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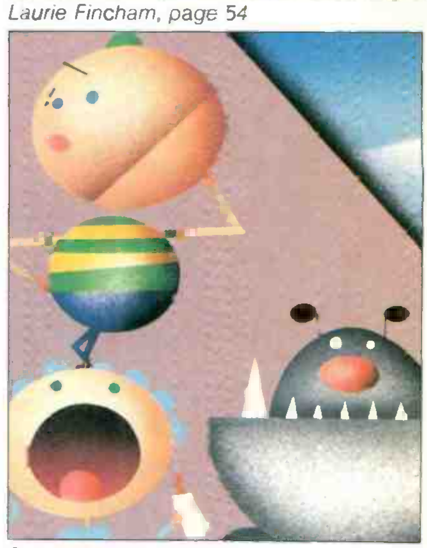
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MPA

The Audit Bureau

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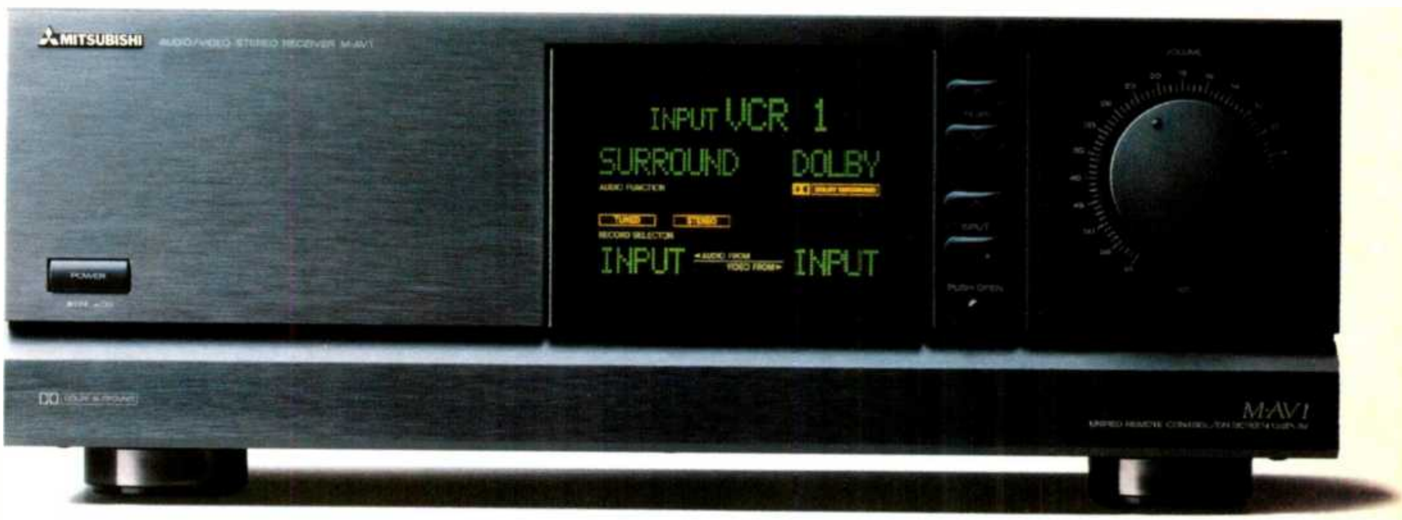

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SIGNALS & NOISE

A Signal Leak

Dear Editor:

I read "Too Many Signal Sources" (June 1989) by Herman Burstein with great interest (who woulda thunk of using a three-head deck and switchbox as a reverb unit?) but was disheartened to see no comment about signal leakage in the units.

I use the Radio Shack model to hook up two cassette decks and a VHS Hi-Fi VCR to my preamp. I've found myself in the situation of recording a program on the VCR while also recording an LP or CD onto cassette. The switches on the Radio Shack controller are set such that I'm monitoring the cassette deck, and the cassette deck is getting its input from the preamp. The sad truth is that I can hear the sound from the VCR—at very low volume, but still quite clearly—during the quiet passages in the audio program. *Arrgggh!* This happens no matter what switch settings I use.

I have been thinking of investing in a higher priced switchbox, in hopes that this leakage (crosstalk?) would be cured. When I saw Mr. Burstein's article, I hoped for some guidance, but no such luck. Any further comments on this subject?

Lonnie Brownell
El Segundo, Cal.

Author's Reply: I do not believe that all the tape control units listed in my article can be all things to all people. For example, there is the problem of hum when dealing with low-level sources such as phono, and I mentioned this in the article. I did not investigate the problem of leakage and was not aware that this was a problem because my interest was in operating one signal source at a time.

My experience is limited to the Radio Shack and Russound units. These are made for a specific purpose where leakage does not enter the picture. For my needs, operating only one signal source at a time, they work admirably.

Perhaps leakage varies from one brand to another. If you could purchase several brands on a money-back trial basis, you might discover that some have sufficiently low leakage. I am not in a position to investigate further, however, or to suggest modifications.—*Herman Burstein*

Getting the Picture

Dear Editor:

I would like to comment on two items in your September 1989 issue. First, James Gillette's letter in the "Audioclinic" column contained an error. The diameter of a human hair is roughly 40 to 60 microns—not 5 microns, as stated. (Check it out with a micrometer caliper, remembering that 1/1000 of an inch equals 25.4 microns.)

Second, Bert Whyte's "Too Hot to Handle," in the "Behind the Scenes" column, was excellent. In questioning some of the myths about HDTV, Whyte said much that needed saying. In fact, few people have ever seen a *really good*, full-bandwidth, 525-line TV picture. It is a revelation. Unless people want to view their TV screens through a magnifying glass, 525 lines can serve for a long time to come.

However, what is *still* needed is adequate bandwidth for roughly 660 "lines" (330 line pairs) of resolution along the scanning lines and a correspondingly higher color subcarrier frequency. A finer dot structure might also be required for picture tubes. But retaining the present raster specs would make it easier to design an NTSC-compatible receiver that could also display improved transmissions.

Charles H. Chandler
Malden, Mass.

What Price Records?

Dear Editor:

In reference to the letter from J. Michael Gatien, Esq. (June 1989), I'd like to say that Mr. Gatien is essentially correct in what he says about record club pricing versus record store pricing, but he doesn't give the full story.

Recording artists do subsidize sales through record clubs in the form of a reduced royalty rate—50% of the rate paid on sales made through the regular (record store) channels and nothing on sale and giveaway items (especially the introductory offer!). Despite this, the actual price you will pay per album through a record club is not all that different from what you'll pay at the chain record store, once you factor in the "mailing and handling fee" they hit you with, plus the 25 cents each time you send back the refusal form. Consider that you pay full list price for your first selection, plus $2 or $3 for ship-

Independent record stores may offer the most for your music dollar, including personal service and maybe even a stock of LPs.

ping and handling. That's quite a bit more than the highest priced mall store will charge! "Bonus" selections, when included, will bring the price you pay down into the "sale price" range you'll find in stores.

While prices from the two sources are now roughly comparable, that does not mean either vendor offers a good deal. For the most part, the chains no longer pay any attention to the list price suggested by some record labels (not all labels suggest a retail price) but charge whatever they think the market will bear. Often, this is actually 50 cents to $1 *above* the suggested list price. In fact, the regular price at most chains represents a markup of almost 70%! The record label generally gets about half of what you pay on a non-sale title at your typical chain store, so you can't really blame the labels for the inflated prices. (Remember that the middleman, the distributor, also gets a small cut on each sale.) These stores have only two reasons for charging as much as they do—huge overhead expenses (fancy chromed-up stores in high-rent malls, large headquarters with large staffs and large salaries) and greed (it doesn't take long to get addicted to the tremendous cash flow these stores can produce!).

If you are truly interested in getting the most for your music dollar, you should check around your area for an independent dealer—in other words, a non-chain store. The independent won't have the huge overhead expenses—no shiny chromed fixtures, no beautifully landscaped office complex, no large staff of salaried accountants, buyers, and advertising executives, and no high mall rents to pay. Further, you will usually find the owner at the store every day!

Your independent store will probably have LPs in stock—try finding them in a chain! Your independent will stock titles that aren't on the charts, representing many different styles of music from around the world, and will usually know something about the music he's selling. If you're looking for an effective special-order source, your independent store can get more for you much faster than nearly any chain store. He deals with dozens of distributors and labels directly, not through a buyer at headquarters who is looking for box-lot discounts (and waiting for box-lot-sized orders). And try getting *any* of this attention from your club! The net result is a price that's usually $1 or $2 *under* the list price, every day, and even lower on sale items.

My apologies if this is beginning to sound like a plug for independent record stores. I happen to own one, and I have an independent label, too—so I can claim some familiarity with the figures involved.

Lloyd E. Townsend, Jr.
Imaginary Records
Auburn, Ala.

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OVED HIM BUT HE DIDN'T LOVE ME · ALL THROUGH THE NIGHT · I AM IN LOV
HERE HAVE YO ... IS THING CALLE
VE · EASY TO L ... OMENT ON · I'M
GOLO · LOVE F ... E · I LOVE PARIS
NCENTRATE ... ALWAYS TRUE T
U IN MY FASHI ... ING GOES · "SIL
TOCKINGS" OVERTURE · MY HEART BELONGS TO DADDY · NIGHT AND DA
BEGIN THE BEGUINE · CA, C'EST L'AMOUR · MOST GENTLEMEN DON'T LIKE LOVE
T'S MISBEHAVE · WERE THINE THAT SPECIAL FACE · I GET A KICK OUT OF YOU
S DE-LOVELY · TOM, DICK OR HARRY · I'VE GOT YOU UNDER MY SKIN · ALL O
U · DOWN IN THE DEPTHS (ON THE NINETIETH FLOOR) · BRUSH UP YOU
AKESPEARE · IT'S ALL RIGHT WITH ME · BLOW, GABRIEL,
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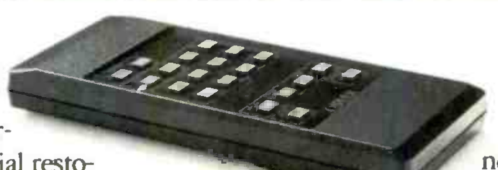

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TAPE GUIDE

HERMAN BURSTEIN

Dubbing Dolby NR

Q. Should the Dolby NR circuits of both decks be switched on when dubbing from deck to deck? I have heard many different theories on this.—Mark Greenblatt, Los Angeles, Cal.

A. The less one tampers with the signal, the better the eventual results are apt to be. Therefore, in theory, it is desirable to dub a Dolby-encoded tape with the Dolby circuits off. However, to maintain substantially flat response, it is necessary to equate the output and input levels of the two decks with reference to Dolby level, which can be a tricky business.

In practice, the wisest course is to use Dolby decoding in playback of the original tape and Dolby encoding in recording the dubbed tape. In this way, one is most likely to preserve correct Dolby level and to achieve flattest response, particularly in the treble region. I suggest you experiment with both modes of dubbing and let your ears decide which gives the most satisfactory results.

Tape Drag

Q. Do you get many complaints about tape drag, that is, speed being slightly slow on cassette decks? I have always had a problem with this, even though I had my decks checked and was always told their speed is okay. If I take up all the slack in a tape, this sometimes helps for a while.—Jimmy Edwards, Greenville, N.C.

A. Yes, I get a fair number of complaints about cassette decks being off-speed. These involve situations where different decks are used for recording and playback. Tape drag can be due to a number of factors: Excessive holdback torque by the supply hub; insufficient take-up torque by the take-up hub; a glazed pressure roller, which cannot grab the tape adequately; insufficient pressure by the roller; a capstan that somehow has gotten lubricant on it and therefore cannot grab the tape, and some brands and types of highly polished tapes, which have a tendency to slip.

Usually a tape deck whose speed is off by no more than 0.5% is considered to be operating at proper speed. Some service shops may even consider speed within 1% as proper operation and hence may put their okay on a deck that, to a highly sensitive ear, is somewhat slow. However, I must repeat, this can happen only if different decks are used for recording and playback or if a deck has changed its speed characteristic over time, so that the speed in playback differs from the original speed in recording. When the same deck is used for recording and playback, and if its speed has not changed, any speed error which occurred during recording is cancelled by the same error during playback.

Dolby Symbol

Q. The fluorescent level meters on my cassette deck have the Dolby double-D symbol between the 0- and 4-dB lines. Please explain the meaning of this symbol and what it signifies for recording.—Victor S. Zupancic, Kirkland Lake, Ont., Canada

A. Dolby level corresponds to 200 nWb/m (nanowebers per meter) on the tape at 400 Hz. This is nearly 2 dB below DIN level (250 nWb/m at 315 Hz), which is generally considered close to the maximum level at which one can safely record in the vicinity of 300 to 500 Hz without running into excessive distortion. In most program material, maximum amplitude tends to occur in the range of roughly 300 to 500 Hz; hence if you are safe at 400 Hz, you *tend* to be safe at all other frequencies.

Recording at a level no higher than Dolby level usually provides a bit of safety margin against recording overload. If you want to push your recording level to the maximum feasible point in order to extract the last dB of signal-to-noise ratio from your deck, you can probably record so that peaks read no higher than +4 or +5 on your deck's meter. However, you should experiment to determine whether this is a safe practice so far as your ears are concerned.

If you have the necessary test facilities, you can use the deck's Dolby-level indications to check for correct Dolby NR tracking. First, record a 400-Hz tone from a test disc or oscilla-

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1633 Broadway, New York, N.Y. 10019. All letters are answered. Please enclose a stamped, self-addressed envelope.

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Crosstalk can be caused by improper head position or even by crosstalk within the heads themselves.

tor, with your deck's level meters set at the Dolby-level mark. If this tone also reads at the Dolby mark in playback, your deck is properly adjusted for correct Dolby NR decoding of the recordings you make on that tape formulation. (Other tapes may require different sensitivity settings on the deck; some decks can adjust themselves for these differences automatically.)

You can also use the Dolby-level marks to determine whether your deck is properly calibrated for tapes made on other decks using Dolby NR. This, however, requires an accurately made test tape containing a 400-Hz tone recorded at a measured level of 200 nWb/m.

Crosstalk from Opposite Tracks

Q. When I listen to cassette tape through my headphones, between selections I think that I can hear material being played backward from the other side of the tape. Why?—Richard Harding, Peabody, Mass.

A. If you count tracks from top to bottom of a cassette tape, then tracks 1 and 2 are respectively for the left and right channels, while tracks 3 and 4 are respectively for the right and left channels in the opposite direction of tape travel.

The position of the playback head should be such that its two gaps exactly correspond to tracks 1 and 2 in one direction, and to tracks 4 and 3 in the other direction. A downward shift in the position of the head may cause the lower gap to pick up a bit of the information on track 3, particularly at lower frequencies, where the magnetic field tends to spread out beyond the track (fringing).

If the crosstalk that you hear is not particularly strong, I would be inclined to leave things as they are if everything else is working well. If you have a technician try to eliminate the crosstalk by shifting the head, there may be an adverse effect on azimuth alignment, with consequent loss of treble.

If your deck has separate record and playback heads, it is possible that they are not correctly aligned with respect to each other in terms of vertical position, resulting in crosstalk.

If yours is a reversing deck whose playback head has two sets of gaps, it is possible that crosstalk occurs *within* the head owing to imperfect isolation between the upper set of gaps (for one direction of tape travel) and the lower set (for the other direction). Perhaps the only thing you can do about this is to try the costly step of replacing the head, although the new head may perform no better than the old one.

Sweet Spot

Q. My cassette deck is nearly 10 years old and suffers from a problem that, at first, seemed to be azimuth misalignment but unfortunately is not. If I play a well recorded tape and skew the tape slightly (the deck is an open design that enables me to do this), I get my sweet spot. As soon as I let the tape go, there is a dramatic loss in high-frequency response, and the tape sounds very dull.

I took the deck to a fairly competent shop, and they made an azimuth adjustment in addition to demagnetizing and cleaning the heads, but the deck behaves the same as before. Physical inspection seems to indicate that the heads are in good condition. Please give me some leads as to what may be wrong with my deck.—Andy Valiente, Winter Park, Fla.

A. If moving the tape with respect to the playback head restores high-frequency response, this suggests either improper azimuth alignment or poor tape-to-head contact. Apparently, you have ruled out azimuth misalignment, but are you *sure*? Did the shop align azimuth with respect to a standard tape or with respect to *your* tapes? Your tapes may have been recorded with a head that was not in standard alignment—that is, not with its head gaps at a perfect right angle to the tape's long dimension. Playing such tapes with a head in standard alignment would result in treble loss. You might check the situation with another repair shop that is more than just "fairly competent."

Poor tape-to-head contact may be due to a flaw in the deck's mechanism that prevents the cassette's pressure pad from doing its job. Perhaps insufficient torque by the take-up hub contributes to the problem, or it may be due to inadequate "grab" by the capstan and pressure roller. A worn, grooved head also may interfere with good contact. A

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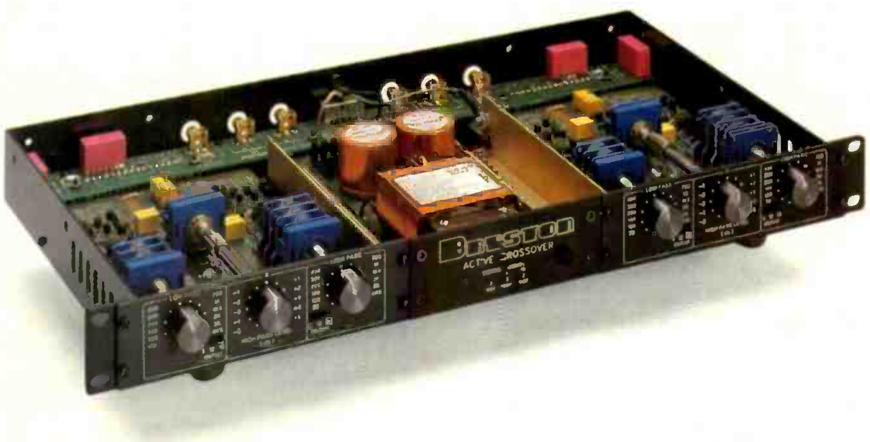

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AUDIOCLINIC

JOSEPH GIOVANELLI

Light Dimmer Interference

I stumbled across a cure for light dimmer interference recently and wanted to share it with other readers. In my house, I have installed two strings of recessed lighting, both of which are controlled by dimmers. These strings are located at right angles to one another, precluding orienting an AM antenna to a null point. I have tried various brands and models of dimmers, all to no avail.

Recently, however, I put an undimmed 100-watt bulb near my turntable to help me see better. With this light on, the horrendous buzz was totally eliminated. (I don't mean when playing records; I mean when I run my AM tuner!) I have no explanation for it, but this cure worked for me in at least this instance.—Keith Richardson, Mason City, Iowa

Loudspeaker Impedance Measurements

I am writing in response to the technique presented in the July 1988 "Audioclinic" regarding measurement of speaker impedance.

Although the reader's question was answered, it is important to point out that the technique presented discusses only the magnitude of the impedance. Equally important to know is the phase of the impedance. The magnitude and the phase together then describe the complex impedance or, equivalently, the "real" and "imaginary" parts of the complex impedance.

One situation where knowledge of the phase will be very important is in determining the amount of power delivered to the load.—Andrew Koranicolas, Cambridge, Mass.

Speaker Protection Problems

Q. *My speakers are protected by 2.5-amp fuses capable of handling 350 watts. When I turn up the volume on my receiver about three-quarters of the way, the speaker fuses blow. Should I use fuses of higher current rating, or must I put up with not being able to use my receiver's full potential?*—Tim Tripp, Osseo, Minn.

A. The amount of power delivered to your loudspeakers depends on the instantaneous loudness of the music being played, the signal level produced by your program source, and, as you say, the position of the volume control knob. There is, however, no relationship between the position of the knob and the absolute amount of power delivered to the speakers.

From what you wrote, I don't know how much power can be supplied by your receiver. Let's assume, for discussion's sake, you've got 400 watts per channel. Under some conditions, full power won't be delivered, even with the volume control turned up fully. Under other conditions, it's possible that full amplifier power will be delivered to your loudspeaker system with the control set to less than half-scale.

To add to this, we don't know how much power the speakers are protected against by those fuses. Are the fuses of the slow-blow variety? If so, they will handle more power before failing than will fast-blow fuses.

We could apply Ohm's law to all this, but I have found this of little help when determining the amount of protection a given fuse size exerts on a loudspeaker system. This has to do with the complexity of the waveforms involved plus the fact that power demands can be great but perhaps not be sustained.

I certainly would not move to a higher fuse rating until I knew for sure that your speakers are not being driven to their limits with the present fuses. If these fuses were supplied or recommended by the speaker manufacturer, you surely should not increase their current rating.

After all, it is possible that your amplifier can't even provide as much power as your speakers can handle but that, due to overdriving, the amp is clipping. Again, those fuses may be saving you from speaker damage.

Spindle Misalignment in CD Players

Q. *I am writing concerning what appears to me to be a problem with several CD players I have examined. When I removed the top covers, I observed that each player exhibited some degree of rotational inaccuracy similar to a moderately warped and/or off-center LP. The cause of this can easily be seen when examining the spindles. They appear to be misaligned and perhaps a bit sloppy. I asked several technicians about my discovery but received conflicting points of view as to whether or not this is a real problem.*—Robert C. Chase, New Cumberland, Pa.

A. Till now, I have never given any thought to the spindle and its alignment. I examined both of my players and was surprised at the close tolerances in the mechanical assemblies. One of these players is rather inexpensive; it is, therefore, amazing that a piece of equipment which is so complicated can be so well made.

Any minor rotational errors don't affect the playback of my discs. Tests have been conducted which demonstrate that most players will track properly despite rotational problems caused by the discs or the player.

If an LP is warped, one can hear wow. If the warp is severe, there may be an audible "thump," as the tonearm tends to ride out of the grooves. Because a CD is not analog, its sound quality should not be degraded by small rotational disturbances. When these disturbances are sufficiently great, the output will either quit altogether or "pop in and out."

In my experience, at any rate, I can't find any conditions which tend to degrade the audio quality of a CD—however slightly—until the errors are so great that the digital information cannot be recovered.

FM "Bleeding"

Q. *I was listening to an album which I am very familiar with, and it seemed distorted. I turned up the volume in an effort to determine the nature and/or cause of this distortion but could not figure it out. In my frustration, I stopped the recording without turning down the volume beforehand, as I usually do. I distinctly heard the FM tuner—the exact station programmed. I switched from LP to both of my tape loops and could still hear the sound, but when I switched to my CD player, I could not hear it.*

I have good patch cords from my CD player to the rest of my system. The rest of these patch cords were supplied by the makers of my gear. Because the problem is not present when

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Impedance, volume setting, and the position of switch contacts can make crosstalk from a tuner disappear when CDs are being played.

I listen to CDs, is it perhaps a good idea for me to replace all of my patch cords? Of course, I can solve the problem by turning off the tuner, but this is not my preferred "way out."—David C. Samuel, Greensburg, Pa.

A. Your signal "bleeding" won't be solved by purchasing different patch cords. Most preamplifiers have provisions to prevent the very thing we are talking about. They work by placing a short across all inputs not switched into use at any given time. As with any switch contact—and that's all we're dealing with here—oxidation can ruin the effectiveness of the short. Clean the program selector switch with suitable contact cleaner. This simple "cure" may be all that is needed.

The fact that the leakage from your tuner is not heard when you play CDs can be the result of a couple of circumstances. First, it may be that you have your volume control turned lower when playing CDs than you do for other program sources. Obviously, the lower the volume, the less you will hear of the leakage. Second, it may be that the switch contacts associated with your CD player are located further from the tuner's switch contacts than are those of some other program sources. Further, the impedance of the player may be lower than that of your other program sources, thus acting to short out some of this leakage. Finally, it may be that the tuner produces high signal output. It is sometimes hard for some shorting systems to remove all traces of such a high signal level. If the tuner has a level control, turn it down a bit—just far enough to "kill" the leakage but not so far as to force you to turn up the preamp's volume control to an exaggerated setting.

Deterioration of CDs

Q. There has been a lot of talk about "laser rot," the deterioration of picture and sound which occurs on perhaps 10% of videodiscs. It has been stated that this could occur on Compact Discs as well, because CDs are coated with just a thin layer of aluminum.

It is my understanding that the deterioration of videodiscs is caused by a problem in the bonding of the two halves. Because CDs have only one play side and are not made the same way videodiscs are, how can "laser rot" occur?—Jim Zerr, Glen Burnie, Md.

A. To date, I have not heard of any problems related to the deterioration of CDs for *any* reason, including the "problem" of the thin coating used to protect the surfaces of these discs. As a result, I don't have an answer as to how such action could take place on Compact Discs.

Audio published the results of some accelerated wear tests in which CDs were submerged in boiling water, left in car trunks during summer days, and more. CD failures involved warping, but no other failures occurred—at least as I understand the test results.

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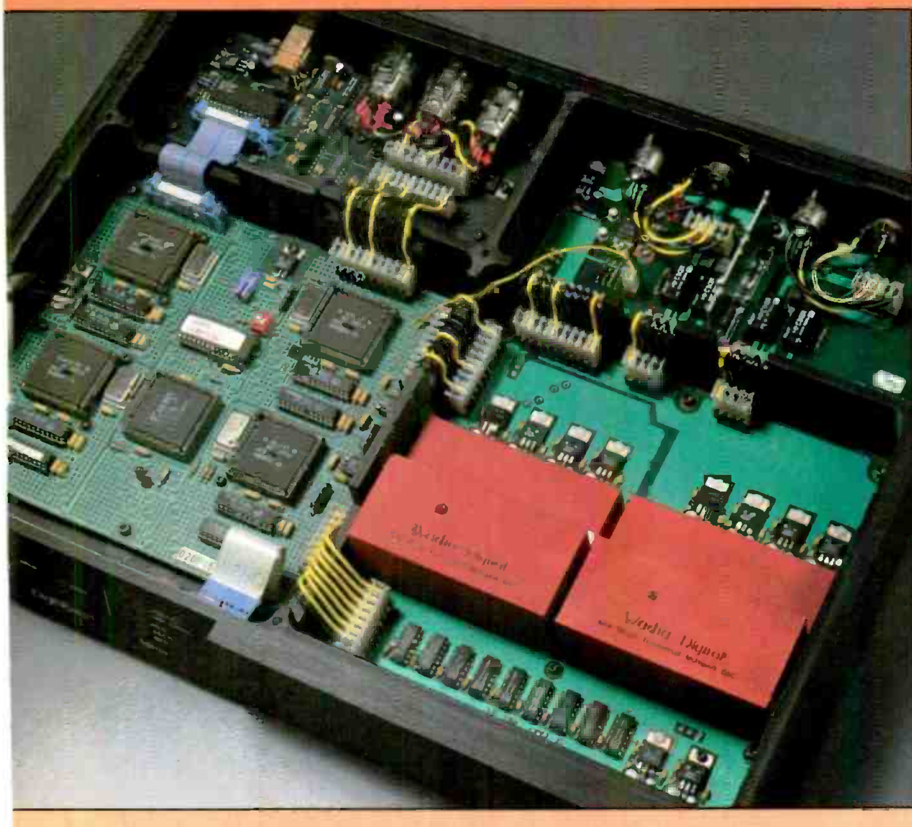
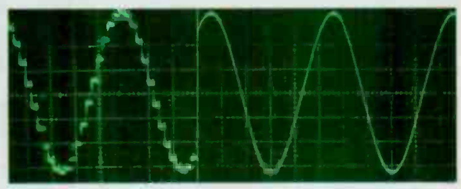


The photo on the left shows Wadia's internal circuitry, the two large red modules are proprietary 18-bit transversal, multiport DACs. They have been called "BOSS DACs" in the press. This is in sharp contrast to finger-nail sized off-the-shelf commercial DACs that cannot handle 2.8-million conversions per second (64X oversampling), nor can they produce the dynamic Wadia Sound!



4X VS. 64X OVERSAMPLING *The left trace is the DAC output of a 4X oversampled CD player. The signal is an 8 KHz sinewave. Notice that there are 22 steps per cycle. The right-hand trace is the output of the Wadia DAC utilizing 64X oversampling. Notice the smoothness due to the fact that there are 353 steps per 8 KHz cycle.*

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Review

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REFERENTIAL TOME

The Art of Digital Audio by John Watkinson. Focal Press (Stoneham, Mass.), hardbound, 489 pp., $49.95.

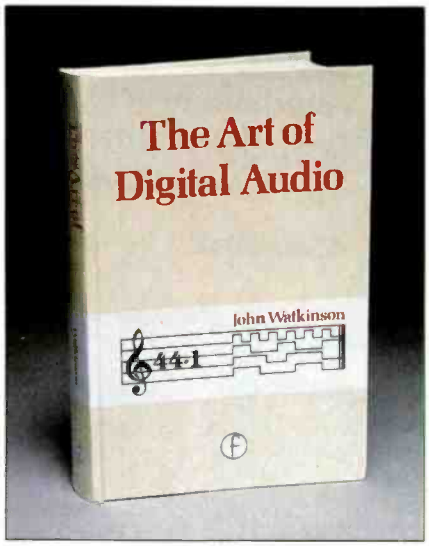
I was pleased to have this book come to me for review. In the past several months, I have not only read it thoroughly, some sections many times, but have also used some of its explanations and information as references in teaching a course on audio system design for senior electrical engineering students. It is without doubt one of the most useful books I have come across for obtaining an overview of the art of digital audio. I recommend that everyone with either a professional, or even a more casual, interest in digital audio rush to get a copy.

A reading of this book by anyone, but particularly by persons with some electrical engineering or computer sciences background, will be refreshingly useful. Jammed with information on everything from floppy disks to Compact Discs, it seems to include discussions of every kind of digital recording ever conceived, whether for numerical data or audio signals.

Now that you are sold on *The Art of Digital Audio*, let me issue some warnings. Most readers will, as I have, develop a love/hate relationship with this book. Though some 480 pages long, it is either too short or contains too much. As a consequence, many topics are covered too briefly. The brevity is a special problem in the discussions of some of the more basic topics, such as digital conversion, coding, and signal processing.

John Watkinson points out in the preface that he has not tried to write a textbook. He moves from the overly simplified to the incredibly difficult with great leaps and fewer connecting links than are necessary to teach the material. There are few facts in the book, he says, because facts can be forgotten; his emphasis is on thinking and understanding. I found the book loaded with facts—very interesting facts, indeed. Unfortunately, there is often no explanation of their significance, nor, frequently, are they tied into the thread of the concepts being discussed. I found many of the discussions of important theoretical issues not only lacking equations but written in such a convoluted manner as to make understanding these complex matters more difficult than necessary.

Many fine figures are presented, some copied from the references, many new. Some are self-explanatory and enlightening; unfortunately, many are not. Often the figures receive little or no discussion in the text and have short, infuriatingly incomplete captions. In many cases, the figures need much-improved captions or more extended discussion in the text. Examples are numerous; I will give only one. Figure 6.16 shows the autocorrelation functions for 10 channel codes, none of which have been discussed yet (some are discussed later). The caption reads, "Comparison of codes by autocorrelation function of run length." The text explains, "Most of the parameters of a code can be read from the autocorrelation function at a glance, whereas the more common use of code spectrum makes this more difficult." Clear? Neither "autocorrelation function" nor "code spectrum" are to be found in the index.



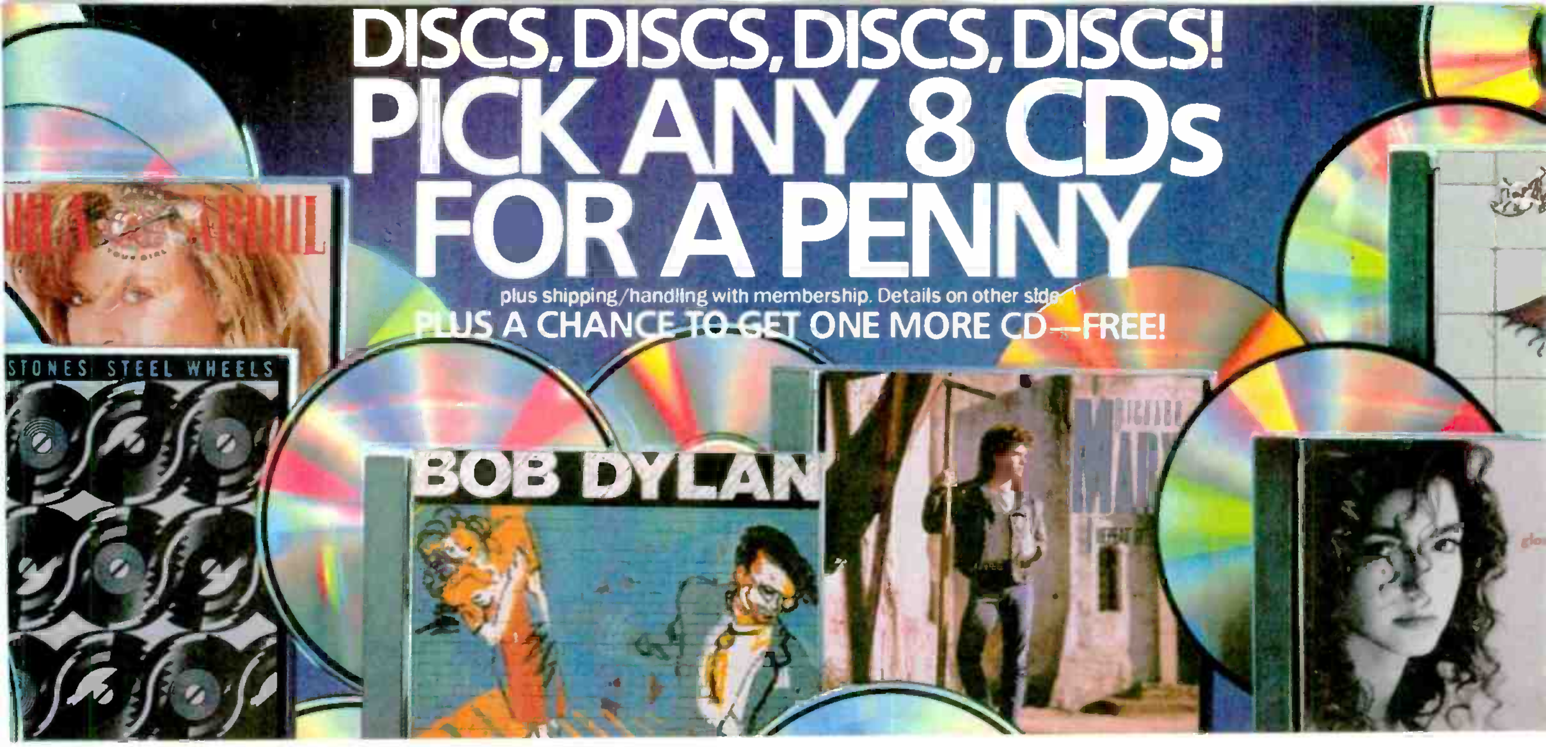
It is simply not possible to teach or understand many of the complex concepts in this book without some mathematics and without a thorough discussion of the terminology being used. Nevertheless, this is in many ways a wonderful book. I will try to give you a balanced view of its contents.

In general, the chapters on basics are inadequate, while those on specific topics are full of interesting facts. Chapter 2 covers basics, such as conversion of signals from analog to digital form and vice-versa. Sampling and quantization are covered without benefit of mathematics; only the roughest idea of the process can be gained from the figures and text. The author has distilled several good references on these matters and condensed them into a series of "facts." I suggest that the original papers, or other textbooks on theory, be consulted for an understanding of the basics of digital processing of signals. A treatment of the accuracy and speed of the currently available D/A and A/D converters, as they are applied in the latest digital equipment, would be more in keeping with the level and content of the later chapters.

Chapter 3 contains about 10 pages on binary logic, adding, and the like. Its last 20 pages are on a strange, almost random collection of digital topics, some of which seem quite out of place: Level metering, gain control, mixing, cross-fading, and companding. Only digital dither, time-base correction, and FIFO (first-in, first-out) time-base correction seem to fit well into the presentation at this point. Overall, however, Chapters 2 and 3 seem weak.

Chapter 4 is a 55-page treatment of digital filters. This includes finite impulse response filters, infinite impulse response filters, z-transforms, filter design, and zero/pole positioning, with 14 pages on sampling rate conversion thrown in for good measure. If you understand these topics before you read this chapter, you will find it an interesting treatment. It is a bit like Alice in Wonderland, since it goes through topics fast, fast, fast. Despite its faults, the chapter will give the novice a flavor of digital filtering practice; the expert will find the treatment gives interesting insights into digital filtering. All in all, not a bad chapter.

The 21-page Chapter 5 seems too short. Very interesting and well written, it goes into detail about the various digital interconnection standards for digital equipment. Many standards are discussed, including those used in PCM tape machines, Compact Disc players, digital audio tape machines, and other equipment. The topics fit the author's style beautifully. There are facts, details, and well-done figures.



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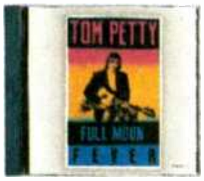

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Santana—Greatest Hits (Columbia) 244·459
Janis Joplin—Greatest Hits (Columbia) 231·670
Simon & Garfunkel—Greatest Hits (Columbia) 219·477
Blood, Sweat & Tears—Greatest Hits (Columbia) 214·650
Sly & The Family Stone—Greatest Hits (Epic) 196·246
Bob Dylan—Greatest Hits (Columbia) 138·586
Fine Young Cannibals—The Raw And The Cooked (I.R.S.) 379·214

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Liza Minnelli—Results (Epic) 382·333
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Bodeans—Home (Reprise/Slash) 384·206
The Call—Let The Day Begin (MCA) 384·156

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The Cure—Disintegration (Elektra) 382·093
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One can really understand both the problems of interfacing among various standards and how to go about solving some of these problems. The detail presented is excellent, and I would like to have seen even more of it.

Chapter 6 is where *The Art of Digital Audio* really comes to life. The author clearly knows a great deal about digital recording, and it shows. The dozen pages on the magnetic recording process and the qualities of the channel are enlightening and to the point. It is made clear why channel coding is needed. The discussion of simple channel codes is useful (even though the dreadful Figure 6.16, mentioned above, appears in this section). A 10-page review of group codes and convolutional codes follows. I would like to have seen this material expanded, as it is one of the most important topics in digital audio and the material is very well written. Partial response receives five pages. This subject, which involves very advanced concepts of trellis coding and Viterbi decoding (a topic usually called delayed decision coding) unfortunately cannot be explained in five pages and probably should not be included in this book. These are topics much more applicable to modems and communications systems, since they are not effective for burst errors, which are more typical in digital storage media. This chapter would have been better had it treated fewer topics more thoroughly.

Chapter 7, 46 pages long, is nicely presented in that it starts with relatively simple examples, those of parity code checking, and proceeds to more complex topics by giving a nice example of a Hamming code. Cyclic codes are discussed in the next seven pages. The discussion is clearly presented and at a level which can be followed easily if the reader puts in some effort on working through the examples in detail. Codes such as cyclic redundancy check codes (CRCC) are very important because they are widely used in digital audio systems. Even the brief discussion of Galois field manipulations seems in place in this chapter. It is greatly simplified but nevertheless gives some insight into the complexities required in useful and practical coding systems. Correction of burst errors is essential in digital recording, since errors are caused by defects in the medium which wipe out "chunks" of data. The author, in 16 pages, attempts to ease the reader through the burst-correction maze by treating several coding techniques in order, from the simpler to the more complex. The Fire code, B-adjacent code, and Reed-Solomon code (used for Compact Discs) are discussed. It would have been useful to improve the code structure figures, and I find the discussion of the Fire code more confusing than clarifying. When the author allows himself to write a few equations and to give examples, his exposition becomes very clear. I find his treatment of the Reed-Solomon code a very nice starting point for understanding the purpose of all the complexity required to make the Compact Disc work so well. The final eight pages of Chapter 7, on interleaving, are nicely written, readable, and understandable.

The 48-page Chapter 8 is on rotary-head recorders: Video recorders, PCM machines, EIAJ-format recorders, and the R-DAT machine. This is where the book really starts to pay off in a big way. Chapters 8 through 11 alone are worth the price of admission. Roughly one-half of Chapter 8 is on video-type rotating-head machines (including PCM adaptors and the like) and the rest on DAT (specifically R-DAT). The mechanical problems, channel limitations, and coding techniques used are discussed with just the right amount of detail and at the right level for readers who want an overview of this important digital recording technology. The treatment of R-DAT is excellent—here is another case when the interested reader will wish for more.

A full 53 pages are devoted to stationary head recorders in Chapter 9, half on the DASH formats and half on the Mitsubishi formats (Pro-Digi). Again, the treatment is excellent. There is enough detail for the reader to understand the problems involved and the elegant solutions that have been devised to solve them. This chapter will be of interest to the studio engineer who simply wants to know more about the technology, as well as to those merely interested in digital techniques and how they are applied to audio recording. There are even a few pages devoted to the S-DAT format.

Chapter 10 is a short, nine-page section on digital technology applied to 8-mm video. Chapter 11, 25 pages, discusses professional VTR formats such as EBU/SMPTE, C-format, and other PCM formats. These chapters are adequate discussions of the technology for the specialist; they do not, however, add much to the book in terms of extending the reader's understanding of digital technology. These chapters are more lists of facts than anything else. Though not as thorough as Chapters 8 and 9, they nevertheless will be of interest to studio and broadcast personnel.

Chapter 12 is rather long, 52 pages, on various disk drives that are or might be used for audio recording. It is a sort of mishmash of interesting information about all kinds of disks, from floppy to hard and including optical. I liked the chapter and learned a lot of "facts" about these drives, but I am not sure the information learned will be very useful. The casual reader will find this chapter interesting; the expert will find it too elementary and sketchy.

Chapter 13, 46 pages, is on the Compact Disc. "Finally!" you might say. While this is the last chapter, it is by no means the least. A few pages are devoted to how the CD is manufactured and to a discussion of the mechanics of the tracks and how the "bumps" are read. Yes, "bumps." Why not "pits," which is standard usage in most of the literature? Pits are just bumps looked at from the bottom—or the other way around! Eight additional pages are spent on the reading, tracking, and optics of the CD system. There are a few pages on the pickup structure as well. This is as good and clear a treatment of the mechanics of the CD as I have seen, and the coverage includes most of what the casual reader would like to know. A nice six-page section on the channel coding of the CD includes an explanation of the use of eight-to-fourteen modulation (EFM). The following 12 pages give great detail about the data and control formats on the disc. The serial frame structure is described clearly. The CD subcode blocks used for control and other information (i.e., the P, Q, R, S, T, U, V, and W word blocks) are discussed in depth; the treatment is detailed and well written. The final nine


105.7

6) when a McIntosh Compact Disc Player is the sound source, you can put the CD player in play, next track or preceding track or stop play.

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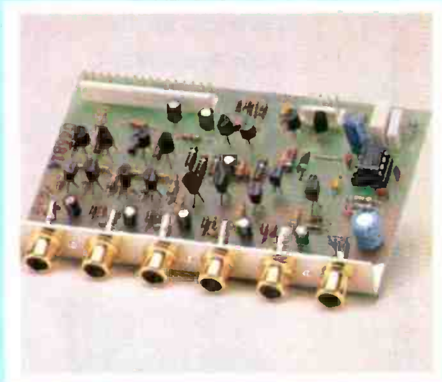

Electronic tape monitor switches for two audio tape recorders, allow either recorder to be heard from the main output. These switches can also select the audio from two video recorders, or one audio recorder and the audio from one video recorder.

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* McIntosh research, engineering and design has developed circuits covered by these U.S. Patents: 3,965,295; 4,048,573; 3,526,847; and 3,526,846.

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pages describe specific circuits and control circuit designs of CD players.

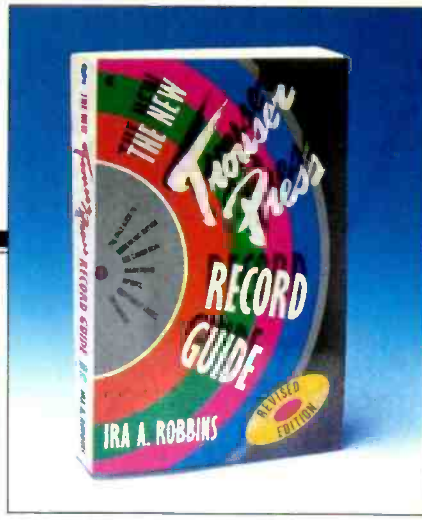
The chapter on the CD is adequate but disappointing in some ways. It passes off CD error-correction techniques with the comment that they have been discussed in Chapter 7. I feel that a section on the specific application of interleaving and Reed-Solomon coding techniques to the CD should have been included. These techniques are too important to the CD to be slighted as they have been here. A large number of potential readers will be interested mainly in the CD.

The other lack in this chapter is its failure to discuss oversampling and digital filtering as they relate to modern digital CD machines. These are two of the most important recent technical developments. They have added greatly to the quality of CD playback processes and deserve extensive treatment. The author mentions oversampling in Chapter 2 but unfortunately fails to discuss the latest CD technology using these techniques.

As indicated at the start of this review, I have a love/hate relationship with *The Art of Digital Audio*. It is very good in many of its parts, and that makes it worth having. In fact, I now keep a copy at home and have put one in my electroacoustics laboratory library as a reference for my graduate students. It is not a textbook, but it is a very good reference for many topics. (It has a good list of references at the end of each chapter and a good index.) I consider this probably the best book available at its technical level at this time, and I would urge anyone with an interest in digital audio technology to buy it. It takes concentration and hard work to read and understand, but with this investment, reading it will be very worthwhile. *R. A. Greiner*

The New Trouser Press Record Guide **chronicles alternative rock groups that you won't find out about anywhere else.**

The New Trouser Press Record Guide, Revised Edition edited by Ira A. Robbins. Collier Books, 657 pp., softcover, $16.95.



So you want to know about alternative rock bands like !Action Pact!, Men They Couldn't Hang, or Xdreamysts. Where do you turn? About the only place is *The New Trouser Press Record Guide*, edited by Ira A. Robbins, now out in an expanded third edition.

The book chronicles the various alternative rock movements that began reacting to the highly formularized pop/rock of the late 1970s. Beginning originally with New Wave and punk, the *Guide* has expanded its scope to include styles from reggae, rap, and hardcore to a small amount of independent heavy metal and new folk music. Entries are alphabetical.

What you'll find here is a wealth of information on both obscure and better known groups that are iconoclastically inclined, either in terms of music (Einstürzende Neubauten) or attitude (Flux of Pink Indians). The majority will never show up in your *Harmony Encyclopedia of Rock and Roll*, and that alone makes this *Guide* valuable.

When it comes to substance, however, there's good news/bad news. The good news is that you get a tremendous range of entries to dip into, and good basic discographies (title, label, year, country, special format info, and CD availability; no ID numbers). An index would have been a helpful addition, but maybe next time. The bad news is that many entries consist more of highly subjective record reviews than of helpful biographical information (e.g., names of band members) or other more objective, historical perspectives. Implicit in this is a tone of somewhat egocentric, elitist critical snobbery which can be annoying if you don't buy the notion that *only* music which is not commercially successful is intellectually acceptable. In the worst cases, all you learn is that the reviewer did or didn't like a record.

Yet despite a subjectivist critical ethos more appropriate to a fanzine, Ira Robbins' *The New Trouser Press Record Guide* provides interesting information on a major chunk of rock music that you won't find out about anywhere else. Now, let's see, what do they have to say about Mofungo?. . .
Michael Wright

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IVAN BERGER

AND THE SURVEY SAYS...

Illustration: Teresa Anderko

Congress, Copyright, and Copying

Ever since the first home tape recorders hit the streets, the record industry has worried that music lovers would borrow and tape records instead of buying them. To prevent the massive losses they envisioned from this practice, the record companies have long sought technical means of hampering home record copying and sought royalty payments from surcharges on home recorders and blank tape.

Because of the continued debate on this topic, Congress asked its Office of Technology Assessment to see just what effect home taping had on sales of commercially recorded music. The OTA survey has now been released, and both the recording and home electronics industries are citing it as supporting their claims.

