transistor hardness or any touch of glare in the upper midrange. That's not to say it produces a tube-like warmth of balance or rolled-off upper midrange and treble, but it is somewhat tube-like in its combination of musical life and musical detail.

The amp did an excellent job of handling sonic differences between high-quality D/A converters. Unlike most equipment in its price range, it was very revealing of differences between analog and digital signals. It also clearly revealed the benefits of the improved recording techniques used in the latest 20-bit CDs, and did a particularly good job with the kind of low-level musical detail that adds realism and interest to recorded music.

Soundstaging and imaging were very good, though the Acurus does not provide the kind of imaging, soundstage size, low-level hall detail, and layered depth you would expect from the most expensive units. At the same time, the Acurus does virtually everything well. The soundstage is large and open yet preserves a great deal of depth. Imaging is detailed without being etched or unnatural. The apparent listening position is just a bit forward, but the amp delivers what is on the recording and does very little to impose its own character on the hall and performance. I wish more units in this price range did half as well.

I must add some caveats to this praise, however. Those small trade-offs that have been made in the DIA 100 emphasize musicality over pure detail or information. The Acurus is not at all euphonic in the sense of making a "hard" CD player sound musical, but the designer is obviously into reproducing music rather than dissecting it, and thus the DIA 100 is more musical than analytic.



More important, although Acurus claims a damping factor in excess of 300, and very high power into low impedance, the DIA 100 does not do well into very demanding crossovers and low-impedance speaker loads. Bass and lower midrange detail and control are also speaker- and cable-dependent. This is not the ideal amp for driving those British and other small monitors that have extremely complex crossovers and demanding loads; the sound could harden a bit. It is also not the ideal amp for a low-impedance load like the Thiel CS-5s (bass became a bit warm and was lacking in control), and it will likely have problems with some ribbon speakers. At the same time, the DIA 100 had no problems with any of the audiophile speakers I tried whose impedance remained above 4 ohms, and it did well with the Quad 63s and Magnepan's Magneplanars. Further, many far more costly tube and transistor power amplifiers present the same interaction problems.

In short, the Acurus DIA 100 is an excellent introduction to the high end. With a little attention to speaker compatibility, you get the kind of sound quality for about $1,000 that normally costs at least 50% more. You also get an amp that delivers long-term musical pleasure. At a time when the high end sometimes seems hell-bent on pricing itself out of reach, or trying to sell eccentricity rather than music, the Acurus DIA 100 is the kind of unit that merits solid recommendation as a best buy.

Anthony H. Cordesman

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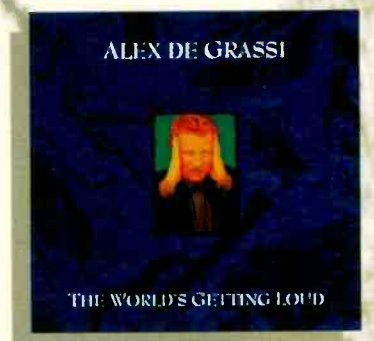

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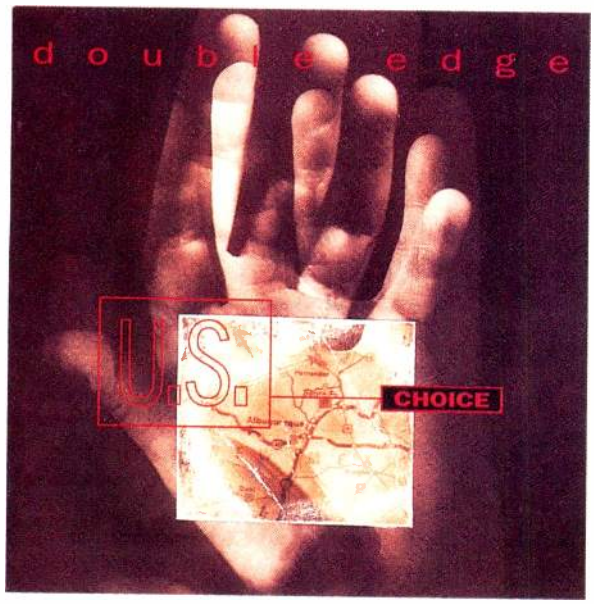

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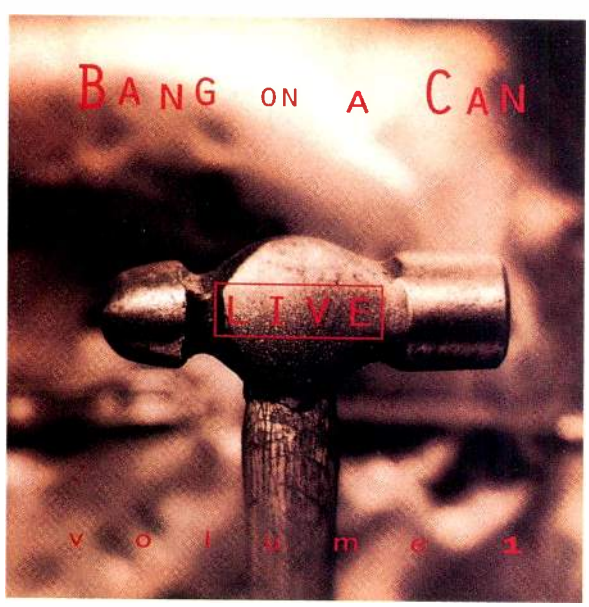
U.S. Choice
Double Edge
COMPOSERS RECORDINGS, INC.
CD 637, CD; DDD; 69:55