According to a summary issued by the Home Recording Rights Coalition, the OTA survey showed the record industry's case to be overstated. To begin with, only about one-fourth of all home taping sessions surveyed involved copying prerecorded music, and only 28% of the people surveyed had copied music from commercial recordings in the preceding year. The vast majority (81%) of this copying was done from recordings owned by either the taper or other members of the taper's family or household. The principal reason for taping was to shift the recording to a format that could be played in portables or in the car. Other reasons were to create customized music compilations, to protect originals from wearing out, and to gain longer playing time.

Only 6% of tapers said their most recent home copy was made to save money or to avoid buying the recording; so few people taped music to help others avoid purchasing it that the OTA considered this activity "marginal." Only about 13% of the music recently taped by adults was from borrowed recordings.

Home taping apparently does not significantly displace prerecorded music purchases. Tapers spend only about 12% of their time listening to home-recorded tapes, and many of these tapes did not duplicate albums that were commercially available in the same form. At least three-quarters of home tapers said that if they could not make home recordings, they would not replace those tapes with purchases of commercially recorded music.

On the other hand, there's evidence that home taping may help stimulate album purchases. Nearly one-fourth of the consumers surveyed said they had heard a homemade tape of their most recent recording before purchasing it. More than one-third of those who bought records on their most recent buying occasion, and about one-sixth of those who bought CDs, did so with the expectation of taping their purchases. The OTA survey showed that home tapers buy albums much more frequently than non-tapers—confirming earlier surveys by the record industry itself.

Are royalty taxes, and technical bars to home taping, fair? Of the consumers surveyed by the OTA, more than half said it would be unfair to build new audio recorders that can't copy commerical recordings or to sell recordings that could not be copied. An even higher proportion disapproved of imposing charges, fees, or royalties on either blank tapes or audio recorders. Nearly two-thirds (63%) felt that "current home taping practices should be left unchanged." And 93% felt that taping for one's own use or to give to a friend was "perfectly acceptable."

To the RIAA, these findings are "frightening." As the RIAA's counterblast to the HRRC's release pointed out, the OTA report confirms that Americans tape more than one billion musical pieces per year, and 40% of Americans have taped prerecorded music in the past year—22% more than 10 years ago. Says the RIAA, "Most consumers don't know that only one out of every six albums recorded makes a profit. It is that one—at the top of the charts—that will be copied most frequently. Ironically, it is also that one that supports the signing of new artists and the diversity of music that Americans have come to expect."

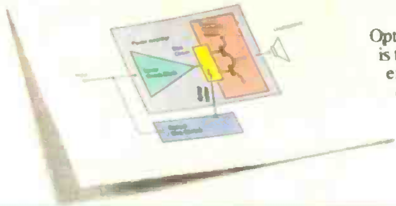
Copies of the OTA's 293-page report, *Copyright and Home Copying: Technology Challenges the Law*, are available for $13 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The GPO stock number is 052-003-01169-7.

Look Ma, No Microphone!

Last June, I saw an engineer at JVC lean down to shout at two tape decks. He wasn't angry, just demonstrating that decks could act as microphones (and, of course, that JVC's newest deck, the TD-V1010TN, had elaborate anti-vibration setups that made it noticeably less microphonic than its predecessors).

Fiber-optic cables can be microphonic too, as another engineer had demonstrated to me a year earlier. He did not show or claim that fiber-optic cables could pick up ambient sound, but did show that tapping such a cable while it was carrying a digital bit stream could cause noise in the analog signal decoded from those digits.

Denon was the first to record music using digital technology and is the only pure audio company involved in every step of the music chain.



Optical Class A bias control is the result of Denon's extensive research into digitally recorded music.

Perhaps the reason why Denon receivers are more "digital ready" is that Denon was ready with digital first.

Denon's digital experience makes Denon more prepared to cope with the challenge digital presents to receivers.

Using their extensive research into the dynamic levels found on digital recordings, Denon developed the Optical Class A system incorporated in the DRA-1025. Denon's Optical Class A system allows the amplifier sections of Denon receivers to produce high power efficiently while maintaining extremely low distortion for critical low and mid-level passages. (A highly respected audiophile publication found the sound of the DRA-1025 the equal of the best separate $1,000 power amps.)

Lest you think Denon is concerned solely with sound quality, Denon receivers over $350 offer IS™ Integral System remote control to command Denon CD players and Denon cassette decks and are fully compatible with Denon's multi-room remote system. Various Denon receivers offer remote speaker switching, NRSC for improved AM reception, variable loudness, video switching and much more.

Why did Denon make these advancements and not some electronics giant? Because since 1910, Denon has been making one thing and one thing only. Music.

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DRA-1025 shown with optional side panels available for most Denon models.
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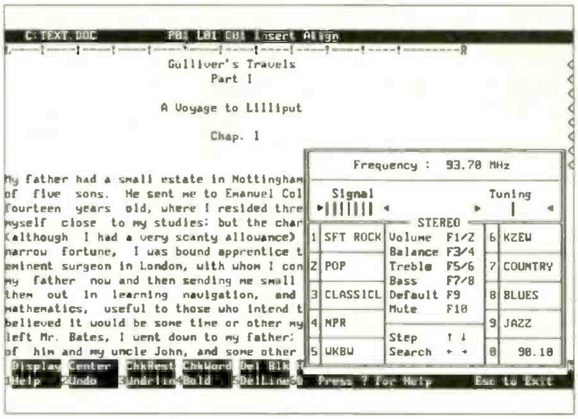
Desktop Stereo works inside your computer, controlled by the computer's keys, with station information displayed on its screen.

Music for the PC Bored

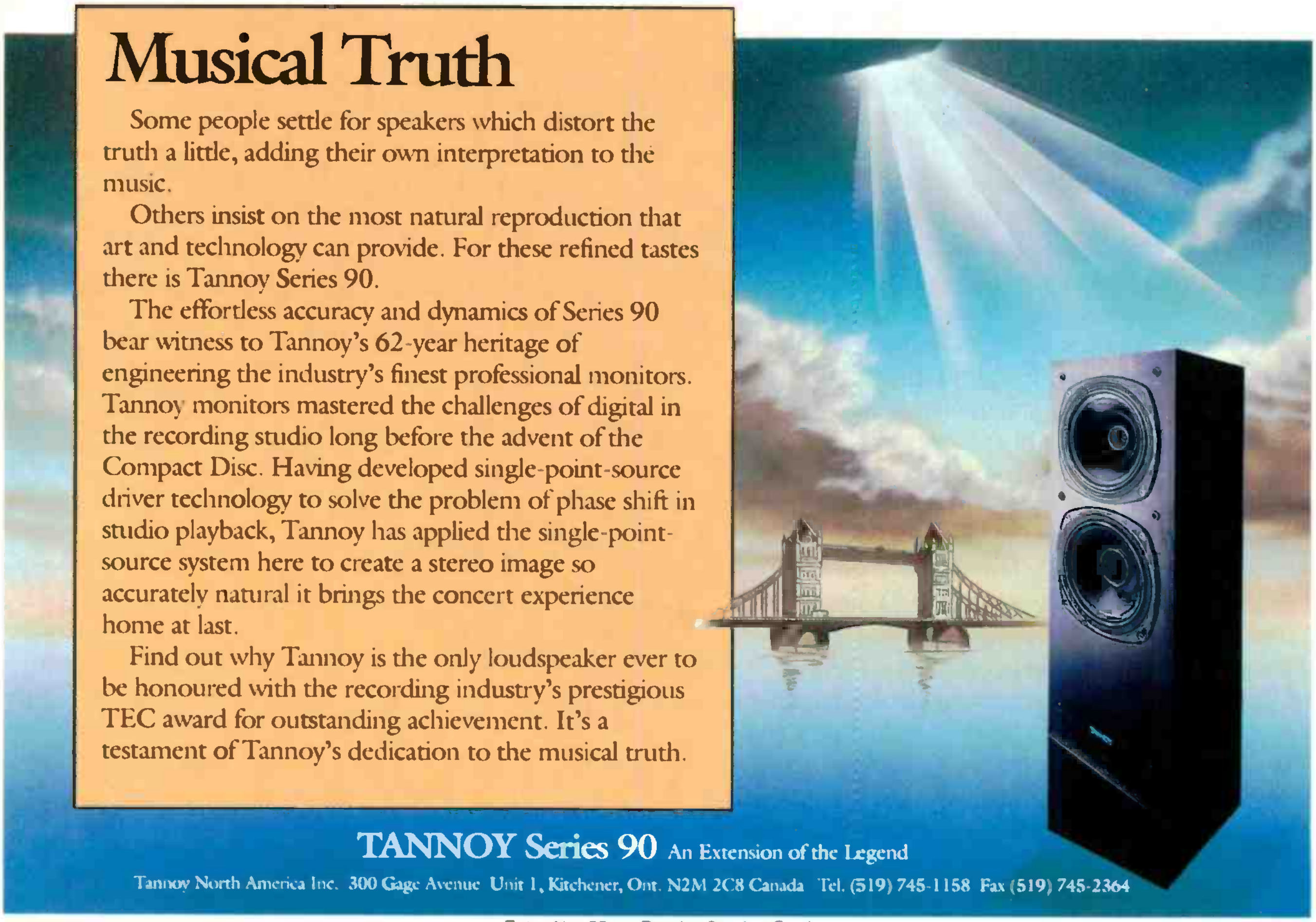
Music can ease long sessions of computer work, but computer systems often hog too much desk space to leave room for a radio. However, Optronics Technology of Ashland, Oregon now offers an FM radio designed to fit into, and be controlled by, PC-compatible computers.

The Desktop Stereo's specifications aren't all that intriguing (S/N of 66 dB, AM suppression of 50 dB, and a nonstandard sensitivity rating of "15 μV for -3 dB"), but Optronics says that their radio is not subject to computer-generated interference, unlike most FM radios and tuners. So it could conceivably outperform your hi-fi tuner when the computer's running.

What is intriguing about the Desktop Stereo is its control interface. It has no controls of its own but is operated from the computer keyboard. The software supports a pop-up screen that shows the currently tuned station frequency, volume and tone-control settings, a fine-tuning indicator, and the contents of the 10 station presets (which can be labelled by format or by frequency or call letters). Stations can also be selected by typing in their frequencies or by using the cursor control keys for manual or automatic search. The system can also generate printouts of all local FM stations (including stereo or mono status and signal strength) and lists of strong stations. Outputs are provided for speakers (4 watts per channel into 4 ohms), headphones, or to feed an external stereo system.



Pop-up screen superimposes tuning and control information on the program currently running.



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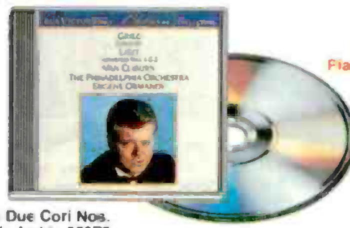

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S P O T L I G H T

Audio Magazine-Juilliard Scholarship Award Dinner.

"Too often those of us in the audio industry forget that the equipment would be useless without music and those who devote their lives to the art of music-making." Steve Goldberg, Vice President and Publisher of *Audio*, is explaining the rationale behind the Audio Magazine-Juillard School of Music Scholarship. The award was presented September 19, 1989 to violinist Brian Dean Lewis. Goldberg continues, "In fact, the foundation on which the component hi-fi industry rests is music. However, it is a platform that must be rebuilt by each generation.

"*Audio* feels obligated to help that renewal process, to help by supporting young performers such as Brian Lewis as well as the Juillard School, an institution that has contributed immeasurably to the training of young musical artists over the years."

Goldberg left the choice of student to the school; he didn't even specify composer, singer, or instrumentalist. Lewis was chosen on the basis of the same criteria as any scholarship student. "I made a general application for scholarship," says Lewis, who is from Ottawa, Kansas. "The only requirement was that you be either a junior or senior—someone who had already hung in for two years.

"Scholarships are awarded on the basis of academic standing, faculty and performance recommendations, and I guess what you'd call 'promising young artist-ness,' " he continues. "I know my teacher. Dorothy DeLay [whose star pupils include Itzhak Perlman, Shlomo Mintz, and Midori, among others], was in on it, as well as Louis Brunelli, the Dean of Orchestral Studies."

Lewis ultimately received $10,000 —the full $8,500 tuition plus a $1,500 living stipend, which will go toward the rent on his apartment. "I was told about it on April 17th—my 21st birthday!" he recalls. "The financial aid office also informed me that I should make plans to be available for a banquet, at which I would be performing."

Publisher Steve Goldberg (left) with Brian Lewis, winner of the first annual Audio Magazine-Juilliard Scholarship. To their right is Avery Fisher, founder of Fisher Electronics and leading light of the classical music industry.

Little did he know what was in store. The awards dinner was held in a private dining room at New York City's Tavern on the Green on a stormy night. The guest list totaled over 150 notables from both the equipment and recording industries and included Avery Fisher, Juilliard President Joseph W. Polisi, Ms. DeLay, Lewis and several of his friends, and, eventually, his parents who arrive in time for dessert after having circled LaGuardia Airport for 2½ hours. It was Lewis Sr.'s first time in New York.

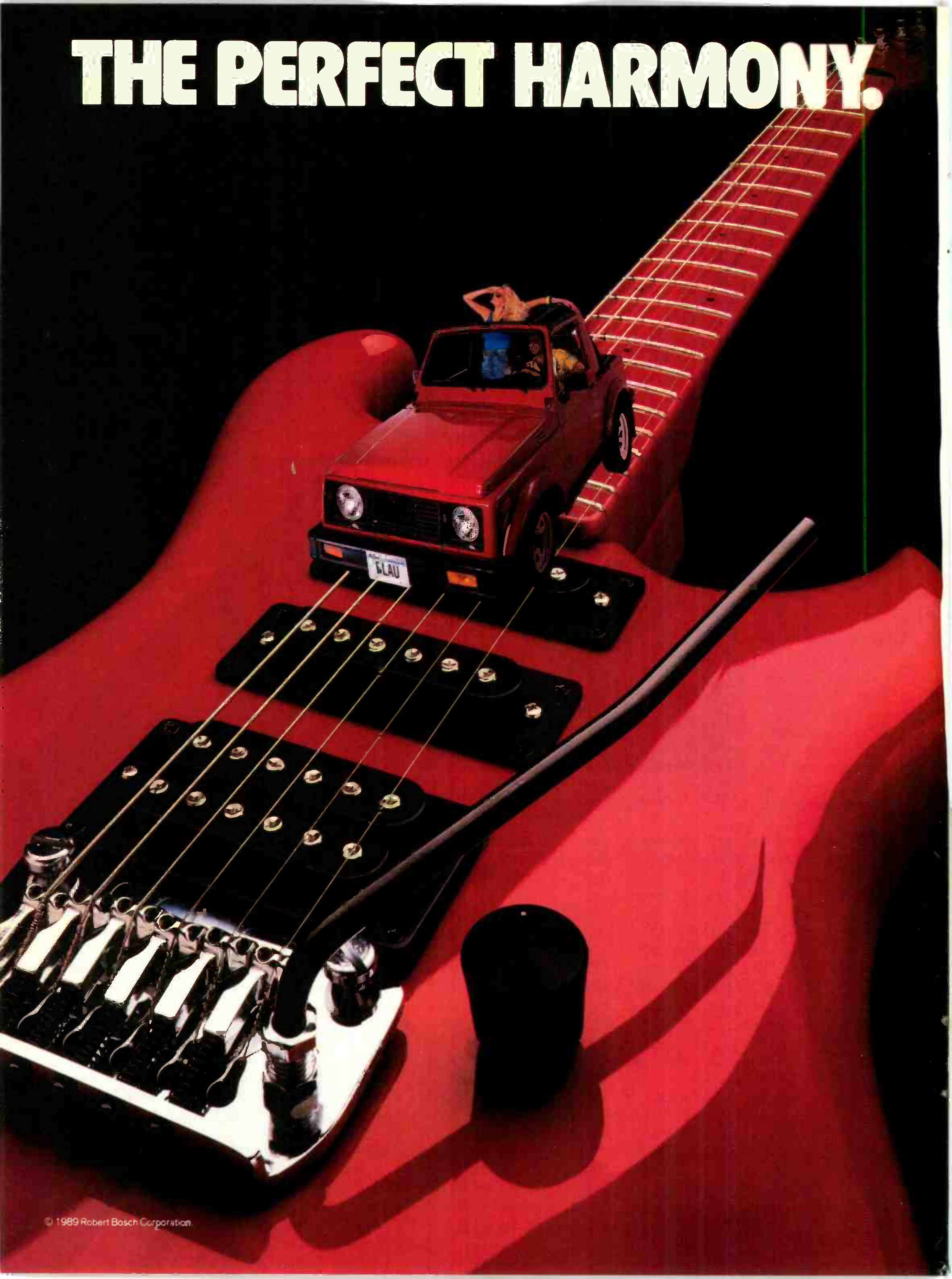
Lewis performed Brahms' "Scherzo in C minor for a Sonata ('Sonatensatz')" and a transcription of Copland's "Hoedown" from "Rodeo" with Pamela Pyle accompanying him. The Tavern on the Green was not set up for an intimate classical soiree, and it took a bit of doing to persuade a big band down the hall to take a break while Mr. Lewis performed. In the end, all went well, enabling Brian to one day tell his grandchildren that he'd fiddled at Tavern on the Green. Of course, playing at Carnegie Hall is more what he had in mind, and, if he continues on his current path, that doesn't seem terribly far out of the realm of possibility.

Lewis began his studies at age four with the Suzuki method and made his solo recital debut a year later. He first played for pay at age 20, in Little Rock, Arkansas. In high school, he served as concertmaster of the Kansas City Youth Symphony, the Kansas State Orchestra, and the National High School Orchestra, which performed in 1986 under James DePriest. Two years ago, he made his European debut with the Berlin Symphony Orchestra conducted by Jesus Lopez-Cobos. Currently, he is co-concertmaster of the Juilliard Orchestra and plays about 10 professional solo engagements annually.

"I need to spend my time studying and practicing," he says. He is practical but confident. "A solo career is the most difficult thing to break into and maintain.

"There will be a shot for me. I need to be ready for it when it happens." And *Audio* is helping him do that.

—*Susan Elliott*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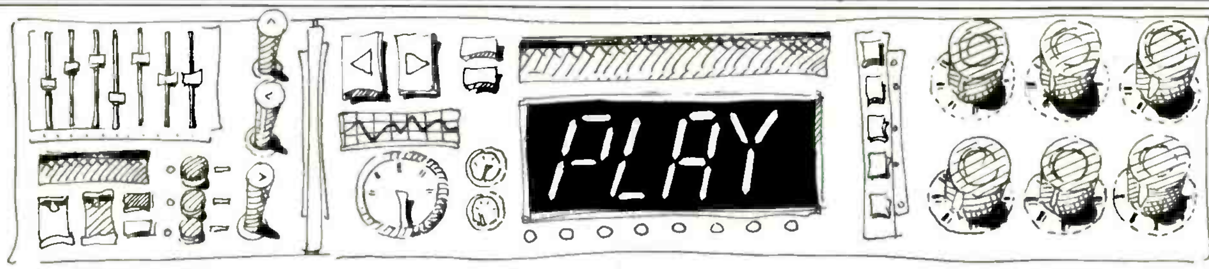


Illustrations: Yvonne Buchanan

Stereos with Everything

The dashboard stereo slots in many Japanese cars (as well as a handful of U.S. and European models) are standard width but twice the standard height. (The "standard" here is DIN for the U.S. and Europe, and nominally DIN for Japan. However, the car stereo mount which the Japanese call "DIN" is a slightly narrower version; the rest of the world calls it ISO.) I was not aware of this until I saw double-DIN car stereos on display at last October's Audio Fair in Tokyo.

Taking advantage of the extra space afforded them, several of these models include radio, cassette, *and* CD plus extra-large displays. In most of the models I saw (Panasonic's CQ-VZ700D, Kenwood's KRC-X11, and JVC's KS-RX835), the CD slot is at the top of the unit so that discs can be loaded easily even when mounted in consoles just ahead of floor shifts. On the Panasonic and on Alpine's Model 7360J, the display swings down to give access to the tape slot; the Alpine has no Compact Disc slot, just controls for a remote CD changer. However, the Kenwood unit (which also includes controls for a trunk-mounted CD changer) has its tape slot just below the display, and the JVC has small dual displays at the left and its tape slot is located in the middle of the panel.

The displays on several models could also act as spectrum analyzers. On the Alpine and Panasonic, the spectrum bars tapered and converged towards the top center of the display, giving an impression of a multi-lane superhighway—appropriate, in this context. The Alpine's display could also be programmed with station call letters or similar information.

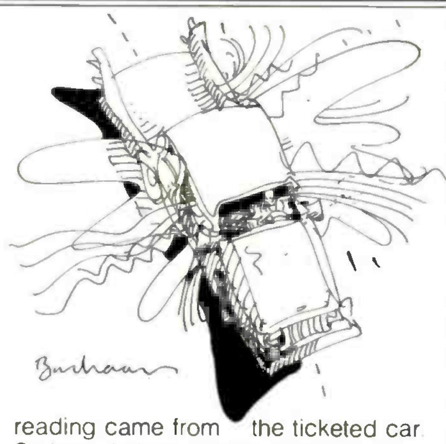
Another double-DIN Panasonic model, the CA-AV1D, lacked CD but had a detachable, flat-panel video screen as its display. I could not determine whether this allowed TV watching while driving or only acted as a TV screen when detached from the in-dash unit and mounted elsewhere.

Prices of triple-threat models range from about $750 to $1,000, while the CA-AV1D is about $1,400. Double-DIN models without CD run about $700 to $850, but these models may not show up here. At least two models, Panasonic's CQ-VZ700D and its CD-less twin, the CQ-VZ300D, would need substantial modification for the U.S. market: Their controls are slanted to the right for Japanese and British drivers.

Car Audio Abuse

We've all heard car stereo systems so loud that you can hear the lyrics from a block away—when, that is, the systems aren't so bass-heavy that the lyrics can't be heard at all. Some lawmakers have heard them too—more important, so have their constituents. From New Jersey to Hawaii, laws have been proposed to curb such nuisances. Some prohibit running a car sound system loud enough to be heard more than 25 or 50 feet away; others prohibit systems which are even *capable* of being run that loud.

Prohibiting system misuse may be more than just prohibiting system capability, but it's harder to enforce. Lawyers could make mincemeat of police who issued a summons when they felt a system sounded "too loud." Even if police carried sound-level meters (hardly likely), it might be hard to prove that a given level



reading came from the ticketed car. So laws limiting system capacity are more likely to be passed. Dealer and manufacturer organizations, lobbying against them, have defeated anti-audio laws in Hawaii and seem to have stalled them in California. However, Jersey City, N.J. has passed an ordinance that prohibits playing audio equipment if it's audible from 50 feet away, and restricts the amplifier power and the number and size of speakers that can be installed or operated in a vehicle. One bill introduced in the California legislature prohibited the operation of "amplified sound systems" where the posted speed was 35 mph or less. The wording of this bill was so loose it would have prohibited all but the cheapest aftermarket systems as well as virtually all factory-installed premium systems.

Meanwhile, a dealer in Columbus, Ga. foresees another potential problem of car stereo abuse. "If the kids buying megabuck stereo systems now were to come back to us as young adults and claim their hearing had been injured, where would that leave us?" asks Mike Hamby of Audio Connection. "Maybe we should get them to sign a release, acknowledging the dangers of misuse, when they buy."

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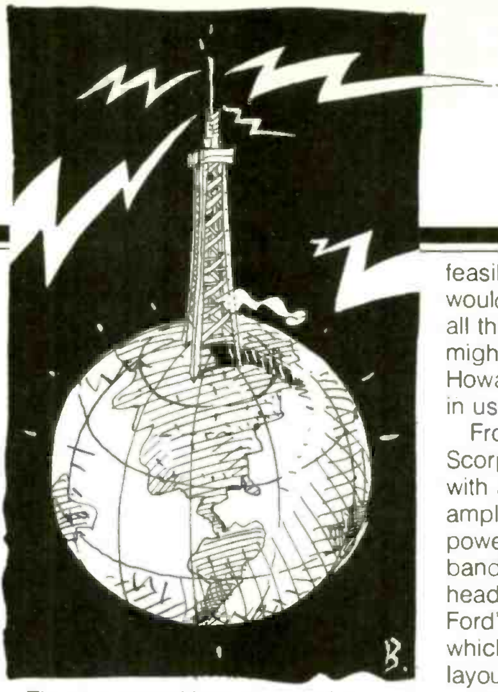

U.K. Update

Frequency synthesis tuners with digital station displays aren't really "digital" (though one might call them digitally *tuned*) because the radio signals they pick up and the audio signals they deliver are still analog. Nevertheless, references to digital tuners didn't bother many people until the CD era, when digital audio became available. There won't be much cause for general confusion until there's digital audio on the air, but that may not be too far off.

According to Geoff Howard, the car stereo columnist for Britain's *Car* magazine, engineers from the BBC and the European Broadcasting Union are working on a digital radio system. At a 1988 international conference in Geneva, frequencies in the 2.5-gigahertz band were reserved for satellite radio broadcasting. According to Howard, these frequencies can easily be picked up in a moving car.

The data rate Howard says is contemplated would be lower than CD's, which would require some reduction in sampling rate (with a consequent drop in high-frequency range), sample size (which would reduce dynamic range), or both. If sample size is reduced, companding techniques could be used to restore some of the lost dynamic range. If it's feasible, I'd hope that car receivers would offer the option of not restoring all that range; on the other hand, cars might be a lot quieter by 1995, when Howard predicts the system might be in use.

From the same source, I learn that Scorpios like mine will soon come with a new stereo system. The new amplifier will be about one-third more powerful and will include a seven-band graphic equalizer. The new head unit (at least in Europe) will be Ford's Premium Sound 2008 RDS, which has virtually the same control layout (and excellent ergonomics) as the Ford Premium units made for U.S. Ford/Lincoln/Mercury cars. However, the 2008 is set up to receive long-wave broadcasts and the Radio Data System ("Roadsigns," August 1989), which are not used here. Therefore, American Scorpio buyers might wind up with a modified version of the 2008 or with the equivalent U.S. head unit.

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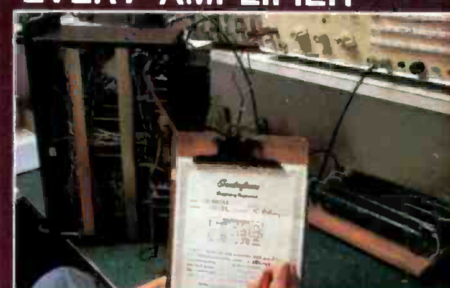

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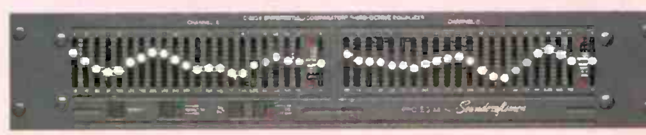

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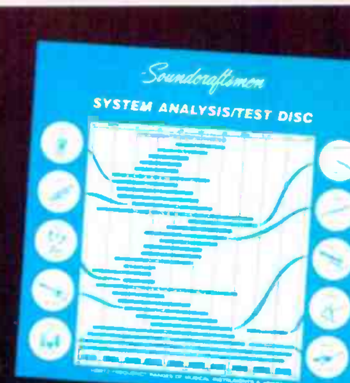

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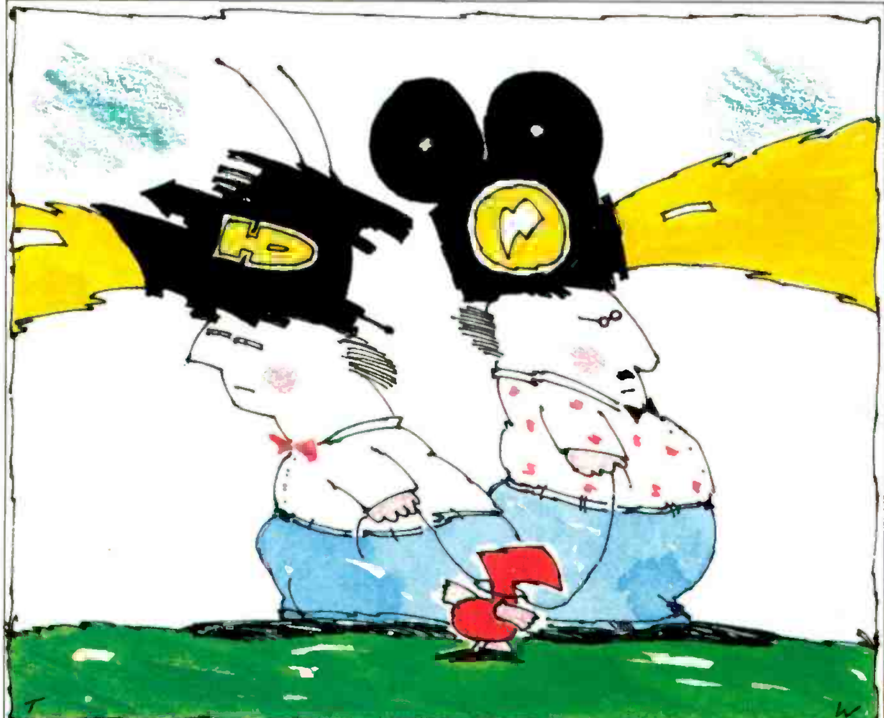

Illustration: Thomas Waters

When we first began to hear about the coming "marriage" of hi-fi and television a good many years back, most of us thought of it simply as a sort of merger of two businesses, if at the time they were rather thoroughly incompatible in their philosophies. Television, better known now in the larger sense as video, was in every way removed from our smaller audio biz, and notably our hi-fi end. We had two industries, or rather groups of industries, which were utterly out of sync both in technology and viewpoint, and they were to be married! Desirable, of course—but how? Somebody was going to have to adjust, i.e., compromise. And we were all too certain it would be *us*, the junior partner in the marriage contract. And so it was, predictably, for a while.

No longer. As suggested in my first articles on the mini-mogul Jac Holzman, founder of the Elektra and Nonesuch labels and now chief technologist for the Warner Communications/Time Inc. group and top man in Cinema Products, the centers of argument have drastically changed. Hi-fi sound and moving pictures, both in the consumer areas and in the huge commercial markets, are already far into each other, and very rapidly moving into further integrations. It is inside this vigorous volcano, the biggest in the entertainment world, that the fierce arguments now occur, in the press—alas—and in the circles of technology. Of course confusion reigns, and indeed, it pours.

In making the point that Jac Holzman has significantly landed not in video, but in film, after his notable days as part of audio, I did not mean to suggest that it is "either/or" with him—either the new HDTV video or the established but still highly dynamic film medium, photography via chemical agents. Far from it. Lately, HDTV has been in the limelight of big publicity—largely ill-informed. Somebody, as I've already noted, has to take the side of the older medium, to restore an objective balance for the good of the whole combined industry. Too few of us are aware of film's immense advantages in certain areas of production. The hoopla about HDTV misleads us all; film has had most of what HDTV offers for many years, and has many more advantages in its special areas, notably "HD" itself—high definition—but also immense superiority in picture sensitivity and in the vital parameters of hi-fi color rendition, as noted last month. Most of all, to recapitulate, film offers a dependable long-time standard of interchangeability, past and present; further, film has the immense advantage (not true of audio) of a fixed and simple mechanism that is never out of date, plus concentrated R & D *on the film itself*, where virtually all the important updating occurs.

The heart of the matter lies, however, in the use of both kinds of photography—let's call them chemical photography (light-writing) and magnetic photography—each of which has special qualities. We should have sense enough to see this. But we don't. It's the marvelous integration of two incredibly refined areas of technique which is in the works and will count in the end—with audio subservient but, nevertheless, right at the center of the integration. Holzman is so excited at this true prospect that he waxes almost poetic, if his poetry is a bit solemn:

"There are clear advantages to each medium, but the choice whether to originate in film or video should be based upon the ultimate intention of the production. Video has a kind of plastic immediacy; film has subtleness and romance. Video brings you up close; film has a softer objectivity."

"Hear, hear," is all I can say! But the man is also entirely aware of the technical details on each side. Having run his own record companies for most of a generation, he goes right on from poetic generalities to specifics:

"A production is not just about capturing images, whether it be on video or film; it is equally about post-production, the editing, manipulation and sometimes digital creation of images to form a synthesized whole. It is here that film, computers, and video can serve each other seamlessly and well." How's that, you audio professionals? He sounds almost like an audio man—though we must always note that in visual motion-picture entertainment, the old audio artistic motto, hi-fi reproduction *of the original*, does not exist and never has existed because, of course, there is no film original. One of these days, I'm hoping, we will understand that except in the technical sense of quality, our audio recording is exactly the same—and always has been.

And so Holzman goes right on: "Routinely, most dramatic television . . . is shot on film, with the use of video assist for instant replay, and then edit-

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A marvelous integration of two techniques—film and video—is in the works, with audio subservient but right at the center.

ed either on film or transferred to video and edited within a video environment." Integration where it matters, you see. Film, for its basic quality; video, at this preliminary stage, only for instant playback, which not even Polaroid can do in the film medium. But if the editing is on video, Holzman warns that, for total integration, "The film negative should be conformed to the video-determined edit decision list so that transfers to formats such as PAL, which have nearly 20% more scanning lines than NTSC, can be achieved without loss of quality." Also HDTV?

Those in the audio profession, particularly the digital end, can see how familiar the film/video integration is going to be, when pictures are "married" to audio. Here's more of the same, a revelation that should be accomplished fact in the photo industry by now. "Kodak," writes Holzman, "recognizing that film would benefit from an easier and virtually automatic method to conform negative to video edit decision list, will introduce in August 1989 a latent image barcode, positioned so that it will relate to the man-readable edge numbers the film editors have used for years. The introduction of Keycode at no additional cost on all EXR film stocks makes it possible to 'print' takes to be routinely transferred to video containing the Keycode numbers within the user bit structure of the SMPTE time code. No record needs to be kept of film takes after that. Once video post-production is complete, the film negative cutters' edit decision list is automatically produced and the original negative is then easily conformed to the video 'answer print.' "

Admittedly, for the casual reader of this magazine, the Holzman account is rather technical. My own head spins a bit at this point, since I am not that close to the film studio! But I know that the audio man who works on his own type of up-to-date editing of sound will instantly see how the techniques are converging toward similar ways of thought and, very soon now, into total integration between film and video—plus the audio that is in both or either, depending on the stage of production. Holzman does not mention audio at this point, but obviously it is *there*, not only coded into the picture timing but necessarily part and parcel of the picture sequence—if mostly after the editing is complete at the dramatic end.

I can't help thinking, on our audio side, of the remarkable advance introduced by the MIDI type of digital integration, whereby, in a similar way, the ins and outs of a variety of instruments, synthesizers, and such are made compatible with each other for easy transfer of audio information; also of machinery such as Colossus, a mighty name for what is, essentially—if I am right—a very ingenious "intermedium" for transferring digital info all over the place, from one format and/or type of equipment to another. This is the crux, of course, in every aspect of the Great Integration, in pictures and sound.

I promised a mention, last month, of one specifically audio bit of information in the material Holzman sent me. It was not in his magazine article but in a reprint of a technical piece by Ed DiGiulio, founder of Holzman's Cinema Products, and was published in *International Photographer*. It's about the rise, fall, and present re-rise of large-size, 70-mm moving-picture film since the 1920s. Obviously, the large size—far more expensive to produce and to equip than the normal 35 mm—was intended for fancier quality in very large-screen projection. The Todd AO process, which many will remember, was introduced with fanfare in the mid-'50s, but its cameras, it seems, actually were wide-screen machines from the late 1920s used by Fox Studios. (Holzman makes the point that film cameras do not go out of date in their basic film transport and lens systems.) Oddly, those 1920s cameras were 65 mm, not 70. Todd AO added the extra millimeters to the production print for—guess what? Two magnetic soundtracks on each side *outside* the film perforations, plus two more inside. That's no less than six soundtracks, all magnetic, back in the 1950s.

The Depression, at near bottom in 1930, finished off the original Fox 65-mm film, but the late-20s cameras were put safely away. The "AO" in Todd AO, when they were resurrected, was for American Optical Company. Their performance update increased the frame speed to 30 fps, but the films also had to be released in 24 fps, which was much too costly. Later on, there were Panavision and Super Pan-

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Big-screen film owes its resurrection largely to audio—to Dolby sound, that is, and the new audio formats yet to come.

avision and Ultra Panavision, with further gimmicks on the same basic system, including various lens-produced squeezes (exactly parallel to our compression/expansion circuitry) for the wide screen. Then, alas, cost being cost, there were cheaper blow-ups from 35 mm to the 65-/70-mm size. All of these, I assume, still included the six soundtracks that gave us the 1950s' "surround" effects, or at least a wide-stage sound, which followed after the famous *Fantasia* presentation.

That took the original 65-mm film, become 70-mm for multiple-track sound, right up into the '70s. But with failing success. Familiarity, as usual, breeds a certain amount of contempt, if not indifference. Then—aha! Guess what, again? You *have* to know: Of course—Dolby. Tailor-made for Mr D., and isn't he always in there when Opportunity knocks?

Dolby and Holzman are remarkably alike in their respective areas. If Holzman got in fast on the new market possibilities for the stereo LP of the 1960s, Dolby saw the light (and the sound) right in time to transfer his attentions from home-type Dolby B NR and C NR to those ailing movie theaters desperately needing some sort of big-space innovation to counter small-space home video. Why not the Big Sound—Dolby Stereo?

And the catch that matched was the old large-screen, large-film format, with its handy six magnetic tracks right out of the 1950s! So large-screen film is now resurrected, and largely thanks to audio. As the DiGiulio article says, more and more first-run theaters are now equipped to show 70-mm presentations—in Dolby, first of all, and in dbx NR and Lucas, with more to come.

"The six magnetic soundtracks on a 70-mm release print were ideally suited to provide multi-channel high-fidelity sound in the theater," writes DiGiulio—and this from a cinema professional in a photo magazine. Audio is getting in there, swinging its real weight.

All the pioneer Dolby system lacked, of course, was the most radical aspect of current audio, also lacking in most video and in professional film releases—digital sound. If I may say so, this is not because Ray Dolby is an ignoramus. It is the industry which consumes analog audio, and Dolby goes along, optimally as usual. There is Dolby for 35 mm too, things being as they are. And for the home VCR. But the optimum format comes with the ultimate in film size and a system now almost 40 years old.

When digital sound finally overcomes analog in the video/film unity we are now working out, you audio professionals will have your biggest chance. All you need is a bit more technical refinement, to mesh with all those other refinements. Holzman, from the film side, is right and so is DiGiulio—and Dolby. We in audio are coming of age in the biggest entertainment of all.

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BERT WHYTE

DAT's BESIDE THE POINT

Illustration: Cristine Mortensen

In the October 1989 issue, colleague Leonard Feldman reported in "Forum" on the Serial Copy Management System (SCMS) for R-DAT recorders. As you know, for more than three years the manufacturers of R-DAT recorders and the Recording Industry Association of America (RIAA) have been embroiled in a bitter battle over the issue of the digital recording of copyrighted music. The RIAA contended that R-DAT recorders were capable of making "perfect" copies of CDs and that this would cause severe financial losses for record companies and composers.

The RIAA expressed their objections to R-DAT recorders even before the Japanese made the first attempts to bring R-DAT to the marketplace. In an effort to placate the RIAA, the Japanese R-DAT manufacturers conceded to having the R-DAT units record only at a sampling rate of 48 kHz per second, thus preventing direct digital copying of Compact Discs at a 44.1-kHz sampling rate. For playback of prerecorded DAT cassettes, 44.1-kHz sampling was provided on the R-DAT machines.

The battle between R-DAT manufacturers and the RIAA has been well documented in the audio press. Except for a limited number of "gray market" recorders brought into the United States, there has been no "official" importation of consumer R-DAT recorders by the American agencies of the Japanese manufacturers.

In his report on the RIAA/R-DAT "peace pact," Feldman described the workings of the Serial Copy Management System. Ostensibly, this agreement, and a new generation of R-DAT recorders equipped with SCMS, will finally enable importation of these new recorders into the U.S. In actuality, there may yet be some points of contention between the two factions that may make some waves in the presently calm waters of R-DAT.

For one thing, manufacturers will likely not rush the new SCMS-equipped recorders into production unless the U.S. Congress legislates the RIAA/R-DAT pact into law. For another, the agreement reached on SCMS in no way precludes the future imposition of some sort of royalty on R-DAT hardware or, more especially, blank R-DAT cassettes. This might be possible through some RIAA-sponsored legislation, although the whole royalty idea is adamantly opposed by the Japanese.

Apparently, the Japanese are not very happy with the technical constraints imposed by SCMS, but they support it because, as a U.S. import law, it would keep "bootleg" Taiwanese and Korean R-DAT recorders—capable of unrestricted 44.1-kHz direct-digital CD duplication—off the market. Although a few SCMS-equipped R-DAT recorders may be introduced at the Winter CES in Las Vegas, in my opinion it will be just an exercise in one-upmanship.

Persistent rumors indicate that manufacturers will not produce large quantities of new-generation DAT recorders unless there is a substantial library of prerecorded DAT cassettes available. This indeed poses some problems—not the least of which is a reported announcement from PolyGram (London/Decca, Deutsche Grammophon, and Philips) that they will not issue any prerecorded DAT cassettes until the SCMS protocol actually becomes the "law of the land." In other words, it is once again the old chicken and the egg riddle—one which has plagued every prerecorded tape medium since magnetic tape was invented. Put simply: No large number of R-DAT machines, no large number of prerecorded DAT cassettes—and vice versa.

Thus, in spite of the SCMS agreement, many problems still remain to be overcome before R-DAT can really become a viable consumer product. The most optimistic insider guesstimate puts the probability of a general launch of R-DAT sometime in the fall of 1990.

It is no secret that a recordable, erasable Compact Disc exists in the laboratories of a number of companies. In fact, several versions of these recordable CDs have reached a pretty advanced state of development—so much so, that nothing much more than marketing decisions are necessary to introduce them into the consumer audio marketplace. It is felt that the imminence of recordable CDs, which the RIAA views as an even greater threat to their interests than R-DAT, was the most compelling reason the SCMS agreement was reached. With the introduction of R-DAT, recordable CDs could be held at bay—on the back burner, so to speak—for a longer period of time.

Viewed in the most simplistic terms, R-DAT is a clever mini-recorder, resembling a VCR in its tape transport

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DAT's usefulness in pro audio notwithstanding, I predict a rocky road for the format in the consumer market.

and mechanical functions but with the considerable advantages and sophistication of digital audio and electronics. I have used a Sony DTC-1000ES R-DAT recorder for some years, and it has performed flawlessly. Unlike with analog tape recorders, wow and flutter is not a problem in R-DAT recording. Frequency response is ruler flat over the entire audio spectrum, dynamic range can reach 100 dB, and tape noise is virtually nonexistent. Add the two-hour recording time of an R-120 cassette to electronically controlled programming and tape handling, and the R-DAT system is a versatile, consistent, reliable, high-quality tape recording medium.

While the consumer R-DAT market has been trying to cope with its numerous problems for the past three years, the professional R-DAT market has flourished.

Early on, most recording engineers who tested R-DAT recorders found that, at least in terms of straightforward two-channel stereo recording, the R-DAT system was the equal of more elaborate and expensive digital audio recording systems. These engineers particularly liked this high performance available in such a small, convenient, lightweight package, ideal for remote and location recording.

After initially using consumer R-DAT recorders, engineers soon were able to use special professional R-DAT recorders from Sony, Technics, Fostex, and others. These recorders had refinements such as AES/EBU inputs and outputs along with SDIF (Sony/Philips Digital Interface Format) outputs and, in at least one case, SMPTE time code. The professional R-DAT recorders could record at the 48-kHz sampling rate and at 44.1 kHz. This was mainly in aid of CD master production. In spite of the 44.1-kHz recording capability, CDs still could not be copied digital-to-digital because of the copy-prohibit flags that are encoded in every CD.

Being considerably less expensive than the usual professional video and open-reel format digital recorders, R-DAT machines soon became favored by the many small "mom and pop," basement and garage recording studios, finally enabling them to offer their clients digital recording. Clearly, the professional market for R-DAT recorders has been firmly established.

Having said all these good things about R-DAT recorders, and even in the light of the SCMS agreement, I predict a rocky road and limited sales for R-DAT recorders in the consumer marketplace. In fact, I predict much the same fate and limited acceptance for recordable Compact Discs. The basic question, quite simply, is, what would the average consumer, or even the most avid audiophile, record on their R-DAT or recordable CD machines? There certainly is no point in recording from vinyl LPs, except to preserve rare items. Copying from CD makes even less sense, unless it is to make customized compilations for use in car DAT players. Live recording, even allowing for requisite good-quality microphones and recording skills, would most likely be limited to children's birthday parties, the church choir, or the high school band—all not very musically satisfying. Recording off-air via a good FM tuner might once have been a worthwhile pursuit in this country, but broadcasts of live music—pop and especially classical—are very rare. One longs for the off-air recording opportunities available in London, with five major symphony orchestras whose live concerts are frequently broadcast by the BBC. The BBC, moreover, has some well-skilled recording engineers who are venturesome enough to use such things as M-S stereo mike pickups and even Calrec Soundfield Ambisonics pickups!

For most people, the recording capabilities of R-DAT machines would be infrequently called upon. Most R-DAT machines would be used for the playback of prerecorded DAT cassettes. And in matters of sonic performance, R-DAT and CD are on about an equal footing.

Inevitably, most audio equipment must make a major contribution to the reproduction, appreciation, and enjoyment of music. If there were no such thing as Compact Discs, R-DAT would be greeted with loud huzzahs and would rapidly establish itself as the darling of audiophiles. But as it is, whether your tastes run to pop or classical music, it is my opinion that CD recordings are likely to remain the preferred medium.


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Laurie Fincham

bass viol to bass driver

DAVID LANDER

In one sense, Laurie Fincham came along too soon. Had he entered this world just two hours later, his birth date would have coincided with King George VI's coronation day. Every child born in England on that auspicious occasion was presented with a free baby carriage.

Yet many would agree that Fincham, a longtime KEF engineer who now holds the title of technical director at this Kent, England loudspeaker firm, arrived on the scene at precisely the right time. Not only can he be credited with numerous advances in KEF speakers over the last two decades, but he pioneered the use of computerized measuring techniques in loudspeaker development and production.

Fincham, whose given name, Lawrence, shortens to Laurie in England (he was surprised to find out it's a woman's name in the U.S.), was born in Southampton in 1937. During the war years, he was sent to a private school in Wales, which he remembers fondly. He later studied engineering at the University of Bristol, where he was more interested in playing bass in a jazz band than he was in applying himself to the curriculum.

Laurie Fincham on string bass, with vibist Bill Le Sage sitting in on piano (circa 1959), at the first anniversary of the Jazz Club

Once professionally involved in loudspeakers, however, Fincham's thirst for knowledge of his chosen subject grew. He even returned to school at age 28 to learn more about acoustics. Finding once again that formal education wasn't a proper route to the understanding he sought, Laurie Fincham began to pave his own avenue to advances in speaker design. In this interview, he describes a few of its significant landmarks.

The author wishes to thank Dick Moore for his insightful help in preparing this article. *D.L.*

PHOTOGRAPH: ELENA SEIBERT

Music and hi-fi were among your interests even when you were a schoolboy, so why don't we begin with some recollections of those days?

I went to grammar school when I was 11. Keen sportsman. Played a lot of cricket and tennis. Minimum amount of work. I was keen on model aircraft, explosives, music, girls—the usual things.

Explosives?

Oh, yes. I was a great bomb maker. I would have made a wonderful anarchist. The beginnings of my engineering came with making my own cannons. I designed them with recoil mechanisms to improve their accuracy. And I used to make delayed-action bombs, remote-control bombs—all sorts of things.

A young friend of yours introduced you to hi-fi at around this time. Was he a fellow bomb maker?

He was the ringleader. He was a bit eccentric, but he could afford to buy equipment, and he had one of the first Quad electrostatics when he was about 16. That would be about '54, '55. He was also quite a keen musician, a guitarist, and introduced me to modern jazz. After a while, I got into model aircraft, so there was a sort of choice between becoming an aeronautical engineer or electrical engineer. And as I didn't want to go into the army, I chose electronics, a deferred occupation. So I went to university when I was about 18 to study electrical engineering. But of course, in those days, there really wasn't any electronics to speak of. We didn't have a single transistor in the department the whole time I was there. They had just one loudspeaker, and they would encourage you to measure interesting things like accession to inertia. It was heavy engineering—hydroelectrics and so forth. So while I was there, I did—again—a minimum amount of

As a student, I played jazz, wrote comedy scripts, acted in revues, and did whatever didn't involve electronics. I didn't have the interest, you see.

The Jazz Club was run by four members of the John West Group, one of whom was Fincham, shown here playing bass with vibist Bill Le Sage, baritone saxist Ronnie Ross, and pianist Stan Jones.

work, but I played in a band. I took up the bass when I went to university. We used to play be-bop with berets and dark glasses and little goatee beards. And I used to act in revues, write comedy scripts, and generally do anything that didn't involve electronics. I didn't have the interest, you see. When you go to school, they get you on this treadmill when you're 15. After about five or six years, I was fed up with it.

What did you do after you graduated?

When I left university, I did an apprenticeship with Rediffusion, and I played a lot of music. Rediffusion are an enormous combine. They owned a TV company; they were into music distribution, they used to make flight simulators, r.f. welding machines, endless-tape players for background music. They used to take on students, and you'd spend maybe a month or three months in various departments. So I did work on flight simulators, which in fact was very interesting because they had speakers there where they were trying to simulate taxi rumble, turbine whine, and so forth. The first job I had was at their research department, which was right at the beginnings of stereo. Rediffusion used to sell these really nasty little speakers that they would put in hotel bedrooms. It was a cable, and they had the idea that they would distribute stereo and sell twice as many speakers and charge more for the service. I became involved in doing some work looking at stereo and played some of the early Capitol tapes with artists like David Rose and Gordon Jenkins. So I did a bit on speakers there, and after that they offered me a job somewhere in the north of England. I was playing so much jazz at the time that I wasn't interested, so I packed up and went more or less full-time as a professional musician. I used to write music all night and play. And then, during the day, I'd sleep.

Did you envision a career as a professional musician?

No, I didn't really. I liked playing, but I wasn't good enough. I wanted to be a really good bass player, but I realized that I was never going to make it.

Are you still friends with any of the people you played with then?

The pianist. We've been friends for over 40 years. Very good player. He has perfect pitch, which is an absolute pain in the ass if you don't have it. He can sit down and play anything, just hearing it first time. For a time, I thought every [musician] could do that.

Mozart could.

Well, that's the point, I suppose. And if you've knocked around with Mozart, I should think he'd probably put you off any thoughts of becoming a musician.

So you got into loudspeaker design at Rediffusion.

I didn't design speakers. I just got the feeling that speakers might be a good thing to do. Then I saw an advert for Goodmans. They were looking for engineers. So I went along there and got a job as a junior development engineer. And I did what everybody else does who gets into speakers—I did all the wrong things. You get into speakers and you think, "Oh, good idea to make stiff cones." I was playing around with expanded polystyrene, things like that. There was a lot of that going on in the late '50s, early '60s. So I did that for a bit, and then they found out I was a musician. Goodmans were pretty old-fashioned at that time, very much a '30s company, and so they used to get me to deal with all the musicians who called at the door with broken speakers. I ended up designing quite a lot of musical instrument speakers—this would be about '62, I suppose, just the beginning of rock and roll. The big revolution had come about in the late '50s, when I was still a student, but, being a good be-bopper, I looked down my nose at rock and roll. I thought it was terribly beyond the pale.

The Maxim loudspeaker, which was sold in the U.S. under the name Maximus, was designed by Fincham while he was working as an engineer for Goodmans. It was his first commercially successful design.

How did rock and roll change things?

I think what happened was that, all of a sudden, the speakers people had been making over the years suddenly became too feeble for use with musical instruments. When I started playing in bands, no place had P.A. There'd be one carbon microphone and a little 10-inch open-baffle speaker stuck up in the corner. Rock changed all that. They had to have stage P.A., and they had to have amplifiers on stage. In the early days, designers in the U.K. designed everything in a classical, orthodox way, so you had hi-fi amplifier designs being produced for guitar amplifiers, and of course that was totally wrong. Fender over here knew perfectly well how to do it. They just designed amplifiers with very little feedback. So I used to travel around to various guitar manufacturers, just talking to them about how guitar amps should be designed, and then I started on a miniature hi-fi speaker called the Maxim. It was sold over here under the name of Maximus.

Tell us something about it.

In the very early '60s, there was a company called Leak, and there was a man there called Don Barlow, a very interesting and quite innovative engineer. He made a tweeter that I think really was a rip-off of a Wharfedale tweeter, which was a sort of straight-sided 3-inch cone with a cloth surround. In the lab at Goodmans, at the time, was a chap called Ted Jordan—E. J. Jordan. He'd seen this cone, thought he could make a miniature full-range speaker based on the design, with lots of bass, and he did a bit on it. He'd stopped playing with this thing, and I decided I would develop it into a little full-range drive unit, but it didn't work out. Then Goodmans took an interest in putting this thing on the market. I panicked. We had about six weeks to go, so I designed a little cone tweeter to go with it, and they did extremely well with it. What was funny was that, later on, it got copied quite a lot by other people, and they copied all the things that were wrong! The reason we were using these huge magnets was that somebody in the buying department had over-ordered. They bought 10,000 of these large steel magnets and said, "Use the damn things up." But of course they were too big, so I had to open up the gap. And they were too mean [British for "cheap"] to spend money on new voice-coil formers, so I made a very fancy plate shape so it would reach into the gap. It was amusing to see how people copied it without really understanding it. There wasn't anything fundamental about the thing. It was just fortunate that it was the break you need early on in your career when they say, "Who did that?" So I then got offered a job by Celestion because the former managing director of Goodmans had left and gone there.

Tell us about your tenure at Celestion.

They didn't really have a hi-fi department. I think that when I arrived there, we didn't have an oscillator. We had to borrow it from one of the subsidiaries in the group. I think we had an AVO meter, which is a very old-fashioned moving-coil meter, and that was about it. Celestion were an even older company than Goodmans, but they were extremely mean. Whereas Goodmans had an anechoic chamber, lots of equipment, and lots of graduate engineers, Celestion had no anechoic chamber and I was the first graduate they'd recruited in 29 years. They used to call me Einstein and a few things like that. But it was a great place to work because there were very, very good mechanical engineers there. I worked for an old fellow called Les Ward—looked like Sir Adrian Boult, actually. He was a bit of a spiky character. He was a former boxer, I think, and used to play the trumpet in a band. He was a very good mechanical man. He taught me lots and lots of things about mechanical speakers, about horn speaker design. He was totally intuitive, completely self-taught.

"Totally intuitive" sounds like a lot of people's conception of the ideal speaker engineer: Three parts magic, one part science.

People like to think there's witchcraft in speakers. Now I'm not here to say there isn't. A good chef, with the same ingredients, will always cook a better meal. What I *am* here to say is that an awful lot of it isn't witchcraft. It's just lack of understanding. If we just get rid of the perhaps 90% that is amenable to analysis, then we could get on to the bit that really matters.

In fact, you've pioneered a lot of the analysis that's been done in the speaker industry during the last 15 or 20 years. One of your principal activities since moving to KEF has been computerized measurement. What got you interested in that?

About 1969, I had a call from a man in Bradford University called Rex Leedham, a genuine eccentric but a very innovative character. He wanted to simulate the acoustics of a living room, which was quite an advanced thing to be looking at in 1969, because there weren't many computers about. He had with him a very bright young student called Mike Berman, who subsequently came and ran our research department. He was doing a Ph.D. on the simulation of room acoustics. Anyway, we got together. At this time, I'd been working with speakers for about eight or nine years, and I realized I knew very little about what I was doing. It hasn't changed much. I'm bound to say, 20 years on, we're still as dumb as we were then. It's just that we thought we were smarter. So I thought there must be a way of measuring speakers other than with sine waves. I've always had this feeling that we use the wrong signals, the wrong instruments, to test speakers. What we do is use the instruments that are to hand. We don't ask ourselves whether that's appropriate. I think we should test speakers using the signals that the speakers are actually going to be used for—music. A lot of the work I've been doing over the years has been trying to get signals that are closer to musical sounds than they are to sine waves.

Famous British electronics engineer Peter Baxandall aided KEF's work on the 104/2 when he suggested that the driver be put into the box, rather than on its face, and that servo feedback be used.

You're getting ahead of yourself. Tell us about the first computer experiments you did.

We started measuring the transient behavior of speakers using pulses. We bought an instrument called a single-point correlator to do this. So I said to the salesman, "What are we going to do with that?" He said, "Well, can't do much. It's just the pulse response." And I said, "Well, I can't tell anything by looking at that." "Ah," he said, "what you want is a Fourier analyzer. It'll analyze the frequency content of this pulse." I said, "How much are they?" "Oh," he said, "they're about 14,000 pounds." Now in 1970, 14,000 pounds was like $300,000, so what we did was obtain a grant from the government—the university did—which enabled them to buy one of these Fourier analyzers. Rex Leedham and Mike Berman did a project there and also acted as consultants for KEF. They did this for three or four years, I suppose, and every weekend I used to travel up and down the motorway to Yorkshire, which is about 200 miles from where I lived, to see how the experiments were coming. In the end I said to Mike Berman, "You'd better come and work for us because I'm fed up with doing all of this." So he said he'd come down to Kent, and he did in 1975.

And KEF bought its own Fourier analyzer at this time?

Before we bought it, I went to HP in California. Now these things were used on nuclear subs and by car manufacturers. They weren't used in the audio industry at all. I said, "We'll buy it on one condition. You've got a mass storage device. Surely we can record music on it." So they set up these experiments, and I think we could sample at 20 kHz, which gave you a maximum frequency of 7 kHz. But the idea I had at that time was this: If we could record music, store it on the computer, and measure the speaker digitally, then maybe we could simulate the effect on the reproduced sound of changing the measured performance. When Mike joined, we developed a scheme for recording directly onto a computer disc and did a presentation, I think in 1975, at the AES in London, where we recorded on a hard disc, a removable one.

How much signal could you store?

We could get 20 seconds of music on it. It was 14-bit resolution and 79-kHz sampling—pretty advanced for those days. The A-to-D converters we used cost us, then, somewhere in the region of $8,000. What we did was record the music on the disc, then digitally filter the music as if it had been played through a speaker. We used a technique called convolution, which is pretty slow. In fact, it used to take about eight hours to pass 20 seconds of recorded music through a digital filter. We couldn't do this during the day because it would hog the computer, so Mike Berman had a bed in there. He used to switch the thing on, go to sleep, and then have to wake up halfway through the night because the computer didn't have a very wide dynamic range. At that point, he'd go through the data looking for the largest value so he'd get good signal-to-noise. Well, as you can imagine, the glamor wore off after a few nights. So we didn't really do any more with the technique. In fact, it's taken from then until now to have real-time DSP machines that can do what we wanted to do 15 years ago. We were frustrated by lack of equipment, so we just used the computers for measuring speakers initially.

You've relied on a number of universities for personnel and research over the years, which is not something American speaker companies do. What's your rationale for this?

What we've found is that you cannot have all the skills that you require within a research department, even when it's pretty well equipped and fairly well staffed. Even with six or eight engineers, you couldn't have all the skills you wanted. When I want to get somebody to work on a project, I go and find the best man in that area, [the one, for example,] who knows the most about DSP or acoustics. So from our point of view, going and working with a department of a university was a very good thing for us to do. It was never done hands-off, mind you. It was always directed research. We would certainly go along with a list of things we wanted to know and give them some sort of time scale on it. We must have worked with eight or ten universities, I suppose. But I do a lot of lecturing at universities, so we've always had that link with them. In fact, the man who runs our research department, Dick Small, was an academic.

In the future, the front-end of audio will disappear, and speakers will be the only thing left. They'll be plugged in around the house like table lamps.

A live-versus-loudspeaker demonstration featuring jazz bassist Red Mitchell in a showdown with the KEF 104/2 speaker system. Such a test pits the speaker against its true signal—music.

Right, in Australia. How did you come to meet him?

I've known Dick for ages. He was doing a Ph.D. in Sydney, and he'd measured some speakers I'd designed. That all really stemmed from Neville Thiele. I'd got hold of Thiele's famous paper on reflex enclosure design, which he wrote in '60 or '61 when I was at Goodmans. I didn't understand a word of the thing, but I persevered with it and eventually put in measuring-system equivalents that used a lot of Thiele's techniques. Dick Small, when he was doing his thesis, was surprised to find a company that appeared to understand what this was about. Thiele was not as well known as he is now.

In fact, Small first worked for KEF while he was on sabbatical from his university job. When was that?

I think it was '84. He stayed with us six months or a year; the time just flew by. Then he went back to Australia.

How did you get him on a full-time basis? A lot of people would agree that was a great coup.

At that time, there were a lot of cutbacks—more students, less time for research—and he wanted to do research. And the equipment he'd so carefully built up for pulse testing had all been cannibalized for other purposes. I think he became pretty disenchanted with academic life. I went over there, and he voiced that. He said, "I'm really thinking of getting out." So I said, "Give us first refusal." He said, "Well, I didn't think you'd have me." I mean, that was Dick. He's a very modest soul.

In addition to computerized measurement, you're well known in the speaker industry for your work in the area of low-frequency response.

That's the easy part. That's the reason [laughs].

Well, let me combine two thoughts here. For one thing, you've said that *certain things you've worked on have been developed in stages over a period of many years. The coupled cavity in the KEF 104/2 is an example of that and also represents your work in the low-frequency realm. What can you tell us about it?*

We were working on a servo system, in the early '70s, with Peter Baxandall. Baxandall had this idea, and he said, "If we just put the speaker inside the box and listened to what came out of the port and used servo feedback, we could make a really good bass speaker." I got to thinking about that and thought, "Yes, but we could do that with a passive system." I thought it was new at the time, and I did an analysis over Christmas in 1974. Within two months, I got a letter from a good friend of mine named Siegfried Linkwitz, who worked for Hewlett-Packard. He said, "Look at this thing by Onkyo. It looks like the thing you've just described." So I thought, "Forget it; it's not even original." And we left it on the shelf for about five years. Then I thought, "Well, it's interesting. I'll write a paper on it." So I did a paper in '79, and then we produced the product in '84. It had been hanging around for 10 years. It was on the shelf, and I thought, "Well damn it, I'll make it work." And we did, finally.

Then didn't a French company get in touch with you, claiming the idea was theirs?

Elipson. They said they'd invented it and that they'd patented it in 1968. I was sure they didn't have the exclusive patent on this thing, so I went on a great patent search. We then heard through our Danish agent—this is how these things go—that he had read an article reprinted from a French underground magazine saying that the original design had been done by someone in the United States. Now [KEF founder] Raymond Cooke—who loves a detective tale, just loves sleuthing after things—came over to the States and [went through the archives until he] found a reference to this speaker. It was designed by a couple of people called Baruch and Lang in about 1951. They were the ones who had done all the original work.

My feeling about patents in this business is, it doesn't matter a damn who was the first to think of something. Make it into a product; otherwise, it's pointless.

Basic psychoacoustic research is being carried out in the Archimedes project, a joint venture between the Technical University of Denmark, B & O, and KEF, to show how a room interacts with a speaker.

You're now two years into an extremely ambitious project with Bang & Olufsen that involves the interaction of speakers and room surfaces.

What we basically did was to say that the differences in sound between nominally identical speakers must have to do with the reflected sound in the room—that the way sound was reflecting off the walls was influencing what we heard. That must be due to two things: The directional characteristics of the speaker (the way in which it spreads sound around the room) and the acoustics of the room (size, shape, where you're sitting, and so forth). Now there are so many variables with a speaker in a room that we thought it would be nice if we could deal with one thing at a time. We decided to do it by a simulation method, where we set up a number of speakers, a number of sources, in a completely free space, with each source representing one reflection in a room. So—in theory, at least—we could change the nature of these reflections by just attenuating or filtering the input of the various speakers. We knew from Mike Berman's work in the early '70s that you could analyze a room in this way, make computer models where you used an analogy between the behavior of sound in a room and [the behavior of light if] the walls in the room were mirrors. So we set up a program where we were going to make sound sources as good as we knew how to make them. We would hang them up in this chamber in an array predicted by a computer, [and that] would simulate a listener in a particular room, listening to a particular speaker.

And how far along are you?

That's pretty well where we've got to now. We've got the thing set up in the anechoic chamber, and we'll be able to simulate the effect of changing the acoustics of the room. I could actually move the room, with respect to the two of us, just by flicking a switch. We can change the directional characteristics of the speaker—at least we can simulate the effect of that change. By doing this, we hope to come up with the degree of sensitivity that the ear has to changes in the room characteristics or in the [loudspeaker's] directional characteristics.

So you'll be exposing live listeners to computer-programmed changes in the reflection characteristics of simulated rooms?

Yes, that's right. You sit in a chair in this anechoic chamber and just look into space, because you can't see any of this at all. You're in a net curtain tube, and all these speakers are hung at various positions around you. You have a keyboard, you're given a sound, and you have to key in a response. The psychoacoustic tests are set up to let you hear two things in relation to one another. For example, we could ask, "How important is the reflection from the floor; does that make a difference?" We could program in a floor that was concrete or a floor with a foam-rubber mattress on it or something like that. Now what we're interested in [determining] is, at what point do you hear the difference? We're interested in thresholds.

So you've come full circle. You're back to flight simulators, except that this simulator is for the ears exclusively.

Absolutely.

Will these experiments lead us to the perfect speaker?

Our object in these experiments is not a reproduction system that is perfect. It's a system that is as good as the best available today, no matter where you use it. Wouldn't it be nice if you could make a speaker that always sounded its best, no matter where it was?

But just how complicated would such a speaker have to be? A number of hi-fi designers are now turning to very complex signal processing. What ever happened to the old audiophile ideal of a straight wire with gain?

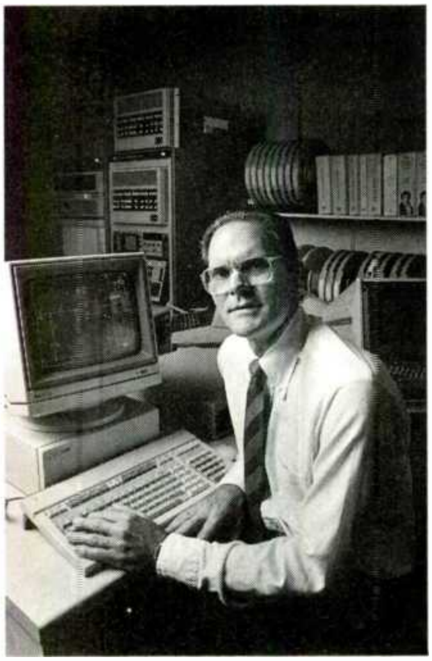
I don't like having a lot of technology if you can possibly help it, and I don't expect that the systems that come out of these researches will be that complicated. People have had a go at these room equalizers, and they came up with immensely complicated systems that tried to recreate the perfect signal at the ear. That's an absolute waste of time. You have to *produce* the right signal at the ear. The ear's very tolerant of the wrong signal in many cases and, [in others], very intolerant of something that's just slightly off.

I'd like to go back to your earlier comment about everything in speakers having been done, or at least having been conceived, before. In the late '50s, Ed Villchur's acoustic suspension was held invalid after he sued Electro-Voice for infringement. Apparently, Harry Olson had written about it.

My feeling about patents in our business is, no matter what you think of, it's always been done before. In a way, I suppose, I cling to the view that it doesn't matter a damn who was the first to think about something. It's the first person to *do* something about it. Go and make it into a product. Otherwise, it's pointless.

It's interesting that loudspeaker technology has changed a lot less than some related audio technologies. The idea of a dynamic, moving-coil loudspeaker, for example, is rooted in another age entirely.

The original moving coil was proposed in 1877. We're still light-years away from other industries. What appalls me about loudspeakers, as I always say to people, is this is an agricultural business.



Australian Richard Small was able to extend his countryman Neville Thiele's work on box design and driver interaction so that designing a system is no longer a black art.

Why? Is it that you and your colleagues are slow, or that your predecessors were so visionary?

I think it's a bit of both, really. I think that the brightest people were in audio when audio was an emerging business. All the bright people worked in Bell Telephone, Westrex, and they were all working in the '30s. It was the cinema which was pushing it forward, the need to have high power output and so forth. Then they got into the war, and it was underwater speakers and hydrophones for sonar. After the war, it was TV, so all the people went to TV. Now they're into computers. So for a long time, we did not attract the best people into the industry; it was a peripheral industry. The other reason, I think, is that the moving-coil loudspeaker was actually quite a good idea. It's like the piston engine. Why do we not have turbines or electric motors in cars now? Because [the piston engine] was really pretty good. The trouble with speakers is they work better than they ought to for such a crude device that's relatively inexpensive to make. That's one of the reasons why they won't change. The other point about speakers is there isn't really an economy. Take a TV set [from] 20 years ago: [Today,] you can make it for a fraction of the price. A speaker you can't quite [do that with], because it's a chunk of wood. It costs *more* money than it did before. All the parts. There's no benefit of miniaturization. Really, when you think about it, there's an indictment. We're not really doing it the right way. All we've got to do is shift a bit of air.

Will it change?

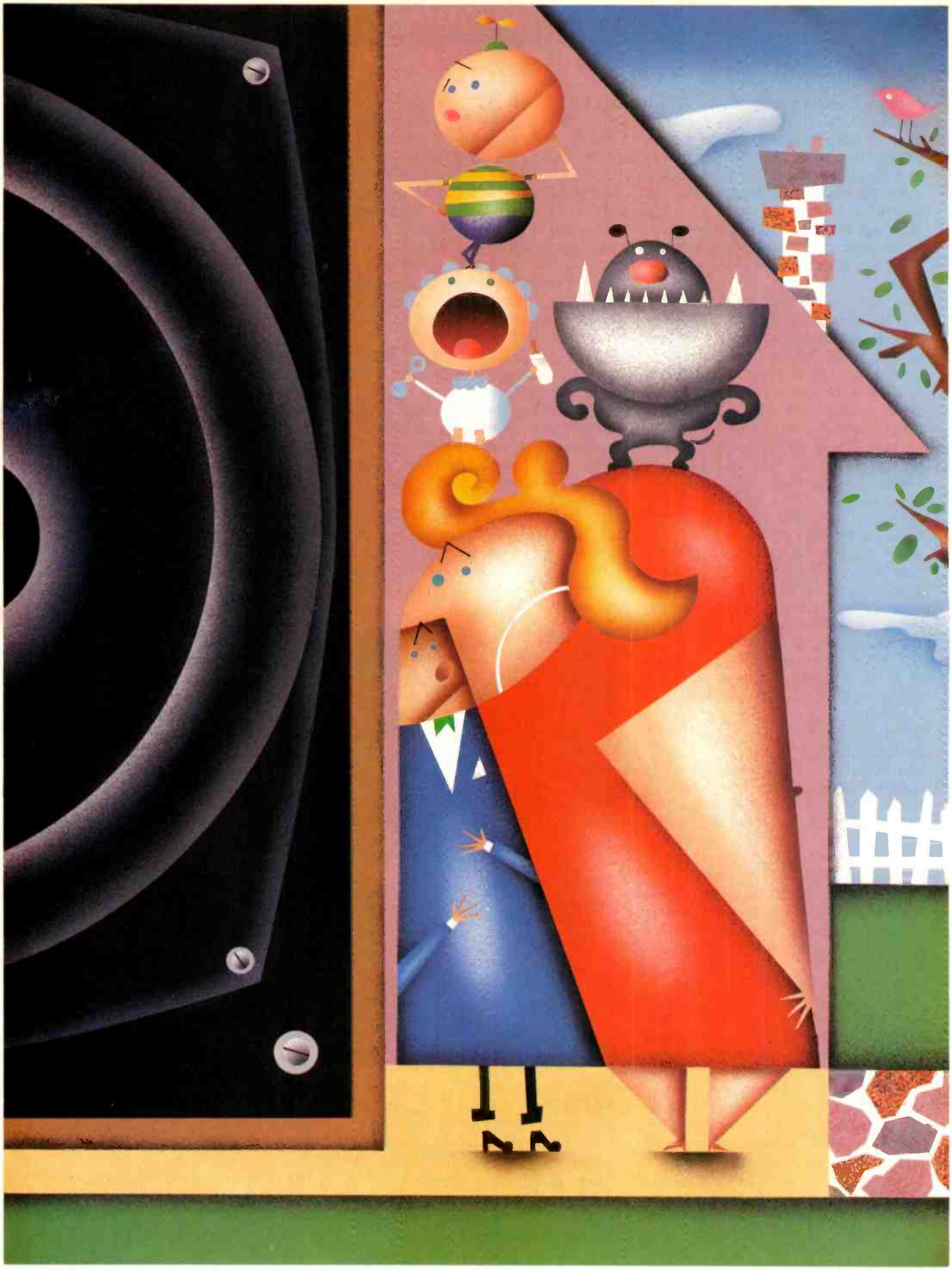
It will change. The thing that will happen is digital processing will go into speakers. There will be other technologies that allow us to reduce the size of enclosures. It will happen. It's happening now.

Can you give us a more detailed picture of this?

Yes. I think what will happen is the front-end of audio will disappear, and the loudspeaker will be the last thing left over—no matter what. I don't think speakers need to get that much better, but they need to be more convenient. I think speakers, in the end, will be things that are plugged in around the house, like table lamps.

But there will be loudspeakers.

You've still got to get something to actually shift the air. It's the last interface with your ear.



JAMES S. SHERWIN

CERTIFIED BASS FOR THE CERTIFIABLE

The design, measurement, and subjective evaluation of large subwoofers capable of complementing the dynamic impact of efficient horn loudspeaker systems in the home has intrigued me for several years. While I recognize that few would choose to live with a pair of subwoofers when each occupies 32 cubic feet of living-room space, many would appreciate the sonic results. I have lived with a JBL Hartsfield corner horn, possibly the most graceful of loudspeaker boxes, and still use a 60-cubic-foot compound bass horn, but neither has had the bass extension below 20 Hz realized by these subwoofers. I've never built concrete exponential horns extending outside my living room nor met anyone who has, but I did once buy an 11-rank pipe organ (653 pipes) to install in my home, so maybe that qualifies me as certifiable.

I recently fixed upon the idea of extending system response another octave below the 40 Hz of my existing horn system as well as realizing improved time coherence by eliminating the folded horn. Even I deem straight bass horns with good 20-Hz response to be impractical, hence my decision to use vented boxes for a subwoofer design. The first step in the transition was to design, build, test, and audition these subwoofers. The next step will be to abandon the large horn for a more compact mid-bass short horn working above 80 Hz.

The desired results have been achieved: The bass extension is significant to below 15 Hz and is flatter than expected, no bass-boost or peaking networks are necessary, and each of the two subwoofers is capable of producing 96 dB SPL at 1 meter for 1 watt input. Their efficiency is only 2.6%, compared to 10 times that for the remainder of the horn-loaded system, but it is nice to know that the full impact of a bass drum can now be reproduced in my living room. These subwoofers do wonders with source material such as pipe organ, large bass drum, synthesizer, thunder, and even cannon shots. Telarc's *Time Warp* (CD-80106) is stunning with this system, but there is another, more important improvement I will discuss later.

The Quest for All of the Music

Much attention has been given to extending loudspeaker response toward and even beyond 20 kHz, where any real improvement may possibly come from an attendant approach to a linear-phase system rather than from the reproduction of any musical harmonic content in the nether reaches. This attention may be well deserved and is certainly less space consuming than an extension downward to 16 Hz. However, when musical response is extended upward without similar extension downward, the balance of the music structure may suffer. I cannot guarantee this to be the case but have observed that the bass at concerts is *much* more apparent than in reproduced music, whereas the highs seem similar.

Commercially available subwoofers were passed over because few, if any, can produce the desired level of clean low bass, and most give up low bass response and/or utilize active equalization to gain bass extension without resorting to large cabinet sizes. While many available units no doubt produce results superior to what may be achieved with conventional loudspeaker systems, I decided on larger boxes for improved efficiency that would enable my system to extract more dynamic impact from the music source. It may be safe to limit the discussion of required SPL to that expected with orchestral instruments, drums, and synthesizers because reproducing cannon, thunder, and other environmental sounds at realistic levels is probably out of the question. Assumptions of a

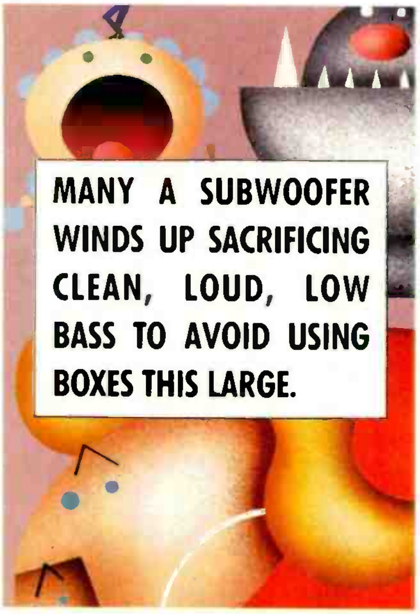
ILLUSTRATION: TERRY ALLEN

90-dB SPL average listening level for symphonic music and 20-dB peak-to-average levels have often been used in determining peak required SPL for effective music reproduction. Rock music is typically played at higher average levels but normally exhibits a lower peak-to-average ratio. Using the above values, music peaks of 110 dB SPL must be reproduced at the listening position. The subwoofer handles most of the power because the orchestral bass drum creates the highest of these peaks at 40 to 60 Hz. Measurements made on one-octave pink noise centered at 31.6 Hz, at the 5-meter listening position in a moderately large living room, show the SPL to be 10 dB below that at 1 meter from the subwoofer. The net result is that the subwoofer is required to generate 120 dB peak SPL at 1 meter. Fielder and Benjamin [1] found that, on some CDs, environmental, synthesizer, and pipe organ sounds would extend the required frequency range to as low as 13 or even 10 Hz (see Table I). It seems likely, then, that the greatest music dynamics can be reproduced only with large subwoofers. Whether this is worth sacrificing 32 to 64 cubic feet of living-room space is up to the individual. This writer is pleased with the trade-off, but you may remember that I am probably certifiable.

The Design

Ground rules for this design were: High efficiency to maintain music dynamics, easily equalized response to 20 Hz, and real but flexible limits on system size.

Thiele and Small [2, 3, and 4] have shown that high efficiency is obtained only with drivers of large cone volume displacement placed in large boxes, so this was the starting point. While other drivers may have been suitable, the JBL 2235 and 2245 15- and 18-inch drivers were the final candidates. The 2245 18-inch driver was initially selected because of its 2.1% half-space efficiency, which gives it a power output of 95 dB SPL for 1 watt at 1 meter. It is important to recognize that this SPL and efficiency are ratings for the flat-band response above 100 Hz and are not necessarily representative of efficiency and output in the sub-bass region between 20 and 100 Hz, where box volume and tuning greatly affect system efficiency. The final choice was two 2235 15-inch drivers per box (see Table II). Because using two drivers per box theoretically doubles their efficiencies, the paired 15-inch drivers operate at 2.6% efficiency with a sensitivity of 96 dB SPL.



MANY A SUBWOOFER WINDS UP SACRIFICING CLEAN, LOUD, LOW BASS TO AVOID USING BOXES THIS LARGE.

The next step was to select an alignment from Thiele's tables [5] and do some computer modelling to determine the system response for various alignments, box tuned frequencies, and box volumes. It was known at the beginning that at least four 15-inch cones were needed to maintain low distortion and that a large box was needed to achieve high efficiency. With this in mind, several possible alignments were modelled before I selected the fourth-order Butterworth (B_4) alignment with box and cone resonance coincident at 20 Hz (Table III). In this alignment, the net internal cabinet volume is 0.707 times speaker V_{as} (the volume of air having the same acoustic compliance as the driver suspension). This requirement ruled out the JBL 2245 drivers, as box volume for two 18-inch drivers would have been 41 cubic feet, whereas it is only 22.9 cubic feet for the two 15-inch drivers. Computer modelling also showed that the system response would be slightly smoother, and cone excursion limits would be slightly less stringent between 20 and 25 Hz, with the 2235s than with the 2245s. Accordingly, the ultimate choice was a pair of 2235 drivers in a cabinet having a volume of 22.9 cubic feet. The same response, but with lower efficiency, could be achieved with one 2235 in a cabinet of 11.45 cubic feet.

Computer modelling [6] of the final design indicates response to be −2 dB at 75 Hz and −8.8 dB at 20 Hz. This meets design criteria, as it can be easily corrected with a simple tone control hinged at 100 Hz. Other specifics in Table IV indicate that each subwoofer can produce 115.5 dB SPL at 1 meter at 20 Hz and 121.6 dB SPL at 100 Hz with a 300-watt input. Actual room response is considerably better than this at the extreme low end, due to bass gain of the room [1 and 7], as will be seen later. The calculated displacement-limited power input is 293 watts maximum at 30 Hz. The thermal-limit numbers are for long-term operation and may be considerably surpassed over most of the passband to produce much greater speaker output for brief moments. For example, if thermal limits are conveniently ignored, the Table IV data in parentheses indicates the displacement-limited average power, which should not be exceeded.

The final design is a box having an internal volume of 29 cubic feet, or a net internal volume of 22.9 cubic feet after deducting 3.1 cubic feet for the

Table I—Compact Discs with audible components below 32 Hz. (From Fielder and Benjamin.)

Frequency, Hz For 120 dB	Frequency, Hz For 110 dB	Composer/Artist	Selection	Record Label	Catalog Number
10	12.5	Tchaikovsky	1812 Overture	Telarc	CD-80041
16.5	16.5	Dupré	Symphony in G Minor	Telarc	CD-80136
15	17.5	Grofé	Grand Canyon Suite	Telarc	CD-80086
18	18	Hindemith	Organ Sonata No. 1	Argo	417159-2
18.5	18.5	Jongen	Symphonie Concertante	Telarc	CD-80096
12.5	22	Flim & The BBs	Big Notes	dmp	CD-454
16.5	22	Strauss	Also sprach Zarathustra	Telarc	CD-80106
22	22	Bach	Kyrie, Gott heiliger Geist	Telarc	CD-80097
24	24	Saint-Saëns	Symphony No. 3	Telarc	CD-80051
25	25	Williams	"Star Wars" Theme	Telarc	CD-80094
19	25	Bach	Toccata and Fugue in D Minor	Telarc	CD-80088
29	29	Billy Cobham	Warning	GRP	GRD-9528
29	29	Various	Movie soundtrack, "Country"	Windham Hill	WD1039

ducted port, 0.4 cubic foot for the two drivers, and 2.6 cubic feet for the bracing. Overall room volume displaced is 32 cubic feet, including the cabinet's base. The phantom views of box construction in Fig. 1 show the preferred off-center driver placement, symmetrical port placement for equal mutual coupling between drivers and port, internal proportions of 0.8 × 1 × 1.25 [5], legless design for improved imaging to the floor [7], and robust panel bracing.

Table III—Box and system parameters.

Box Parameters

Net Internal Volume (V_b): 22.900 cubic feet.
Helmholtz Resonance Frequency (f_1): 20.0 Hz.
Box Leakage Q (Q_1): 3.0.
Minimum Vent Area: 169.2 cubic inches.

Vent Length, Inches	Vent Area, Square Inches	Vent Diameter, Inches
38.63	169.15	14.7
50.11	212.95	16.5
64.73	268.09	18.5
83.34	337.51	20.7
106.99	424.90	23.3

System Parameters

$$\text{Tuning Ratio} = H = \frac{F_b}{F_s} = 1.000$$

$$\text{Alpha} = \frac{V_{as}}{V_b} = 1.415$$

Two monster boxes, each occupying 32 cubic feet, fill the author's living room with bass that's deep and powerful.

Shocks and Surprises

Seeing the completed cabinets for the first time was somewhat of a shock, as the boxes hadn't looked all *that* large on paper. Lifting them into the truck was another shock, as they were built of void-free Finnish birch plywood and maple hardwood, internally braced with hemlock and fir. The boxes looked even larger in the listening room, so only one was installed initially, lessening the shock to my wife. A month later, the other box took its place on the other side of the room.

Initial listening was done with a subwoofer amplifier rated to deliver 325 watts per channel into 4 ohms. Although the system was then adequate for most musical information (including pipe organ reproduction), CDs which contained thunder or cannon shots, and Telarc's *Time Warp*, caused amplifier clipping. I can assure you that amplifier clipping into these subwoofers is quite apparent—and somewhat frightening when you consider the longevity of four expensive drivers. Amplifier clipping does not necessarily mean that the amplifier is delivering maximum power into the speakers because speaker impedance varies with frequency, but there seemed no choice but to invest in a higher powered amplifier. The one selected is rated at 800 watts per channel into 4 ohms. More power would be even more suitable because it is still necessary to exercise care when demonstrating interesting source material. Some source material contains significant stereo information below 80 Hz; this can cause the channel with the higher bass levels to be driven into clipping while some of the other channel's power capacity is unused. To best utilize available amplifier power, it is desirable to sum the subwoofer signals by bridging or other means. This is valid because the ear has little directional sensitivity at very low frequencies.

Table II—Driver parameters for JBL 2235 15-inch woofers.

Free-Air Resonance Frequency (f_s): 20.0 Hz.
Compliance Equivalent Volume (V_{as}): 16.200 cubic feet.
Total Driver Q (Q_{ts}): 0.250.
Half-Space Efficiency (n): 2.60%.
Effective Cone Diameter (S_d): 13.3 inches.
Peak Linear Excursion (X_{max}): 0.330 inch.
Peak Displacement Volume (V_d): 91.69 cubic inches.
Thermal Limit Input Power ($P_{t\,max}$): 300.0 watts.

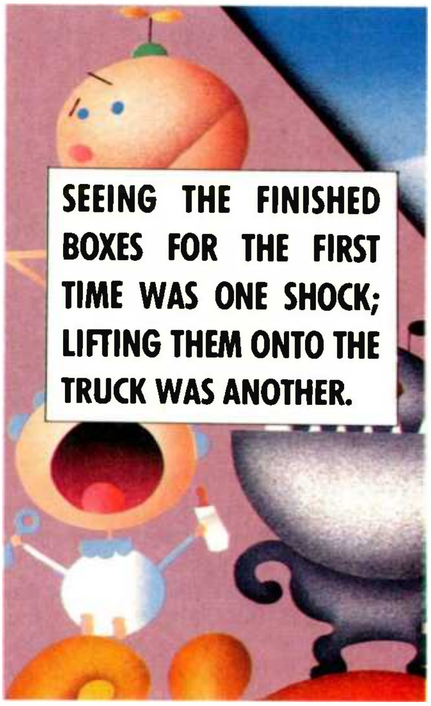
Table IV—Calculated free-field system performance. Figures in parentheses are for short-term performance, set by excursion limits. Other figures, for long-term performance, are governed by thermal limits (T) or excursion limits (E), as shown in last column.

Freq., Hz	Relative Response, dB	Maximum Acoustic Output, Watts	Relative Maximum Output, dB	Maximum Room SPL, dB	Maximum Input Limit, Watts	Limiting Factor
16	−14.0 (−14.0)	0.13 (0.13)	−17.7 (−30.4)	105.2 (105.2)	128 (128)	E
18	−10.9 (−10.9)	0.54 (0.54)	−11.6 (−24.3)	111.3 (111.3)	258 (258)	E
20	−8.8 (−8.8)	1.42 (1.42)	−8.8 (−20.1)	115.5 (115.5)	300 (413)	T
25	−6.2 (−6.2)	1.85 (1.92)	−6.2 (−18.7)	116.7 (116.8)	300 (311)	T
30	−5.3 (−5.3)	2.23 (2.23)	−5.4 (−18.1)	117.5 (117.5)	293 (293)	E
35	−4.7 (−4.7)	2.62 (3.03)	−4.7 (−16.8)	118.2 (118.8)	300 (347)	T
40	−4.2 (−4.2)	2.94 (4.28)	−4.2 (−15.3)	118.7 (120.3)	300 (438)	T
45	−3.8 (−3.8)	3.25 (6.08)	−3.8 (−13.7)	119.1 (121.8)	300 (561)	T
50	−3.4 (−3.4)	3.56 (8.53)	−3.4 (−12.3)	119.5 (123.3)	300 (719)	T
55	−3.1 (−3.1)	3.86 (11.77)	−3.1 (−10.9)	119.8 (124.7)	300 (915)	T
60	−2.7 (−2.7)	4.14 (15.95)	−2.7 (−9.6)	120.2 (126.0)	300 (1156)	T
65	−2.5 (−2.5)	4.41 (21.24)	−2.5 (−8.3)	120.4 (127.3)	300 (1446)	T
70	−2.2 (−2.2)	4.65 (27.82)	−2.2 (−7.1)	120.7 (128.4)	300 (1793)	T
75	−2.0 (−2.0)	4.88 (35.89)	−2.0 (−6.0)	120.9 (129.5)	300 (2206)	T
80	−1.9 (−1.9)	5.09 (45.67)	−1.9 (−5.0)	121.0 (130.6)	300 (2690)	T
90	−1.5 (−1.5)	5.46 (71.28)	−1.5 (−3.1)	121.4 (132.5)	300 (3914)	T
100	−1.3 (−1.3)	5.77 (106.67)	−1.3 (−1.3)	121.6 (134.3)	300 (5543)	T

Measurements

As I firmly believe in measurements as well as subjective evaluation, I listened for but a few days before beginning a series of tests. The measurements made were: Complex impedance, in a search for unwanted cabinet or cone resonances; impedance magnitude, to verify box, cone, and coupled-system resonances; response to single-frequency sweeps, both in the room and outside, and harmonic distortion at several power levels. Indoor measurements were near-field, at 1 meter and at the 5-meter listening position. Outdoor measurements were at 1 meter, with the speaker aimed parallel to the outside house wall. I've no access to equipment for TDS measurements, but my swept-frequency network analyzer measurements are adequate for near-field and outdoor work. The outdoor measurements were made with the speaker standing away from the house, on pavement. The area may be considered free of intruding resonances below 43 Hz but becomes reverberant above this point due to a low wall running parallel to the house. The outdoor placement provides approximately the same bass gain from the pavement and house wall that exists due to the listening room's floor and rear wall, so outdoor measurements may approximate TDS measurements made inside.

Perhaps the most pleasant surprise of all is that the outdoor 1-meter swept-frequency response of Fig. 2 is flat within about ±0.75 dB from 55 Hz down to 17 Hz and is only about 3.5 and 10 dB down at 15 and 13 Hz, respectively. The departure from my computer-generated predictions is at least partially due to the increased radiation resistance caused by speaker proximity to the pavement; the proximity effect, apparent when a surface is 0.1 wavelength from the driver [7 and



8], increases radiation resistance on the lower driver below 100 Hz and on the upper driver below 50 Hz. Irregularities in the measured response from about 45 Hz up are due to the environment and may be ignored. Inside the listening room, additional bass gain—effective at various frequencies due to proximity of side walls (8, 11, 16, and 28 Hz), ceiling (19 Hz), rear wall (20 Hz), and opposite wall (5 Hz)—is expected to further improve bass response, although the effect should be quite smooth and mild due to my room's size and multi-faceted "L" shape [1]. The effect of this bass gain is to significantly increase loudspeaker efficiency and reduce cone-excursion requirements at low frequencies [1]. Averaging peaks and dips of the near-field indoor measurements suggests an essentially flat response to 1 kHz, although there is no intent to use the subwoofers above 70 to 100 Hz.

The impedance magnitude curve of Fig. 3, showing 9.5- and 31-Hz peaks occurring on either side of the 20-Hz common resonance, is typical of ported-box loudspeakers. The impedance is 4 ohms only from 16 to 19 Hz, between the two peaks, and again from 100 to 300 Hz, so power input calculations based on constant impedance can be misleading. For example, an amplifier rated at 800 watts into 4 ohms, supplying 57 V into 4 ohms or more, delivers only 64 watts into 500 ohms, so clipping may occur near the two resonant peaks without driving the speakers to their excursion limits.

It is instructive to plot the power absorbed by the subwoofer from an amplifier rated at 800 watts into 4 ohms and compare it with the calculated excursion-limited peak-power measurements (Fig. 4). The top curve is the excursion-limited power curve, factoring in corrections for the effects of bass gain in the room. This bass gain

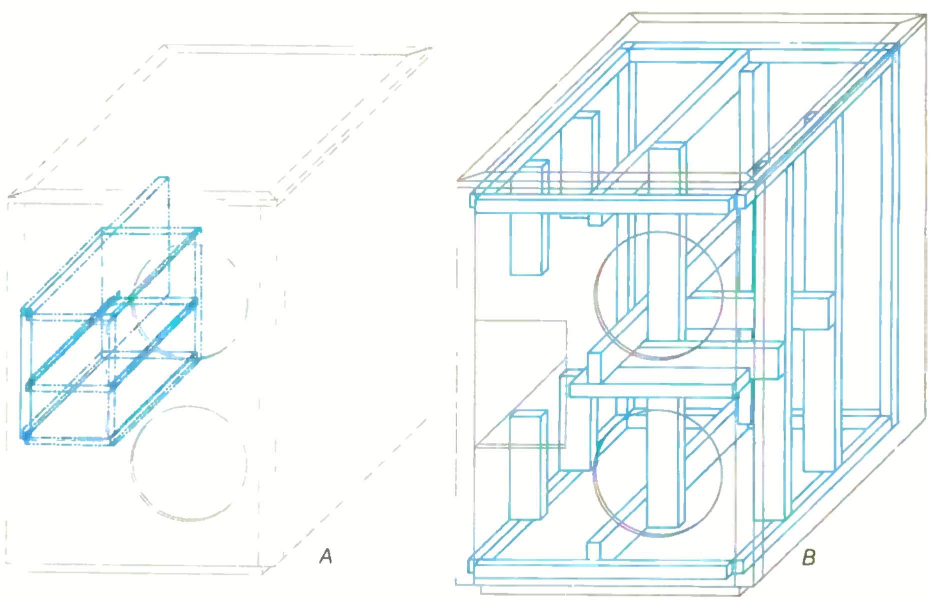


Fig. 1— Composite views, showing port construction (A) and internal bracing (B).

reduces driver cone displacement to below calculated values; hence higher power is required to drive the cones to their linear excursion limits. The corrected curve indicates that the cones will remain within their linear excursion limits with the full voltage output of the suggested amplifier at all frequencies, thus keeping distortion within acceptable limits over all available operating conditions.

The complex impedance curve (not shown) indicated only two very minor subwoofer resonances, at 125 and 145 Hz; these are also visible in the impedance magnitude curve (Fig. 3). Since the cabinets will be used only below 100 Hz, these resonances (which may be either cone- or box-related) are of only academic interest and have no effect on the reproduced sound.

Second- and third-harmonic distortion components are plotted versus frequency in Fig. 5 for nominal 10- and 100-watt inputs, equivalent to 106 and 116 dB SPL at 1 meter. The levels of the 100-watt curves have been lowered 10 dB for clarity. Each distortion component is commendably low, less than 2% for all frequencies, where each subwoofer is driven by a nominal 10 watts to produce 106 dB SPL at 1 meter.

In any case, the constant-voltage frequency response is flat down to 17 Hz, there are no measurable cabinet resonances in the intended frequency range, and distortion is within acceptable limits over the full operating range of power and frequency. An amp rated at 800 watts per channel allows unclipped listening at full symphonic levels, in a moderately large room, for anything except cannon and thunder. Technically, the project can be considered a success, but what of the listening experience?

Listening Evaluation

Perception of bass frequencies in small, regularly shaped rooms can be highly variable depending on the listener's location relative to standing waves generated by normal-mode resonances. Normal-mode resonances of a room may be calculated from:

$$\text{frequency} = \frac{C}{2}\left[\left(\frac{m}{L}\right)^2 + \left(\frac{n}{W}\right)^2 + \left(\frac{o}{H}\right)^2\right]^{1/2}$$

where C is sound velocity in air; L, W, and H are room dimensions, and m, n, and o take on all positive integers [1]. A large number of closely spaced resonances is desirable, as they will

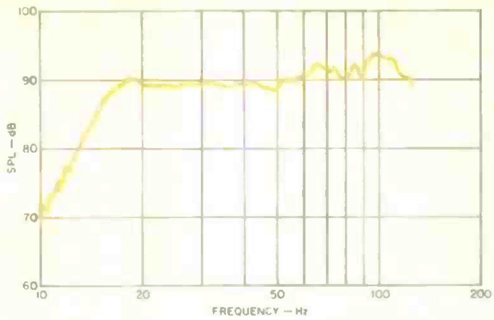


Fig. 2— Frequency response, measured outdoors at 1 meter, for 1 watt input. Reverberant-field effects caused by a nearby wall become evident at about 40 Hz (13-foot critical dimension); see text.