Bang on a Can LIVE, Vol. 1
Various
COMPOSERS RECORDINGS, INC.
CD 628, CD; DDD; 78:00

Previously staid contemporary classical label Composers Recordings, Inc. (CRI) has experienced a rebirth under its new young managing director, Joseph R. Dalton. At the center of the new image is the Emergency Music series, which thus far totals nine discs devoted to provocative young emerging artists in the New Music world. The accent is on works that communicate directly with today's audience members who may not have the benefit of academic/international-serial-style sheepskins.



U.S. Choice, by Double Edge, will be one of the most accessible of the series to the average music listener. The piano duo's members, Edmund Niemann and Nurit Tilles, are known for their work with leading minimalist Steve Reich. Music for two pianos by Meredith Monk, Duke Ellington, Paul Bowles, David Borden, and five others make up the nine-track recital. The pianists credit another pioneering piano duo, Gold & Fizdale, as showing the way by commissioning new pieces from composers of their day. Thus, John Cage, Kevin Volans, and "Blue" Gene Tyranny have all written for Double Edge.

In spite of the focus on minimalists, there is much variety on this disc. Paul Bowles is the earliest composer here—the duo considers his "jump-cut" technique, used in "Night Waltz," makes him the John Zorn of his day. The Ellington/Strayhorn "Tonk" brings the jazz world into that of New Music. Tyranny's "The De-Certified Highway of Dreams" also partakes of jazz and blues. Meredith Monk turns from her usual unaccompanied avant-garde vocal creations to a pair of lovely Satie-style pieces for two pianos, "Ellis Island" and "Phantom Waltz." One aggressively minimal yet somehow compelling piece that might drive those new to New Music nuts is David Borden's lengthy "Double Portrait."

Also of interest in the CRI Emergency Music series is *Bang on a Can LIVE, Volume 1.* This audacious little New Music festival has invigorated the New York scene for six years now. Most of its composers expand minimalism to include dissonance, but the structural basis for many is simple pitches built on rhythm, not harmony. Some works derive from the performance-piece milieu, such as Tom Johnson's often hilarious "Failing: A Very Difficult Piece for String Bass." Bassist Robert Black explains to the audience that this work requires him to address them while playing the solo string bass. The music is often extremely difficult, and portions of both it and his commentary must at some point be improvised; the title says it all. Evan Ziporyn's "LUV Time" on the same CD mixes minimalism, jazz, and gamelan music in a heady stew.

John Sunier

Haydn: Symphonies "Le Matin," "Le Midi," and "Le Soir" (Nos. 6, 7, and 8)
Lausanne Chamber Orchestra, Jesús Lopez-Cobos
DENON 81757 9612-2, CD; 57:07

Alert record collectors should do a real double take on this one—look at the numbers! The very first such works Haydn composed for the Esterházy family, for whom he worked as head musician during the next quarter century before breaking loose into international fame. Altogether, there are over a hundred symphonies in this series. And until not too long ago, nobody in the general music world knew anything about the "early works"—those dozens and dozens stretching back from the 80s and 90s.

Except for one, No. 45, the "Farewell," which was mainly played for its amusing ploy: The musicians departing one by one, each with his candle, in the final movement until only a single violin (presumably Haydn himself) is left. It was, in fact, a kind of union protest against a season that had run much too long—a demonstration, if you will. But what a superb demonstration! When I discovered an early recording of this No. 45 while in college, it dawned on me that *all those other works* must have the same qualities. But who ever heard them?

Then, as a sort of sequel, I found these three little jobs from the very beginning. I was smitten. They are small, simple in style, but benignly polished to perfection. All of them are full of solos, for each of Haydn's new employees (some 13 at that point), to show them, quite literally, that he cared. He was only 29, but as you listen you can almost feel the warmth of interest each of those pros took in the special bit reserved for him alone! A masterpiece of managerial tact, a triple masterpiece of music-making on an intimate scale, and the whole really charming to hear, ideal for the recording mikes.

Although these three little jobs are simple in style, they are benignly polished to perfection.

The Swiss musicians are excellent, the international conductor very understanding (considering all the other stuff he does, worldwide), and the sound is absolutely superb. Fine example of Denon's longtime excursions into Western-type music.

Edward Tatnall Canby

Mendelssohn, Brahms, and Debussy: Various Works
Stockholm Guitar Quartet
OPUS 3 CD 9001

In their third album for Opus 3, the acoustic-purist Swedish label, the Stockholm Guitar Quartet turns to Peder Riis' transcriptions of composers whose works

are not normally heard on even a single guitar. The rich sound is due to the use of four differently constructed and tuned guitars covering the soprano, alto, tenor, and bass ranges. This also helps the listener in the already nearly holographic imaging of the four guitarists.