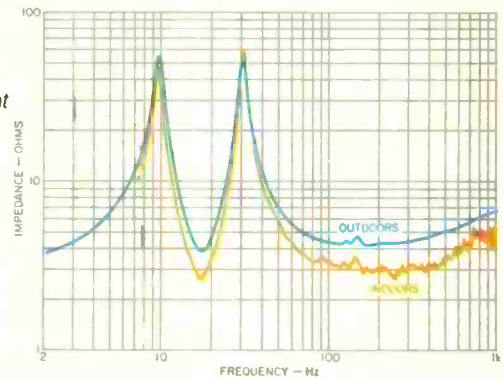


Fig. 3— Magnitude of impedance, measured indoors in a reverberant field and outdoors in an almost nonreverberant field.

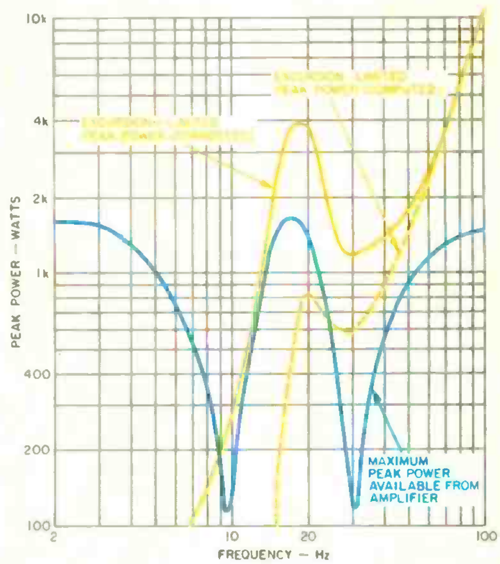


Fig. 4— Permissible peak power input, limited by driver excursion capabilities, compared to maximum peak power available from the amplifier, as functions of frequency. Both excursion-limited curves are computed, not measured; the corrected curve includes the effects of increasing radiation resistance at low frequencies. The amplifier is rated to deliver 800 watts into 4 ohms; the curve shows power available into the impedance actually presented by the speaker at each frequency.

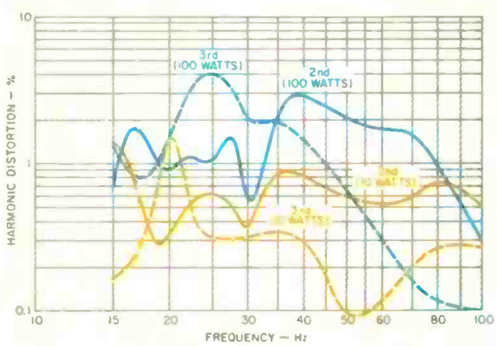


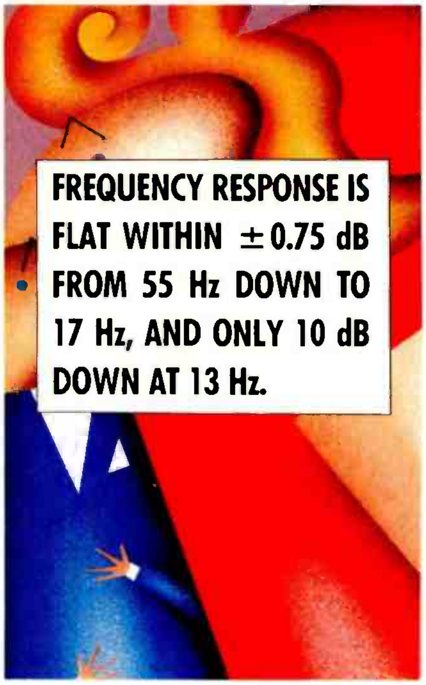
Fig. 5— Main harmonic components vs. frequency, for 10- and 100-watt inputs. The 100-watt curves have been lowered 10 dB for clarity.

smooth the overall room response rather than appear as individual resonances. As my listening room is L-shaped, it has eight pairs of parallel surfaces; thus, for me there are eight factors to the equation instead of three. The room is 5,800 cubic feet in volume and has a projecting fireplace wall; it should be fairly neutral, as it has 23 normal-mode resonances below 100 Hz, nine below 50 Hz, and four below 30 Hz. The four lowest resonances are rather closely spaced, at 18, 22, 25, and 28 Hz.

All listening was done in this large room, with the subwoofers placed flanking the existing stereo speaker cabinets. The entire system is currently in transition but presently includes the two subwoofers, crossed at 80 Hz into a three-way system that's completely horn-loaded. The system comprises JBL 15-inch mid-bass drivers in exponential horns, JBL 2445 titanium-diaphragm compression drivers (with 2-inch throats and 4-inch voice-coils) in 500-Hz horns, and JBL 2405 diffraction-horn supertweeters. Additional crossovers are at 700 Hz and 7 kHz. All four channels are multi-amped via Rane four-way Linkwitz-Riley constant-phase crossovers with a slope of 24 dB per octave and adjustable low-channel phase-delay compensation. All eight individual channel gains are set for flat response to wide-band pink noise, as observed on a third-octave analyzer with its microphone at the listening position.

Subjective evaluation of any loudspeaker system is always difficult, as one can never be certain whether what one seems to hear is real or imagined. With these subwoofers, I am constantly amazed as I listen to familiar recordings and hear additional bass information that I never suspected was present. The bass extension is certainly real and not imagined, as it represents a new or additional sonic experience rather than a changed experience. The lowest organ, drum, and synthesizer tones on recordings are distinctly felt, in an almost unimaginable way, as well as heard. One can actually feel the spaceship departure in the "2001: A Space Odyssey" section of Telarc's *Time Warp*, as floor and walls rumble and vibrate, yet the bass is neither overpowering nor tiring, as is sometimes the case with subwoofers placed near the corners of relatively small listening rooms.

On first listening, there appeared to be an immediate improvement in the mid-bass and middle frequencies as well as the low bass. What I believed I heard was a difference in timbre; difficult to describe in words, it may be the expected reduction in amplitude modulation or intermodulation of mid-bass and midrange by the low bass. (In any system without a subwoofer, audible or inaudible bass-cone excursion modulates [10] the remainder of the spectrum radiated from that cone. In most systems, this includes frequencies to 1 kHz or higher, or most of the fundamental musical spectrum.) However, now that I'm used to the system's new sound, I don't hear this improvement as much—was it ever real at all? I can report that it did seem to be real and was immediately apparent upon installation of the subwoofers.



FREQUENCY RESPONSE IS FLAT WITHIN ±0.75 dB FROM 55 Hz DOWN TO 17 Hz, AND ONLY 10 dB DOWN AT 13 Hz.

One unexpected, dramatic, and demonstrable difference in sound occurred when I installed the subwoofers. Telarc's digitally mastered LP (DG-10039) and CD (CD-80039) of Stravinsky's "Firebird" paired with Polovtsian dances from Borodin's "Prince Igor" exhibit an unusual buzz on the most dramatic part of the Polovtsian dances. The buzz diminishes neither with changes in tracking force nor with listening level, and it was initially disconcerting. I later accepted the buzz as part of the music, particularly when Telarc's Jack Renner assured me that the buzz near four minutes into track three of the CD "is real, is a bass tuba, and is a particularly raspy bass tuba, at that." Eventually, I came to like the sound of the raspy bass tuba. With the addition of the subwoofers, the rasp has disappeared, either because of reduced distortion or increased fundamental presence. Point made, but I rather miss the raspy sound.

The dynamics of the music are improved with the addition of the lower octave and the cleaner reproduction of the mid-bass to midrange. A larger soundstage appears, possibly due as much to the visual effect as to the mirroring of the mid-bass speakers in the subwoofer cabinetry. I recommend that you try subwoofers like these if you want all the music and have the space to spare; you'll like them.

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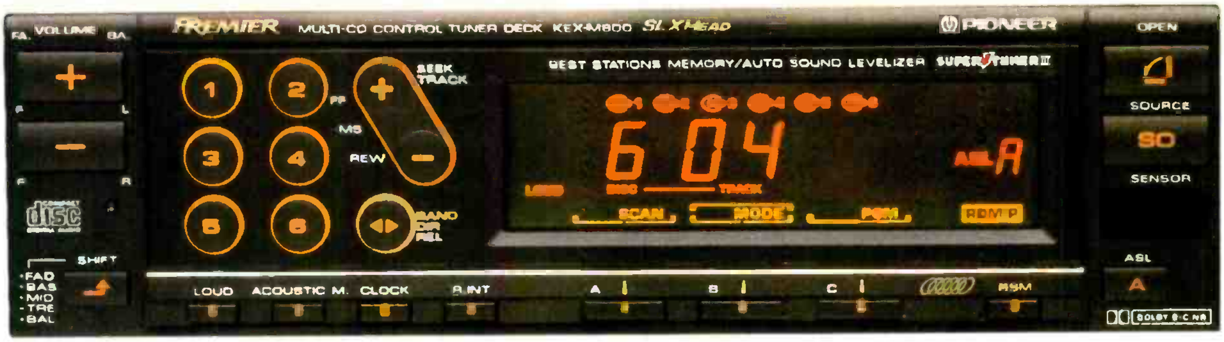

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In a slightly smaller package, the RTA 8t offers the same driver complement as the larger, more expensive RTA 11t, and thus shares its benefits of superior imaging, musicality, and detail.

Both Polk RTA series loudspeakers achieve the extremely rare combination of good looks and state-of-the-art performance. The tall, elegantly slender and deep "tower" design cabinets allow for substantial internal volume for high efficiency and powerful bass, but only require less than one square foot of floor space! The small baffle surface area around each driver minimizes diffraction (sonic reflections), thereby insuring outstanding imaging and low coloration.

Positioning the 1" silver-coil dome tweeter between the two 6½" trilaminate polymer bass/midrange drivers achieves what is called "coincident radiation." This means that both the mid- and high-frequencies appear to radiate from the same place on the baffle resulting in perfect blending at the critical crossover point. (See illustration, below).

Polk RTA speakers have an uncanny ability to perfectly reproduce the human voice, pianos, guitars, and every other instrument whose faithful reproduction demands superlative midrange and high-frequency performance. Bass and percussion instruments are accurately reproduced with full visceral power and realism, without the heaviness, boominess, or lack of detail that plague lesser designs.

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Polk Audio's RTA 8t and RTA 11t High Performance Tower Speakers

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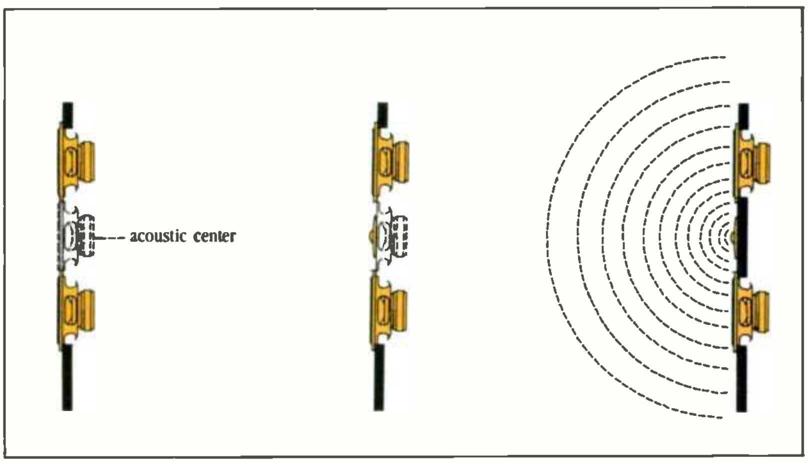

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1

McINTOSH MC 7200 POWER AMPLIFIER

Manufacturer's Specifications

Power Output: Stereo, 200 watts/channel across 8 ohms or 300 watts/channel across 4 ohms, 20 Hz to 20 kHz, both channels driven; bridged mono, 600 watts across 8 ohms, 20 Hz to 20 kHz.

THD: 0.005%, stereo or bridged mono, from 250 mW to rated power per channel.

SMPTE IM: 0.005% for any combination of frequencies from 20 Hz to 20 kHz.

Frequency Response: 20 Hz to 20 kHz, +0, −0.25 dB; 10 Hz to 100 kHz, +0, −3.0 dB.

S/N: 105 dB below rated output (A-weighted).

Damping Factor: Greater than 200.

Input Impedance: 20 kilohms unbalanced, 40 kilohms balanced.

Input Sensitivity: Switchable, 1.4 or 2.5 V.

Power Guard: Clipping prevented and THD held below 2% with up to 20-dB overdrive at 1 kHz.

Power Requirements: 120 V a.c., 50/60 Hz, 0.6 to 15 amperes.

Dimensions: Chassis, 14¾ in. W × 7⅛ in. H × 15⅝ in. D (37.5 cm × 18.1 cm × 39.7 cm); front panel, 16⅛ in. W × 7⅛ in. H (41.1 cm × 18.1 cm).

Weight: 53 lbs. (24 kg).

Price: $2,595.

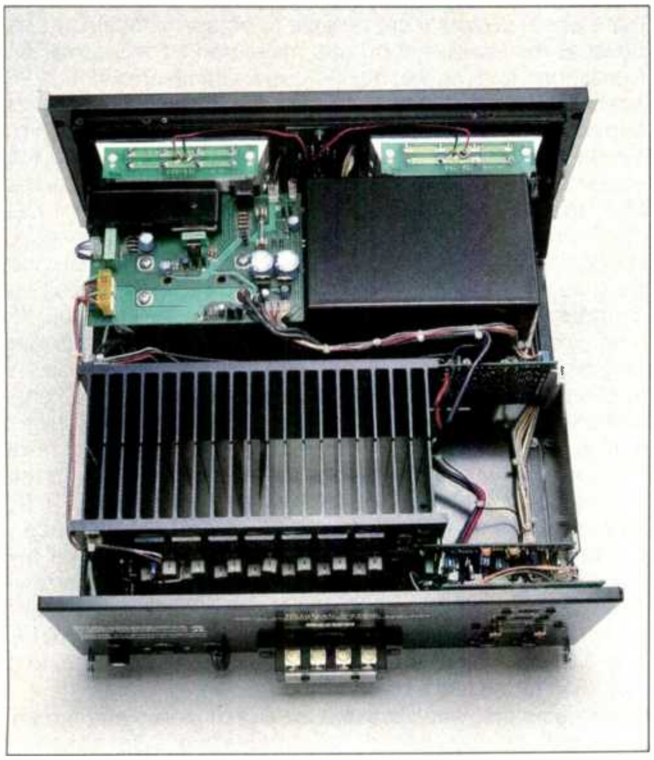
Company Address: 2 Chambers St., Binghamton, N.Y. 13903.

For literature, circle No. 90

It's been a long time since I last tested a piece of McIntosh equipment, and I was delighted when this massive (and *heavy*) high-powered amplifier was delivered to my lab. While other domestic and foreign manufacturers come and go, McIntosh, located in upper New York state, seems to go on forever. Although the company introduces new products far less frequently than most other audio component producers, when "Mac" does come up with a new product, you can bet that it's been designed with the same conservative approach, ruggedness, and reliability this company has always been known for.

The MC 7200 is a stereo power amplifier designed to operate with loudspeakers having a nominal load impedance of 8 or 4 ohms. Both balanced and unbalanced inputs are provided. The amplifier design provides nearly perfect linear operation, without loop feedback, for every stage of voltage or current amplification. According to the preliminary instruction manual supplied with my sample, this is accomplished by several techniques, including careful selection of each transistor used, light loading of each stage by its following stage, and higher, more linear input impedances of stages (made possible by using emitter cegeneration). In addition, careful selection of resistors and capacitors in the signal path and the use of matched output transistors that have uniform current gain, high current-gain-bandwidth product, low output capacitance, and large active-region safe operating areas help to eliminate any crossover distortion normally associated with high-efficiency amplifier designs.

There are no fewer than six protection circuits in the MC 7200. Power Guard, which I have seen in earlier McIntosh components, eliminates amplifier clipping caused by overdrive. In this circuit, the output waveform is compared with the input waveform. When a waveform difference develops due to the onset of clipping, Power Guard indicators light and an electronic attenuator at the amplifier input reduces overall gain. Another circuit, Sentry Monitor, constantly monitors the output signal and reacts to prevent overload of the output transistors. Thermal sensors within the MC 7200 will interrupt a.c. power if temperatures become excessive. A turn-on delay of about 2 S prevents any pops or thumps from annoying the listener or damaging loudspeakers. Another protection circuit prevents speaker damage caused by d.c. in the output signal; should the circuit detect d.c. in either channel's output, it will clamp the power supply to zero, causing the fuse in the MC 7200 to blow. The sixth protection circuit guards against power-line transient surges.



Like all McIntosh components, the MC 7200 comes with the necessary hardware and template for custom mounting in a cabinet, using the company's well-known Panloc installation system. This allows you to lock the unit firmly in place while still being able to unlock and remove it easily. The procedure is not difficult, as I've found in earlier tests. If you prefer shelf or table-top mounting, McIntosh also offers component cabinets to fit all of their products.

Circuit Description

Each MC 7200 amplifier channel uses two stages of voltage amplification followed by three stages of current amplification. The input signal feeds one input of a differential amplifier stage. Negative feedback from the amplifier output is applied to the other input. The differential amplifier outputs connect to current-mirror stages and feed a positive-drive cascode voltage-amplifier stage. The cascode amplifier feeds complementary Darlington driver transistors; these supply the signal to 14 complementary-connected output transistors. The chassis is arranged for convection cooling and requires no mechanical fan to maintain proper operating temperature. The power supply uses a massive power transformer, full-wave bridge rectifiers, and large filter capacitors having 100 joules of energy storage. Two large heat-sinks cool the 28 output transistors.

Control Layout

Two large illuminated power output meters on the front panel are calibrated in both watts and decibels. The meters' logarithmic calibration permits you to read from 200 watts down to 0.002 watt. The meters respond to the peak output of each channel; when amplifying musical signals that might be too "fast" for the mechanical pointer to follow, a special circuit provides a "time stretched" electrical pulse so that the peak position of the pointer can be observed by the human eye. Furthermore, the meter can be locked at the peak indication by selecting a "Meter Hold" switch just to the left of the panel's center line. The "Power" on/off switch is symmetrically positioned just to the right of that line.

Whenever the Power Guard circuit limits the output to prevent clipping, left- and right-channel lights on the front panel turn on to let you know that the amplifier is being overdriven. Left- and right-channel gain controls complete

Six different protection circuits contribute to the MC 7200's ruggedness and reliability.

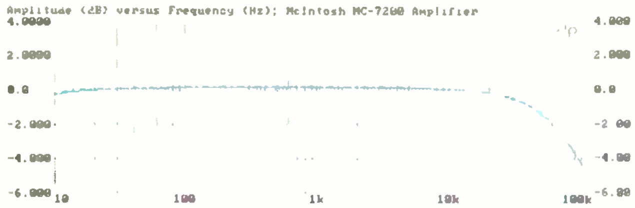
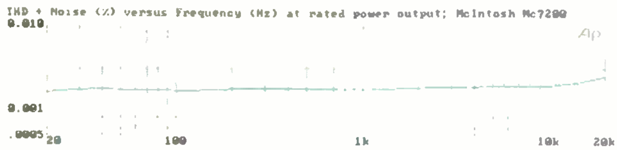


Fig. 1—Frequency response measured at 2 watts output into 8-ohm loads. Note that response was virtually identical for both channels.



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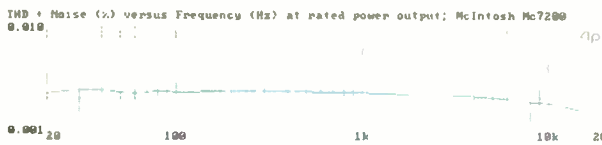

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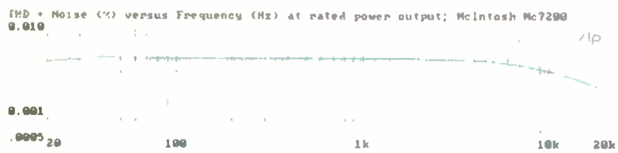

C

Fig. 2—THD + N vs. frequency at rated output levels of 200 watts per channel into 8 ohms (A), 300 watts per channel into 4 ohms (B), and 600 watts bridged mono into 8 ohms (C).

the front panel layout; when using the amplifier in the bridged mono mode, only the right-channel gain control is active.

The rear panel has three types of input jacks—pairs of XLR connectors and quarter-inch phone jacks for balanced lines, and RCA-type phono jacks for unbalanced inputs. McIntosh has come up with clever speaker terminals that accept either heavy-gauge wire (up to AWG #4) or spade lugs; when spade lugs are not used, the connector screws must be replaced with other screws, which are supplied separately in a small bag. All elements of the speaker terminals that come in contact with the speaker wires, including the special screws, are gold-plated. Recessed slide switches on the rear panel select input sensitivity (1.4 or 2.5 V) and stereo or bridged mono operation. When the bridged mode is selected, a single speaker is connected between the two "hot" terminals, with no connection made to the "common" or ground terminals. Under these circumstances, a single input is applied to the balanced or unbalanced right input on the rear panel.

Measurements

Frequency response of the MC 7200 amplifier, for 2 watts output, is shown in Fig. 1. Response was down less than 0.2 dB at 20 kHz and down about 0.1 dB at 20 Hz. The gain of both channels was virtually identical. The high-frequency −3 dB roll-off point occurred at around 80 kHz; at 100 kHz, response was down 4.2 dB.

When McIntosh decided to let me test this amplifier, I received a letter from their chief engineer, Sidney Corderman, whom I have known for many years. He warned me that I would probably not be able to obtain distortion values down to the levels that he had measured for this amplifier. Corderman told me that he had used a Panasonic VP-7722P analyzer, which, he said, is one of the few instruments capable of measuring the ultra-low distortion levels produced by this amp. I took this with a grain of salt, having acquired the Audio Precision System One test system some time ago. Well, I must confess that my test equipment has met its match—and then some. How do I know? Because Corderman supplied his own test data for this amplifier, and his graph of THD versus frequency showed a THD reading of under 0.001% over most of the audio range, when driving 8-ohm loads to a constant output level of 200 watts per channel. The best I could get, as shown in Fig. 2A, was a reading of just under 0.002% for the same test conditions. There was a slight rise in THD + N, to 0.0025%, at 20 kHz. I hasten to add, however, that my readings are the sum of THD + N, whereas Corderman's were for THD only. In the not-too-distant future, I expect to be able to read THD figures as low as my friend up in Binghamton can—once I get the digital signal processing upgrade installed in my Audio Precision gear, which will allow me to use narrowband filtering when I analyze harmonic distortion. Meanwhile, let's not quibble over the difference between 0.001% and 0.002%. For all I know, I may be reading the residual distortion of my test setup's signal generator.

The same test was repeated for 4-ohm stereo and 8-ohm bridged mono operation, at 300 and 600 watts per channel, respectively; results are shown in Figs. 2B and 2C. In Fig. 3,

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McIntosh warned me that the MC 7200's THD would be lower than my instruments could measure, and they were right.

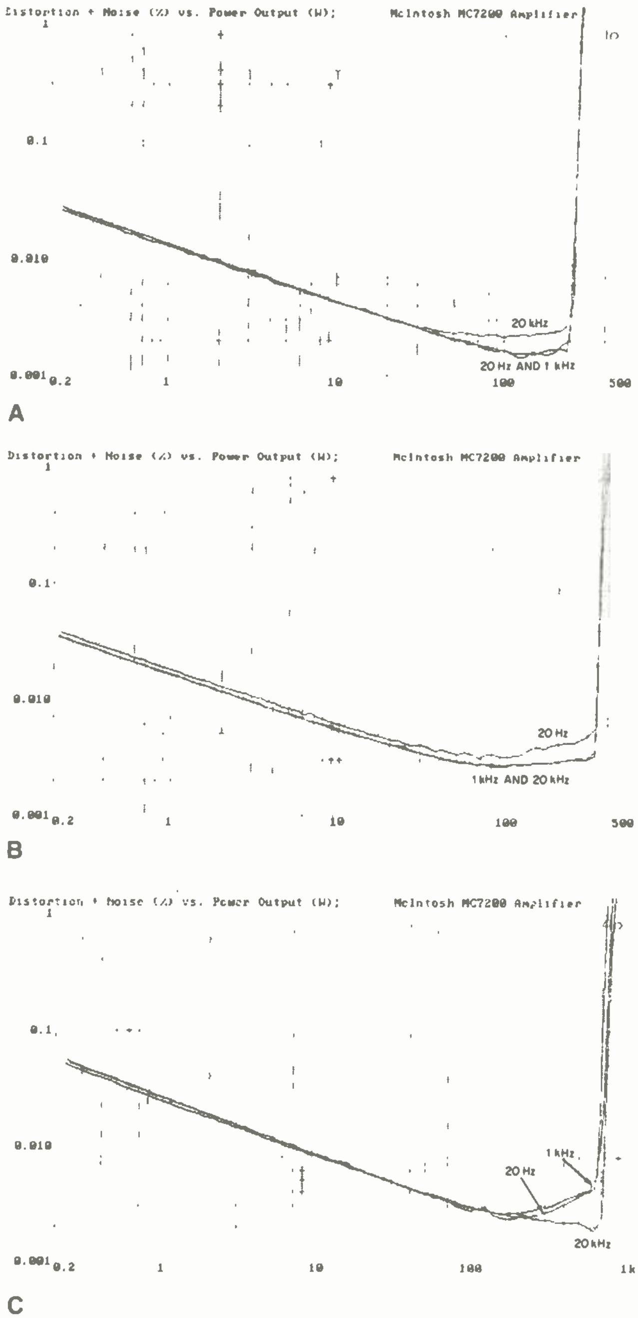

Fig. 3—THD + N vs. power output for stereo operation into loads of 8 ohms (A) and 4 ohms (B) and for bridged mono operation into 8 ohms (C).

I plotted THD + N versus power output. As usual, although readings seem higher at low output levels than at high ones, this is the result of noise and *not* harmonic distortion. At or near the rated output levels on these graphs (200 watts for Fig. 3A, 300 watts for Fig. 3B, and 600 watts for Fig. 3C), results correlated fairly well with those shown in Figs. 2A, 2B, and 2C.

Since McIntosh specifies power bandwidth (the frequency range over which full power can be maintained at rated THD or less), I ran some tests to confirm this specification. (Normally, I omit this test, preferring instead to measure dynamic headroom in accordance with the EIA Amplifier Measurement Standards.) Figure 4 shows the power levels that can be obtained at various frequencies for a fixed, specified THD level of 0.005%. In the case of 8-ohm loads, that power level was about 230 watts per channel for nearly all of the audible frequency range. When I used 4-ohm loads, the amplifier delivered about 400 watts per channel at all but the extreme bass and treble frequencies. This should give you some idea of how conservatively McIntosh rates their products!

The only test results that did not conform to McIntosh's claims were those for SMPTE-IM distortion, shown for stereo operation into 8- and 4-ohm loads (Fig. 5A) and for bridged mono operation into 8-ohm loads (Fig. 5B). I suspect that this small discrepancy may be mostly due to noise and/or ground loops in my setup. Even with that, the readings I obtained for the equivalent of rated output (after compensating for the test waveform) are hardly anything to be concerned about. In stereo operation, I measured 0.006% at 200 watts into 8-ohm loads and 0.022% at 300 watts into 4-ohm loads; in bridged mode, I got 0.021% at 600 watts into 8 ohms.

I had much better luck when I tested CCIF-IM distortion, which essentially measures the "beat" 1-kHz frequency present at the output of an amplifier when two high-frequency signals are fed to the inputs at the same time. In the case of the McIntosh MC 7200, I applied equal amplitude signals at 18 and 19 kHz (Figs. 6A and 6B). At the rated output levels for the three operating conditions, CCIF IM was only

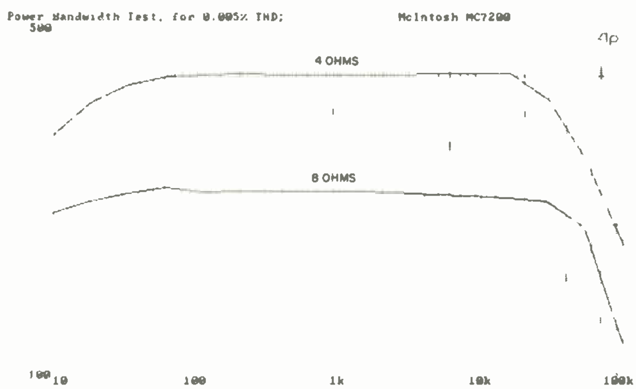

Fig. 4—Power bandwidth for rated THD level of 0.005%.

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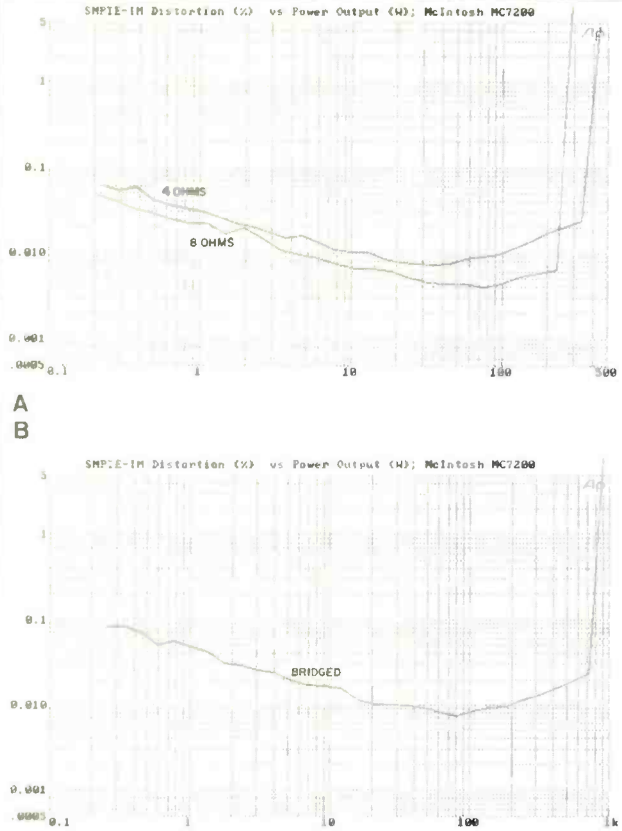

Fig. 5—SMPTE-IM distortion vs. power output for stereo operation (A) and for bridged mono operation into 8 ohms (B).

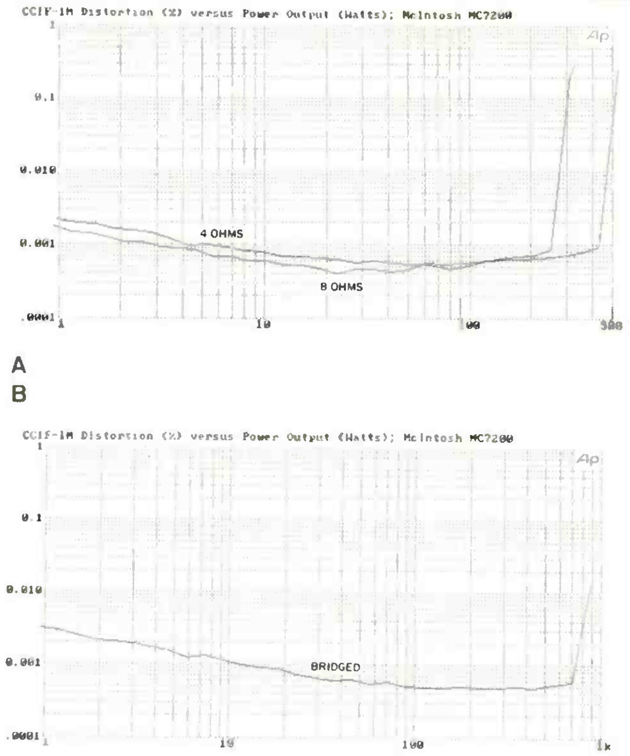

Fig. 6—CCIF-IM distortion vs. power output for stereo operation (A) and for bridged mono operation into 8 ohms (B).

0.0007% at 200 watts into 8 ohms and at 300 watts into 4 ohms and was 0.00052% at 600 watts into 8 ohms in bridged mono mode.

Damping factor, referred to 8-ohm loads and using a 50-Hz test signal, measured 235, well above the minimum of 200 claimed by McIntosh. The A-weighted S/N ratio was 85 dB below 1 watt. Translated to a reference level of rated output (200 watts per channel into 8 ohms), this works out to an S/N ratio of 108 dB—again, better than the 105 dB claimed by the manufacturer. Using 8-ohm loads, dynamic headroom amounted to 2.1 dB, which means that for short musical peaks of 20 mS or so, this amplifier can deliver nearly 325 watts per channel into 8-ohm loads. With 4-ohm loads, the dynamic headroom was even greater, measuring nearly 2.5 dB.

Use and Listening Tests

Because this amplifier has gain controls, I was able to connect my reference CD player directly to the MC 7200. To have done otherwise would have meant using a preamplifier whose characteristics may not have been as good as those of the amp I was trying to judge. At almost the same time I started to test this amplifier, some new Delos releases arrived in my lab. One of these, *Organ Works by Ned Rorem* (Delos D/CD-3076), was perfect for putting this amp through its paces, what with the powerful, sonorous tones that the Marcussen organ at Wichita State University in Kansas produced. The MC 7200 never seemed strained, nor was there ever a time when the Power Guard lights illuminated. Although not all of this organ music suited my taste, it certainly was a good disc for testing a high-powered, low-distortion amplifier such as this.

Once I had satisfied myself that the "Mac" could handle the peaks and complex sounds of the organ, I turned to another recent Delos release that features, among other works by Haydn, his Symphony No. 51 in B-Flat Major (Delos DE-3064). This recording may not have made as severe demands on the MC 7200, but it certainly offered a soothing respite after all the bench testing. All of which proves that a superbly designed amplifier such as the McIntosh MC 7200 delivers good sound, whatever the type of music.

Leonard Feldman


PHILIPS
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2

DOLAN PM1 PREAMP

Manufacturer's Specifications

Frequency Response: Phono, 20 Hz to 20 kHz, ±0.2 dB; high level, 1 Hz to 500 kHz, +0, −1.0 dB.

THD: 0.02%, 20 Hz to 20 kHz.

S/N (Unweighted): Phono, 80 dB with "Low" sensitivity setting, 76 dB with "Mid" setting, 72 dB with "High" setting; high level, 90 dB.

Phono Input Sensitivity: "Low" setting, 1.5 mV; "Mid" setting, 0.5 mV; "High" setting, 0.15 mV.

Phono Overload Level (for 0.1% THD at 1 kHz): "Low" setting, 180 mV; "Mid" setting, 60 mV; "High" setting, 18 mV.

Output Level: Main, 1 V; tape, 0.1 V.

Power Requirements: 120 V a.c., 60 Hz, 20 watts.

Dimensions: 19 in. W × 2¾ in. H × 10 in. D (48.3 cm × 7 cm × 25.4 cm).

Weight: 13 lbs. (5.9 kg).

Price: $2,495.

Company Address: c/o Fanfare International, 500 East 77th St., New York, N.Y. 10021.

For literature, circle No. 91

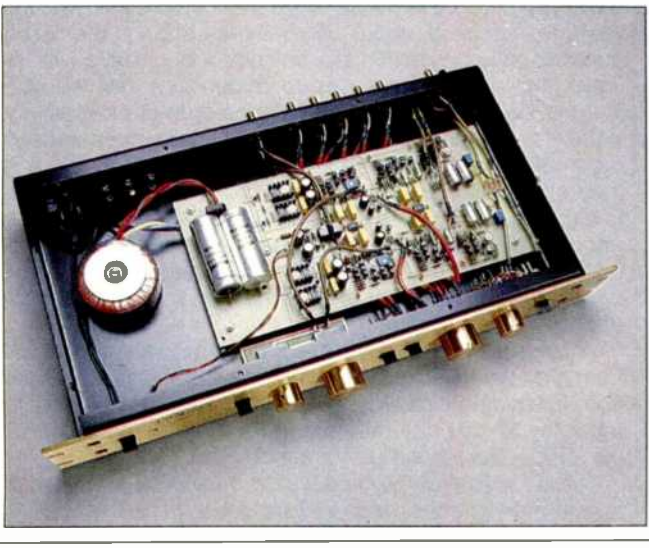
The Dolan company was formed in 1983 by a couple of computer consultants who decided to turn their audio hobby into a business. From what I understand, the PM1 is the only product in their line at present, but an interesting power amplifier that will drive 0.1-ohm loads is in the works and should be out in early 1990. Their preamplifier has a rather striking appearance because of its low, rack-width front panel, which is brushed gold with knobs to match.

The PM1's front panel includes rotary balance and volume controls; switches for power and mute on/off, mono/stereo mode, tape monitor, and, finally, selection of input, phono input resistance, and phono input capacitance. Rotary switches are used for the input and phono input-resistance selectors.

Located on the rear panel are seven pairs of high-quality Tiffany input and output RCA connectors, a ground binding post, a three-position phono gain switch, two switched outlets, one unswitched outlet, and a combination a.c. power cord socket and line fuse.

Looking within, we find a single-sided p.c. board taking up about 60% to 70% of the interior space. To the left of this board, as seen from the front, is a 30-VA toroidal power transformer. While most components built with p.c. boards have board-mounted switches and signal jacks, the PM1's jacks and switches are not mounted to the board. Numerous pairs of shielded wires by Straight Wire connect the front-panel controls and signal jacks to the board. Of note here is that these shielded wires go right to the point of use on the board rather than to the edge, as is typical. The volume and balance controls have a small p.c. board under them for circuit interconnection because these parts are of the p.c.-mount type. Parts and construction quality appear to be of high order.

The chassis is a single sheet of steel, bent up to form the rear, sides, bottom, and front subpanel. The front subpanel and rear panel are further bent over at the top to create a ⅝-inch ledge to mount Pemm nuts for attaching the top cover. The top cover is a U-shaped piece of steel that covers the sides of the chassis and is screwed into the Pemm nuts in the rear panel and front subpanel and to Pemm nuts in the chassis sides. The assembled unit is rather heavy for a simple preamp and is solid and rigid.



Circuit Description

I wasn't supplied a schematic diagram for the PM1. However, the owner's manual gives some circuit details, and along with some observation of the insides on my part, I was able to get a pretty good idea of what makes the PM1 tick.

The overall topology of this preamp has three gain blocks per channel, two in the phono preamp, with the third being the line-output amp (Fig. 1). Across the phono inputs (which are also, of course, the inputs to the first phono amp block) are loading networks controlled by two front-panel switches. One is a rotary switch selecting input resistances of 10, 30, 100, 300, and 1,000 ohms and 47 kilohms; the other, a three-position toggle, adds shunt input capacitance of 0, 150, or 390 pF.

The phono preamp's first gain block has flat frequency response and a choice of three gain levels, selected by a switch next to the phono input jacks on the rear panel. The output of this block is capacitor-coupled to an RC network (a resistor in series and a capacitor in shunt) that performs the RIAA equalization's 2,120-Hz roll-off. This RC network then feeds the input of the second phono circuit block.

This second block adds more gain and provides the RIAA equalization's bass boost from 500 to 50 Hz in the feedback loop around this gain block. A servo circuit around this block keeps its output d.c. offset low, so that output coupling capacitors won't be required between this block and the tape-out jacks and selector switch. The servo is said to have a low-frequency cutoff of 0.5 Hz, with a slope of 6 dB per octave; this means the low-frequency cutoff of the second phono stage and the line stage is also 0.5 Hz.

The output of the phono preamp, along with three of the four high-level inputs, is applied to the selector switch. Output of the selector switch feeds the tape output jack and one input terminal of the tape monitor switch; the tape input jack feeds the switch's other terminal. Emerging from the tape monitor switch, the signal next encounters the stereo/mono mode switch, a double-pole/double-throw toggle. In stereo mode, this switch just passes the signal through. In the mono mode, the signal-source channels are tied directly together, and series resistors are inserted in the signal path for each channel—presumably to reduce the level of the mono sum. In my opinion, this is not the way to do it, as it shorts the two channels of the selected source together, which could cause distortion with strong out-of-phase information. Perhaps there was a wiring mistake in the sample I was sent for review.

Next come the volume and balance controls. The volume control is a 50-kilohm, log-taper unit. The balance control is a silvered, 25-kilohm unit—that is, its wiper track is of low resistance from one end to the center, with the 25-kilohm resistance between the center and the other end. The balance control's wiper feeds the input of the line amplifier. Also, at this circuit point, the front-panel mute switch shorts the signal to ground when in the mute position. Another result of this topology is that, in stereo mode, the selected source gets shorted to ground if the front-panel muting

For better phono cartridge matching, the PM1 has both resistance and capacitance selectors right on its front panel.

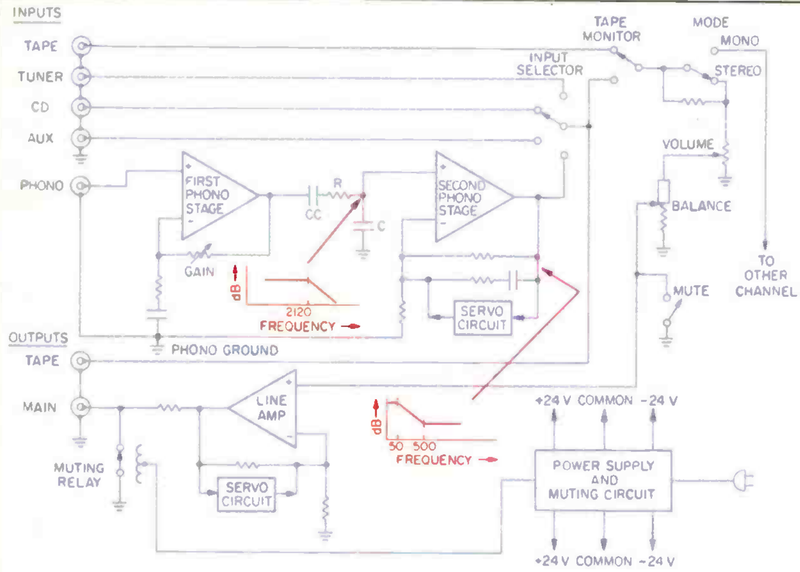


Fig. 1—Circuit topology of the Dolan PM1. Note that RIAA equalization is split between two networks. The switchable circuits for phono input loading are not shown.

switch is engaged when the volume control is full up. This is not a likely condition, however, as the volume control is rarely set to its full-clockwise position.

The signal circuitry of each of the gain blocks is all discrete, with the exception of IC op-amps in the servo circuit. At the start of each gain block is a differential amplifier that is resistively loaded and direct-coupled to another differential amp that forms the block's second stage. This stage is connected in a cascode arrangement and terminates in a current-turnaround circuit whose output signal to ground is the sum of both differential phases. This signal then drives complementary emitter followers that are biased for Class-A operation and produce the final output signal from a low output impedance.

The first stage of the phono circuit uses a low-noise LM394 monolithic transistor pair. This device is an NPN type, and presumably the other gain blocks start out with input devices of N-channel polarity. This would mean that the second stage's differential amp and cascode devices would be of P polarity and probably bipolar, and the current-turnaround devices would be N polarity. The line amp is said to use FET devices, so an input coupling capacitor to that gain block is not needed. In all three of these blocks, the input signal is applied to the noninverting input of the input differential pair and the feedback is applied to the inverting input, in typical op-amp circuit topology.

The power supply in the PM1 starts out with a 30-VA toroidal power transformer feeding a bridge rectifier and capacitor input filters to produce an unregulated positive and negative 32.5-V d.c. supply across two 1,500-µF, 50-V capacitors. Two positive and two negative four-terminal TO-220-sized IC regulators of a variety I'm not familiar with feed the two amplifier circuit channels with ±24 V. From what I could see, these regulated voltages feed all three gain blocks of each channel directly, with no resistive decoupling along the way. There are small, apparently monolithic (and hopefully Mylar) bypass capacitors on the supply lines at the local site of each gain block.

A time-delay circuit mutes the output for a suitable period at turn-on, so that circuit-settling surges won't emerge from the main outputs. The tape monitor outputs are not so muted. A normally closed pair of contacts in the muting relay directly shorts the main output until the time-delay circuit energizes the coil and thus unshorts the outputs. Upon turn-off, the relay immediately shorts again, thus preventing turn-off thumps from coming through.

Measurements

Focusing on the output line section first, output resistance was measured and found to be about 660 ohms at the main outputs. Since this unit has no buffer resistors in series with the tape-out jacks, the output impedance looking back into these jacks is that of the selected source. The impedance of the line inputs is about 50 kilohms—that of the volume control's value when the volume control is turned down. This input impedance decreases to about 13.5 kilohms at full volume, due to the 25-kilohm balance control's becoming in parallel with the 50 kilohms of the volume control and some input resistance in the line amp also coming in parallel. The theoretical value would be 16.7 kilohms if no other resistance was in shunt. The input impedance will stay above about 45 kilohms until the volume control is taken past half rotation. In my use of the unit, I generally set the volume control below that point for the weakest source, which was phono in medium gain mode.

Volume control tracking was found to be within 0.2 dB from the control's highest setting down to the second detent from full counterclockwise (60 dB). At the next-to-last detent (about −87 dB), the difference between channels was 2.4 dB. This is very good performance.

The d.c. offset of the output amp measured about +1 mV for the right channel and +13 mV for the left.

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Volume control tracking was within 0.2 dB, from full up all the way down to the penultimate detent, which is very good.

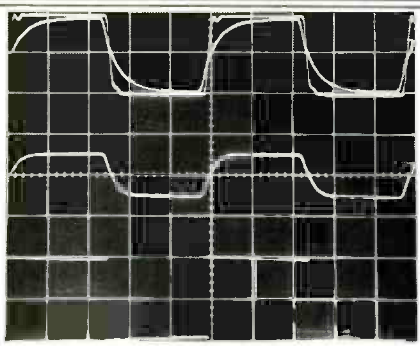


Fig. 2—Line-section square-wave response. Overlapped traces (top) show 100 kHz into instrument and IHF loads; middle trace shows 100 kHz into instrument load, with volume control turned down 6 dB; bottom trace is 20 Hz into instrument or IHF load. (Scales: Vertical, 5 V/div.; horizontal, 2 μS/div. for 100 kHz, 100 mS/div. for 20 Hz.)

Referred input noise for the line section is shown in Table I. This unit seems to have some kind of ground-loop problem when the volume control is fully clockwise and the inputs are terminated in any low to medium impedance, as the noise was mostly composed of a strong, 60-Hz-based signal with strong, lower odd harmonics. This is evident in Table I in the cases where the volume control is fully clockwise and the inputs are terminated, for those measurement bandwidths that don't attenuate the lower harmonics of the 60-Hz line frequency. This hum is just audible at the speakers in my setup, with the line inputs terminated and the volume fully up. With the volume clockwise and the inputs open-circuited, this waveform went away and full-bandwidth noise was much lower. In the rest of the spectrum (above 400 Hz), noise is satisfactorily low. Interestingly, the IHF S/N ratio was not affected by this full-volume 60-Hz noise. This is because the IHF measurement, which is A-weighted and referenced to 500 mV, is made with the volume control turned down about 20 dB, to the point where 500 mV input produces 500 mV out.

Crosstalk between channels was measured for the line section and was found to be quite symmetrical with respect to direction. It was better than −80 dB up to about 3 kHz, decreasing to −70 dB at 10 kHz, −64 dB at 20 kHz, and −56 dB at 50 kHz. At 10 kHz, rotating the balance control toward the driven channel increased the crosstalk to about −63 dB, and with the balance control centered and the volume control turned down to worst-case crosstalk, the amount increased from −70 to −64 dB. This is quite good performance in this area.