The emphasis is on Romantic-era character pieces, such as selections from Mendelssohn's "Songs Without Words" and Four Movements for String Quartet, Op. 81. Five Brahms piano pieces combine tenderness with passion. Debussy's seven short pieces originally drew a panoply of poetic imagery out of the solo piano's strings, but now successfuly substitute the 24 strings of the guitar quartet.

John Sunier

Brahms: Haydn Variations; Reger: Mozart Variations; Ives/Schuman: Variations on America
New York Philharmonic, Kurt Masur
TELDEC 9031-74007-2, CD; 55:50

Our brave Philharmonic in the Big Apple is like no other major orchestra. Wherever its players may come from, they become in a trice typical New Yorkers—tough, combative, moody, able to harass an unloved conductor without mercy, outrageously sloppy when the music bores them (you can hear!). Yet, they can be soft, infinitely sentimental, moist-eyed, and wholly artistic when things go *right*. They can rise to the highest, if they want to.

Their latest conductor, Kurt Masur, I think has them somewhat confused, still, after a year and more. Working from Leipzig, where Bach and all the central German composers congregated for centuries, Masur is curiously rigid at times; a Robert Schumann recording had me shocked with its dogmatic cold beat. But Masur, too, has the power to rise.

This disc is a very superficial connotation of Variations, good for cover title but otherwise rather hideously contrasted. The belle of this ball is the Brahms Haydn Variations—but somehow not the beginning. It said to me, do we *have* to play this chestnut once again? But all of a sudden,

something happens and the music takes off. For my ear it was at Variation V, a scherzo-like *vivace* that flew like the wind; other ears may find differently. The rest is all clover—accurate, lean, expressive, Toscanini-like. Crazy Philharmonic!

The cover order is different. The CD begins with the very youthful Charles Ives and "America," our alternative and singable national anthem. I used to think of it, when small, as "My Country *Tisofthee.*" Ives was 17; the music was for organ. But this is very much Ives already, corny as all get-out, then suddenly screeching dissonances, playful if you ask me. William Schuman has made a vast, pompous orchestration, which is fitting if you think so. (Ives could have made a lot of noise on his sedate church organ, before a flabbergasted congregation.) Ives surely had the devil in him, whatever else.

As for Reger—well, Reger. Is this high-German composer and once-God ever less than outrageously longwinded? Worse—heavy, stuffy, ultra-thick—with the inevitable fugue to end all fugues. Poor little Mozart, and that tiny little tune that everybody knows. A chocolate candy buried under a landfill.

The Teldec recording in Avery Fisher Hall is labelled "live." This is increasingly becoming the preferred way to go, it would seem. Three dates are given—obviously three complete performances, edited seamlessly into one—and not a clap or a cough from any audience member. It is a good technique, if always risky.

Edward Tatnall Canby

Mahler: Symphonies No. 1, "Titan," and No. 2, "Resurrection"
New York Philharmonic, Leonard Bernstein (in No. 1); Janet Baker, mezzo-soprano; Sheila Armstrong, soprano; Edinburgh Festival Orchestra; London Symphony Orchestra, Bernstein (in No. 2)
SONY CLASSICAL SM2K 47573, two CDs; ADD; 2:22:20

This is No. 45 of the 100-volume Royal Edition reissue series of Leonard Bernstein recordings for CBS from the '50s through the '70s. The royalty involved is Prince Charles, whose watercolors adorn each album's booklet. The massive collection, primarily featuring the New York Philharmonic, is being issued gradually, mostly alphabetically by composer. It provides a new look at (and audition of) Bernstein's always exciting interpretations.

These two works are a good introduction to the wonders of Mahler. The all-instrumental No. 1 is a natural step from Beethoven and Bruckner symphonies, and No. 2 is one of the most heavenly works in the repertory for voices and orchestra.

All the original tapes have been remastered using the same 20-bit Super Bit Mapping technology as on the premium-price gold Mastersound pop and jazz series. The increased resolution, depth, and even ambience are immediately apparent. An especially welcome improvement is heard during the tremendous orchestral climaxes common in Mahler: No longer do the sonics turn congested and muddy. Other CDs I have sampled in the Royal Edition series, and the similarly reissued Glenn Gould Edition, live up to the same high standards.

John Sunier

Messe de Tournai
(The Tournai Mass)
Ensemble Organum, Marcel Pérès
HARMONIA MUNDI HMC 901353, CD; 53:13

Here is another example of early "Western" music from a remarkably innovative series.

Since the advent of the CD, the French-based label Harmonia Mundi (Harmony of the World) has energetically produced a remarkably innovative series of recordings that combine advanced research into the earliest period of "Western" musical culture with superbly musical performances that, consequently, convey new meaning to listeners. This recording provides a case in point. If you understand that this is a long and rigorous sonic Mass, not only the standard five sections of the more familiar Mass music but with a wealth of "inserts" of special import, the sound is remarkably varied and interesting, indeed a kind of survey of numerous aspects of a burgeoning musical art right at its very beginning back in the 1300s.