THD + N was less than 0.01% from 20 Hz to 20 kHz at 4 V rms output or less, with instrument or IHF loading. Harmonic distortion was dominantly second order. The distortion level stayed reasonably constant with frequency, but the distortion products got a bit more complex from 10 to 20 kHz. Clipping, with either instrument or IHF loading, occurred at about 13 to 14 V rms. The unit drives 600 ohms quite nicely, with no low-frequency roll-off, as there is no output coupling capacitor.

Output amplifier rise- and fall-times for ±5 V out, volume at maximum, and instrument loading were about ±0.3 μS, with some ringing evident. Under the same conditions but for IHF loading, the rise- and fall-times were ±1.6 μS. With

Table I—Line-section noise levels (in μV), referred to input, vs. bandwidth for counterclockwise volume setting with 1-kilohm input termination (CCW), clockwise volume setting with inputs open-circuited (CWO), and clockwise with inputs terminated by 1 kilohm (CW). The IHF S/N ratio was 88.0 dB for the left channel and 88.5 dB for the right.

	Left Channel			Right Channel		
Bandwidth	**CCW**	**CWO**	**CW**	**CCW**	**CWO**	**CW**
Wideband	3.0	4.8	22.0	4.3	4.8	27.0
20 Hz to 20 kHz	2.1	2.9	21.0	3.8	4.2	25.2
400 Hz to 20 kHz	1.2	2.2	4.1	1.8	2.6	4.9
A-Weighted	1.3	2.1	4.5	1.9	2.6	5.5

Table IIA—Gain (in dB) with instrument and IHF loads, at all three gain settings.

	Left Channel		Right Channel	
	Instr. Load	**IHF Load**	**Instr. Load**	**IHF Load**
Phono to Tape Out				
Low Gain	37.7	37.0	37.7	37.0
Medium Gain	47.0	46.2	46.9	46.2
High Gain	56.3	55.6	56.2	55.4
Phono to Main Out				
Low Gain	58.9	58.2	58.9	58.2
Medium Gain	68.1	67.4	68.1	68.4
High Gain	77.4	76.7	77.4	76.7
AUX to Tape Out	0	0	0	0
AUX to Main Out	21.5	21.0	21.6	21.0

Table IIB—IHF sensitivity (in mV), at all three gain settings.

	Left Channel	**Right Channel**
Phono to Tape Out		
Low Gain	7.1	7.2
Medium Gain	2.4	2.5
High Gain	0.84	0.85
Phono to Main Out		
Low Gain	0.62	0.62
Medium Gain	0.21	0.21
High Gain	0.072	0.072
AUX to Tape Out	500.0	500.0
AUX to Main Out	45.0	44.5

Introducing the 300-watt mo

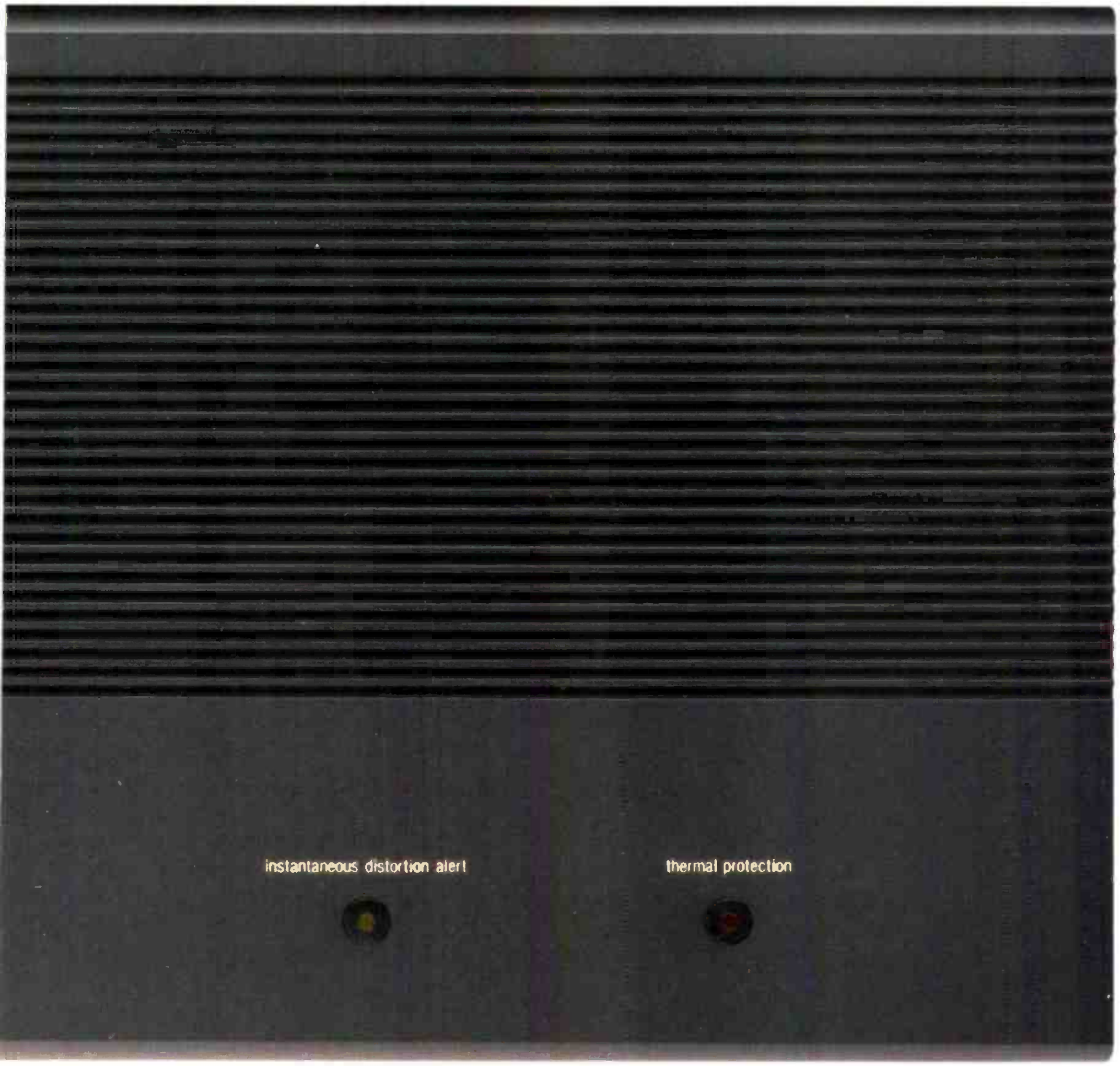
Adcom stereo components have a loyal and devoted following, having earned a reputation among audiophiles, engineers and musicians for extraordinary performance at affordable prices. Now Adcom introduces its newest amplifier, the no compromise GFA-565, for those in pursuit of absolute power and sonic perfection, but who prefer not paying a king's ransom.

The Evolution of Adcom's GFA-565

Adcom's new mono GFA-565 evolves from the design of the critically acclaimed GFA-555, greatly extending its capabilities. Representing brute strength, it delivers 300 watts at 8 ohms, 450 watts at 4 ohms and an awesome 850 watts at 2 ohms.* Most significantly, it will accurately drive even esoteric loudspeakers which present loads as low as 1 ohm.

Inspired by the GFA-555, the new GFA-565's well-regulated, high-current power supply has an enormous reserve capacity to meet tremendous dynamic demands, resulting in distortion-free reproduction on a continuous basis.

Adcom GFA-565 no amplifier.



Why Use Two Mono Amplifiers?

The ability to deliver very high power into complex loads is a prerequisite for superior sound reproduction. Power supplies capable of delivering the energy necessary for high power, high-current amplifiers are massive. But there are practical limits to the size and weight of stereo amplifiers designed for home use, as well as heat dissipation and reliability constraints. Consequently, the use of two Adcom GFA-565 mono amplifiers offers optimum sound definition, detail and dynamics, satisfying even the most demanding perfectionist.

More Sound, Less Money

Like the GFA-555, the new Adcom GFA-565 sounds superior to amplifiers costing two and three times as much. It is so powerful and pure that it may be the last amplifier you ever buy, even if you upgrade your loudspeakers several times over the years. And that makes the GFA-565 an extraordinary bargain considering its exceptional performance.

**Continuous power output, 20 Hz - 20 kHz < 0.02% THD, measured in accordance with FTC specifications.*

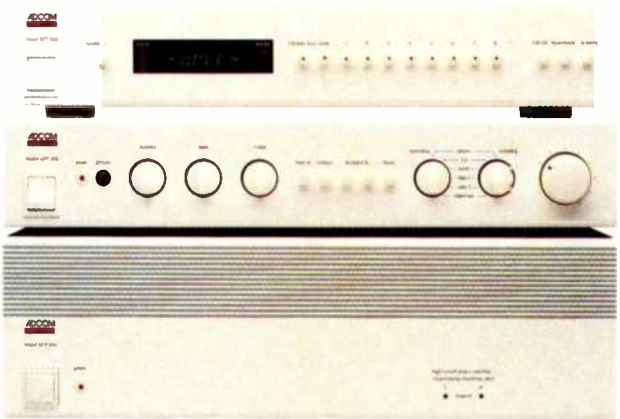
(over please)

The Adcom GFA-565: details you can hear.

High-Current Output Stage

More and more of today's high performance loudspeakers exhibit very low impedances and particularly difficult loads. Many so-called esoteric amplifiers are incapable of delivering large amounts of undistorted power continuously into these complex loads thereby defeating the objectives of the loudspeaker's design.

The GFA-565's highly advanced, triple Darlington output stage featuring 20 rugged, discrete output transistors is designed to deliver extremely high-current at low impedances into reactive loads. No protection circuitry or current limiting devices are incorporated which would restrict the delivery of full power output. Protection against short term overloads, short circuits or long term, excessive output is achieved by non-interfering power supply fuses and thermal circuit breakers.



Adcom components are also available with white front panels. Shown: GFA-545 with GFP-555 preamplifier and GFT-555 AM/FM stereo tuner.

Specifications

Power output, watts/channel, continuous, 20 Hz - 20 kHz, <0.02% THD: 8 ohms/300
4 ohms/450
2 ohms/850

Signal-to-noise ratio, A-weighted, full output: >106 dB

Input impedance: 50,000 ohms

Input sensitivity:
For rated output: 2.15 V
For 1 watt: 130 mV

Damping factor (20 Hz - 20 kHz): >1000 @ 8 ohms

Dynamic headroom (at 4 ohms): 1.6 dB

Voltage: 120 V/60 Hz (available in 220 V/50 Hz on special order)

Dimensions: 17″ × 8¼″ × 11½″D (432 mm × 210 mm × 292 mm D)

Shipping weight: 45 lbs (20.50 kg)

Available options:

565 FAN: Top mounted, automatically variable, ventilating fan.

565 BAL: Rear mounted, symmetrical (balanced line) input circuit.

RM-8 rack mount adaptors.

White front panel and switch.

Well Regulated, High-Current Power Supply

Advancements in CD technology and the introduction of digital audio tape have created opportunities to reproduce the full dynamics and psychoacoustic experience of a live musical performance. To realize the full potential of this technology, amplifiers and loudspeakers must be capable of delivering tremendous energy continuously, not just for tiny fractions of a second.

The massive power supply of Adcom's GFA-565, featuring 70,000 microfarads of filter capacitance and a huge 1.25kVA toroidal power transformer, has enormous reserve power capability. This is a no compromise power supply that eliminates all audible limitations. Hum, vibration and noise, the byproducts of lesser power supplies, have also been reduced to an absolute minimum. For most home applications, the optional variable speed cooling fan is unnecessary, making the GFA-565 a silent performer despite its formidable power.

Instantaneous Distortion Alert

A highly accurate LED on the front panel is activated by a unique monitor circuit if any form of distortion—THD, IM, TIM, SID, etc.—exceeds 1 percent. This will provide ample warning that the music system is being operated beyond its design parameters.

Ask for a Demonstration

No amount of words or technical specifications will adequately describe the experience of listening to a music system featuring a pair of Adcom GFA-565 amplifiers. If you are one of those few who are seeking real power and sonic perfection, please contact your authorized Adcom dealer for a demonstration of this most remarkable audio component.

ADCOM®
details you can hear

11 Elkins Road, East Brunswick, NJ 08816
U.S.A. (201) 390-1130

Distributed in Canada by PRO ACOUSTICS INC.
Pointe Claire, Quebec H9R 4X5

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Distortion stayed below 0.01% from 20 Hz to 20 kHz; it was mostly second-order up to about 10 kHz.

instrument loading and the volume reduced to −6 dB, rise- and fall-times lengthened to ±1 μS. Slewing started to occur above 10 V peak to peak and was worse on the positive-going transition. Figure 2 shows 'scope photos of output amp square-wave performance. The top trace is for 100 kHz at an output level of 10 V peak to peak, with both instrument and IHF loading. The middle trace shows the same signal, with instrument loading but with the volume control turned down 6 dB from maximum. The bottom trace is for 20 Hz and is the same with either instrument or IHF loading. A slight amount of tilt is evident here, due to the servo's low-frequency corner.

Turning to the phono section, gain and sensitivity measurements are shown in Table II. Table III shows referred input noise as a function of phono gain setting for a variety of bandwidths and input terminations; IHF S/N ratios are also listed in this Table. Noise performance of the phono section is pretty good, and noise is unlikely to be a problem except when using MC cartridges, of extremely low output, without a step-up transformer.

Crosstalk between channels was measured for medium and high gain settings, with the undriven channel terminated by 100 ohms. Results were about the same for both gain settings and were quite symmetrical with respect to direction. Crosstalk was down more than 80 dB at frequencies up to about 10 kHz, increasing to about 72 dB at 20 kHz. In the low gain mode, treated as an MM input and terminated in the dummy IHF MM load, crosstalk was down more than 80 dB at frequencies up to 1 kHz; crosstalk peaked at 10 kHz, where it was about 50 dB down.

Phono overload versus frequency is shown in Table IV for low and high gain settings. The left channel is shown here; both channels were very close in their measurements. The output level at the overload point is quite constant with frequency, which means the input acceptance is effectively constant with frequency as well—that's very close to ideal.

A bit of clarification on that: Both MM and MC cartridges are velocity-responsive. When playing an LP of test signals from 20 Hz to 20 kHz, made with RIAA record equalization, the cartridge's output will rise with frequency, and that rise will be the inverse of the RIAA playback EQ curve. Now imagine a test disc that would drive the cartridge so hard that it made the phono preamp circuit just begin to clip at 1 kHz, and that it put out correspondingly high levels at all frequencies from 20 Hz to 20 kHz. (In actuality, no such disc could be cut, and no cartridge could track it.) A phono preamp with ideal signal acceptance would just begin to clip at all the frequencies from 20 Hz to 20 kHz.

Figure 3 shows RIAA equalization error versus frequency. The curves shown are for the medium gain setting; the response curves for the low and high gain positions were virtually identical. IHF loading didn't change the curve's shape, just its level. Of note here is the very close channel match and the general roll-off shelf at the low end.

Oscilloscope photos of pre-equalized square-wave signals going through the phono preamp are shown in Fig. 4. From top to bottom, the test frequencies are 10 kHz, 1 kHz, and 40 Hz. The 10- and 1-kHz waveforms look really good, and the effects of the low-frequency roll-off shelf in the frequency response can be seen in the 40-Hz square wave.

Table III—Phono-section noise, referred to input, and IHF S/N ratios vs. gain setting and source impedance.

	Referred Input Noise, μV	
Bandwidth	**Left Channel**	**Right Channel**
Low Gain, IHF MM		
Wideband	1.15	1.25
20 Hz to 20 kHz	0.95	1.1
400 Hz to 20 kHz	0.74	0.78
A-Weighted	0.7	0.73
Medium Gain, 100 Ohms		
Wideband	0.45	0.8
20 Hz to 20 kHz	0.28	0.35
400 Hz to 20 kHz	0.12	0.12
A-Weighted	0.12	0.13
Medium Gain, IHF MM		
Wideband	1.0	1.2
20 Hz to 20 kHz	0.85	1.0
400 Hz to 20 kHz	0.72	0.76
A-Weighted	0.7	0.71
High Gain, 100 Ohms		
Wideband	0.4	0.7
20 Hz to 20 kHz	0.25	0.35
400 Hz to 20 kHz	0.1	0.1
A-Weighted	0.1	0.11
	IHF S/N Ratio, dB	
Low Gain, IHF MM	−76.6	−76.0
Medium Gain, 100 Ohms	−72.4	−72.0
Medium Gain, IHF MM	−77.0	−76.3
High Gain, 100 Ohms	−73.5	−73.0

Table IV—Phono overload vs. frequency, gain, and load.

Frequency,	Instrument Load		IHF Load	
Hz	Input, mV	Output, V	Input, mV	Output, V
Low Gain				
20	10.0	13.5	10.0	12.6
50	26.7	13.7	26.7	12.9
100	43.5	13.7	43.5	13.0
300	96.5	13.7	96.5	12.9
1k	177.0	13.7	177.0	12.9
3k	305.0	13.7	305.0	12.9
5k	450.0	13.7	450.0	12.9
10k	865.0	13.6	865.0	12.8
20k	1700.0	13.6	1700.0	12.8
High Gain				
20	1.05	13.2	1.05	12.4
50	3.0	13.6	3.0	12.8
100	7.2	13.8	7.2	12.9
300	11.2	13.7	11.2	12.9
1k	21.0	13.7	21.0	12.9
3k	36.0	13.7	36.0	12.8
5k	54.0	13.7	54.0	12.9
10k	102.0	13.7	102.0	12.8
20k	207.0	13.6	207.0	12.7

Summing up, the Dolan PM1 is a good preamplifier that basically serves the music. I recommend it.

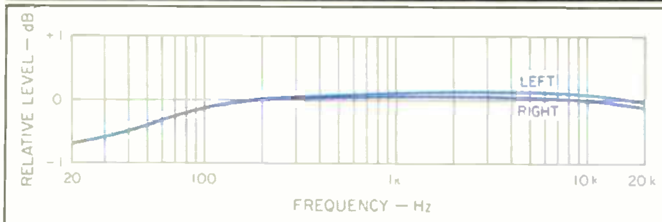


Fig. 3—RIAA equalization error at medium gain setting, with instrument load on output and 47-kilohm resistive load on input.

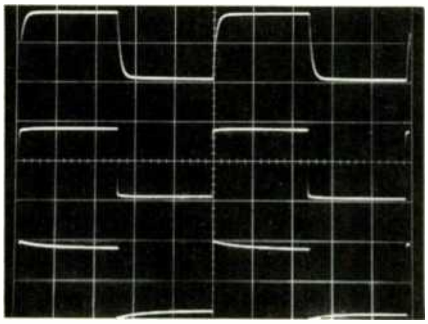


Fig. 4—Response to pre-equalized square waves through phono input for, top to bottom, 10 kHz, 1 kHz, and 40 Hz. (Scales: Vertical, 0.5 V/div.; horizontal, 20 μS/div. for 10 kHz, 200 μS/div. for 1 kHz, 5 mS/div. for 40 Hz.)

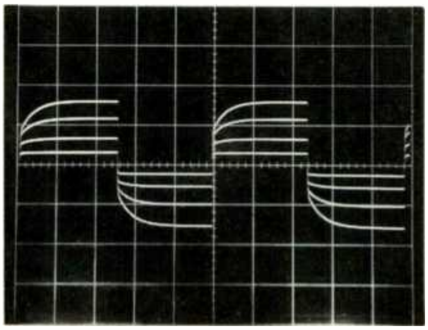


Fig. 5—Results of deliberate high-frequency overload from 1-kHz square waves at four different input levels. Note the symmetrical clipping; see text. (Scales: Vertical, 2 V/div.; horizontal, 200 μS/div.)

The traces shown are for instrument loading; IHF loading didn't change their shape, though it did change their level slightly.

Figure 5 shows the result of feeding in a 1-kHz pre-equalized square wave whose high-frequency content is not band-limited and then increasing this signal's amplitude at the input. All phono preamps ultimately overload when out-of-band high frequencies are applied in this way. As Fig. 5 shows, when the PM1 overloads, the resulting compression is symmetrical, which is desirable circuit behavior.

I also tried this test with the low gain setting—a largely academic test, since the resulting signal levels would be unlikely to occur with actual cartridges—and something interesting happened: The preamp latched up and went to +20 V d.c. output in one channel and −20 V in the other! "Oops, there goes this circuit," I thought. "I won't be able to listen to it." But after some dispirited tweaking of the gain switch and the input signal level, lo and behold, the PM1 came back and worked again!

Phono-stage harmonic distortion was, as usual, hard to measure without some hum contaminating the results. In the high gain mode, I got about 0.01% THD + N from 20 Hz to 10 kHz, rising to about 0.014% at 20 kHz at an output level of 3 V rms—both good results—with either instrument or IHF loading. The harmonic distortion residue was essentially second-harmonic.

I also measured d.c. offset. At the tape output, with the phono input selected, it was less than 10 mV in either channel.

Use and Listening Tests

Equipment used to evaluate the Dolan PM1 included an Oracle turntable fitted with a Well Tempered arm and Koetsu Black Goldline MC cartridge, a California Audio Labs Tempest II Special Edition CD player, a Nakamichi 250 cassette deck, a Technics 1500 reel-to-reel recorder, a Cook-King reference tube phono preamp, and EAR 519 mono tube power amps driving Siefert Research Magnum III speakers and Stax SR-X/Mk3 electrostatic headphones via an SRD-7 Pro energizer.

First listening with the PM1 was with Compact Discs as a source, using the line section of the unit. Generally, the sound was pretty satisfactory and listenable, but the Dolan had a noticeable tendency toward a slight coarsening of texture and a reduction in depth and delicacy when compared to my reference stepped attenuator used as a system volume control.

Phono reproduction through the PM1 was musical and satisfying. However, my sense that the music was being performed in real space, my sense of that space's size, and the general believability weren't as good as with my reference tube phono preamp and stepped attenuator, and the bass was not as prominent.

Operationally, the unit worked nicely; there were no real surprises. I felt that the selector and the phono resistive-loading switches felt a little clunky, with slightly too much play in their shaft bushings.

Summing up, I think the Dolan PM1 is a good preamp that basically serves the music, and I recommend it.

Bascom H. King

3

PHILIPS LHH1000 COMPACT DISC PLAYER

Manufacturer's Specifications

LHH1001 CD Transport

Coaxial Output Level: 0.5 V peak to peak, 75 ohms.

Optical Output Level: –15 to –23 dBm.

Number of Programmable "Blocks": 20.

Favorite Track Selection Memory Capacity: Typically, 150 discs with five selections each or 70 discs with 20 selections each.

Power Requirements: 120 V a.c., 60 Hz, 0.18 ampere.

Temperature Range: 41° to 95° F (5° to 35° C).

Humidity Range: 5% to 90%.

Dimensions: 17⅞ in. W × 4⅛ in. H × 13⅝ in. D (45.4 cm × 10.3 cm × 34.5 cm).

Weight: 30.8 lbs. (14 kg).

LHH1002 D/A Converter

Sampling Rate: 48 kHz, 44.1 kHz, or 32 kHz, automatically selected.

Frequency Response: Unbalanced outputs, 2 Hz to 20 kHz, ±0.1 dB; balanced outputs, 20 Hz to 20 kHz, +0.3, –0.6 dB.

S/N: 101 dB.

Dynamic Range: 96 dB.

Channel Separation: 100 dB.

THD: 0.0015% at 1 kHz.

Digital Input Level: 0.5 V peak to peak, 75 ohms.

Optical Input Level: –15 to –23 dBm.

Analog Output Level: Unbalanced outputs, 2 V; balanced outputs, 3 V; headphone output, 45 mW into 32 ohms.

Power Requirements: 120 V a.c., 60 Hz, 0.2 ampere.

Dimensions: 17⅞ in. W × 4⅛ in. H × 13⅝ in. D (45.5 cm × 10.3 cm × 34.5 cm).

Weight: 30.8 lbs. (14 kg).

Price: $4,000 for complete system, including remote.

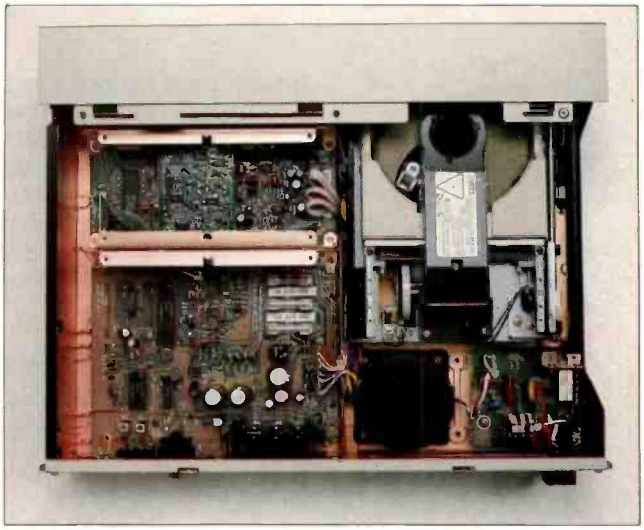
Company Address: P.O. Box 14810, Knoxville, Tenn. 37914.

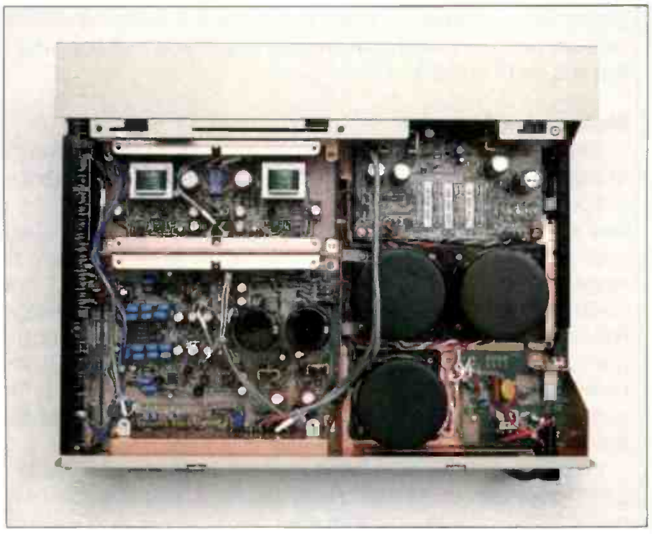
For literature, circle No. 92

There's a definite, if still small, trend toward two-piece, no-holds-barred CD players. Philips' version, the limited-edition LHH1000, consists of a transport (housing the laser pickup assembly, the rest of the mechanics for the CD player, and the servo electronics) and a separate digital-to-analog converter. This player carries a suggested list price of $4,000, half what some other two-piece models cost but still twice as high as state-of-the-art single-unit CD players.

According to Philips, the LHH1000's D/A converter and digital filter use special "select grade" TDA-1541 AS-1 chips with four-times oversampling, and they are supposed to realize more than 15.75 bits of resolution out of the 16 bits available in the standard CD format.

The transport section features a Philips CDM-1 mechanism made of die-cast aluminum alloy. A single-beam laser pickup floats on a radial/linear swinging arm that is supposed to result in improved tracking ability and faster track access. The unit also has Favorite Track Selection (FTS), an innovation introduced by Philips and Magnavox (another Philips trade name) in many CD players costing far less than





this one. With FTS, you can set the LH1000 so that, when a given disc is inserted, the unit will play only those tracks or selections you have previously programmed for that disc. This is possible because each CD, according to the Philips/Sony CD standards, carries an identifying code. The player memorizes this code along with the track numbers that you prefer to hear when the disc is played.

The transport and D/A sections of the LHH1000 can be linked via a coaxial cable or a supplied optical-fiber cable said to have diamond-polished connectors.

The two components are a champagne gold color—rather a welcome departure from the all-black finish almost every audio manufacturer has adopted as a de facto "standard" for high-end equipment. The system comes with a sophisticated universal remote control that can learn 150 functions from other remotes of audio and video products.

Control Layout

Each of the LHH1000's components is fitted with a swing-down door, along the lower edge of the front panel, which

The spectrum analysis of residual noise shows how well the power supply is shielded from the audio signal circuitry.

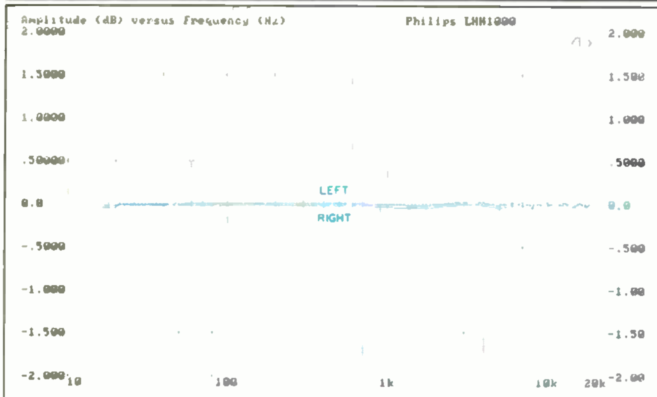


Fig. 1—Frequency response.

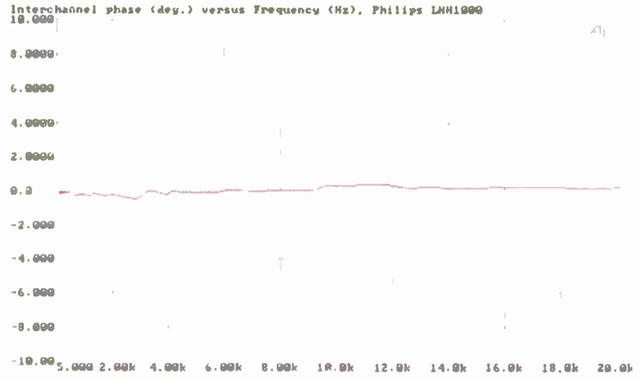


Fig. 2—Interchannel phase difference vs. frequency.

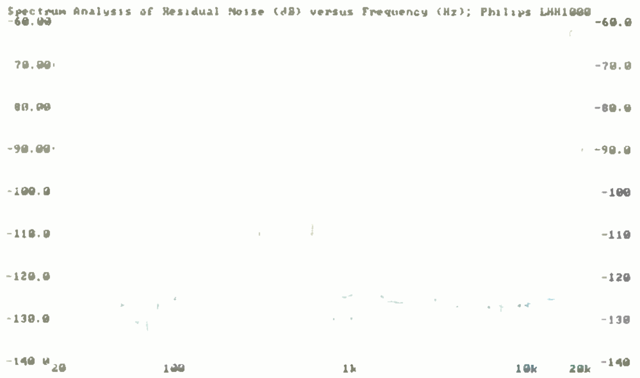


Fig. 3—Residual noise vs. frequency for "quiet" track of CD-1 test disc for left channel (solid curve) and right channel (dashed curve).

hides seldom-used controls. With the panel closed, the transport unit shows switches only for power, drawer open/close, play/stop, and track advance/reverse. An elaborate display is also visible; it shows the usual track number, index number, and playing time as well as such modes as shuffle play and repeat, FTS data, and in tiny numerals from 1 to 24, the total number of tracks present on the disc.

When the hinged door of the transport unit is swung down, numeric buttons, selection and memory keys, and program cancellation and recall buttons are revealed. Here, too, are buttons for "FTS," the time display (elapsed time of track, total remaining time, and time of current track being played), repeat, and pause as well as rockers for fast forward/reverse and "Index" forward/reverse.

The transport's rear panel has two coaxial digital output terminals and an optical output terminal. A fuse-holder is also accessible from the rear, and a separate power cord connects the transport to an a.c. source.

The front panel of the LHH1000's D/A unit has a power switch at the left and a central display divided into three areas. The first shows digital tape-monitoring mode (coaxial or optical), the second shows whether the current sampling frequency is 48 or 44.1 kHz (it's unlit when playing material made with 32-kHz sampling), and the third shows which of the two coaxial and two optical digital inputs has been selected. Opening the hinged door reveals a stereo headphone jack and level control, a "Digital Tape Monitor" selector, and an "Input Selector." An abbreviated block diagram of the D/A converter is also screened onto the surface behind the hinged door.

The converter's rear panel is equipped with two digital coaxial inputs, two optical digital inputs, left and right unbalanced analog outputs, and left and right balanced XLR analog output connectors. A fuse-holder and a second power cord comp ete the rear panel.

I was surprised to find that Philips had not provided even one convenience a.c. outlet, either on the transport or the D/A converter. As things stand, you will need two wall outlets to power this two-piece system. Furthermore, you will have to push the power switches on both components to power up the player. (Philips says this is in keeping with the design philosophy of maintaining separation all the way to the a.c. wall outlet.)

Measurements

Since Philips' published specifications suggest the unbalanced outputs will yield flatter response than the balanced outputs, I used this hookup for measuring performance of this system. No doubt, matching transformers in the analog section account for the slight deviation from perfectly flat response encountered via the balanced XLR output connectors. In any case, interfacing the ordinary unbalanced RCA-type output jacks with my Audio Precision test equipment, I plotted the response from just above 10 Hz to 20 kHz using my CD-1 test disc. The results are shown in Fig. 1. The slight ripple evident at the high-frequency end of the plot amounts to less than the claimed ±0.1 dB.

I used a greatly expanded vertical scale (in degrees) to plot interchannel phase shift between channels. For all practical purposes, the shift was negligible (Fig. 2).

No difference was audible between the optical and the coaxial interfaces, though the fade-to-noise test did show some variance.

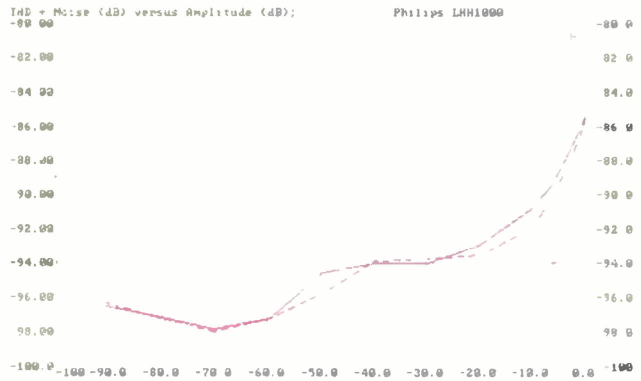
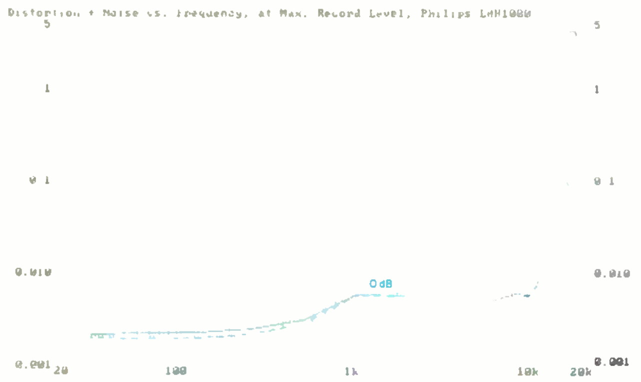


Fig. 4—THD + N vs. signal level for left channel (solid curve) and right channel (dashed curve).



A
B

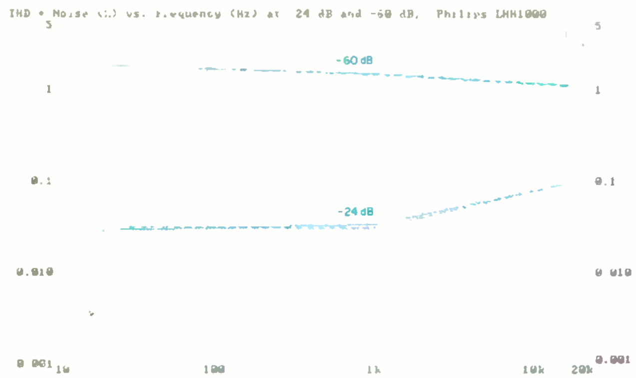


Fig. 5—THD + N vs. frequency for 0-dB recorded level (A) and for recorded levels of −24 and −60 dB (B).

A-weighted S/N ratio, referred to maximum recorded level, was a very high 112.8 dB for the left channel and 113.3 dB for the right. These results are far better than the 101 dB claimed by Philips. A spectrum analysis of the residual noise generated by the analog section of the system is shown in Fig. 3, and it is clear from this plot that the power-supply components are extremely well shielded from the audio signal circuitry. There is virtually no rise in noise level at the 60-Hz power-line frequency or its harmonics.

Next, I plotted THD + N (expressed in dB and referred to maximum recorded level) versus amplitude, from 0 to −90 dB, using a 1-kHz test signal that decreased in amplitude in discrete steps (Fig. 4). Some slight increase in THD + N was noted at higher output levels and was caused, no doubt, by a minute amount of nonlinearity in the analog output circuitry as higher audio levels were reached. The THD + N value of about −86 dB shown for both channels at 0-dB recorded level corresponds to roughly 0.005%. This is just about what I measured at 1 kHz when I plotted THD + N versus frequency for a signal recorded at maximum level (Fig. 5A).

In a spot check of SMPTE-IM distortion, using test signals at maximum recorded level, I obtained readings of 0.00315% for the left channel and 0.00265% for the right.

I have recently acquired a new test disc issued by Philips. Much of its content is similar to what the CBS CD-1 test disc offers, but a couple of tracks yield new information that I thought might be worth including. Figure 5B, therefore, shows THD + N for recorded levels of −60 and −24 dB, using signals from the new Philips disc. As Figs. 5A and 5B demonstrate, distortion in a digital playback system rises as signal levels *decrease*. However, even at −60 dB, THD + N was only about 1.5%.

Figure 6 is a plot of separation versus frequency over the range from 125 Hz to 16 kHz. At 1 kHz, separation measured 105 dB, while at 16 kHz, separation actually increased somewhat, to 110 dB. Notice, too, that at all frequencies, separation from left to right was virtually identical to separation from right to left. There are actually two curves in Fig. 6, both following the same path over most of the range tested.

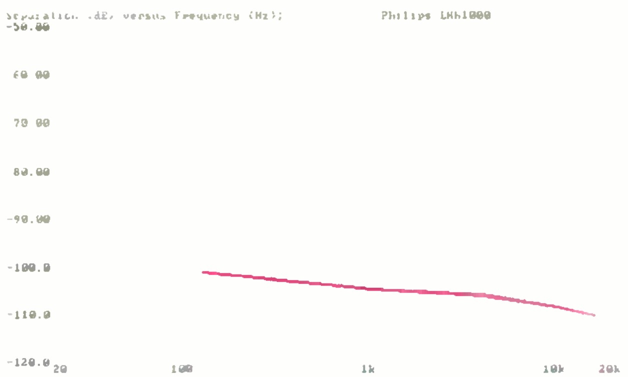


Fig. 6—Interchannel separation.

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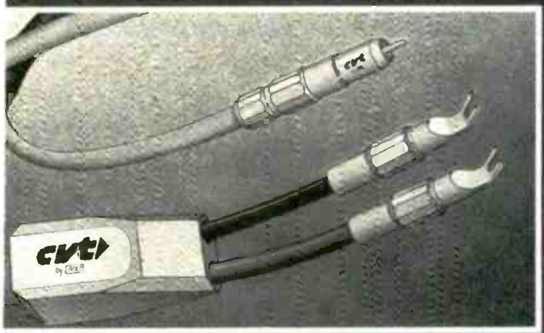
The Fruit Doesn't Fall Far From The Tree



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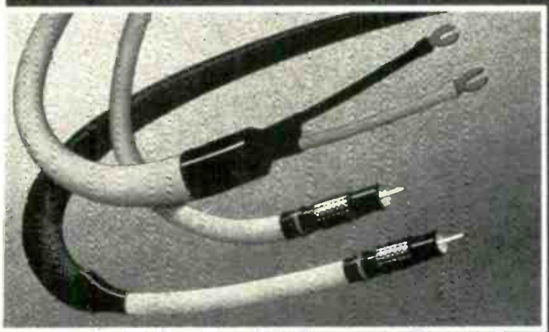

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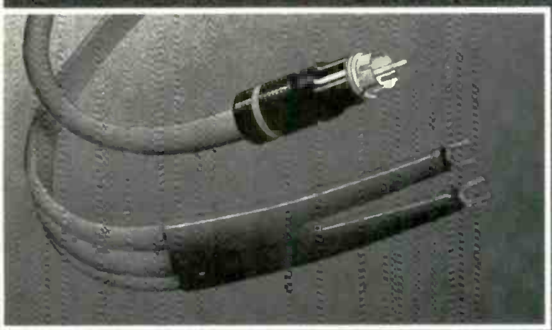

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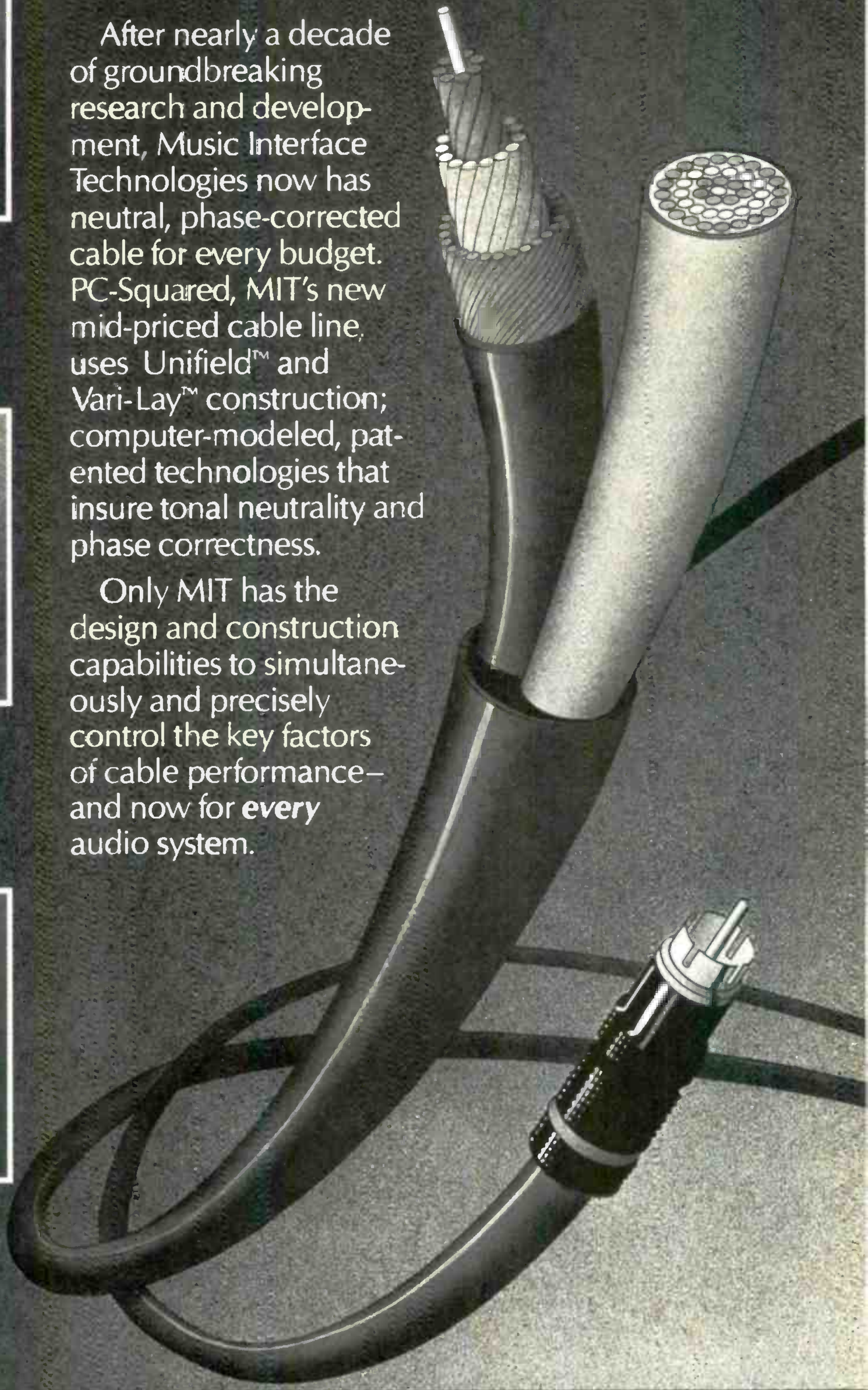

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The remote control was so awesomely versatile that I used it for bench testing as well as my listening sessions.

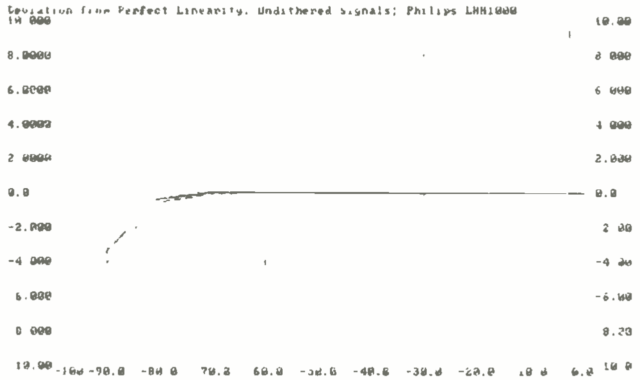


Fig. 7—Deviation from perfect linearity using undithered, 1-kHz signals for left channel (solid curve) and right channel (dashed curve).

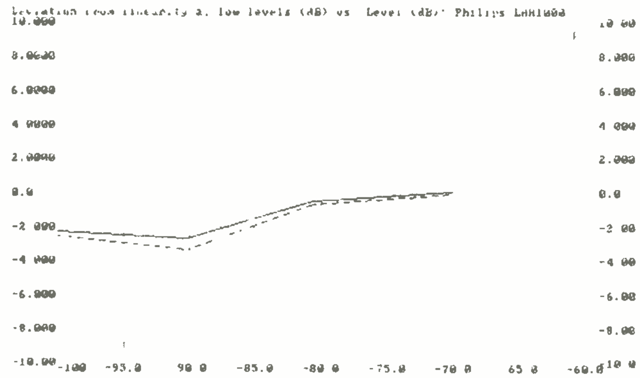
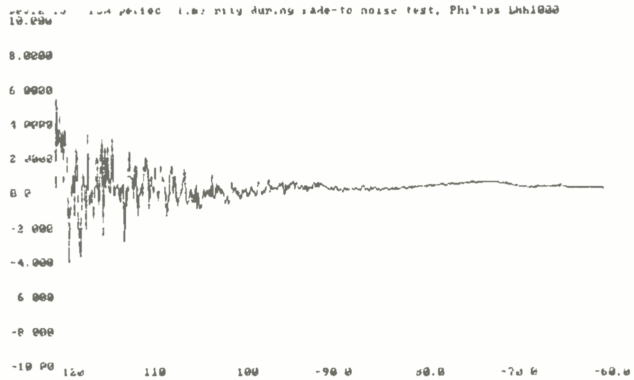


Fig. 8—Linearity deviation using dithered, 1-kHz signals for left channel (solid curve) and right channel (dashed curve).



A

B

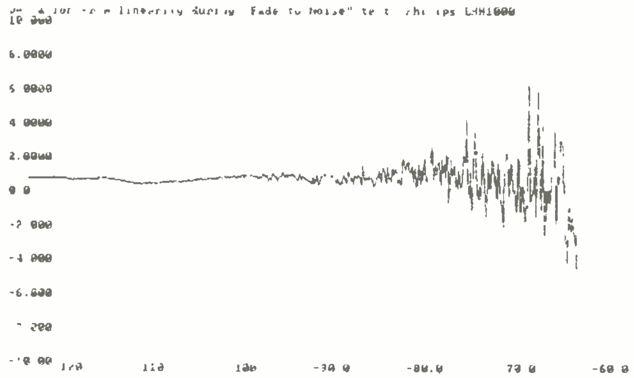


Fig. 9—Linearity deviation for "fade-to-noise" test of dynamic range, using coaxial connections between transport and D/A unit (A) and using optical connections (B).

I have come to the conclusion, as have others in the field, that the most important difference between the "good," "better," and "best" CD players is their ability to reproduce low-level signals with good linearity. The three tracks of the CD-1 test disc I use for checking linearity are, therefore, the tracks that perhaps tell me the most about a CD player—no matter what its cost. Figure 7 shows the Philips LHH1000's deviation from linearity using undithered signals from 0 to −90 dB. Linearity was virtually perfect down to −80 dB; at −90 dB, deviation from perfect linearity measured between −3 and −4 dB. These results are above average for all players I have tested in the past year or two, though they are not the best I have ever obtained. Some CD players costing a good deal less have yielded equal or better results for linearity.