This earliest written-down Mass, somewhat before that by Machaut, the first by a single composer, is made up of many separate and often quite different segments clearly from different sources. The whole is interspersed with the single-melody Gregorian chant in its later and florid manner, and the words are spread out and highly ornamented. Even here, in the spirit of the whole, these seven male singers show interesting differences in interpretation of the Gregorian music (there being, of course, no direct evidence, only the inferences of the visible notation).

Most listeners will, however, find the "polyphonic" music the most notable, composed and performed in three melodic lines, not just one. The sound is astonishingly dissonant—that is, as we hear it. Any audio expert will understand that the harsh fifths, fourths, and octaves are actually the most mathematically "consonant" intervals in the overtone series! Of course they came first, and the softer (for us) thirds and sixths, basis for later music, are in plain fact more dissonant, physically speaking. Not for the 1300s. Those sounds are very sparingly used, if at all, and surely sounded then as radical as 20th-century dissonance sounded to us in the early part of our own century.

The recording is totally appropriate, inside an ancient abbey, all stone, with a die-away of many long seconds. You will likely note immediately how well designed this music is for precisely that situation, where it was first heard well over six centuries ago.

Edward Tatnall Canby

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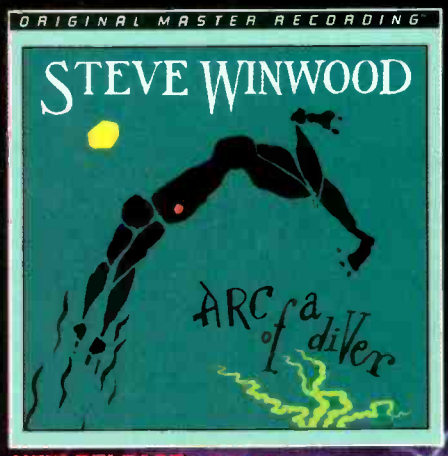

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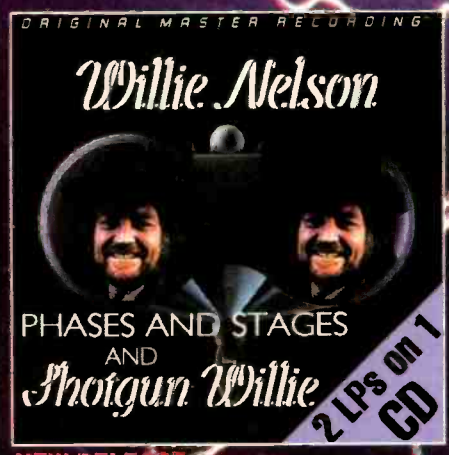

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ROCK ~ POP RECORDINGS

ACROSS THE BORDERLINE

WILLIE NELSON

Photograph: ©Ken Settle

Across the Borderline
Willie Nelson
COLUMBIA CK 52752,
CD; 60:07
Sound: A, Performance: A

Loss is a theme that permeates Willie Nelson's *Across the Borderline*. Appropriately, this release is his first since his settlement with the I.R.S., and that traumatic confrontation surely was a big contributor to the angst that also leaves its mark throughout the set. *Borderline* predominantly consists of Willie performing other people's material, with help from some star-studded guest appearances, underscoring a second theme of friendship and camaraderie when the chips are down.

Borderline begins with Paul Simon's "American Tune." Built on a sparse arrangement that pairs Willie and Paul's guitars—with support from organ, pedal steel, and harmonium—the performance is riveting, as it captures the battering that comes with life. T. S. Bruton's "Getting Over You" gets a brilliant treatment via a duet with Bonnie Raitt. Another duet matches Willie with Sinéad O'Connor on Peter Gabriel's aching "Don't Give Up." It is a superb and adventurous arrangement, featuring Mark Isham's trumpet during the coda. "Heartland," cowritten and sung with Bob Dylan, is about the failure of the American Dream, a theme further developed in the Ry Cooder/John Hiatt/Jim Dickinson-penned title cut and Paul Simon's redemption-after-rejection song "Graceland." Pairing Simon's band with Paul Franklin's pedal steel and Mark O'Connor's fiddle gives the latter song a country sendup that is surprisingly effective.

The second half of *Borderline* is more personal but no less sentimental when it comes to the album's main theme—witness Lyle Lovett's "Farther Down the Line," about an unlucky young cowboy, and "If I Were the Man That You Wanted," about doomed love. A counterpoint of acceptance to all this desolation is provided by Willie Dixon's "I Live the Life I Love," which features Mose Allison's piano and the rhythm section of Milt Hinton and Marvin "Smitty" Smith. Willie closes the album with three of his own songs. "Valentine" is a new love song so nice it's almost out of place. "She's Not for You," from 1962, is played with a hint of danger. The finale, "Still Is Still Moving to Me," serves as something of a credo.

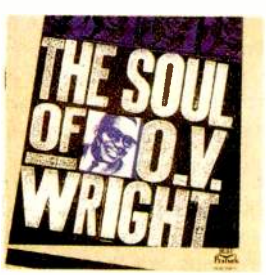
Producer Don Was plays an essential role, acting as a catalyst to help the artist realize his intentions. Thus, Willie has never sounded more assured, comfortable, and authoritative. *Borderline* brims with his confidence and undoubtedly breaks new ground for him. He's primarily an interpreter here, and interpretation, at its best, requires the artist to bring life experience to a song. Willie certainly has reams of them. The irony is that in singing the songs of others, artists sometimes reveal the most about themselves.