The same holds true for the test using low-level dithered signals covering the range from −60 to −100 dB, as seen in Fig. 8. Once again, deviation from perfect linearity was between −3 and −4 dB at −90 dB. Because of the dithered nature of the test signals, I was able to read down to −100 dB, where deviation from perfect linearity improved somewhat, to between −2 and −3 dB.

Up to this point, I had not been able to measure any difference in performance when I used the optical or the coaxial interface between the system's two sections. I decided to give the comparison study one more try during the fade-to-noise test on the CD-1. Sure enough, a difference finally turned up. Figure 9A shows deviation from linearity using the coaxial interface; it also shows how noise increases at low levels (from about −110 to −120 dB).

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Clearly, Philips spared no expense on the LHH1000, a reference CD player of elegance and style.

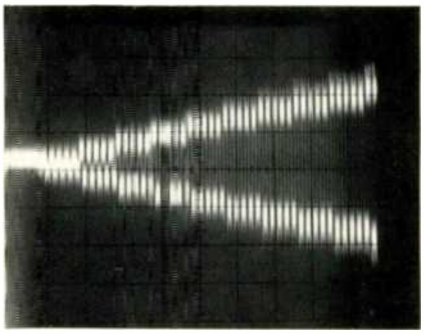

Fig. 10—Monotonicity test. See text.

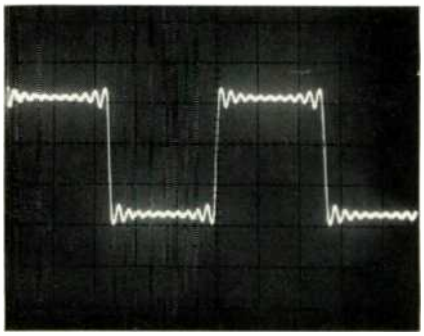

Fig 11—Reproduction of 1-kHz square wave.

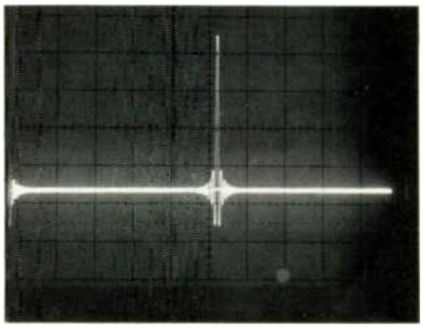

Fig. 12—Single-pulse test.

Observe carefully the amplitude of the noise spikes between −110 and −120 dB and compare them with those in Fig. 9B, where optical coupling was used. The noise spikes in Fig. 9B are actually greater in amplitude than those in Fig. 9A—so much for the noise-reducing advantages of optical coupling! Of course, both graphs depict noise floors which are extremely low and somewhat better than average for CD players. Using the better display (coaxial coupling) to calculate EIA dynamic range, I came up with a figure of around 111 dB. The EIAJ method of measuring dynamic range resulted in 98.8 dB for the left channel and 98.7 dB for the right. Judging from their specs, Philips must have used the EIAJ method rather than the newly approved EIA method.

Getting back to the question of optical versus hard-wired connections, I would quickly add that during the careful listening tests that followed the lab measurements, I was unable to detect any difference in sound quality between the two interface types. Could the departure from linearity in my particular sample have masked even more subtle sonic differences I might otherwise have heard when changing from optical to coaxial connections? I'll never know, one way or the other—at least not with this unit.

I got good confirmation of the minor low-level departure from linearity when I photographed the test signal used to check monotonicity. Careful examination of Fig. 10 shows that the second steps in the up and down "staircases" are not positioned with perfect symmetry above and below the display's central axis.

Figures 11 and 12 show how a 1-kHz square wave and a unit pulse were reproduced by the LHH1000. These results are pretty much what we have come to expect from players employing digital filtering and oversampling.

Use and Listening Tests

The versatility of this system's remote control is truly awesome. Just about every function of the CD player was controlled using the remote, both during the bench tests and subsequent listening tests.

I used my two new "defects discs" to check out the tracking capabilities of the transport. In general, mistracking occurred whenever the data gaps reached 1 mm in length. (The largest data gap any CD player has been able to track since I started using these test discs has been 1.5 mm; poorly tracking units misbehave at or below 0.7 mm.)

The minor linearity deviation at ultra-low levels could not be heard by me or the several guests in my lab who had an opportunity to compare this player with one that is somewhat more linear at low levels. I listened to everything from large orchestral works to chamber music with light, extremely soft passages.

Clearly, Philips has attempted to design and build a reference CD player and has spared no expense in doing so. Aesthetically, the two units are attractive and, mounted one above the other, give the impression of elegance and style that I'm sure was intended. I doubt Philips expects to sell this two-piece CD player in any great quantity. Rather, borrowing from the technology inherent in the LHH1000, perhaps Philips will come up with somewhat more economical models incorporating much of the new technology in this, their reference CD player. *Leonard Feldman*

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4

VECTOR RESEARCH VRX-5200R RECEIVER

Manufacturer's Specifications

FM Tuner Section

Usable Sensitivity: Mono, 11.2 dBf.

50-dB Quieting Sensitivity: Mono, 15.6 dBf; stereo, 37.6 dBf.

S/N: Mono, 74 dB; stereo, 70 dB.

THD at 65 dBf, 1 kHz: Mono, 0.17%; stereo, 0.35%.

Frequency Response: 50 Hz to 15 kHz, ±1.5 dB.

Capture Ratio: 1.3 dB.

Alternate-Channel Selectivity: 60 dB.

Image Rejection: 52 dB.

I.f. Rejection: 80 dB.

AM Suppression: 56 dB.

Spurious-Response Rejection: 65 dB.

Separation: 42 dB at 1 kHz.

Amplifier Section

Power Output: 50 watts per channel into 8 ohms, 60 watts per channel into 4 ohms.

Power Bandwidth: 20 Hz to 20 kHz (see text).

THD: 0.07%.

IM Distortion: 0.07%.

Dynamic Headroom Power: 80 watts (see text).

Frequency Response: High level, 10 Hz to 50 kHz, ±1 dB.

Damping Factor: 50.

Input Sensitivity: MM phono, 2.5 mV; high level, 150 mV.

S/N: Phono, 80 dB; high level, 95 dB.

General Specifications

Power Requirements: 120 V a.c., 60 Hz.

Dimensions: 17 in. W × 4½ in. H × 12 in. D (43.2 cm × 11.4 cm × 30.5 cm).

Weight: 18½ lbs. (8.4 kg).

Price: $369.95.

Company Address: 1230 Calle Suerte, Camarillo, Cal. 93010.

For literature, circle No. 93

Despite some published specifications that are less than spectacular (not to mention some mildly "creative" nonstandard specifications I will discuss later), the Vector Research VRX-5200R receiver has much to commend it. The unit's quartz frequency-synthesized AM/FM tuner section features 20 presets. There's an audio/video signal-processing loop in addition to two tape-monitor loops. One feature I particularly like is having separate FM muting and mono/stereo controls. Most receivers link these two functions to a single control, making it impossible to receive weak signals in stereo—even if the user is willing to tolerate somewhat higher noise levels. With this receiver, you can choose whether to switch to mono under such conditions and, separately, whether to apply muting to eliminate those weak signals altogether. Unlike some other units which are called, as this one is, audio/video receivers, the VRX-5200R actually lets you route video signals through it and connect a TV monitor to it as well. In other words, within limits, this receiver can serve as your total audio/video control center. Vector Research has brought back some of the nice features I used to find on receivers years ago, such as separate preamp-out/amp-in jacks and separate 75-ohm coaxial and 300-ohm screw-terminal FM antenna inputs.

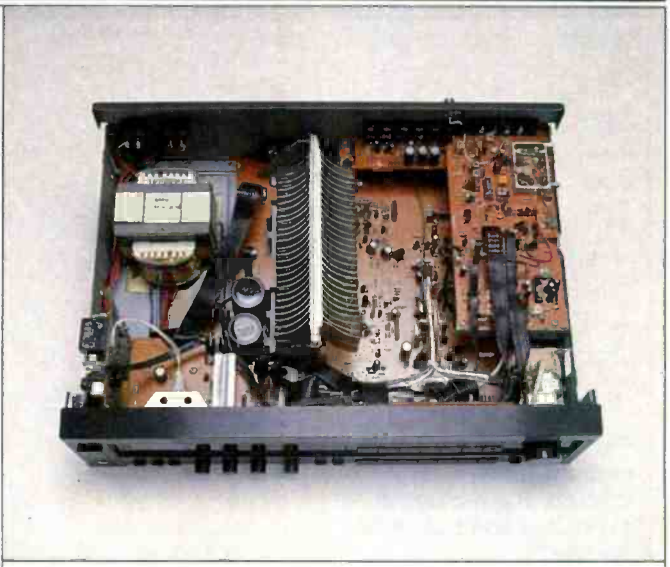
In many other ways, though, this receiver is as modern and up-to-date as the competition. It has AM and FM autoscan tuning and a dedicated remote control that handles preset station selection, volume adjustment (including mute), function selection, and power on/off. There is provision for connecting two pairs of speakers in parallel. If four speakers are used in the same room, a matrix circuit can be switched in to provide a simulated surround effect. The addition of a midrange tone control adds to the flexibility of audio spectral balance that can be achieved with this receiver. To make the unit more flexible when used as an A/V control center, there's even a video signal-processing loop (video in/out) which is normally interconnected by a removable jumper. With the jumper out, such devices as video noise-reduction units or video enhancers can be interposed in the video signal path.

Vector Research's brochure and owner's manual provide little detail concerning actual circuit approaches used in the VRX-5200R, other than pointing out that the output stages utilize discrete transistors. They have come up with a name for this: DOS, which computer aficionados will immediately surmise stands for Disk Operating System, but which, in fact, is Vector Research's acronym for Discrete Output Stage.

Control Layout

At the extreme left of the front panel is the on/off switch and, below it, a stereo 'phone jack. A frequency display is further to the right. To its right are banks of LEDs, two of which serve as approximate power output meters. The third bank, consisting of three LEDs, serves as a signal-strength meter. The display area flashes the word "Memory" when the "Memory" button is pressed to store station frequencies. A stereo indicator light is also found in the display.

The lower left portion of the panel contains a pair of speaker on/off switches; the "Matrix Surround" button; rotary tone controls for bass, midrange, and treble; a rotary balance control, plus pushbuttons for loudness compensation and audio muting. Buttons for 10 numbered presets, up/down tuning, and "Memory" are at the upper right portion of the panel. Below these are seven program source selectors, three of which are associated with tuner operation. After pressing the "Tuner" button, you must then select either AM or FM by pressing an additional button nearby. I wonder why Vector Research couldn't have simply included one button for AM and one for FM, without the additional "Tuner" button. Perhaps they did it for visual symmetry, since the preset/memory bank of buttons just above also has a button count of seven. At the extreme right of the panel are the aforementioned "Mute," "Mono," and "Auto Scan" buttons, with a good-sized rotary volume control above. This control is motorized, so it rotates when the remote control is used to adjust volume.



The rear panel is equipped with 300-ohm FM antenna screw terminals, a 75-ohm coaxial FM antenna terminal, and AM antenna screw terminals. A separate AM loop antenna, supplied with the receiver, can be snapped into a clamp and then rotated for best reception, or an external AM antenna can be connected. The usual array of input jacks for "Phono," "CD," "AV/Tape 1," and "AV/Tape 2" are augmented by sets of "Video" input and output jacks, a video "Monitor" output jack, the previously mentioned "Processor" in/out jacks, and the two preamp-out/amp-in jacks. A separate ground terminal is provided for turntable grounding. Spring-loaded speaker terminals accommodate two pairs of speakers. One switched and one unswitched receptacle complete the back panel's layout.

Tuner Measurements

Figure 1 shows the frequency response of the FM tuner section of the VRX-5200R. The dashed curve, measured for the right channel, has been deliberately displaced for clarity. Notice that the actual response meets Vector Research's claims, since response at 50 Hz was off by less than −1.0 dB, and left-channel output exhibited a slight rise of about +1.0 dB at 15 kHz.

This receiver's versatile controls include such niceties as a motorized volume pot that can be operated remotely.

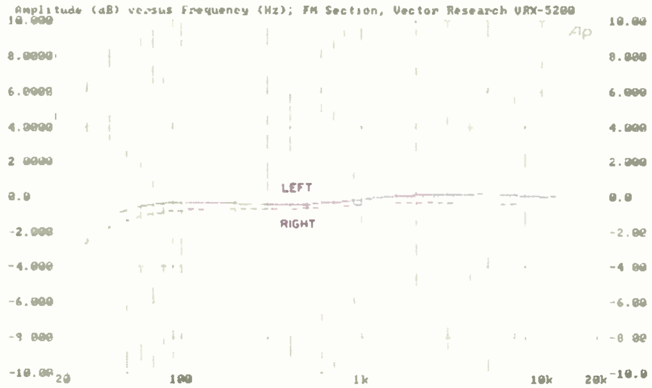


Fig. 1—Frequency response, FM tuner section. Right-channel curve has been displaced for clarity.

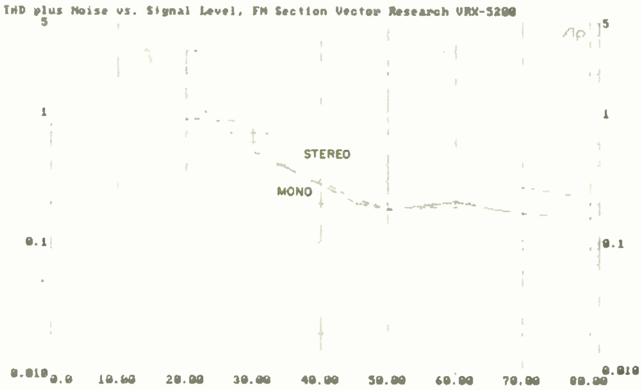


Fig. 3—THD + N vs. signal strength at 1 kHz.

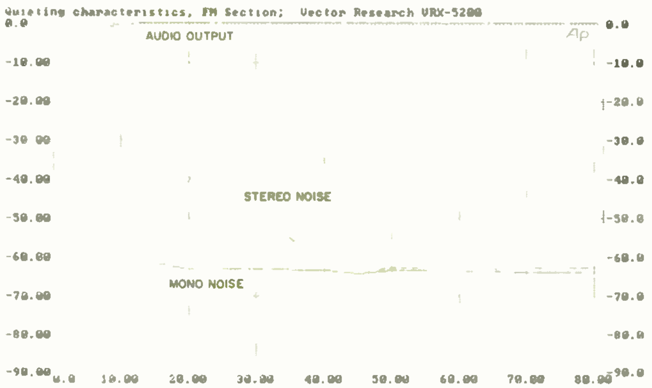


Fig. 2—Mono and stereo quieting characteristics.

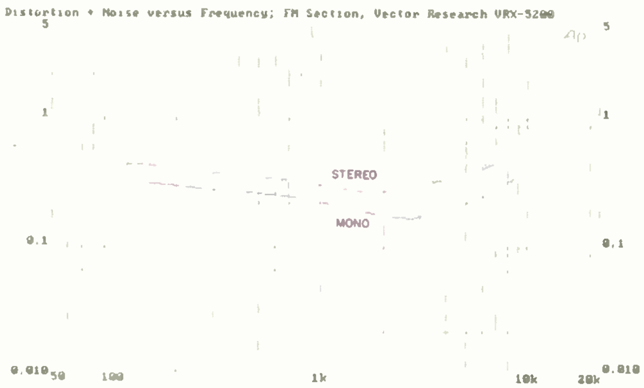


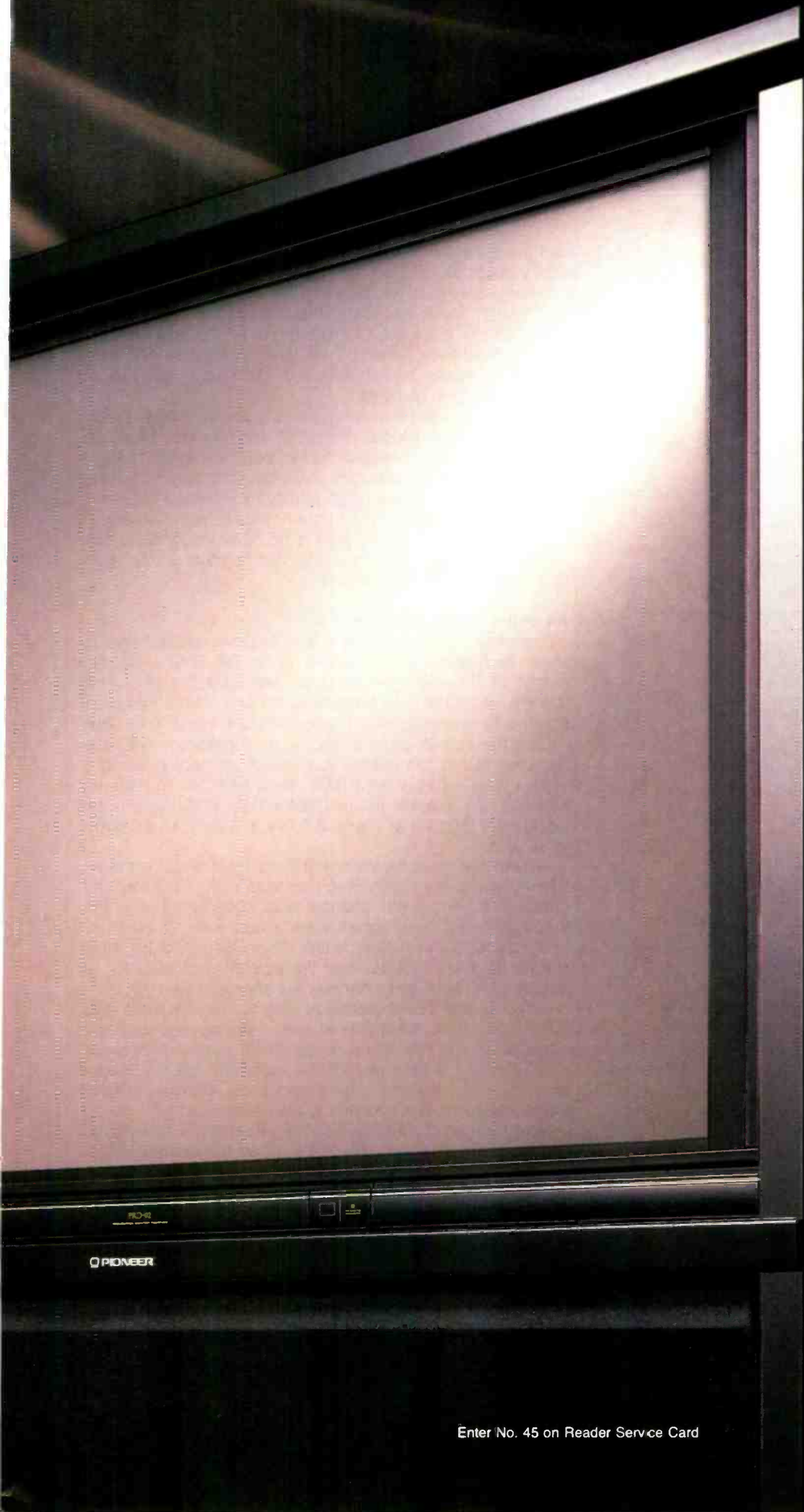
Fig. 4—THD + N vs. modulating frequency for 65-dBf signal.

My usual plot of S/N versus signal input level for the FM tuner section is shown in Fig. 2. Maximum S/N fell short of Vector Research's claims; my results were 65 dB for mono and 63.5 dB for stereo at 65 dBf and above. Notice that the stereo switching threshold occurred at about 15 dBf. Sensitivity for 50-dB quieting was very good, whether in mono or stereo. To be specific, the results I obtained were 12 dBf for mono and 30 dBf for stereo.

Plots of THD + N versus input signal level are shown in Fig. 3. At 65 dBf, THD + N for 1-kHz signals was only 0.18% in mono and 0.25% in stereo. The usable sensitivity measurement, derived from this test, was 13.5 dBf in mono. It may seem odd that this is not as good as the 50-dB quieting sensitivity measurement, but this is not unique. Usable sensitivity measurements take distortion and noise into account, while 50-dB sensitivity is based on noise alone. When the noise slopes off more rapidly with signal strength than the THD does, this apparent discrepancy can occur.

Figure 4 shows how THD + N varied with frequency for a constant 65-dBf input signal. The 1-kHz figures correlate fairly well with those in Fig. 3. At 100 Hz, THD + N measured 0.27% in mono and 0.36% in stereo. At 6 kHz, the other standard frequency for this test, THD + N was 0.24% in mono and just under 0.4% in stereo.

FM separation is plotted in Fig. 5. Separation reached 40 dB at mid-frequencies, decreasing to 33.5 dB at 100 Hz and 26.5 dB at 10 kHz. A spectrum analysis of a 5-kHz, 100% modulated, left-only signal (Fig. 6) revealed that actual separation was somewhat better than the results in Fig. 5. In Fig. 5, crosstalk products other than the fundamental frequency are included, such as subcarrier output and harmonic components of the modulating signal. In Fig. 6, these additional components are isolated from the actual 5 kHz present in the unmodulated channel's output. Accordingly, you can see that the amount of 5-kHz crosstalk present in the unmodulated channel's output is some 48 dB lower than



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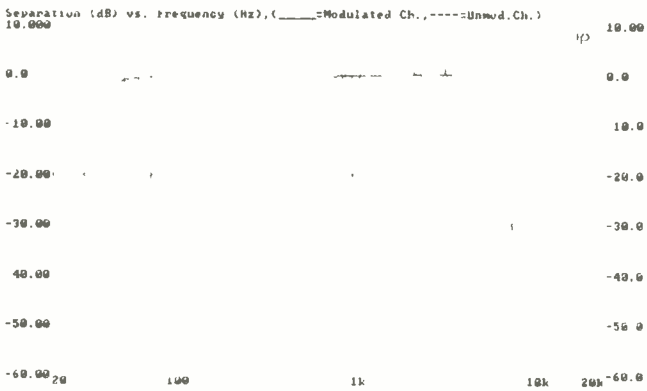

Fig. 5—FM frequency response (top) and separation vs. frequency.

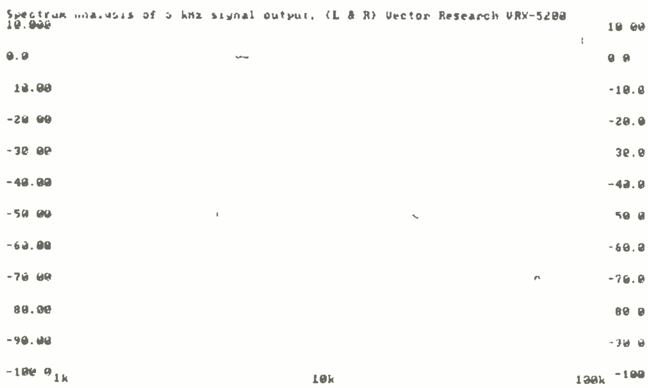

Fig. 6—Spectrum analysis of 5-kHz modulating signal (top) and crosstalk, including subcarrier and other components (bottom); see text.

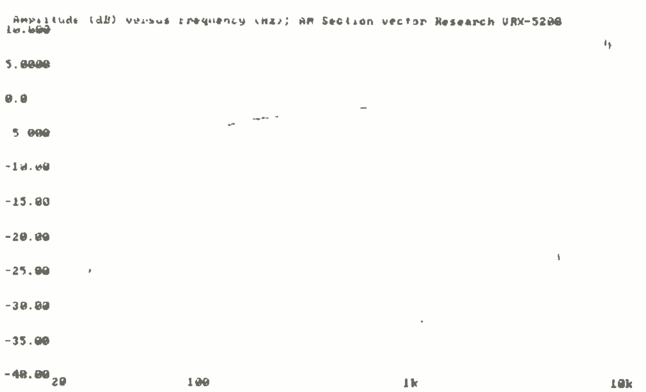

Fig. 7—AM frequency response with 75-μS pre-emphasis.

in the modulated channel's output, while components at 10, 15, 19, 38, and 57 kHz are also clearly visible. The 38-kHz component at the modulated channel's output was attenuated by about 53 dB.

Secondary FM tuner specifications turned out to be pretty much as claimed—in most cases a bit better. I measured a capture ratio of 1.5 dB, i.f. rejection of 83 dB, AM suppression of exactly the rated 56 dB, image rejection of 55 dB, alternate-channel selectivity of 62 dB, and spurious-response rejection of 70 dB.

Vector Research doesn't quote any performance specifications for the AM tuner section of this receiver. However, my listening tests revealed that this unit's AM section was not all that bad—certainly no worse than most such sections supplied with otherwise "high-fidelity" tuners and receivers. I measured the AM tuner's frequency response, and results are shown in Fig. 7. Using the −6 dB convention for quoting AM response, this tuner can be said to have a frequency response from 80 Hz to 2.7 kHz.

Amplifier Measurements

The amplifier section easily met its power output specification for 8-ohm loads. As shown in Fig. 8A, THD + N, at an output of 50 watts per channel, was 0.009% at 1 kHz, 0.006% at 20 Hz, and 0.048% at 20 kHz. The same measurements were repeated using 4-ohm loads (Fig. 8B). Again, the output claimed by Vector Research—60 watts per channel, in this case—was easily attained at levels of THD + N well below the 0.07% rated value. At an output of 60 watts per channel, the results for THD + N using 4-ohm loads were 0.013% at 1 kHz, 0.018% at 20 Hz, and 0.049% at 20 kHz.

Almost perfect correlation with these figures was obtained when I set up my Audio Precision test equipment so that a constant 50 watts per channel was delivered into 8-ohm loads, and test frequencies were swept from 20 Hz to 20 kHz. Results of this distortion test are shown in Fig. 9A, while results for 4-ohm loads, with the system regulated for an output of 60 watts per channel, are shown in Fig. 9B.

I plotted SMPTE-IM distortion only for 8-ohm loads (Fig. 10), since results were almost identical when the load was changed to 4 ohms. At an output of 50 watts per channel, SMPTE-IM distortion was 0.055%, well within the 0.07% limit set by Vector Research. Damping factor, referred to 8-ohm loads and using a 50-Hz test signal, measured 52.

Next I turned my attention to the preamplifier and control section of the receiver. Figure 11 shows the characteristics of the loudness compensation circuitry. The degree of bass and treble boost increased gradually as volume levels were decreased from maximum to −40 dB. I would have preferred to see less, or no, treble boost. Many manufacturers, however, insist on including both bass and treble boost, as Vector Research does in this loudness circuit.

Figure 12 shows the maximum boost-and-cut range of the bass, midrange, and treble tone controls. In my opinion, given the relatively limited dynamic headroom of this receiver (less than 1 dB), entirely too much boost has been provided by the bass control. While a maximum boost of 10 dB is available at 100 Hz, the output continues to rise below this frequency, so that at 20 Hz, it reaches an extreme boost

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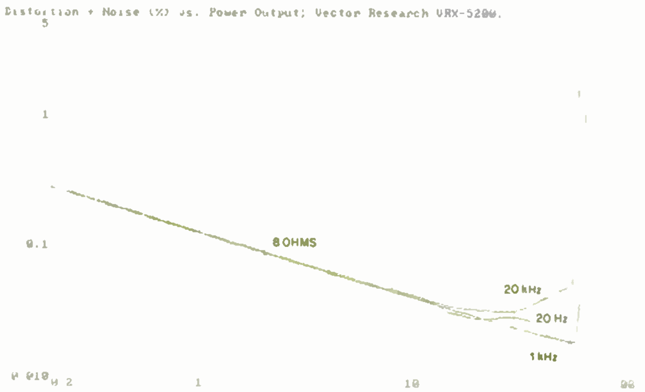

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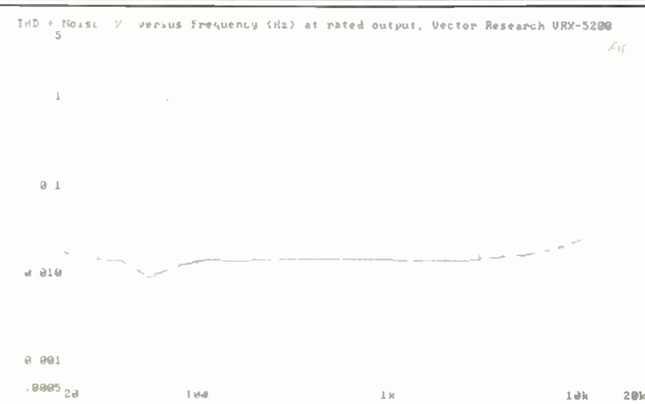
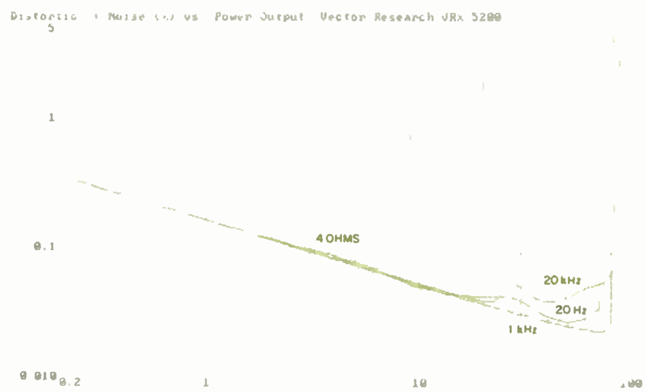


A

B



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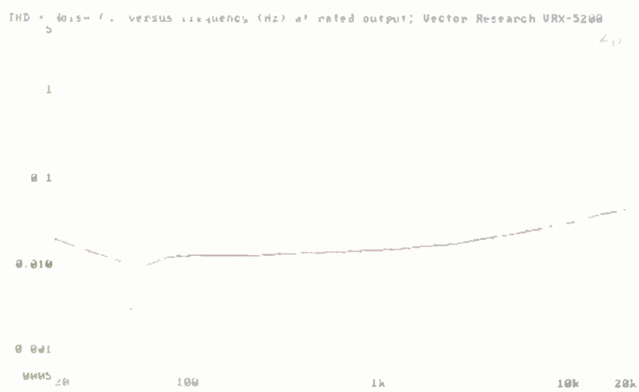

Fig. 8—THD + N vs. power output per channel into 8 ohms (A) and 4 ohms (B).

Fig. 9—THD + N vs. frequency at rated output of 50 watts per channel into 8 ohms (A) and 60 watts per channel into 4 ohms (B). The two curves are virtually identical from 40 Hz to 1 kHz.

of nearly 15 dB. Anyone setting the bass control to maximum while listening to, say, organ records is likely to notice an increase in turntable rumble; in extreme cases, acoustic feedback and howling may actually occur.

I also measured dynamic headroom. Vector Research quotes this in actual power, rather than in dB, as called for in the EIA/IEEE measurement standard. This duplicate power rating causes confusion. Coupled with their failure to quote power ratings properly (the frequency range over which rated power can be delivered must be quoted in the same sentence as the power level itself), it could potentially trigger some action by the Federal Trade Commission, whose "Power Rule" they are violating. This would be a pity, since the amplifier did, in fact, meet all its power ratings very adequately over the entire range from 20 Hz to 20 kHz.

Getting back to my bench tests, sensitivity for the high-level inputs measured 22 mV for 1 watt output. Like so many other manufacturers, Vector Research doesn't quote input sensitivity—or, for that matter, amplifier S/N ratios—in accordance with EIA/IEEE measurement standards. This accounts for the discrepancy between my high-level input sensitivity figure of 22 mV and their quoted figure of 150 mV, which is referred to rated output. Signal-to-noise ratio for the high-level inputs was an adequate 77 dB, referred to 500 mV of signal input and with the volume control adjusted for 1 watt output.

Input sensitivity for the MM phono inputs measured 0.35 mV for 1 watt output. Signal-to-noise ratio for the phono inputs, referred to 5 mV input and with the volume control again adjusted to produce 1 watt output per channel, was 76.4 dB. There is no exact way of correlating these S/N readings with those quoted by Vector Research, since their figures are referred to rated output, with the volume control set at maximum.

Figure 13 shows the deviation from exact RIAA playback equalization over the frequency range from 20 Hz to 20 kHz. At 30 Hz, overall equalization and response from phono inputs to speaker outputs was off by −1.8 dB. Maximum error in treble equalization was +0.9 dB at around 5 kHz, decreasing to +0.4 dB at 20 kHz.

For a mid-powered receiver that sells for a moderate price, the VRX-5200R has many features of costly, higher powered models.

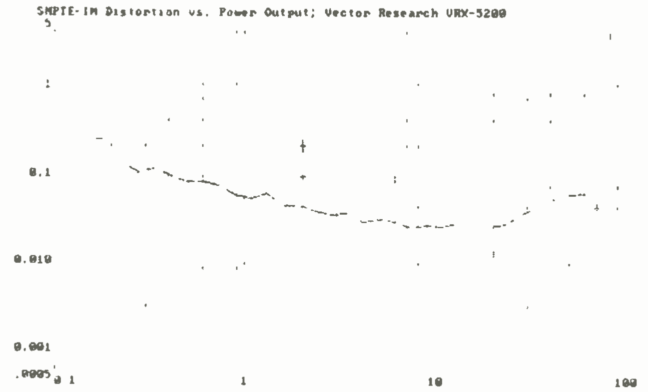

Fig. 10—SMPTE-IM distortion vs. power output for 8-ohm loads.

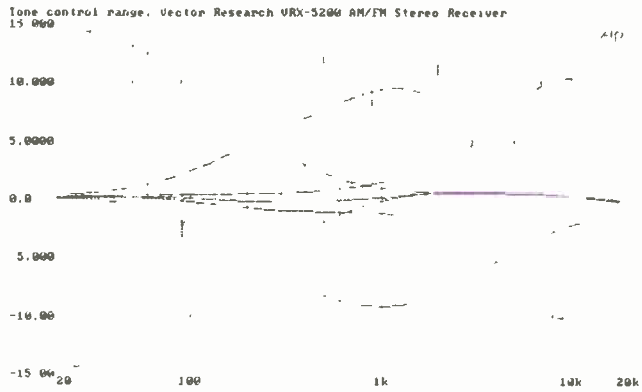

Fig. 12—Tone-control characteristics, including midrange control; see text.

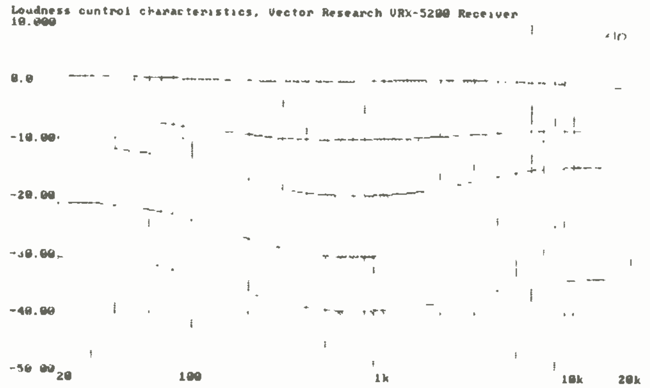

Fig. 11—Loudness compensation characteristics for volume settings from maximum (0 dB) to −40 dB.

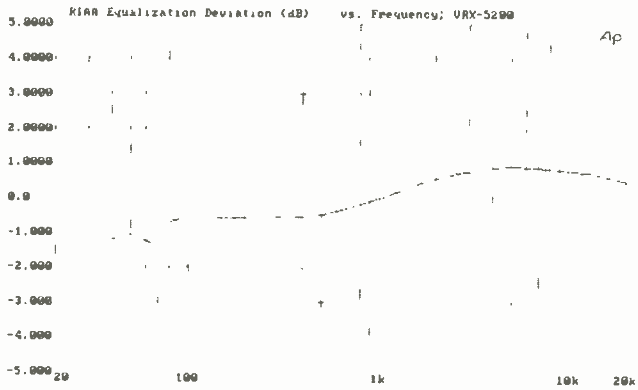

Fig. 13—Deviation from RIAA equalization.

Use and Listening Tests

I was particularly interested in checking the effectiveness of the simple matrix surround decoding featured in this receiver. My lab/listening area is equipped with a pair of reference speaker systems and a smaller pair of monitor speakers mounted above my test bench, so I connected both sets of speakers to the terminals on the VRX-5200R. My KEF 105.2 reference speakers flank my video monitor, so I was able to approximate the way a user might set up the receiver in a complete A/V system. The surround-sound effects I heard were quite good, considering that this receiver does not have gain-enhancement circuitry. The rear channels simply reproduce L − R signals, which is not unlike the arrangement popularized by David Hafler and others in those prehistoric days of quadraphonic sound. (Does anyone else remember those primordial matrix ambience and surround systems?)

But let's get back to more serious listening and evaluation. I liked the front-panel control setup even more during my listening tests than I did while testing the unit on the bench. Most of the things I wanted to do were possible with the supplied remote control. Had I wanted a more versatile remote—one that could control other video and audio components by "learning" their codes—I could have tried Vector Research's optional, more elaborate universal control, Model VRC-125 ($99.95).

Of course, the 50 to 60 watts per channel available from this receiver were really not enough to drive my relatively inefficient KEF reference speakers to the kind of lifelike levels I prefer for listening. But when the VRX-5200R was connected to a more efficient pair of speakers, such as those I use on the lab bench or in my office (yes, I actually listen to music while I write test reports), the sound levels were more than adequate. Further, distortion was imperceptible, and musical transients were clean, with little or no hangover evident. Although the VRX-5200R is essentially a mid-powered receiver with a relatively modest price tag, what I liked most about it is that it has many of the operating and control features of higher powered receivers costing a great deal more.

Leonard Feldman

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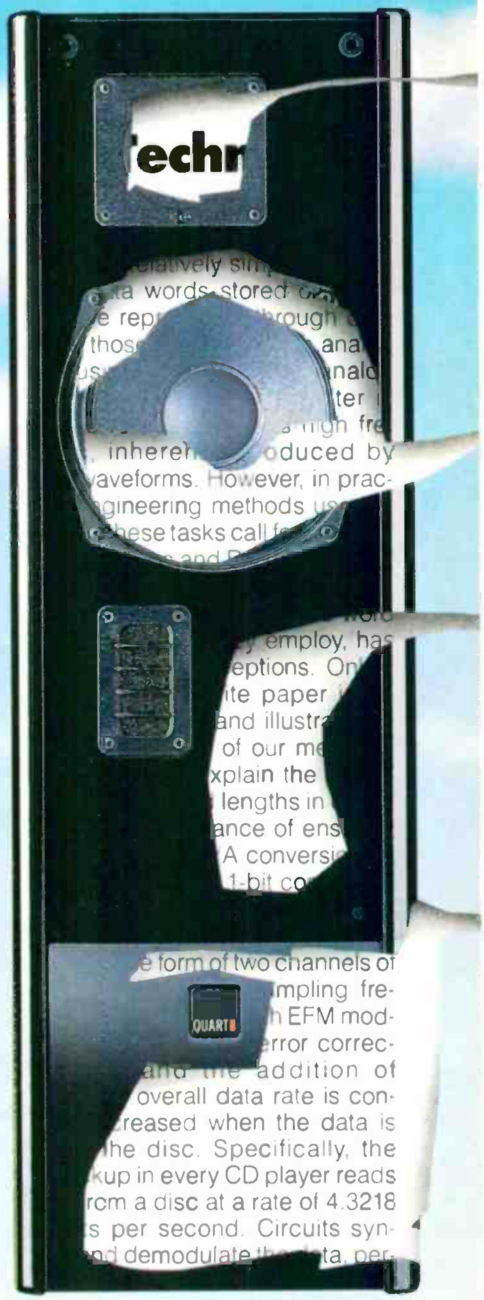

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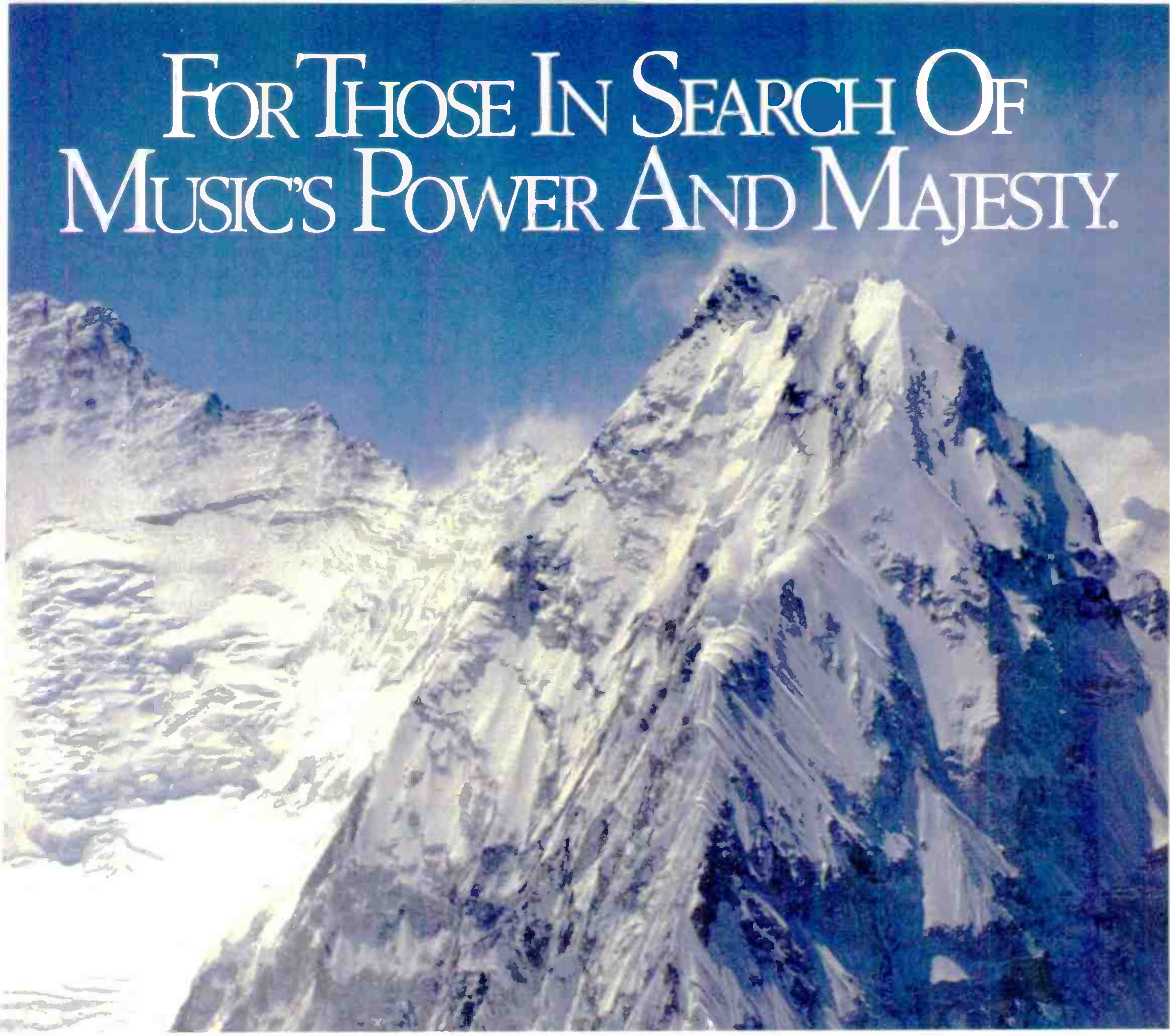
5

BRÜEL & KJAER 4011 STUDIO MIKE

Manufacturer's Specifications
Type: Prepolarized condenser.
Directional Characteristics: First-order cardioid.
Frequency Response: On axis, 40 Hz to 20 kHz, +1, −2 dB at 12 in. (30 cm).
Nominal Sensitivity: 10 mV/Pa (−40 dB re: 1 V/Pa), individually calibrated, with integral 20-dB attenuator.
Maximum Sound Pressure Level: 158 dB peak SPL, before clipping.
THD: Less than 0.5% at 110 dB peak SPL.
Equivalent Noise Level: 19 dBA re: 20 μPa.
Output Impedance: 180 ohms.
Phase Response Matching: ±15°, 100 Hz to 20 kHz, for any two microphones.
Power Requirements: 48 V phantom, per DIN 45-596.
Connector Type and Polarity: Three-pin XLR type; pin 2 positive with increasing sound pressure.
Supplied Accessories: 16-ft. (5-meter) cable, windscreen, locking stand mount, and mahogany box.
Optional Accessories: Shock mount and clip-on stand mount.
Dimensions: ¾ in. diameter × 6⅞ in. long (1.9 cm × 17.5 cm).
Weight: 5.9 oz. (165 grams).
Price: $1,497 each.
Company Address: 185 Forest St., Marlborough, Mass. 01752.
For literature, circle No. 94

The Model 4011 cardioid and the similar Model 4012 are welcome additions to the line of Brüel & Kjaer studio microphones, whose omnidirectional models were reviewed in the November 1984 issue. Application of the latter has been somewhat limited by their omnidirectional characteristics. The cardioid pattern of the new mikes opens up the possibility of using B & K mikes for coincident stereo microphone arrays, such as X-Y or ORTF. Cardioids can also reduce acoustic "leakage" in multi-track recording and will permit increased gain before feedback in live concerts where sound reinforcement is used. The inherent proximity effect of a pressure-gradient mike (such as a cardioid or figure eight) may be used to give "warmth" to vocals and to cancel background noise.

The Model 4011, which I tested, is intended for use with mixers that can provide 48-V phantom power. The Model 4012 is intended for use with the Model 2812 power supply, which provides 130 V to the microphone, giving it a 10-dB higher input-level capability. The 2812 is a two-channel unit with line-level outputs that can be connected directly to a recorder for improved S/N. Both the cardioid microphones



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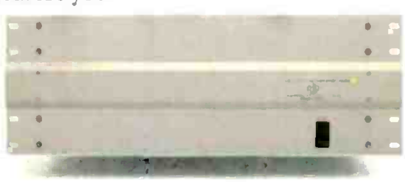

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These cardioids are best suited for close-up work because their response is flat up to about 4 feet, rolling off with distance.

and the power supply are transformerless, which can reduce low-frequency distortion. In my 1984 test of the omnidirectional mikes, transformers were needed at the recorder in order to reduce hum and noise when the 2812 was used with long output lines. The 4011, however, yielded good S/N when used with long house lines.

The coincident arrays mentioned above, often used for classical recording, are not the prime application for which the 4011 and 4012 were intended. B & K feels they are better suited to pickup of individual instruments in multitrack "pop" applications or as accent mikes in classical music recording. The reason is that these mikes are designed to have flat response to a point source at 12 inches (30 cm). The response at 4 feet and beyond is rolled off at low frequencies, due to proximity effect. All pressure-gradient microphones exhibit this effect, and the curves are published in books.

In his April 1989 "Behind the Scenes" column, Bert Whyte states: "Some B & K mikes respond as low as 2 Hz!. . . In contrast, most cardioid mikes have a low-frequency response that rolls off rather steeply below 40 Hz." Whyte indicates that the omni mike is the best choice for recording low bass. (He was discussing high-grade condenser mikes for recording applications; some omni mikes, such as dynamic models made for speech use, also have rolled-off bass.) My files of test data show that Whyte was correct: The response of the B & K omnidirectional studio microphones was ruler flat down to as low as I could measure, and many cardioids exhibited a roll-off below 50 Hz (at infinite distances). Two cardioids I have tested had exceptional bass, the AKG C-422 stereo mike (whose mono version is the C-414) and the Sennheiser MKH 40 (reviewed in the January 1988 issue). With both of these mikes, response at 30 Hz was −3 dB at infinite distances and +7 dB at 12 inches. However, there is a trade-off, as these microphones have larger diaphragms than the 4011 and 4012. Thus, their gain in bass response is at the expense of the off-axis high-frequency response. According to B & K, the problem with extending the bass in a small-diaphragm mike is that the cardioid pattern becomes non-uniform at higher frequencies. The company is researching this and may eventually offer a version with extended bass for classical recording.