Michael Tearson

Frank Black
Frank Black
4AD/ELEKTRA 9 61467-2

Frank Black's former self was Black Francis of The Pixies, the roly-poly guy who screamed indecipherable non sequiturs in English and Spanish over guitar chaos and occasional pop-ish melodicism. And yes, the weird, wacky stuff continues. Frank Black Francis (whatever his name is) has restyled his appearance in a way that makes him look like a cross between John Wayne Gacy and a fetish-video participant. Musically, Black remains enigmatic and unpredictable, not unlike his prose. Consider: "Beyond below above/A gravity slumbers/At the center of/Places named after numbers." What are we talking about here? UFOs? Kinky sex? The tunes range from a horn-embellished instrumental ("Tossed"), Pixies-like surf/punk/garage, and a Giorgio Moroder-esque cover of The Beach Boys' "Hang On to Your Ego" to some things better left undescribed.

Mike Bieber



The Soul of O. V. Wright
O. V. Wright
MCA DUKE/PEACOCK MCAD-10670

"A Nickel and a Nail" is one of the finest soul records ever issued. The song never brought O. V. Wright national success, but it did guarantee him a place in soul history. Recorded with the same Memphis musicians who would later back Al Green, "A Nickel and a Nail" is at once riveting in its emotional intensity and sensual in its throbbing rhythms. Ray Charles merged gospel and R&B to create soul. Yet deep soul singers like Wright and James Carr gave the church the upper hand in their work.

Wright remains little known outside of soul circles, despite acknowledgment of his songs by such peers as Otis Redding ("That's How Strong My Love Is") and covers by fans such as Robert Cray ("Gonna Forget About You").

The Soul of O. V. Wright is an overdue compilation of his best sides. Wright's soaring vocals can be breathtaking. His band, the Hi Records rhythm section, is a recognized touchstone for studio soul groups. A must-have for soul fans.

Roy Greenberg

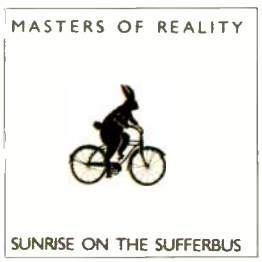
The Great Deceiver: Live 1973–1974
King Crimson
DISCIPLINE CAROL 1597-2

You'd expect four CDs, averaging 75 minutes each, to provide a wide-angle shot of a band, but actually this set offers a rather telescoped view of guitarist Robert Fripp, violinist David Cross, bassist/vocalist John Wetton, and drummer Bill Bruford. The stage life of this King Crimson lineup was almost 1½ years, yet these recordings cover only the latter eight months. And though there are multiple versions of some songs, the takes are rarely more than two months apart—and in a couple of cases, only days apart. Most revealing are the four versions of "Easy Money," where guitar and arrangement grow increasingly eccentric. Hammering home the band's fondness for experimentation are 14 improvs—a few unremarkable, many fascinating. Other attractions include excellent sound and packaging, the previously unreleased song "Doctor Diamond," and two unedited recordings of the band trying its legs on "Starless," complete with Fripp's occasional inability to follow Bruford's abandon. (Caroline Records, 114 West 26th St., New York, N.Y. 10001.)

Ken Richardson

Push
Gruntruck
ROADRUNNER RRD 9130

Summer-of-love psychedelia (see body-painted cover girl) meets the wall of grunge on Seattle-based Gruntruck's second release. *Push* is an intense experience of throbbing distortion, mantric guitar lines, and yowling Joe Cocker-style singing of semi-cognitive lyrics suggesting politically correct sentiments for hip collegians. This is the earthier side of the noise-pop syndrome: Urgent, elemental, the compelling voice of youth trapped pogo-ing between isolated despair and hope for a cleaner, greener world—aware, but not really activist. Dig out your blacklight and confront the end of the century. *Michael Wright*



Sunrise on the Sufferbus
Masters of Reality
CHRYSALIS 3 21976-2

Many musicians dream of sitting in with Cream, but few actually have the experience of playing in a power trio with *the* Ginger Baker. Chris Goss and Googe, respectively guitarist/vocalist and bassist in

Masters of Reality, have realized this aspiration (note the irony of the band's name). Upholding the spirit of the Bruce/Baker/Clapton combo, the band shows experimental and compositional virtues that definitely hark back to another age. The grooves on "T.U.S.A." and "J.B. Witchdance" are infectious, with Baker's drumming at its best. Pop-song snippets between the actual songs are distracting, yet this is a minor problem. Overall, *Sunrise on the Sufferbus* is an impressive second effort.

Jon & Sally Tiven

Wandering Spirit
Mick Jagger
ATLANTIC 7 82436-2

There is simply no way to overstate the triumph of Mick Jagger's third solo album. One play of the first four tracks, all Jagger originals, is enough to leave you breathless, as Mick charges through hard rock ("Wired All Night"), funk ("Sweet Thing"), gospel ("Out of Focus"), and tough balladry ("Don't Tear Me Up") with the voice, melody, and natural confidence

of decades past. What's more, lyrics have a new subtlety, a finesse so long dormant it was easy to forget this is the same man who wrote "Moonlight Mile" and "Memory Motel." In fact, *Wandering Spirit* might just be the best Rolling Stones album since *Exile on Main St.* That it was made by this particular Stone alone makes it all the more important—and exciting. *Ken Richardson*

FAST TRACKS

Earth and Sun and Moon: *Midnight Oil* (Columbia CK 53793). The Oils return with more "soapbox" rock and one of their best records yet, perhaps attributable to their renewed association with producer Nick Launay. Less pop and more guitar-driven intensity. **M.B.**

The Spin: *Fernando Saunders* (A&M 31454 0054 2). This bassist's big-time solo debut is a nice fusion of pop, R&B, and jazz, no doubt the result of playing with everyone from Motown artists and Lou Reed to The Mahavishnu Orchestra. **M.B.**

The Wheel: *Rosanne Cash* (Columbia CK 52729). Recorded in Rosanne's new hometown of New York, *The Wheel* is superbly executed—brighter in tone and texture than its predecessor and with a real thread of hope running through it. **M.B.**

Mercury: *American Music Club* (Reprise 9 45226-2). This San Francisco band doesn't exactly leave you with indelible melodies. Still, their songs are the kind that when you're hearing 'em, you can't help but be hypnotized. **M.B.**

People Get Ready—A Tribute to Curtis Mayfield: *Various Artists* (Shanachie 9004). An excellent and moving all-star tribute featuring Don Covay, Delbert McClinton, Steve Cropper, David Sanborn, and a host of others. **M.B.**

Phobia: *The Kinks* (Columbia CK 48724). And you thought *you* had problems? The brothers Davies unload their baggage on you—the listener—in an amusing way, not forsaking some pretty rousing songs in the process. **M.B.**

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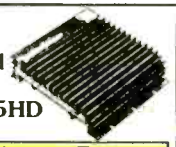

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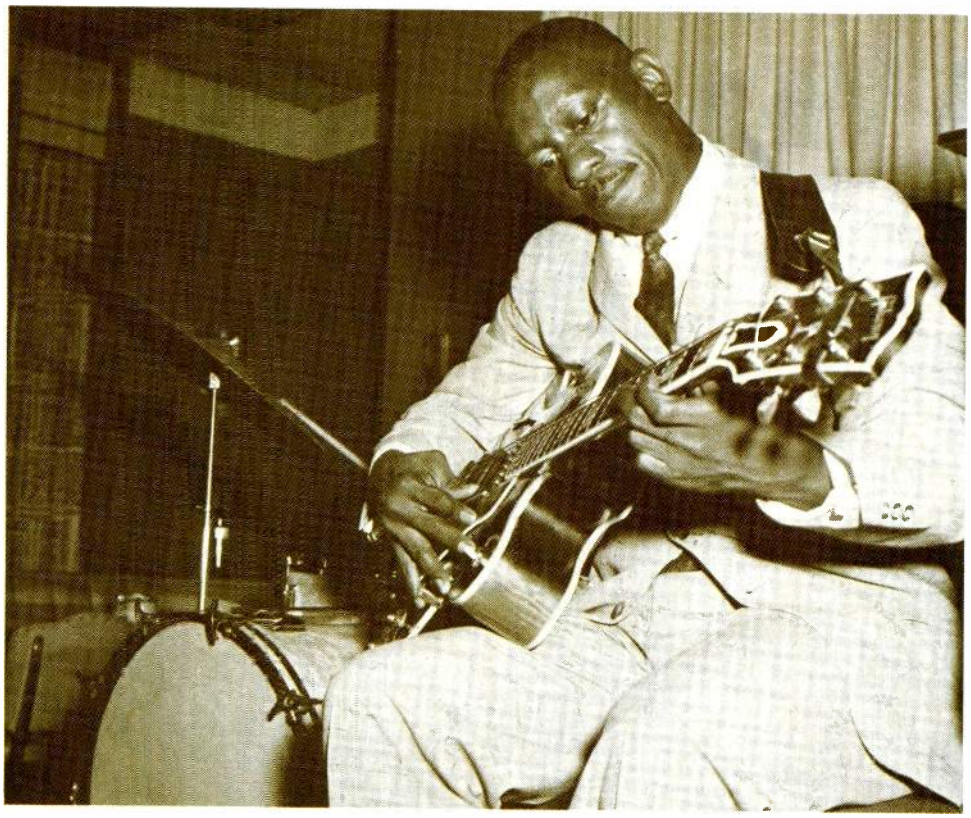

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The Complete Riverside Recordings
Wes Montgomery
RIVERSIDE 12RCD-4408-2,
12 CDs; 14 hours
Sound: A–, Performance: A

On the heels of the Sonny Rollins and John Coltrane box sets arrives this compendium of Wes Montgomery's abundant output. Producer Orrin Keepnews was made aware of the Indianapolis guitarist by Cannonball Adderley and subsequently fell in love with Montgomery's chordal and octave configurations. As history continues to prove, Montgomery's style turned out to be the freshest approach to jazz guitar since Charlie Christian's.