My review of the remarkable Nakamichi CM-700 series of condenser microphones (September 1978) indicated that the response of the Nakamichi cardioid was flat at 12 inches, similar to the 4011's, yet I made good orchestral recordings with it. When I tried a bass equalizer, as shown in the review, room rumble was excessive.

The B & K press release states that they spent 10 years developing the 4011 and the 4012, and that each has a

IN THE STUDIO

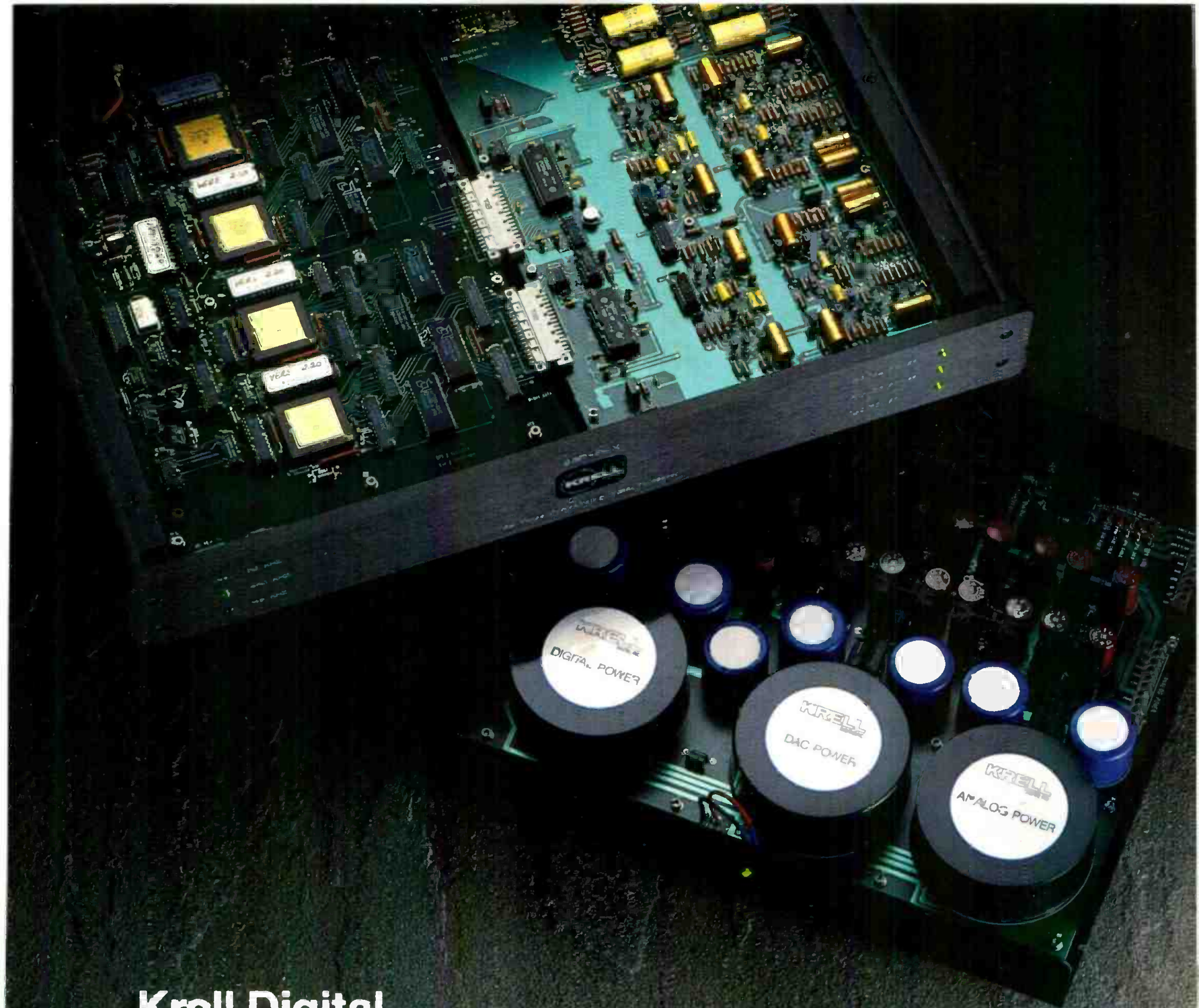
If product presentation equalled product recognition, then Brüel & Kjaer would surely be the world's most well-known microphone manufacturer. These people border on the compulsive when it comes to microphone development and construction; even the mike carrying cases are finely tooled. Open up the shipping box, and you find a smooth hardwood case with top-quality hinges and a sure-closing clasp. Inside is a molded, hard-plastic carrying form so perfectly cut the mike fits *exactly*. You almost have to flip the case over and shake it for the mike to fall out.

B & K sent two Model 4011s for review. My principal testing site was Servisound, an audio production facility located on West 45th Street in New York City. With the help of friend, engineer, and overall advertising dude Joseph Casalino, I put the 4011s to the test. I wanted to see how they fared in different settings within a commercial studio. These mikes, by their design, should be flexible—capable of properly reproducing many sound sources. I started off with voice, a basic narration at first, and later, at another facility, male vocal. In each case, the B & K mikes were unbelievably accurate and extremely sensitive—so sensitive they were prone to "popping" when hit with breath blasts (such as when "p" was spoken or sung). Three quick solutions remedied this undesirable effect: Moving the mike further from the speaker/singer, placing the mike so that the singer was off axis, or placing a commercially available windscreen, such as a Popper Stopper, between the artist and the mike. (The more common sock-type screens hurt more than help, because they block out too much of the sound source.)

I went on to miking bass and snare drums, cymbals, acoustic piano, and electric guitar with the 4011s. The snare drum produced such a hot signal that console attenuation was employed. The result was not as punchy as I would have liked for heavy rock music, but when reduced levels—such as those for pop and jazz—were used, the mike once again came alive.

Placement becomes very critical when miking a snare drum with the 4011; the mike does not have to be placed so close to the drumhead. B & K offers a −20 dB attenuation switch on the 4011. However, it is positioned in the base of the mike, in the center of the three XLR pins. This is inconvenient for studio and stage work, as it's annoying to have to take the mike cable off and insert a tiny screwdriver into the base simply to kick the attenuator into action. A switch on the housing would be less time consuming.

The kick drum test was interesting because the 4011 doesn't have a large diaphragm. When that much air is being moved, manufacturers generally go to a mike with a larger diaphragm. This was the only case in which I had to employ creative equalization to get a real rock kick drum, and I was still impressed with the result. One "drawback": The 4011 is so sensitive, you will have to make sure that you limit extraneous



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There's no need to search for a matched pair of 4011 mikes. For all practical purposes, any pair will be almost exactly alike.

nickel-based diaphragm similar to that of the company's measurement microphones. The microphone's matte black housing is machined out of solid brass. The intergral 20-dB attenuator is selected by a switch recessed behind the output connector. The locking stand mount is a clever design that holds the mike securely. A quick-release clip mount is also available.

Measurements

The 4011 has no accessory power supply, so I opted for battery operation using my UTC HA-108X line transformer, which is very well shielded and offers a 200/200-ohm impedance match for isolation. I found a nominal 9-V battery at Radio Shack (Cat. No. 23-583), which actually delivers 9.6 V. The magic of this is that five of these batteries add up to exactly 48 V. My test methodology eliminated the effects of the transformer from the resulting data: In the impedance test, the effective series resistance was measured by substituting a resistor of known value for the mike and then subtracting this value from the measured data. In the response and noise tests, a calibrating voltage was inserted in a balanced mode between microphone and transformer. By this means, the open-circuit voltage of the microphone was measured. For descriptions of my impedance and frequency response test schemes and the sound source used for response tests, see "The Compleat Microphone Evaluation" (April 1977; update, September 1978).

Two microphones were furnished by B & K from their demo stock, each in its own hardwood box. There would have been no need for B & K to hand-pick a matched pair; thanks to tight production tolerances, all these mikes are, for all practical purposes, alike. Each 4011 is calibrated at the factory and comes with a computerized frequency response curve made in an anechoic chamber. As I said in the 1984 review, the accuracy of calibration at the B & K factory is comparable to that at our National Bureau of Standards. Since B & K provides individual data only for the axial frequency response of each mike, my other measurements could only be compared to the nominal data in the manual.

Just as I began testing, I encountered a vexing problem: The cable furnished had Neutrik connectors on it that fit one mike snugly and were extremely tight in the other. Then I tried lab cables with Switchcraft plugs; they latched up tightly and had to be removed with pliers. B & K had indicated that the inside diameter of each mike housing was machined to fit at least three brands of connectors, but that they had still encountered problems because the various manufacturers of XLR-type connectors do not make them alike. I hope B & K will opt to open up the barrel and settle for a more sloppy fit. A subsequent tour of local electronics

noises—such as bass drum pedal squeaks—or you'll have those on tape. You'll probably start hearing sounds you didn't know were there. In fact, the mike itself adds practically no noise to the circuit, even when the console preamps are cranked way up for recording quiet signals.

In all miking situations, the B & K 4011 performed extraordinarily—especially when compared to microphones which have become known as industry standards. The final sound was more realistic, more detailed, and simply more accurate. What I heard in the studio was more faithfully transferred to the control room, and thus to the tape.

There are two major reasons, however, why individuals and professional studios might be reluctant to accept the B & K line of microphones. One is they are very expensive; each 4011 retails for $1,497, and even many top-quality studio mikes cost several hundred dollars less. The price of the B & K does include a case and a mike stand holder, however. (The holder is very good and secures the mike solidly. Other manufacturers should look to duplicate or secure a licensing agreement for this design.)

The second reason lies in the performance. The 4011 is so accurate that many engineers, producers, and musicians may feel what they hear is too strident, too sterile. Because of their frequency response, many microphones impart a particular sound quality to a voice or instrument. They give a sound source a warm or mellow quality. This is what many in the recording industry have come to know as the "right" sound. It is not. Any time a mike or mixing console alters the tonal quality of a voice or instrument, it becomes something other than the passive sound conduit it was meant to be. What you hear in the studio, from the instrument, is what you should hear in the control room, through the monitor speakers. B & K will have to get its communications guns out and try to reeducate many people in the industry. This will not be an easy task in a business steeped in imitation.

The B & K 4011 is an excellent product. You'll be hard-pressed to find a better microphone. It is certainly capable of handling a multitude of miking tasks. Still, despite its ability to handle the wicked levels produced by snare and bass drums, its rightful place seems to be miking other acoustic instruments—piano, guitar, percussion—and vocals. I imagine string sections, brass, and reeds would also sound true to life. Unfortunately, these instruments were not available to me during my evaluation.

Studios in the habit of purchasing numerous mikes, each manufactured for specific purposes, may well be spending more than it might take to purchase a few of the more versatile B & K mikes. Others who should look into B & K microphones are individuals who do minimal stereo miking of jazz or classical music, and electronic musicians. MIDI players ordinarily don't need more than two or three mikes in their arsenal—for vocals, acoustic guitar, and sampling—so those mikes may as well be the best available. *Hector G. La Torre*

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Overall noise was 1.5 dB better than specified, and its spectrum was smooth, with no bad features such as hum pickup.

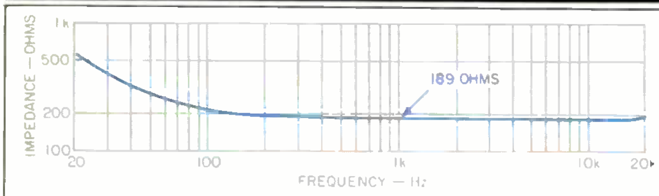

Fig. 1—Impedance vs. frequency.

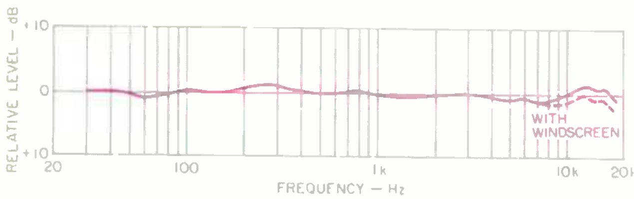

Fig. 2—On-axis frequency response at 12 inches (30 cm) from source; 0 dB equals −40 dBV/Pa.

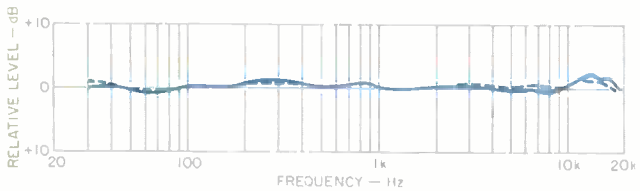

Fig. 3—Comparison of on-axis frequency response of two B & K 4011s, at 12 inches (30 cm) from source.

stores turned up connectors from Neutrik, Switchcraft, Cannon, and an unmarked Cannon look-alike (the latter two from Radio Shack)—not all of which mated with each other. This appears to be a very serious problem that calls for attention from a standards organization.

I noticed another mechanical problem when I tried mounting a 4011 on a stand using the furnished locking adaptor. It held the mike securely, but its hinge was too loose and could not be tightened to give the desired degree of friction.

I did not run all tests on both mikes. I selected the mike with the easier fitting connector for all tests. The other mike was tested only for axial response and sensitivity, plus cross-checks on selected aspects of performance. Both mikes were used in the listening tests.

The impedance curve (Fig. 1) shows that the measured value of 189 ohms at 1 kHz was close enough to the rated 180 ohms. The low-frequency rise indicates a series capacitor, perhaps to block d.c. in this transformerless mike. If the mike were connected to a matched load (200 ohms), a serious loss of bass response would result. I suggest using a minimum input impedance of 5 kilohms to avoid this loss of low-end response.

The axial response curve (Fig. 2) shows, for all practical purposes, a ruler-flat response from 30 Hz to 18 kHz. (I measured response at 12 inches from the source, as did the factory.) I was pleased to find that the resulting curve was very close to the factory calibration chart. The 1-dB wiggles below 1 kHz in Fig. 2 are not on the factory curve and may by systematic errors caused by the acoustics in my room, which is not quite anechoic.

This may be the first time my measurements at low frequencies on a pressure-gradient mike have agreed with the manufacturer's data. The usual measurement problem has been related to the sound source. I use a 2-inch-diameter aluminum dome set flush in an 8-inch aluminum sphere, specially made by the late Al Witchey of RCA more than 30 years ago. (I have tracked its calibration for 25 years, and there has been negligible change.) Various manufacturers of microphones I've reviewed in the past have used commercial speakers, typically 8-inch, for microphone testing. Tests at distances closer than twice the source diameter do not yield the correct response. With the 2-inch source, accurate tests can be made at 4 inches or more, but with an 8-inch speaker, proximity effects are all but unmeasurable. The small source probably could be duplicated from the drawings I have, but to date, no company has expressed interest.

B & K has avoided the complexities of building a small sound source by using a small commercial speaker and an FFT analyzer. The speaker is the "David" Model 2001 made by Visonik in West Germany. They use the tweeter only, energized by repetitive pulses that are converted to frequency response curves by an FFT analyzer. This analyzer can store curves from the mike under test as well those of a standard mike and can then print out the difference curve. How can they test bass response with a tweeter? The answer seems to be, "with difficulty." The printout is at spot frequencies, spaced a constant number of hertz apart. Thus, the curve is continuous at high frequencies but choppy at low frequencies. My old-fashioned test with a swept sine wave and a proper sound source may be more accurate at low frequencies, albeit more time consuming. In this regard, it is interesting to note that at high frequencies, there are no differences between the data I obtained and B & K's, but at low frequencies, my curve is flat whereas theirs is down by 1 to 1.5 dB. For microphone testing, the FFT method seems better than the TDS method, as the latter is limited by average room size to frequencies above about 200 Hz. However, the TDS method (as used by B & K for experimental microphone tests using a microphone as the source) yields the energy-time response of the mike under test, which is of interest.

Figure 2 also shows the effect of the windscreen on frequency response; it is negligible.

Axial response is basically ruler flat from 30 Hz out to 18 kHz, for sources at a 1-foot distance—flatter than B & K's own curve.

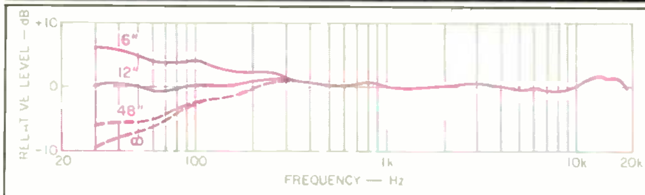

Fig. 4—Frequency response as a function of distance from source.

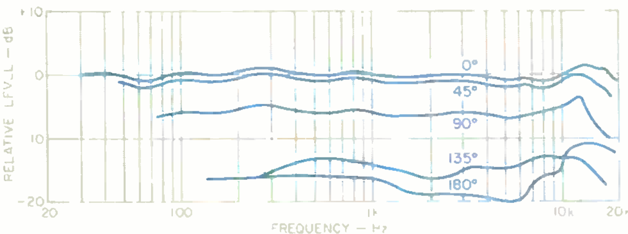

Fig. 5—Frequency response vs. angle.

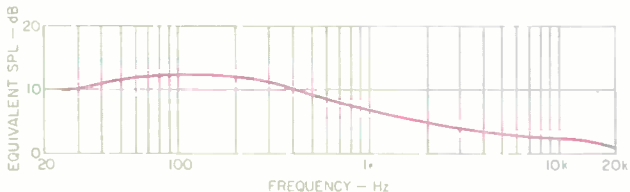

Fig. 6—Third-octave noise spectrum; 0 dB equals 20 µPa.

The axial near-field frequency response of two 4011 units is compared in Fig. 3; one of the units is even more ruler flat than the other.

Figure 4 shows how the bass response varies with distance. The solid curves indicate measured data at 6 and 12 inches. The dashed curves show the calculated responses at 48 inches and infinity; these calculations are fairly accurate due to the physics involved. The dashed curves suggest the sound one would obtain when recording outdoors; in real rooms, actual bass pickup may vary with source geometry and room acoustics.

Figure 5 shows directional characteristics of the 4011. The responses out to 90° are essentially identical up to 12 kHz. The responses at 135° and 180° are down about 15 dB, which is sufficient, and if my room was more perfect, the 180° curve would probably show "cancellation" of 20 dB or more, as in the manual. The peak in the 180° response at high frequencies is attributable to the mike but is not a significant defect. These results indicate performance which is about as perfect as can be attained in a ¾-inch mike.

Overall A-weighted noise level was 17.5 dB (1.5 dB lower than specified), and the unweighted noise level was 24.0 dB. Figure 6 shows the noise spectrum; the curve is very smooth, with no bad features such as hum pickup or increasing levels at very low frequencies. The noise level is comparable to that of the lower noise version of the B & K omni mike and should not be noticeable in a quiet studio.

Use and Listening Tests

To get a feel for the sound of the 4011, I first conducted a crude listening test using my voice, some noise from an air conditioner, and a new CD of the Empire Brass played on my outdoor test source. (The latter is an Altec Lansing 755E 8-inch speaker in a rigid fiberglass sphere; see the September 1978 issue.) I had just heard the Empire Brass in concert, so I thought I remembered how they really sounded. The best reference mike on hand was a Nakamichi CM-700 cardioid. It is an audiophile mike, but its frequency response is very similar to the 4011's. The mikes sounded very similar when picking up on-axis speech or music. Speech at 3 to 6 inches sounded the same on both; the proximity effects were the same. Speech from any direction sounded the same on both mikes. After adding the air-conditioner noise to the room, I found that the speech-to-noise ratio of each mike was the same. This indicated that the directional patterns were similar. Each mike was very wind sensitive, but this was reduced by the windscreens on each. With the CD, each mike sounded the same when picking up on-axis sound. With sound sources 90° off axis, the B & K sounded the same as it had at 0°, but the Nakamichi sounded high-pitched or "tinny." The 4011 had essentially no sensitivity to magnetic hum, having no transformer, but the Nakamichi had high hum output.

The more formal listening test was conducted in the 900-seat sanctuary of the United Methodist Church in Haddonfield, N.J., where I am the sound person. The ceiling is 40 feet high, and an AKG C-422 stereo microphone is suspended about 17 feet above the floor, aimed downward and forward to the chancel area. The capsules are set for an included angle of 90° because their patterns are normally set for figure eight (bidirectional); this forms a Blumlein array, which I find works best in this auditorium. The 4011s were mounted on a Shure S-15 stand using an M-27M mounting and were positioned as high as possible, about 2 to 3 feet below the AKG. They were aimed downward and forward, with the 120° included angle that is correct for cardioids. The AKG was set for cardioid, but it was not practical to increase the included angle between its capsules. The 4011s were connected, via about 250 feet of cables in conduit, to the Soundcraft M200B mixing board in the balcony. The board has eight inputs and four main outputs. The stereo outputs were connected to a Sony SL-HF500 Beta Hi-Fi VCR.

The church has an active program of concerts, and this year we did the Brahms "Requiem" with 50 members of the Philadelphia Orchestra and 150 voices. It would not have been appropriate to agitate the musicians by setting up microphones that they hadn't seen at rehearsals, so I waited for a concert that did not involve professionals. It was a lively affair put on by the young people's choir and included

The B & K is an excellent microphone. It will handle wicked levels, and yet its rightful place seems to be with acoustic instruments.

50 voices, pipe organ, piano, percussion, electric guitars, and synthesizer. Thus, the sound was more "pop" than classical. They performed modern sacred music plus some classical and popular tunes. The vocal mikes (Beyerdynamic M500 ribbons and Audix dynamics) used six channels, so I had only two left to play with. Therefore, I used the AKG for the first half of the concert and the B & Ks for the second half. The problem was that some instruments were moved and others were changed during the intermission.

I played the tape in my listening studio, which has been described in previous reviews. Briefly, I have a pair of modified Altec Lansing 604C speakers in sealed, stuffed boxes of more than 10 cubic feet apiece; they are equalized and driven by 100 watts per channel. This system can produce 120 dB SPL, and since the ambient noise is 30 dB SPL or less, I can use the rated 90-dB dynamic range of the Beta Hi-Fi recorder. Unfortunately, the acoustic S/N in the church is much poorer, due to the organ blower, the blower of the ventilation system, people, and outdoor traffic.

I have a curtain hiding the speakers in my listening room, which is helpful in localization of recorded sound sources. I found that the sources recorded by the AKG were contained within a smaller angle than those recorded by the 4011s because of the difference in microphone included angles. The sonic images from the 4011s extended from wall to wall, so I concluded that 120° is correct for X-Y cardioids in this auditorium. I fixed the problem by moving my chair forward when listening to the AKG.

I found that the AKG and B & K mikes sounded alike on choral music, with the B & K sounding perhaps a shade better on piano overtones. The 4011s were outstanding in reproducing percussion from the far right. The sound of the cymbals was perhaps the best I've heard from any mike—not bright and brassy as with a "gimmick" microphone, just natural, clear, and crisp. The lowest bass in the concert was from the guitar, not exactly earthquake sound, but the 4011s did not seem to lack in bass. The AKG has a linear frequency response at high frequencies, as do the B & K mikes, but it has wiggles due to reflection from the cage surrounding the capsules. These have minimal effect on sound quality, because unlike resonant dips or peaks caused by defects in the diaphragm, they do not spoil the transient response. However, this comparison with a microphone having very smooth response revealed the effects of the wiggles in the AKG's response.

I consider the AKG C-422 a super mike and, as the B & Ks seem to be just a shade better, concluded that they too must be in the super category. Since a pair of 4011s costs roughly the same as the C-422, I judge the 4011s to be a good value. The lesson I learned from this is that a ¾-inch-diameter cardioid can offer an optimum combination of acoustical performance and dynamic range. *Jon R. Sank*

CLASSÉ AUDIO DR-5 PREAMP

Company Address: 9414 Cote de Liesse Rd., Lachine, Que., Canada H8T 1A1.
For literature, circle No. 95

I have never made any particular secret of my passion for the high end, and one of the major joys of being a reviewer is having the opportunity to make extended trials of top-price components I would never otherwise be able to afford. At the same time, I find it amazing to see how close some of the more affordable high-end designs can come to the ultimate reference designs which are three or more times as expensive. The Classé Audio DR-5 preamplifier is a case in point. It costs approximately $2,000. This is scarcely cheap by mid-fi standards, but it is very affordable by high-end standards, and the DR-5 comes close enough to the ultimate reference preamps to be a serious rival.

Unlike many top high-end preamps, the Classé DR-5 comes on a single chassis which contains both the audio components and the power supply. The styling is attractively functional, and the control features are excellent. You have a choice of phono, tape, or three high-level inputs. There are the traditional balance and volume controls, and switches for tape monitor, phase inversion, and muting. Unlike a number of preamps, this unit also gives you a full-featured selection switch so you can choose between left or right only, stereo, reverse stereo, and mono.

The DR-5 is very definitely configured for outstanding reproduction of analog phono—something which is only optional in an increasing number of competing high-end preamps. It has one of the best moving-coil gain stages I have ever encountered; this preamp is self-matching to the impedance of an MC cartridge, a feature which saves experimentation with MC phono loading. The DR-5 seemed to be able to get the best from given MC cartridges, rivalling the selectable impedance features of my reference preamplifier.

The DR-5 offers 11 different levels of gain, from 20 to 40 dB, in order to ensure that the phono level will match that of the high-level stages and have the gain which suits a given MC cartridge. The Classé also has switchable 47-kilohm loading and 35 dB of gain for MM cartridges.

Other important phono-stage features include a passive RIAA network and zero feedback in the phono gain and equalization stages. For purists, there is a phono bypass switch which eliminates the input-selector, tape, and mode switches from the signal path. This bypassing has a small but audible

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effect in allowing you to get the best possible performance from a phono cartridge.

The other inputs and outputs are relatively conventional, except for the tuner input and the provision of balanced outputs. The tuner input is padded down, or attenuated, by 6 dB. Tuner outputs are usually higher than those of other audio front-ends, and this allows you to maintain a constant level between components. Alternatively, it would be equally useful with one of the higher output CD players.

Balanced outputs are rapidly becoming the rule in high-end preamps and amps. They do, however, require very careful engineering to ensure that the balanced circuitry does not alter the sound of a unit and that the potential benefits in S/N ratio can actually be realized. The Classé is one of the few preamps I have heard in which using a balanced line does not significantly alter the sound character of the unit. While my system is not noisy enough to make the use of balanced lines important, I did find through experiment that the balanced output will sharply reduce interconnect noise if long interconnects are used or when an interconnect is placed near a transformer or other source of line noise.

As for technical specifications and features, the DR-5 joins virtually all modern high-end transistor electronics in setting frequency and distortion standards which are so demanding that detailed comparisons of specifications are largely meaningless. The S/N specs do, however, provide an indication of why the DR-5 has exceptional transparency: With A-weighting, S/N is 80 dB at the phono stage for both MM and MC cartridges and 90 dB at the high-level stages. The output impedance is also exceptionally low—only 1 ohm—allowing the use of long interconnects with minimum problems in terms of hum and noise.

The circuit features include a large toroidal transformer which is fully copper shielded and has eight times the power needed to drive the circuit. The power supply has eight stages of regulation and 73,200 µF of filter capacitance. The Classé's power supply and all power-line inputs and accessory outlets are in a separate shielded compartment.

As with all good high-end components, the internal construction is something of a work of art, and careful attention is paid to both components and circuitry. While I make no claims for being able to distinguish the sonic effects of individual technical features, the manufacturer provides an impressive litany. All controls and switches have silver- or gold-plated contacts. All resistors are 1% metal film, and polystyrene and polypropylene capacitors are used in the RIAA equalization and bypass circuitry. There is a single printed circuit board, with oxygen-free, deposited copper sealed with solder mask. In addition to the phono-circuit features discussed earlier, the manufacturer emphasizes "streamlined" signal paths and "a true balanced high-level section" that finishes with "an ultra-high beta (current stage) which results in the preamplifier having an output of 1 ohm."

Anyone who buys a high-end preamp does so for its ability to provide a degree of transparency and musical realism unavailable from mid-fi components. These qualities seem to have little to do with ordinary technical measurements, since many relatively cheap preamps yield performance—in terms of frequency response and distortion measurements—which is so good that it should theoretically make the differences between such preamps and their higher priced cousins inaudible.

In practice, however, preamps differ sharply in the details of their sound quality, and only a few provide the kind of transparency and realism available in the DR-5. In fact, if this unit has a special sound quality, it lies in its ability to reveal an astounding amount of musical detail at every level of dynamics.

Anyone who compares a preamp like the Classé DR-5 to a good mid-fi preamp in a high-resolution, high-end system will immediately be struck by the extent to which the DR-5 reveals details in top-quality recordings that the mid-fi preamp cannot. This may take the form of new data about the soundstage, an added degree of realism in male or female voices, or a sudden ability to distinguish individual choral voices or massed string instruments. It may also take the form of a sudden increase in the life and apparent speed or dynamism of rock music and jazz, particularly in piano or other percussion instruments. The difference is roughly equivalent to the difference between a picture taken by a run-of-the-mill viewfinder camera and one taken with a top-of-the-line Nikon or Pentax: There is a major increase in "focus."

The DR-5 also has the special merit of providing this detail in a musically natural way. A number of high-end preamps tend to provide transparency that almost seems etched, and the additional detail eventually seems unnatural. Other preamps provide musical sweetness but do so at the expense of transparency. The DR-5 gets the balance right to a degree that few preamps in its price range have yet approached.

The DR-5 also has an exceptionally low apparent noise floor. Many preamps whose measured S/N is exceptionally good, nevertheless seem unable to reproduce all of the low-level detail in classical music and jazz; they make soft passages sound muted or dull. The DR-5 has an outstanding ability to provide lifelike and musical sound in soft passages. You may be a bit shocked to realize that a superior ability to reproduce low-level musical information can contribute at least as much to your listening enjoyment as the ability to handle music peaks.

In terms of frequency balance, the Classé has a slightly "forward" sound, with a bit more upper-midrange data than other top high-end preamps such as those made by conrad-johnson, Krell, or Jeff Rowland. It is closer to the Mark Levinson No. 26 in terms of midrange and treble balance, although it is not quite as smooth or transparent. The DR-5 does an excellent job of reproducing the lower midrange and upper bass. It has none of the warmth of tube preamps but little of the leanness of some transistor preamps. The mid and lower bass of the Classé are outstanding, although detail and control are emphasized over power and dynamics.

The soundstage is slightly forward, and you have more of a feeling of moving slightly further toward the concert hall stage than you do with many other high-end preamps. At the same time, the right-to-left imaging is excellent. The soundstage seems to extend to

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the right and left of the speakers without any loss of center fill. Instruments are well placed in terms of depth and from right to left, and the imaging is stable and musically realistic. There is no unnatural expansion or contraction of the image, and the bass and upper-midrange imaging are fully consistent—qualities which are rare in even the very best high-end preamps.

Dynamics and transient information are very good up to very loud listening levels. The Classé does not, however, handle symphonic spectaculars, massed voices, or other loud complex music quite as well as its top competitors. This effect is minor, however, if you pay careful attention to your choice of interconnects. You want interconnects that stress frequency range and detail, rather than coherence or smoothing of the sound.

The DR-5's high-level inputs are also exceptionally clear of residual levels of coloration. While the Classé is not perfectly neutral, it does a much better job of maintaining neutrality than any of its mid-fi counterparts, and it rivals many much more expensive high-end units. You can hear this neutrality for yourself at any good high-end dealer. Simply listen to a system where the power amp is directly connected to a top CD player or decoder with preamp controls, like the Spectral SDR-1000 or Theta DS Pre. Then insert the DR-5 into the signal path and make sure the levels are matched. The "sound" of the DR-5 is barely audible compared to that of all but a handful of reference-quality preamps.

The phono stages of the DR-5 do an equally good job of getting the best from a moving coil. A few audiophiles may bemoan the lack of opportunity to play around with different loadings, but most will find that the DR-5 sets the impedance for an ideal combination of upper-octave smoothness and soundstage detail. The Classé preamp also produced a very low phono noise level with a wide range of different high-end tonearms, including several that often produce hum or noise problems with other preamps.

Even one or two years ago, I doubt you would have been able to find a rival to the Classé DR-5—at any price. It reveals an exceptional degree of mastery of both the science of electronics and the art of listening. It also has outstanding ergonomics, providing the kind of real-world features a true audiophile needs in an easy-to-operate and logical form. There are now a few superior preamps, but few rival the Classé at anything like it's price. Given the high-quality balanced outputs, the DR-5 is also well equipped for the latest fad in high-end electronics, although the standard RCA outputs worked just as well in my system. All in all, the Classé DR-5 offers superb value for the money, without forcing you to mortgage your home.

Anthony H. Cordesman

RECLIMBING EVEREST

JOHN EARGLE

One of the promises of the CD revolution that is now being fulfilled in abundance is the reissue of the best of the various "golden ages" in phonographic history. In many cases, we are hearing these old recordings as they've never been heard before, with more clarity than we'd ever thought was in the grooves or master tapes. The major companies are scouring their vaults, looking for their best and earliest source material, and transferring it to digital formats for further processing or direct transfer to Compact Disc.

Philips is doing something that is rare for a major label: They have gone beyond their own vaults and are rereleasing some of the classic recordings of the old Everest label, which thrived as a division of Belock Instrument Corp. during the '50s and early '60s.

Most readers of *Audio* are aware that Associate Editor Bert Whyte was responsible for the technical side of these recordings. In its day, Everest was celebrated for the quality of its recordings, and only on rare occasions did the major labels match what Everest did on a routine basis. As an engineering student during the late '50s, I was enamored of their two-track reel-to-reel tapes and had amassed quite a collection of them, expensive as they were. For those without a tape player, there were the noisy Everest stereo pressings, which gave little indication of what was really on the master tapes.

Later, when I came to know Bert Whyte, I had the privilege of hearing his own proof copies of the carefully prepared tape duplicating masters. These gave me an even better idea of how truly remarkable the recording technology was.

Whyte pioneered the use of three-track magnetic recording on 35-mm film. With a speed of 90 feet per minute (18 ips), track widths of one-quarter inch, and a very thick base material, the medium was extremely quiet, had virtually no print-through, and exhibited excellent time-base stability. Not all Everest recordings were made with 35-mm film, and standard 15-ips, three-track half-inch tape was also used. In the early '60s, Belock decided to get out of the record business, and the company was sold. Its image receded, and pressing quality got even worse. The legend remained, however, and record and sound buffs have never forgotten Everest's original accomplishments. Bert Whyte's greatest contribution was his ability to emphasize the sonic values of rich modern scoring without getting in the way of the music or detracting from it in the least. Over 30 years later, this remains a worthy goal for all recording engineers.

For their first group of Everest reissues, Philips has picked five examples of the 35-mm technology, and they have processed them with the remarkable NoNoise system developed by Sonic Solutions of San Francisco, which is the culmination (at least for now) of the long search for systems that can remove noise already present in recordings.

Such systems have nothing in common with the dbx, Dolby, and other noise-reduction systems that attack noise before it becomes a problem, by compressing the signal during recording and expanding it during playback. In this way, the signal can be maintained well above the noise floor of the medium during recording; playback processing restores the program's original dynamics while pushing the noise floor lower.

Once a noisy recording has been made, there are limited options for quieting it. Over the years, static techniques such as low-pass filtering and removal of discrete noises through tape editing and dynamic techniques such as program-directed filtering have both been used. Their effectiveness has varied, depending on the nature of the program, but in general, it is felt that any kind of filtering removes music at the same time it removes noise.

Many years ago, Harry Olson of RCA developed a novel method for removing noise from recorded program material. His technique was to divide the spectrum into octave bands by way of sharp filtering. Within each band, he established a user-variable noise-floor threshold. Any signal below the

In its time, the Everest label was revered for the quality of its tapes. The majors rarely matched what Everest routinely released.

threshold could be defined as noise and be "squelched." When the several bands were recombined through further filtering, the noise was all but gone and the music left virtually intact.

In 1984, at the AES Conference on the Art and Science of Recording, Roger Lagadec, then of Studer Revox, demonstrated a digital version of the Olson scheme, this time using 256 discrete frequency bands. Although the system was demonstrated in mono, the results were impressive. We could hear that the threshold of noise, if set too high, could affect the ring-out of reverberation. It became obvious that good musical judgment had to be exercised to produce acceptable results.

With cyclical interferences such as hum, buzz, and the like, it is possible to sample the interfering signal, duplicate it, and return it in opposite polarity, achieving a virtual cancellation without affecting the music in the least. The NoNoise process accomplishes all of this. In addition, it can detect discrete disturbances, such as clicks, and replace them with a replica of previous cycles of music waveforms so that absolute playing time is not affected.

Digital technology can do all of this with the appropriate programs. The processes are not cheap, and good ears must be constantly at hand to ensure that good taste prevails. It is always wise to leave a little of the noise floor audible. After all, some of that noise was in the original venue.

I have listened to four of Philips' Everest reissues made with NoNoise, and the listening is almost magical. With the background noise all but inaudible, it is easy to imagine that you are hearing the "line out" of the recording console. The sound may be quieter than what the recording crew heard when they played back the masters, and details of the soundstage become remarkably clear. One also hears a characteristic of the day, the sound of the early Neumann U-47 microphones, with their relatively undamped high-frequency peak. Nothing bad, but not a match for the ultra-smooth microphones of today. Let's look at the four discs I have auditioned:

Leopold Stokowski is represented by the Shostakovich Fifth Symphony, performed by the New York Stadium Symphony Orchestra, and Scriabin's "The Poem of Ecstasy," performed by the Houston Symphony Orchestra (422-306-2). The Stadium Orchestra was in reality the New York Philharmonic, which at the time was under contract to Columbia (now CBS) Records and could not record for other labels under its own name. The recording was made in the eighth-floor ballroom at Manhattan Center in 1958, and it stands up well today. The immediate ambience and "bloom" of such rooms as the one in Manhattan Center are rare in the United States, but such spaces are highly valued in England and Europe and account for the sound

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When it comes to recording orchestral music, today's best techniques have nothing on the methods of 30 years ago—witness these albums.

heard on many imported recordings. After many years of inactivity (due to changing of hands and unfortunate carpeting), the old Manhattan Center ballroom is once again coming into its own as a recording venue; its carpet is now covered, on request, by thick sections of particleboard, thus restoring the original reverberation. The Houston Symphony recording, dating from 1960, does not come off as well, mainly due to acoustics.

The music of Mexico's Carlos Chávez, conducted by the composer, also features the New York Stadium Symphony Orchestra recorded in Manhattan Center in 1958 (422-305-2). The program consists of Sinfonía India, Sinfonía de Antígona, and Sinfonía Romántica, all richly scored works making use of native coloristic elements—exotic music for exotic tastes.

Copland's Third Symphony and "Billy the Kid" Ballet Suite are conducted by the composer with the London Symphony Orchestra (422-307-2). The recording venue was Walthamstow Town Hall, near London, a room famous for recordings for four decades. Normal seating is removed, and the orchestra is placed toward the center of the room. Just a few microphones are needed to pick up the ensemble, with an assist from the dense array of early lateral reflections in the space. These 1958 performances hold their own with any of today.

The Eastman Theater in Rochester, New York was the venue for Ferde Grofé's "Grand Canyon" Suite and Piano Concerto, also conducted by the composer, with pianist Jesús Sanroma and the Rochester Philharmonic Orchestra (422-304-2). The recording was made in 1960. The Eastman Theater is a quirky room, large and with particularly disturbing reflections from the fascia of the balcony and loge. Under such conditions, a fairly close-in approach to the orchestra was dictated. This works quite well on the "Grand Canyon" Suite, with its detailed scoring and reminiscences of studio writing. Grofé certainly knew what he wanted and brought out the best in the Suite. The Concerto is a lesser work, and even the consummate virtuoso Sanroma cannot carry it off.

The fifth release in the series will be Stravinsky's "Ebony" Concerto, featuring Woody Herman, plus "Petrouchka" and Symphony in Three Movements—all with Eugène Goossens conducting the London Symphony Orchestra. I look forward to a hearing.

As I survey these four releases, it becomes apparent that the best current recording techniques, as applied to classical orchestral recording, have nothing over what was done 30 years ago. Such men as Bert Whyte, RCA's Lew Layton, Kenneth Wilkinson of British Decca, and a handful of others set down the rubrics for those who followed. Everest has truly been rescaled, and the view is loftier than ever.

Good Grief, Charlie Brown, The Peanuts Gang Is Turning Forty

Would you believe that Charlie Brown and Lucy, Snoopy, even little Linus, are in their 40th year?

It's true, and some of the folks at GRP Records have gotten together to celebrate the event. The company's recording, *Happy Anniversary, Charlie Brown*, features such GRP stalwarts as label co-founder Dave Grusin, vocalist Patti Austin and musicians David Benoit, Chick Corea and Lee Ritenour. These artists are joined by jazz greats Dave Brubeck, Gerry Mulligan and Joe Williams, to name just three of the album's other attractions.

The Peanuts gang originally encountered jazz in 1965, the year producer Lee Mendelson created the first of his many TV specials featuring animated Charles Schulz characters. "I didn't want to use what was then known as cartoon music," he commented in a recent interview. "I wanted something unique."

Mendelson, who had inherited a love of jazz from his father, was driving across the Golden Gate bridge one day when the radio station to which he was tuned began playing the well-known Vince Guaraldi tune, "Cast Your Fate to the Wind." The mood of it struck him, he recalls. After finding that, like himself and cartoonist Schulz, Guaraldi lived and worked in the Bay area, he contacted the pianist-composer about scoring his new show.

A couple of weeks later, Guaraldi called and insisted on playing a new composition (soon to become known as "Linus & Lucy") over the telephone. Mendelson's objections to the medium's fidelity were squelched by the composer's enthusiasm. The producer listened and immediately knew he'd hit upon the correct choice. "We went on to do 16 shows together," he stated, noting that Guaraldi's untimely death in the mid 1970s ended a very happy association.

With his groundbreaking eight-program series, *This is America, Charlie Brown*, Mendelson juxtaposed Schulz's cartoon characters with historical figures ranging from the pilgrims to the astronauts. He wanted to continue the tradition of backing the Peanuts gang with jazz and thought the scope of the project, which was network TV's first animated mini-series, was wide enough to interest such artists as Dave Brubeck, Grusin and others.

GRP was later approached with the idea of putting some of the music from

Ultimately, 11 selections were culled from some 50 pieces of music spanning a quarter of a century.

This is America, Charlie Brown on disc. Larry Rosen, Grusin's partner at the record firm, felt the idea should be taken a step further. Why not, thought Rosen, make it a no-holds-barred anniversary celebration and re-record tunes from Peanuts gang specials all the way back to the original 1965 Christmas show? And why not invite artists from outside the GRP stable to extend the album's musical dimensions?

Ultimately, 11 selections were culled from some 50 pieces of music spanning a quarter of a century (eight by Vince Guaraldi, one by Brubeck and two by Grusin). Then performers most likely to catch the spirit of each were singled out.

Both Larry Rosen and Lee Mendelson are highly pleased with the result, which Mendelson calls "a wonderful marriage between the comic strip and jazz, both American institutions and both known around the world." Rosen goes so far as to affirm that, thanks in part to the global appeal of this collection of now-middle-aged kids and their canine companion (as licensed characters, the Peanuts gang is second in popularity only to Walt Disney's clan on a worldwide basis and ranks number one in Japan) *Happy Anniversary, Charlie Brown* could outsell every other title on his and Grusin's popular label.

Pianist David Benoit, a longtime Vince Guaraldi fan, gets the album moving with "Linus & Lucy" and is followed by B.B. King, who steps out smartly on "Joe Cool." Dave Grusin quickly warms the atmosphere with his composition, "History Lesson," and a trio led by pianist Chick Corea turns the mood mellow with an arrangement of Guaraldi's "The Great Pumpkin Waltz." It's a classic sort of tune, classically played.

The vocal acrobatics of Joe Williams turn Guaraldi's "Little Birdie" into a rhythmic stunt pilot, and Gerry Mulligan's oh-so-sweet baritone sax on "Rain, Rain, Go Away" really could drive off clouds. The soprano saxophone of Kenny G. keeps "Breadline Blues" plaintive yet colorful.

Guitarist Lee Ritenour's "Red Baron" follows as does silken-voiced Patti Austin's "Christmas Time is Here." A 13-year-old musical prodigy, Amani A. W.-Murray, plays the "Charlie Brown Theme" on alto sax and the redoubtable Dave Brubeck is ably abetted by Bob Militello's nimble flutework on Brubeck's own "Benjamin."

The year-long birthday celebration of the Peanuts gang continues through October 2, 1990. By then, this stylistically wide-ranging anthology may well have justified Larry Rosen's lofty expectations. *Happy Birthday, Charlie Brown* is a recording certain to appeal to a large number of today's listeners.

ROCK HOMEWARD, ANGEL

Cry Like a Rainstorm, Howl Like the Wind: Linda Ronstadt
Elektra 60872, CD; DDD; 42:39.
Sound: A Performance: A−

Shelve the big band arrangements. Tuck the lamé sheath dress into the closet. Close the lid on those Spanish guitars and say goodbye to roots-rock *olé* (thanks for the *canciónes*, Dad). Let's welcome Linda Ronstadt back to the world of pop.

Ronstadt has been living every working musician's dream: Play what you want while the public and your label support you, no matter how far into the musical jungle you trudge. Still, even musicians leading the good life need to come back to their core audience and say hello, and with this album, Linda seems to be saying, "Hi, I'm back; didja miss me?"

Cry Like a Rainstorm is no fooling around. This is a *big* album, big in scope and sound: 12 quality songs by six sets of quality songwriters, including Karla Bonoff, Jimmy Webb, and Issac Hayes/David Porter. Onboard are a load of L.A. session stars—Lee Sklar (bass), Russ Kunkel and Carlos Vega (drums), Robbie Buchanan and Don Grolnick (keyboards), and Dean Parks (guitar). Add the "Skywalker Symphony Orchestra" and the Oakland Interfaith Gospel Choir, each with more than 50 members, and cut the affair at George Lucas' Skywalker Ranch post-production studio, with Peter Asher producing and George Massenburg recording and mixing. . . . *Whew!* What a cast.

Ronstadt gets substantial help on four songs from Aaron Neville, the tenor from heaven. Their vocals blend beautifully. Listen to how closely matched are their enunciation, phrasing, and feel ("I Need You"; "Don't Know Much"). Neville is a wondrous singer, but Ronstadt is fully able to contribute, not simply hang on for the ride. She's learned her lessons well, singing big band and mariachi music. Her phrasing has been refined; she no longer has to worry about where the beat is but can play with it, moving ahead or hanging back. She even flows easily into falsetto and back ("Adios," featuring Brian Wilson's creamy multi-tracked background vocals).

Earlier on, I mentioned this album's bigness, a natural ambience and power not often found in pop music. Sometimes this grand scale creates drawbacks. It's difficult, if not impossible, to sound intimate and personal with scores of players and singers working away behind you. Eleven of the 12 tracks use the orchestra, two use orchestra *and* choir, and all this power can knuckle the lyrics into submission. It sometimes sounds as if Ronstadt's vocals were recorded last, with the singer hearing all the tracks in her headphone mix; her voice seems to be pushing too hard in order to compete with the accompaniment—going for power when understatement was needed.

The final piece in this excellent jigsaw is engineer, mixer, and sound designer George Massenburg. This guy is making unbelievably clean, powerful recordings: If anyone is presently doing better recording work than Massenburg, let him please step forward. He uses natural and electronic ambience, for instance, in near-perfect combination. Plus, he has mixed a masterpiece: Every instrument, acoustic and electric, can be heard clearly, even when all parts are playing at once.