The sound that so tremendously influenced guitarists from George Benson to Emily Remler (and everyone in between) is immediately identifiable, and a huge chunk of Montgomery's prime inventory is captured on *The Complete Riverside Recordings.* Included are 25 sessions, all produced by Keepnews, which date from October 1959 to November 1963. As in previous box-set compilations where Keepnews has produced both original and reissue, the breadth and scope of this project is overpowering. Special to this set is the inclusion of a greater number of alternate takes. Keepnews has often said that Bill Evans, Rollins, and Montgomery represent some of jazz's best but more insecure players: They always wanted to get it right. The casual listener may, but should not, think of these alternate takes as repetitive, because there are ever-present nuances and subtle changes in arrangement.

In the end, *The Complete Riverside Recordings* offers an insightful look at a preeminent jazz guitarist in his prime. Toward the latter stages of Montgomery's career, another producer, Creed Taylor, increased the guitarist's visibility by having him record Beatles tunes and other pop numbers, many overproduced with what can only be described as a tasteless use of strings. Under Keepnews, Montgomery was recorded with organ trios, standard quartet and quintet settings, an octet, and a big band with, by contrast, an intelligent use of strings. He was surrounded by many of his peers, as well as brothers Buddy and Monk. It's nearly impossible not to sense the immensity of these recordings and Wes Montgomery's contribution to jazz. *Jon W. Poses*

Rocks the House
Etta James
MCA CHD-9184

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its infancy. Yet that year, Chicago's Chess Records travelled to The New Era Club in Nashville to record Etta James with her small band. Against the odds, Chess caught magic for eternity.

Etta James on stage was an explosive mixture of sensuality and talent—and she knew it. Although a veteran performer at 25, she boasted the boundless energy of youth. When she sings "Believe I'd fly if I only could" in an adrenaline frenzy, no one doubts that she's already taken off. Both her gospel-inflected singing and sexual swagger provided a needed role model for a generation of women who refused to cry in their beer.

"All I Could Do Is Cry," one of three tracks added for the CD, is reason enough to replace the original vinyl release.

Roy Greenberg

FAST TRACKS

Tokyo Live: *Tony Williams* (Blue Note CDP 7 99031 2). This live two-disc set may be the final assemblage of Williams' incredible mid-'80s to early '90s quintet. It draws from the unit's rich past and stands as a strong summary/tribute. **J.W.P.**

I'm a Mad Man: *Blyther Smith* (Bullseye Blues BB 9527). A straight-ahead blues effort from a no-punches-pulled guitarist. Smith isn't a great vocalist by any stretch, but this full-bodied, instrumentally thorough date (including The Memphis Horns) is pretty good. **J.W.P.**

Aminah's Dream: *Stephen Scott* (Verve 314 517 996-2). Pianist Scott, a member of Bobby Watson's Horizon, delivers a fine follow-up to his 1992 release. Mostly in trio with Ron Carter and Elvin Jones, Scott smokes colorfully in some nicely orchestrated septet embellishments. **J.W.P.**

Dial & Oatts Play Cole Porter: *Garry Dial and Dick Oatts* (dmp DMP-495). Pianist Dial and saxophonist Oatts, working with bassist Jay Anderson and drummer Jeff Hirshfield, flex their modernistic improvisational skills as they interpret 11 Cole Porter songs (many of them lesser known). Highly recommended. **J.W.P.**

Reverse the Charges: *Etta Jones* (Muse MCD 5474). This is a swinging, pan-generational effort led by vocalist Jones and buoyed by saxophonist/partner Houston Person. The respectful rhythm section of Benny Green, Christian McBride, and Winard Harper sensitively strengthens each track. **J.W.P.**

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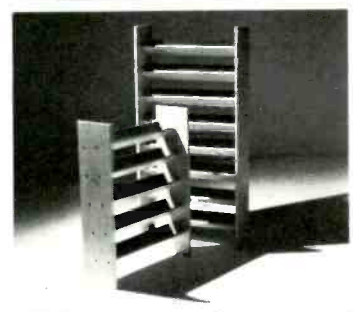

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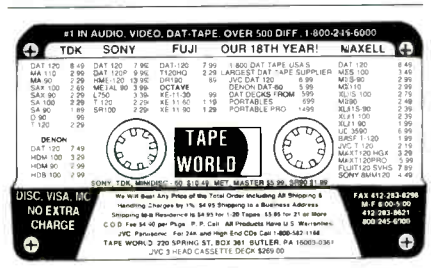

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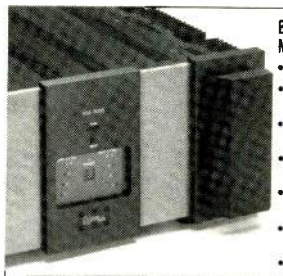

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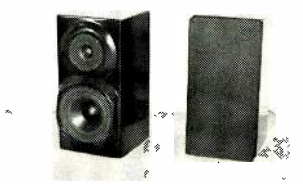

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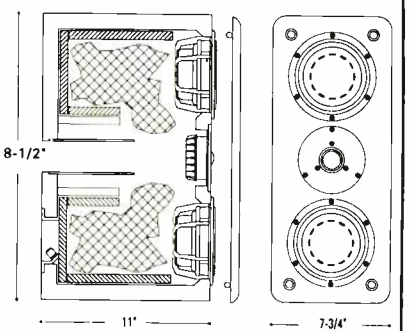

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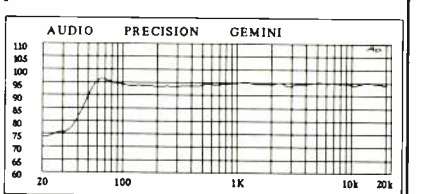

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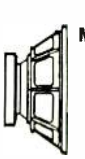

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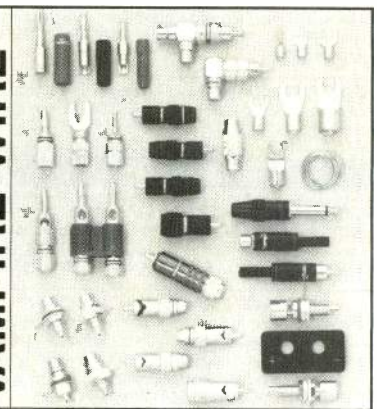

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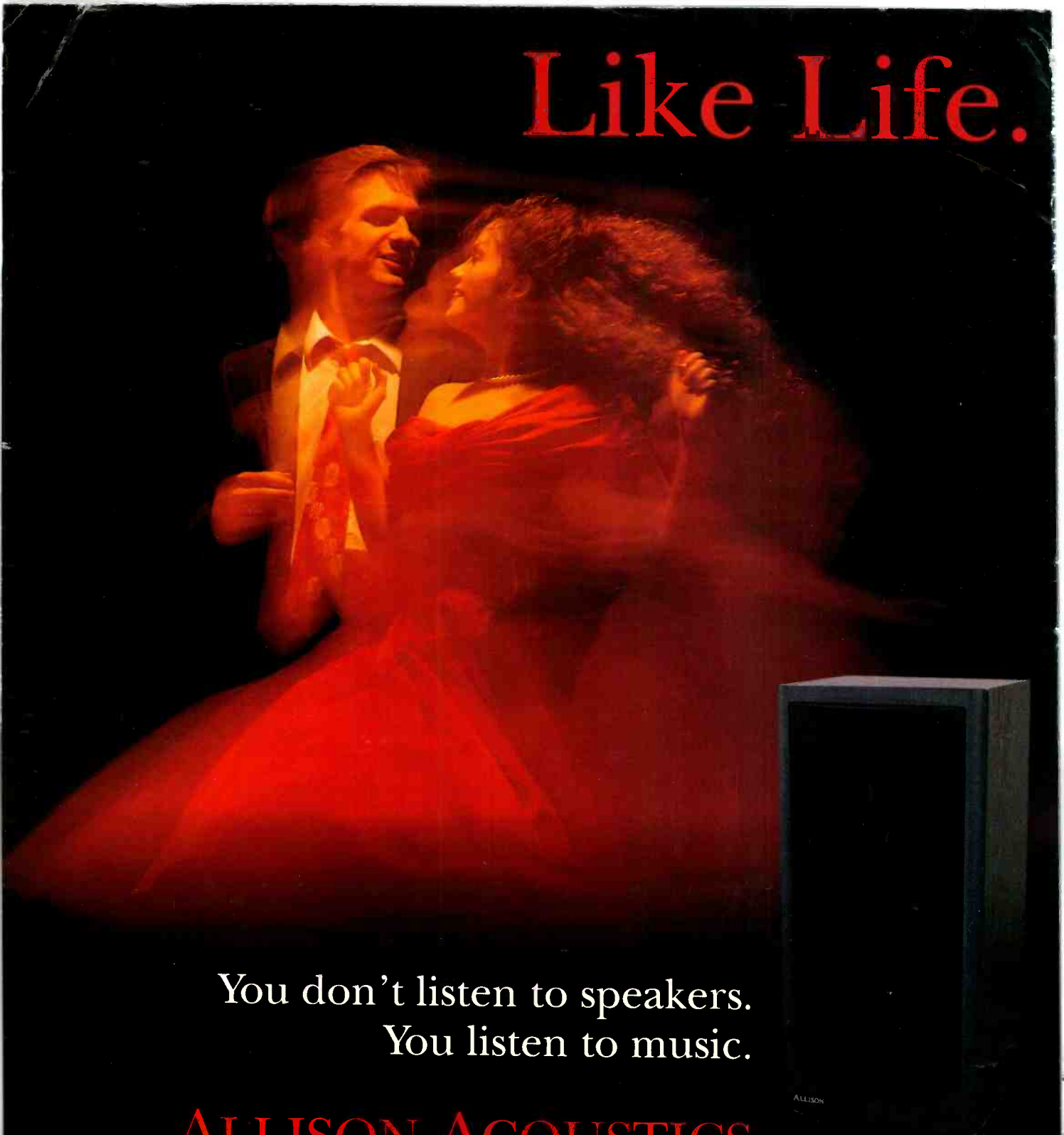

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