The more you listen to *Cry Like a Rainstorm*, the more you realize that of greater importance than Ronstadt's return to pop/rock is the enormous musical development that has taken place in this woman. Ronstadt, Massenburg, and Asher have put together a candidate for 1989's best album. *Hector G. La Torre*

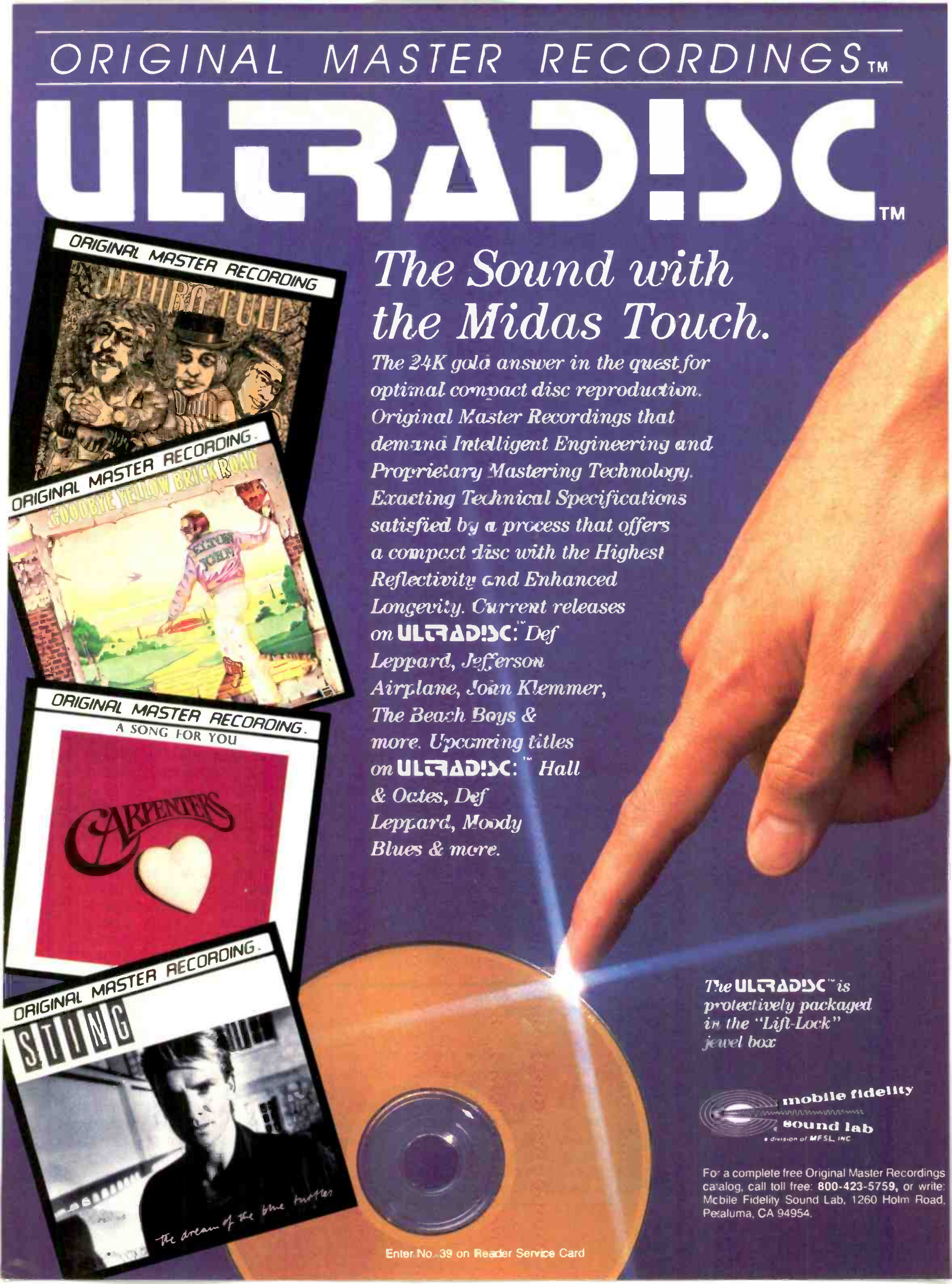
Freedom: Neil Young
Reprise 25899, CD; DDD; 61:04.
Sound: B+ Performance: A

This is strange. I thought Neil Young was a vocal political conservative. Yet judging from the masterful *Freedom*, he's suddenly developed a heart of gold.

I'm tempted to call this the album of the '80s. Young opens with a raucous live version of "Rockin' in the Free World," bringing up concerns he fleshes out fully in the studio version later on, where he angrily strips away the facade of our "kindler, gentler, machine-gun hand." He gives the old standard "On Broadway" disturbing new meaning; today, the lines "When you're walking down the street/ And you ain't had enough to eat" are no longer starving-artist romantic. On the dark and anxious eight-minute opus, "Crime in the City (Sixty to Zero Part I)," Young gives us a cop bemoaning his lot; just when we're nodding our heads and clucking, "Poor man, somebody ought to do something," we find the cop is just rationalizing why he went on the take.

The same strange and awful landscape appears in the sad romance of "Wrecking Ball," the odd site where two lovers plan to meet. Though she wears "something pretty and white," they rendezvous at a grimy symbol of destruction and regeneration. Perhaps, then, Young means something more abstract by "wrecking ball"—like a surreal, symbolic party where power-broker princes and princesses gather to dance till dawn.

What makes *Freedom* such an achievement is that never has so politi-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Al Green's *Love Ritual* presents unreleased cuts from the period in which his imagination was most fertile. It's a revelation.

Photograph: ©David Gahr

cal an album sounded so good technically (it's digital at all stages) and musically, from the dirty sound, rough as beard stubble, of the live "Rockin' in the Free World" to the sad and hopeful horns and piano of "Someday," sprinkling notes like stardust. Like the ideal it celebrates, *Freedom* is magnificent. If this musical and lyrical cacophony doesn't wake you up to what we're increasingly in danger of losing, maybe you're better off asleep.

Frank Lovece

Just Lookin' for a Hit: Dwight Yoakam
Reprise 25989, CD; AAD; 35:25.

Sound: B+ Performance: A−

A word about my Dwight Yoakam problem.

Of all country music's so-called neotraditionalists, none satisfies me more than Doo-wight. He makes Randy Travis sound like MOR treacle, Nancy Griffith precious, k. d. lang fickle, Ricky Skaggs bland, and Steve Earle monotonous. He rocks with a lean & tensile urgency, gots a memorable, instantly recognizable voice that's just a shade tinnier than silver (that's okay, country voices shouldn't go down too smooth), and's had the smarts, or luck, to hook up with a clever & pretty courageous producer who may also be the supplest, most butt-kicking lead guitarist in

country music: Pete Anderson. Guided by Anderson's enlightened-trad studio choices (live sessions when possible, ditto tube gear and real reverb plates 'n' chambers), Yoakam's cut three albums since '86. This here's a best-of, plus two lagniappes—a k. d. lang/Yoakam duet on Gram Parsons' "Sin City" and a scorching remake of The Blasters' "Long White Cadillac"—and if you're looking to make the most informed possible entry into country music, circa 1990, git it.

So what's the problem? Well, the boy's got a mean streak. There's a smirking falsity here, a deep-seated churlishness. Unwilling to stand foursquare behind his real emotions, whatever they are, Yoakam hides behind mannerisms and a great voice; sometimes he's so stylized he sounds like a parody ("I Sang Dixie"). And his smarminess can degenerate into real ugliness. Bad enough that he opened his third album with an anti-Semitic slur, worse that he shoves the song containing it ("I Got You") in our faces again. If he's trying to assert his independence of critics (who rightly jumped on him the first time), he succeeds only in looking unlovely.

But no, I ain't turned him off yet. Offsetting Yoakam's twerpiness is a devotion to good hard honky-tonk, plus—one almost hates to admit—a core of genuine, burning talent. I'm still a big fan, Yoakam, but any more bigotry, and wham—you're off my shelf.

Tony Scherman

Love Ritual: Al Green
Hi/MCA 42308, LP.

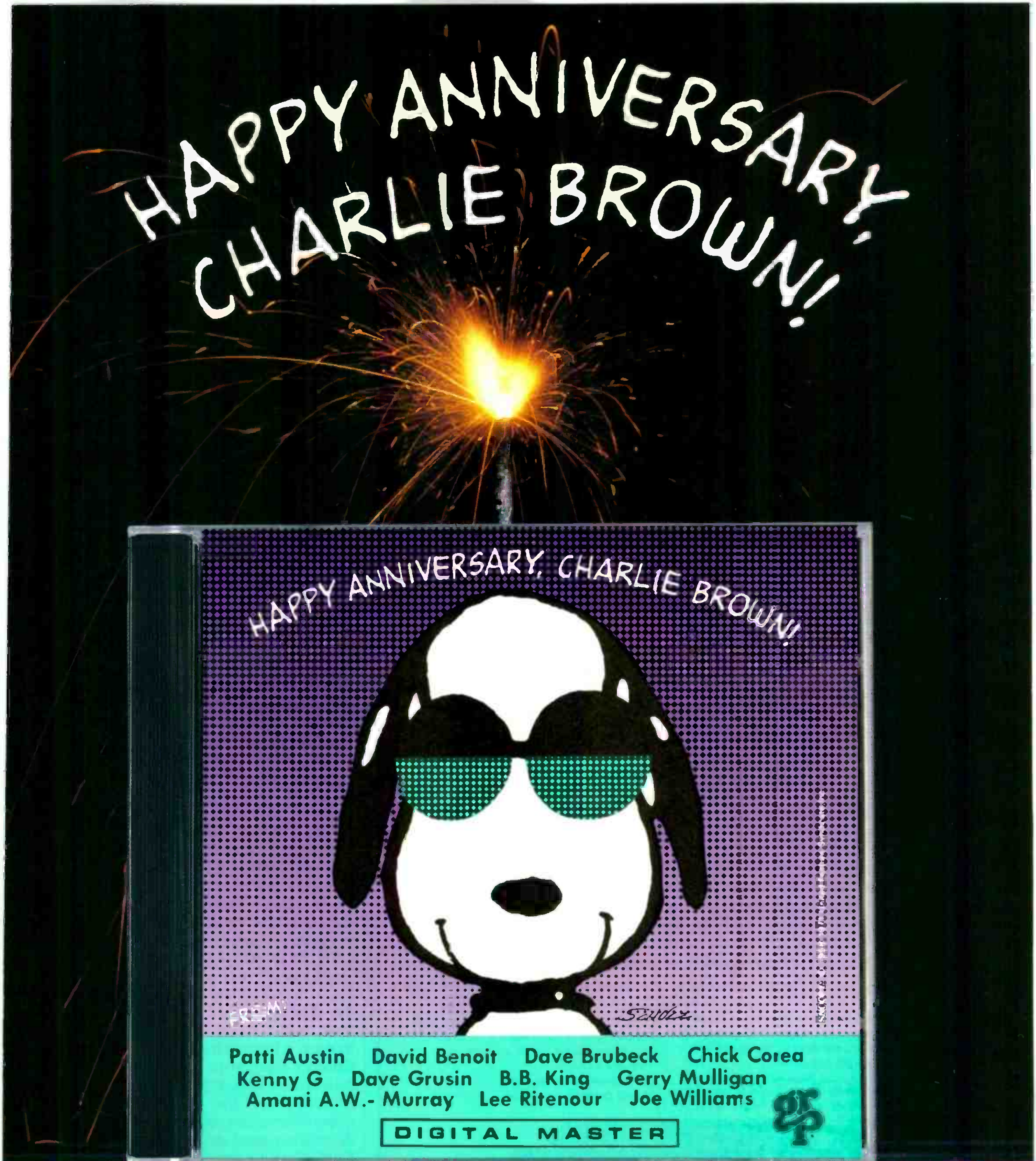
Sound: B Performance: A

Al Green's work in the late '60s and early '70s rivalled that of his great predecessors Otis Redding and Sam Cooke. Green's Hi Records material would become a yardstick by which all soul singers would be judged, and although he still continues to record, most followers of rhythm and blues write off his post-Hi work. There are moments when Green transcends the confines of pop-gospel, but the fire this master vocalist commanded so handily with Willie Mitchell and Teenie Hodges at his side was extinguished with the notorious grits-hurling incident. This record presents unreleased material from the period during which Green's imagination was most fertile, and it is a revelation.

The earliest track is his 1968 version of Lennon and McCartney's "I Want to Hold Your Hand," which shows Green owing much to Otis and not completely realized as a stylist. His 1970 version of Mack Rice's "Mustang Sally" (for which he claims author's credits here, as "Ride Sally Ride") is a far better representation of the Al Green we know and love. And there's a remix of "Love Ritual" that exposes the rhythmic urgency of the track, lost on the original.

Enough about the tracks that might be familiar to Al Green fanatics; some bona-fide, unreleased gems make this volume a must buy. "Up Above My Head," a mid-'70s classic that's never seen the light of day, has Al doing smooth improvs over a chord sequence reminiscent of Stevie Wonder's "I Don't Know Why." Let there be no doubt: This track slays. "Love Is Real" has its roots in late Stax and "Proud Mary," with an approach slightly more guitar-oriented for Green. Some of the unreleased cuts here are a bit unfinished, but hearing Green experiment in the studio beats the daylights out of his collaboration with Al B. Sure. These recordings draw the listener in by sheer force of personality.

As for sound quality, it varies from track to track. All but one of the selections have been digitally remixed, and it would have been nice to have Willie Mitchell participate in the mixes, as the warmth of the midrange is missing. There is also some annoying distortion on the end tracks which surely could have been avoided, considering the album is not overlong. In all, the remixes are more sympathetic to Al than to


HAPPY ANNIVERSARY, CHARLIE BROWN!
HAPPY ANNIVERSARY, CHARLIE BROWN!
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Kenny G Dave Grusin B.B. King Gerry Mulligan
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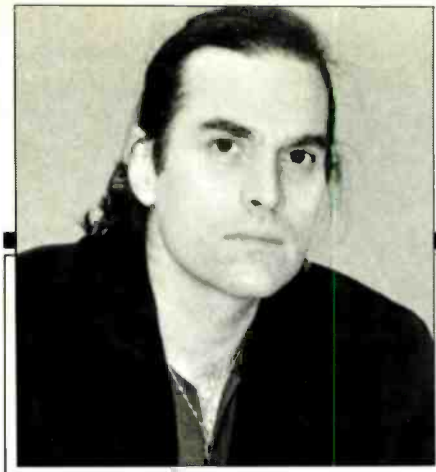

With Suzanne Vega's producer at the helm, Eric Andersen weighs in with a raw, intense album, his best in almost twenty years.

the band. This is no butcher job, simply the work of people who weren't present at the original sessions.

Overall, this is a superior collection of must-hear work by one of soul music's leading living exponents. It's Al Green's best release by far in more than a decade. *Jon & Sally Tiven*

Ghosts upon the Road: Eric Andersen
Gold Castle D2-71327, CD; AAD; 50:59.

Sound: A Performance: A

When Eric Andersen first blew into Greenwich Village, drawn by the brilliance of the young Bob Dylan's songs, he quickly cut a swath through the Village's female population. They couldn't help but notice those dark, lean, brooding good looks. That tall guy singing about dusty box-car walls and thirsty boots was the real romantic of that impossibly rich crop of folk-based singer/songwriters.

His best album was his 1972 major-label debut, *Blue River* (Columbia, just out on a terrific-sounding budget CD). *Ghosts upon the Road* plays like *Blue River*'s companion piece as it spins through its cycle of love chronicles. Sound and production are superb. Eric co-produced this album with Steve Addabbo, whose work graces both Suzanne Vega albums. (The aggressiveness of *Solitude Standing*'s arrangements is felt here.) Eric's always been a pretty low-key guy, so his focus and intensity are a most pleasant surprise.

The title song is clearly the centerpiece. A nearly 11-minute narrative, it recalls Andersen's scuffling young-and-hungry days in all their grime and splendor—who was around, who did what, who survived, who didn't. An ominous piece, it's got a dark, commanding presence, made eerier by the cry of Frode Larsen's harmonica.

"It Starts with a Lie" stretches from John Leventhal's African-toned guitar figure into churning rock, propelled by the drums of Andy Newmark. In contrast, "Listen to the Rain" is a slow tune to ease a friend's hurting heart. Shawn Colvin's harmonies shine (check her own album, just out).

Throughout, the emotions are exposed-nerve raw, often painfully vivid. Addabbo's production savvy and Greg Calbi's fine mastering job are critical to the project's quality.

It is especially satisfying to hear an old musical friend doing such vital work. *Ghosts upon the Road* is a triumph. The stories here are not all pretty, but they ring true, even if it hurts. Pain always was Eric Andersen's strong suit. *Michael Tearson*

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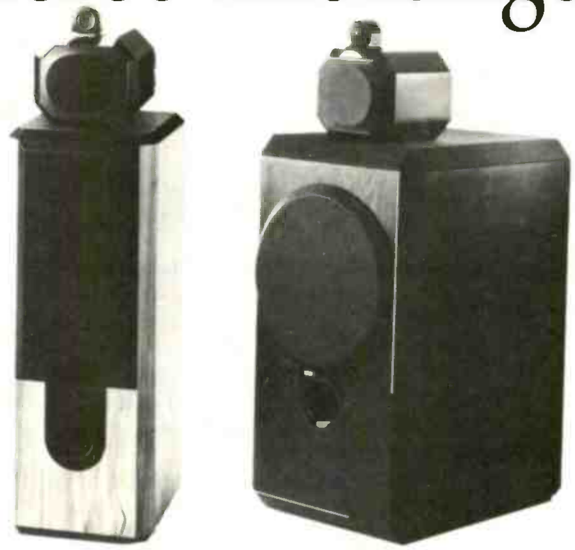

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Dvořák: Symphony No. 6 in D Major and Husitská Overture. Milwaukee Symphony Orchestra, Zdenek Macal. **Koss Classics KC-1001,** CD; DDD; 57:55.

The curious and jumbled contents of a reviewer's mail are a constant reminder that, thank God, music and audio still have something to do with each other. Witness this CD, the first of at least five releases from Koss Classics, the recent CD-producing offshoot of Koss Corp., the headphone people. It is a world-class recording of a very remarkable performance. You may know the Milwaukee Symphony (Koss' home-town band, as it were) from their beautifully recorded concert broadcasts to the nation. The same engineer who has brought us these warmly recorded and spacious sonics on the air, Larry Rock, is responsible for the balanced, tonally true, rich sound on this CD and on the one other I have heard so far. Session producer Evans Mirageas and assistant Mary Gaffney worked with overall producer Michael Koss to turn out what I can only call a rather addictive album.

But don't we have several Dvořák Sixths from established labels and European orchestras that have more cachet than that lakeside city with its breweries and sports and such? Oh yes, we do. However, anyone who has been guest-conducting his way across this country will tell you, perhaps with a mild air of wonder, that he can get flexible playing in the proper spirit from the many U.S. orchestras that lie between the two coasts. Some former guest conductors, such as Zdenek Macal, have settled in as artistic directors and music directors—far from Prague, Berlin, London, and other sanctioned cultural capitals. They have found orchestras bearing the imprint of previous conductors and with an affinity for, perhaps, one or two broad areas of music. Orchestras of this sort are willing and able to mold their sound and feel to the idiom asked of them by a communicative baton. And that is what we have here.

This is Dvořák of the most idiomatic and luxurious sort. The woodwinds are full, the strings secure and possessed of a light, expressive vibrato—except where broader gestures are appropriate—and the brass department is noble-toned and rich. The incisive bite of the Prague Symphony (Macal's old gang at home) and the Czech Philharmonic, both of which I recently heard in their home halls in Prague and can thus compare quite well with the Milwaukee ensemble, is absent. Also absent is the bright, quicksilver shimmer of the upper woodwinds, but the more relaxed, round American sound is very appropriate for these scores from the end of the last century.

It costs about one-quarter as much to record in Eastern Europe as in the realm of the American Federation of Musicians, umbrella organization for the players. So why commit the budget to tape and issue recordings here when excellent ensembles in Bratislava, Katowice, Ljubljana, and Prague can do the same job for much less hard currency? I think the musical results and the ensuing support for a very fine orchestra, heard to stunning effect on these first CDs from Koss Classics, will speak for themselves. With playing and conducting like this, it would be arrogant to say "welcome to the big league, guys"; they are already there and have been for some time, as have numerous other U.S. orchestras not as famous or often-recorded as the Big Five.

The production team is from or associated with FM station WFMT, Chicago—long a source of beautifully and simply produced tapes for broadcast. Mirageas, guiding hand in the artistic shaping of this and the other releases from Koss, has had such success at WFMT that the Boston Symphony has recently snapped him up. (Sorry, WFMT, and I hope this will not end his Milwaukee work.) Michael Koss can be proud of his company's first CD and of the further riches from Milwaukee—the Dvořák Eighth and Czech Suite, a Beethoven Ninth, and two albums of music composed and led by Lukas Foss (Macal's predecessor).

A note on the recording should be of interest to those who follow the techniques used in today's best releases. Uihlein (pronounced "*E*-line") Hall, Milwaukee, is problematic for listeners but not for a resourceful recording team prepared to use effective, simple multiple miking to achieve their results. The main microphones were a pair of Sennheiser MKH-20 (string fill) and a B & K 4006 pair (center). The important wind section (especially in Dvořák!) had a pair of B & K 4007s, while the double bass section had its presence enhanced with a Schoeps cardioid; a 20-meter-high pair of Neumann KM83 omnidirectional mikes picked up ambience. There was no processing. Mastering was done, as increasingly these days, on professional DAT recorders with a Beta/PCM-F1 digital backup. All, of course, edited digitally—thus the DDD SPARS code.

Good on yer, Koss! Since most major stores now carry this and the next few Koss Classics Compact Discs, I envision something of a run on them as alert listeners become aware of their excellence. Bass freaks will note there is very solid, luxurious bass wherever

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Maestro Giuseppe Sinopoli has New York's Philharmonic playing in top form on two works from Scriabin's later, "mystic" period.

the orchestra is called on to produce it, not just in the bass drum eruptions so wretchedly popular on too many recordings. The music lover *and* the audiophile will have reason to cherish this disc and eagerly await further gems from Milwaukee.

Christopher Greenleaf

Scriabin: "Le Divin Poème," "Le Poème de l'Extase." New York Philharmonic, Giuseppe Sinopoli.
Deutsche Grammophon 427-324-2, CD; DDD; 69:43.

From both musical and sonic viewpoints, this is one of the best Deutsche Grammophon recordings on CD. Alexander Scriabin was something of a "mystic," a follower of occult beliefs in the latter part of his 43-year existence. This is reflected in the dreamlike, sensual, and often phantasmagoric scoring of his Symphony No. 3 ("Divine Poem") and the later "Poem of Ecstasy." Scriabin often embellished the mystic aspects of these works with the simultaneous projection of various colored lights on a screen—this in 1905 to 1908!

Conductor Giuseppe Sinopoli has the New York Philharmonic playing at the top of their form in a lush, effusively romantic performance of "Le Divin Poème," but the gem on this CD is the searing emotional intensity and passion of "Le Poème de l'Extase."

Scriabin employs a huge orchestra, including eight French horns. Yes, the finale of this work is indeed "ecstatic," with the full orchestra building to a great crescendo, the eight horns playing in unison in an impossibly high register, all abetted by organ pedal and concluding on a monumental sustained chord. "Thrilling" is the word!

The sound is very clean and well detailed, with great weight. The ambience is a little on the lean side, with reverb about 1.3 seconds. The work was recorded in the Manhattan Center in New York City, a venue used by many record companies over the years. In fact, I recorded Stokowski there, conducting the Shostakovich Fifth Symphony, Prokofiev's "Cinderella" Suite, and others, as well as Carlos Chávez conducting some of his own works. In recent years, the Manhattan Center came under the control of the controversial Reverend Sun Myung Moon and his followers. Unfortunately, they carpeted the wood floor of the Center, thus greatly attenuating the reverb time. Deutsche Grammophon increased the reverb time in Chicago's Orchestra Hall by covering the seats with 4 × 8-foot plywood sheets, which were then covered with vinyl sheeting. Deutsche Grammophon employed the same technique on the carpeted floor of the Manhattan Center. In my opinion, the Center sounded better in the old days, but at least the DG treatment provided a reverb period of 1.3 to 1.4 seconds, which makes for a really excellent recording.

Bert Whyte

Shostakovich's music may be deeply troubled—and troubling—but it is also full of tenderness, as in these three quartets.

Shostakovich: String Quartets Nos. 4, 8, and 11. Coull String Quartet.
ASV CD-DCA-631, CD; DDD; 63:41.

It's astonishing how endlessly viable the seemingly "limited" medium of the string quartet is. If Haydn had done nothing more than point the way for future composers in this respect, he would have to be reckoned a master. Two centuries later, the form served the purposes of Dmitri Shostakovich, a master of comparable stature but utterly different in temperament and outlook.

Too much has been made of (to quote the liner notes from the present disc) the "increasing spiritual desolation" of Shostakovich's music, and all but three of his 15 quartets date from the last 25 years of his life. In contrast to Haydn (or even Beethoven), Shostakovich's output is deeply troubled—and troubling—but it also is full of wit and tenderness. And that last quality in particular shows itself repeatedly in these quartets.

Quartet No. 4, in D Major, is the most relaxed of the three, though it was composed in 1949, a year after his denunciation (along with Prokofiev and others) at the Congress of Soviet Composers. The folk-like melodies and rhythms of the Fourth Quartet seem almost carefree next to the darker. more energetic moods of the other two quartets, though the driving finale has considerable power.

ASV has chosen to place No. 4 second on the disc, so that it acts as a foil to each of the others and as a buffer between them, which is basically a good idea. Unfortunately, however, each of the 16 movements on the disc is individually banded, so to play the Fourth Quartet by itself, you have no choice but to program its four bands in order. Had PolyGram's original guidelines been observed—which even PolyGram doesn't bother to do—each quartet would have been banded and the movements indexed, instead.

Quartet No. 8, in C Minor and composed in 1960, is understandably the most frequently played of all Shostakovich quartets. It is as beautiful and as beautifully wrought as any work in the medium in this century. Each of the five movements—largo, allegro, allegretto, and two more largos—has a distinct character, but there are no pauses between them. The writing ranges from searing dissonance to haunting, Borodinian lyricism.

Quartet No. 11, from 1966, is in F Minor and comprises seven movements, several of them less than two minutes long. Among them are a scherzo and a humoresque, but, though Shostakovich's wit certainly shows through here, neither section is exactly jocular. The étude movement that precedes the humoresque is brutal and crushing; the elegy that follows it is a touching memorial to a violinist who had participated in almost all of the quartet premières up to that date.

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Richard Kapp has a sensible feel for Bach's concerti, keeping up a good rhythmic flow but giving the details time to get past the ear.

The quartet begins and ends rather epigrammatically.

The Coull String Quartet plays these works with great authority. Incisive articulation takes priority over ravishing tone in much of this music; elsewhere, the variety of the writing provides opportunity to display a range of tonal color. In some passages, only outright virtuosity will do, and the Coull is in its element throughout. The digital pickup is very good, though the long reverb time of the venue (St. Silas, London) gives a juicier ambience and a more stentorian feel to these quartets than I would consider ideal. *Robert Long*

Bach: Violin Concertos. Philharmonia Virtuosi, Richard Kapp; Paul Peabody, violin.

ESS.A.Y. CD-1002, CD; DDD; 63:38. (Available from ESS.A.Y. Recordings, 145 Palisade St., Dobbs Ferry, N.Y. 10522.)

Seldom do we get to hear these big baroque works played on records by a real out-and-out local, U. S. of A. performing group. Most are mixed international from everywhere but here—some competition for our locals! They do very nicely in this recording from the company with the inexplicable name, ESS.A.Y.

Richard Kapp keeps music lovers in the New York City exurbs busy with a series of concerts that attracts a very loyal audience which seldom gets into the big city for the international stuff. What matters more is that Kapp has a very balanced and sensible feeling for these familiar Bach concerti, including the overly played E Minor. All too often, they are blasted out at high tension, perhaps to match the virtuoso fiddlers that play them as part of repertory. Kapp mostly takes the music at par value, allowing time for the details to get past the ear but keeping up a good rhythmic flow. This, mostly, I liked.

Paul Peabody, the violin solo, is on the gentle, soft side, never hacking the music out stridently as some do. A bit too soft in the tone for Bach's architecture, but no matter; he communicates. Not mentioned in the title (lack of space) are more fiddles for a three-violin concerto, excellently transcribed from a somewhat messy and confusing three-harpsichord concerto originally intended for Bach himself and his two sons. Well, that's one version of the story and probably out of date, what with the hectic Bach research that has been going on recently. Kapp thinks it is an early Bach.

Anyhow, the three-violin form is easily listenable, much less confusing than the presumed triple-harpsichord version—if there was such, or is. The thing that most bothers Kapp (and intrigues me) is the anonymous possibility: How many Bach works are actually by the well-known Anon.?

Still and all, there's more variety on this CD than you might think from the title. *Edward Tatnall Canby*

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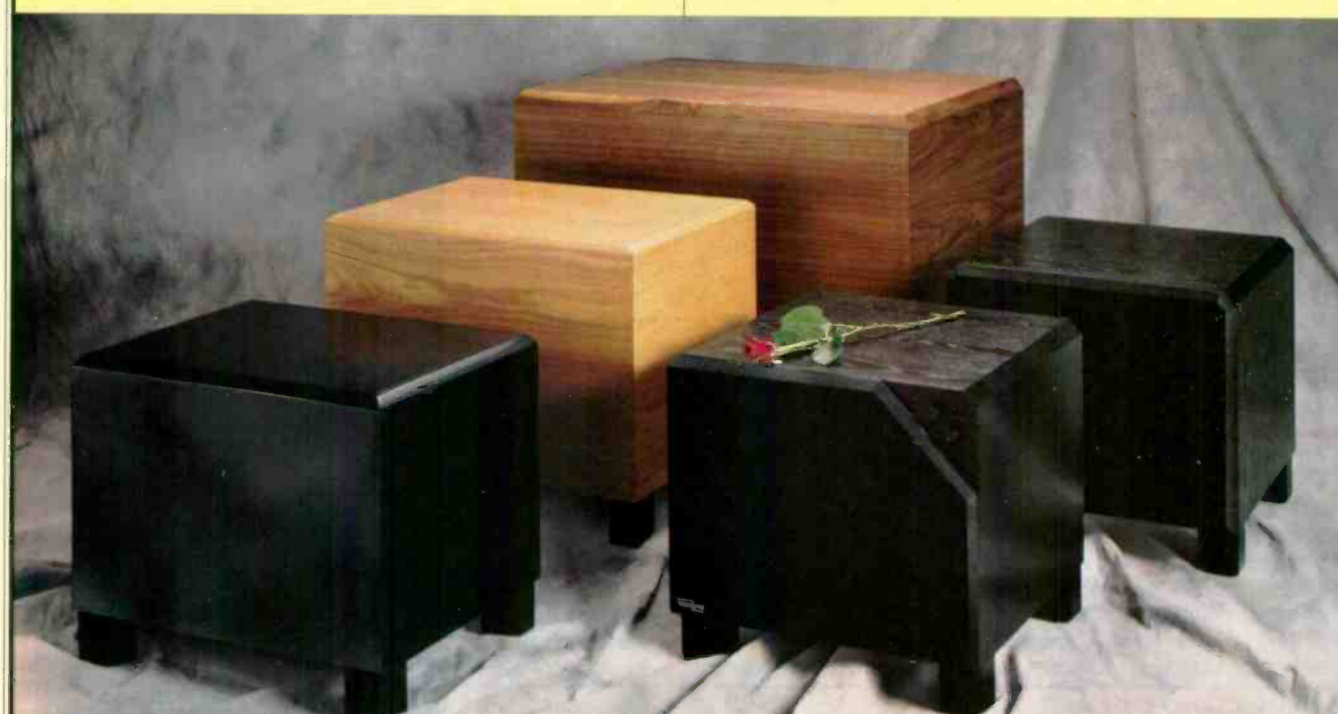


KEYBOARD KWEEN

Twylight: Geri Allen
Verve/PolyGram 841152, CD; ADD; 43:06.

Sound: A– Performance: A–

Just as the sound of machines grinding to a halt concludes the introduction to "Stop the World," pianist Geri Allen launches into a wobbly clave rhythm; her lines, buoyed by bassist Jaribu Shihad and drummer Tani Tabal, dart joyously in the newfound silence. In fact, most of Allen's new trio album, *Twylight*, bubbles with the enthusiasm of an elaborate hoedown.

Of the young, Brooklyn-based musicians currently trying to expand jazz's boundaries—Steve Coleman, Greg Osby, Robin Eubanks—Geri Allen may be the most extravagantly gifted. Drawing on influences from Milton Nascimento to Motown to Andrew Hill, she plays with a restless energy she is only beginning to harness. She's been more successful in blending seemingly disparate elements with her octet than with her trio. Until now.

On *Twylight*, Allen augments the trio with her own synthesizer, percussionists Sadiq Bey and Eli Fountain, and (on some tracks) vocalist Clarice Taylor Bell; the additions deepen the orchestral coloration. With the exception of Bell, whose lilting vocals float right upfront, Allen's bandmates are submerged in a subtle groove. They surface to trigger transitions and for solo spots, only to recede into the swirling backdrop. This is particularly effective, since Allen's incorporation of ethnic musics and natural sounds is finally beginning to imply something of a cosmology, something beyond mere genre-hopping and the busy execution of stylistic gestures. There is a new coherence to her work. Thus, a song like "When Kabuya Dances" evolves from an introspective series of minimalist chords to a whimsical, soulful jaunt. On several tunes, particularly "Shadow Series," Allen will suddenly reclaim an ascent into the ephemeral with an earthy barrage of blues phases—and it's all starting to mesh.

Allen's ability to weave familiar sounds and rhythms into jagged, angular runs makes for fresh, wonderfully imagistic arrangements. And most of *Twylight* swings with a headlong momentum—even the tender "Blue," which is played at an expectant crawl that would make Thelonious Monk and Delta bluesman Skip James proud. What's most important, however, is that *Twylight* conveys the spirit, liveliness, and vision of music in the service of a community. Without resorting to fusion's ready-mades, Allen weds the conversational and populist with the abstract—she plays dance music for the nimble of foot. *Don Palmer*

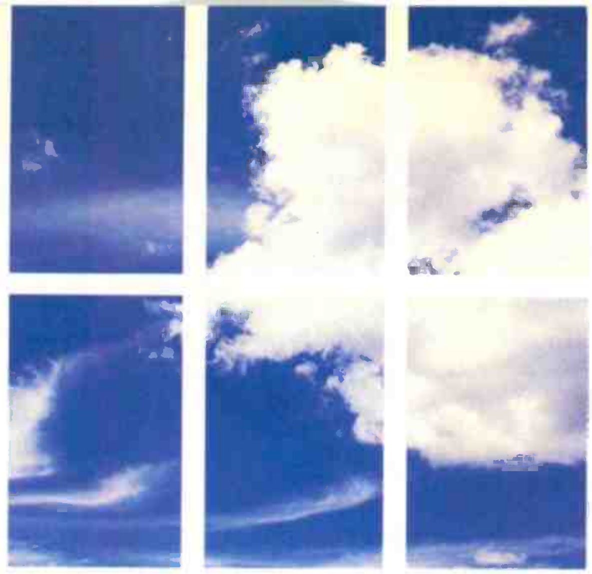
Reflections: Frank Morgan
Contemporary C-14052, LP.

Sound: A– Performance: B+

There are those who hail Frank Morgan's 1985 return to the scene as the second coming of Bird. Morgan's lengthy drug addiction and three-decade incarceration are well documented; his ability to overcome the odds is, indeed, remarkable. But enough is enough. Ultimately, he must be critiqued on the basis of his musical, not sociological, contribution; I don't think Morgan, or any artist, would want it otherwise. Not only is Morgan not "the greatest alto saxophonist alive," as he's been labelled more than once, but media hype and heavy-handed hooks have hurt more than helped him. Today, releasing his seventh disc in five years, Morgan flirts with becoming a self-caricature.

There are instances of great music on *Reflections*. However, far more often than not, they're the work of Morgan's "accompanists"—tenor saxophonist Joe Henderson, vibist Bobby Hutcherson, Mulgrew Miller on piano, Ron Carter on bass, and drummer Al Foster. Morgan is, in many ways, the weak link in this ensemble: The most traditional and predictable and, tonally, the least strong. Whereas, for instance, Henderson's note choice on Hutcherson's "Starting Over" excites and tantalizes, Morgan's, I'm afraid, borders on the constricted. It is, in fact, Henderson's introspective "Black Narcissus" that forces Morgan to push

Photograph: ©Jonathan Atkin



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Frank Morgan is good, very good, but it's time for him to move forward. In many ways, he's the weak link on his own album.

himself. Morgan needs to be prodded; otherwise, he can sound mundane.

It's not my intention to get on Morgan's case here. He's good, very good, and I'm glad "Bebop Lives!" But it's time for Frank Morgan to move forward. The five consummate musicians hired to envelop him all but leave him behind. *Jon W. Poses*

Early Black Swing—The Birth of Big Band Jazz, 1927-1934: Various Artists
Bluebird 9583-2-RB, CD; ADD; 67:12.

Sound: B Performance: A to C

If they're well thought out, projects like this can provide a real aural picture of how pioneering big bands developed a style and sense of swing years before anyone other than musicians had heard of the term. This new Bluebird CD has some wonderful recordings, many of which I have treasured for years, and it covers an important segment of jazz. Unfortunately, as produced here, *Early Black Swing* does not succeed.

Even if these were the *only* choices available, the way they're programmed makes it impossible to get a real feeling for swing as it was developing in the late '20s and early '30s. Years ago, when few had even heard this music in any form, such programming would have been acceptable. But today, with big band jazz rapidly slipping into the limbo of history as its originators leave us silently, one by one, a project such as this compilation *demands* more careful planning.

Ten bands were chosen to illustrate the development of big band swing, and not all of them are necessarily the best. Each is given two or three selections. Band after band, moving back and forth from tuba/banjo to guitar/bass, and back again . . . the effect is a bit bumpily monotonous.

The set begins with Fletcher Henderson, called the Father of Big Band Jazz—though this title properly belongs to Don Redman, Henderson's pint-sized alto saxist and principal arranger. In fact, Redman wrote the majority of Henderson's arrangements for nearly four years, establishing the brass size and sound (five men—three trumpets and two trombones) used by most big bands for the next 15 years. The choices here are good ones, but

Don Redman is this reissue's unsung hero, the pint-sized arranger to whom the title "Father of Big Band Jazz" properly belongs.

why fudge by using an after-the-fact 1936 example ("Jimtown Blues"), no matter how good, when the wonderfully relaxed 1934 recording of "Harlem Madness" is available?

Bennie Moten's popular and long-lasting 1928 recording of "South" is exuberantly rocking and old-fashioned, albeit with unswinging solos. The style Moten's orchestra exhibited on this track was changed somewhat when Count Basie and Eddie Durham joined the band in 1929; "Moten Swing" beautifully illustrates this.

Back to tuba and banjo with McKinney's Cotton Pickers (1928), now under Don Redman's direction. He has completed his mastery of big band arranging, now using *four* saxophones, and this time establishing the basic number and sound of reed sections for the next decade. (By the way, none of these Redman innovations are mentioned in the liner notes.)

Even though Earl Hines' brilliance as a soloist shines, and there is some good Shirley Clay trumpet work, Hines' 1929 sides are stiff and unswinging overall; he had not yet overcome his own nervousness and inexperience as a bandleader.

I love the funky, hard-rocking Charlie Johnson band, with its magnificent, sometimes overwrought soloists. The near ecstasy of exultation in the out-chorus on "Hot Tempered Blues" simply has to be heard to be believed—no arranger could possibly score something like that.

I'm fond of almost anything Louis Armstrong did during this period, and although "I've Got the World on a String" and "Basin Street Blues" are certainly good choices, I wonder if "Some Sweet Day" or "Honey Do" might not have offered up a better sense of his swing. Also, I think I would have closed the program, not with Armstrong, but with the Jimmie Lunceford selections; Lunceford was one of the most forward-looking of the early swingmen.

Overall, there is too much emphasis on bass, which at times makes listening unpleasant. One really ought not to have to make adjustments to properly enjoy listening to this music—not at this stage of the game, with all the much-touted technology used.

Frank Driggs

Spy Vs. Spy—The Music of Ornette Coleman: John Zorn
Nonesuch 60844-2, CD; AAD; 41:03.

Sound: B Performance: B+

Composer John Zorn garnered much acclaim for his pastiche recordings, *The Big Gundown* and *Spillane*, as well as his works for The Kronos Quartet. However, he's rarely been noted for his sax playing. Covering the music of Ornette Coleman, a musician who can still stoke controversies about his style after three decades, is unlikely to remedy that—but it should. Zorn, alto saxist Tim Berne, and their group, Spy Vs. Spy, tackle compositions from throughout Coleman's career in speed-demon, hell-bent forays that are time-compressed and more tightly wound than an air-traffic controller at Chicago's O'Hare.

From "The Disguise" in 1956 to "Space Church" in 1987, they render Coleman's pieces in one-, two-, and three-minute bursts of fury. These are speed-metal versions, with blistering reads of Coleman's intricate melodies followed by cat-fight skirmishes of freely improvised solos that somehow resolve into the main theme before you can catch your breath.

Zorn (in the past, as likely to pick up a duck call as fart into his instrument) and Berne are gifted players who circle around Coleman's melodies like piranhas in a feeding frenzy. They attack 17 tunes in 41 minutes, mainly by overdriving the improvisations; Berne and Zorn play with the gas pedal to the floor, circling, jabbing, careening. Though "Ecars" is taken at a methodical pace and "Feet Music" retains its jaunty swagger, on "Good Old Days" Zorn and Berne scream in a cracked improvisation, Berne alternating between honks and high sustains as Zorn warbles and scurries.

The rhythm section is like a dam burst, with bassist Mark Dresser and drummers Joey Barron and Michael Vatcher creating a storm of polyrhythms and countermelodies. The two drummers are overkill, however, often muddying the bottom of the sound in a music that needs sonic clarity. It sometimes sounds like they're banging in a large room, and the album is recorded with the hollow sound of those early Blue Note and Atlantic jazz LPs.


John Zorn

Spy Vs. Spy is the group's collective name, and they have done a service to Ornette Coleman by giving his music a place as the repertory work it can be. Coleman's is a living classical music.

John Diliberto

If Walls Could Talk: Little Milton
Chess/MCA CH-9289, LP.

Sound: B Performance: B+

The only thing that's ever been small about Little Milton Campbell is the size of his national audience. Blessed with one of the biggest voices in blues, he began his career as a guitar-picking disciple of B. B. King and Bobby Bland. During the Mississippi-born bluesman's decade with Chess Records, the label came to realize that Milton's strength lay not in emulating King or covering standards but in squaring off against a big band on songs that would showcase his gospel-based singing. Perhaps Chess sought, more pragmatically, to carve a new niche for Milton because the label already had its pick of guitar bluesmen (Buddy Guy, among others).

If not for its liner notes, few listeners would realize that *If Walls Could Talk* was actually cut in 1969. The performances on this album, with their elaborate but crisp arrangements, percolating rhythms, and contemporary lyrics, forecast the drift of urban blues toward the assimilation of soul music. All tracks are singles-length and feature Milton's vocal sparring with a group large enough to merit the description "studio orchestra." At worst, his producers are overly enamored of Milton's ability to shout down a horn section; rarely does he get the chance to demonstrate the subtlety he later honed on his Stax recordings. Milton suggests his true range as a singer, though, when he capitalizes on the stop-time breaks of "I Don't Know."

If Walls Could Talk is among the least dated of Chess recordings. It's good to have it back in print.

Roy Greenberg

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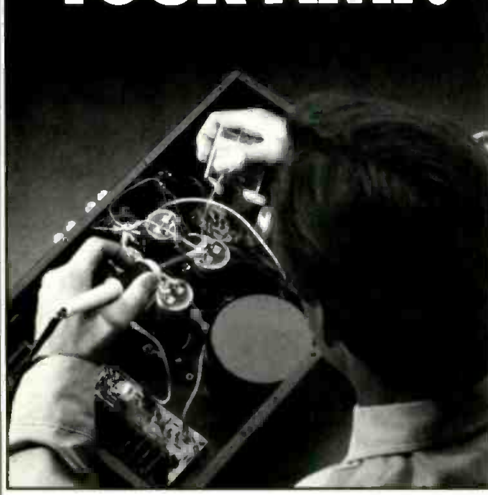

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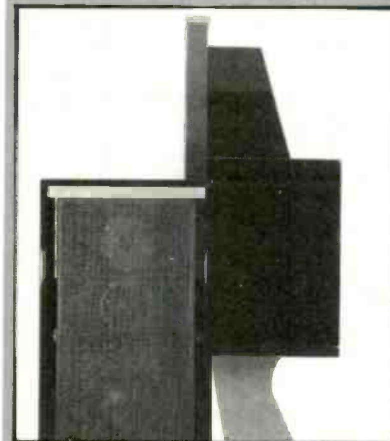

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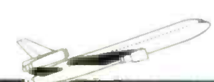

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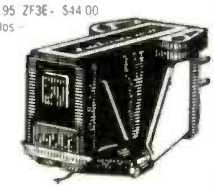

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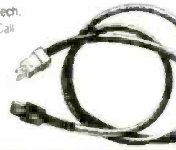

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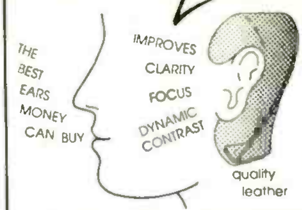

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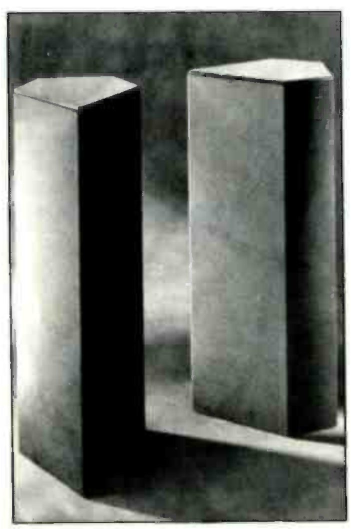

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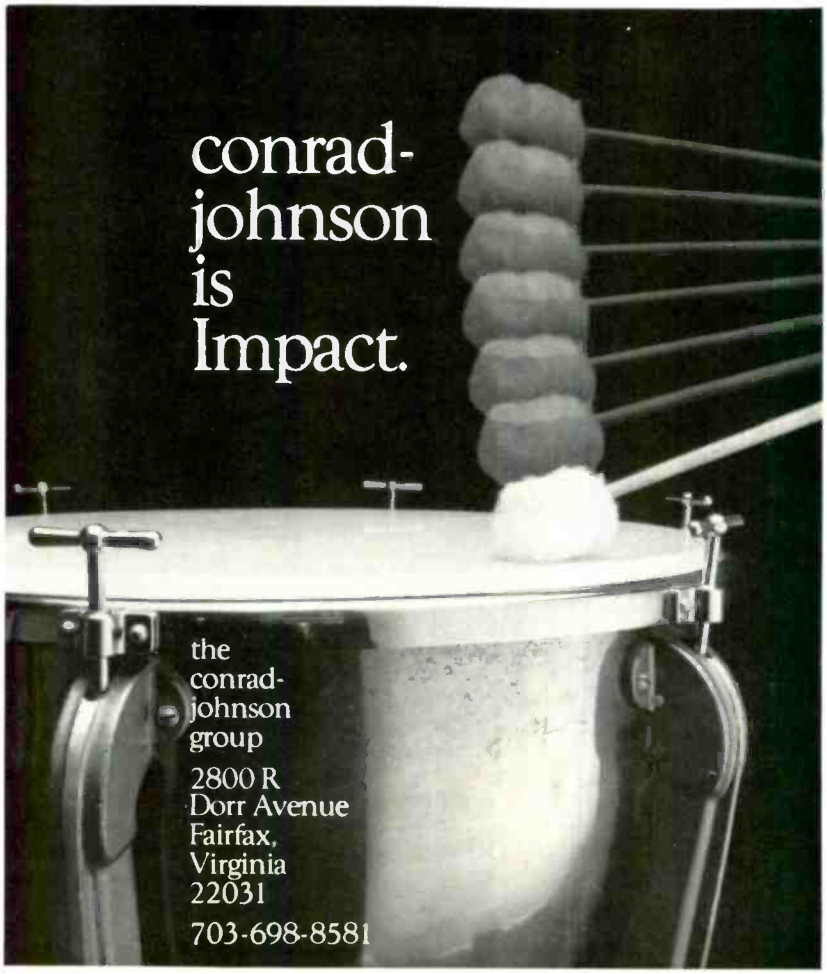

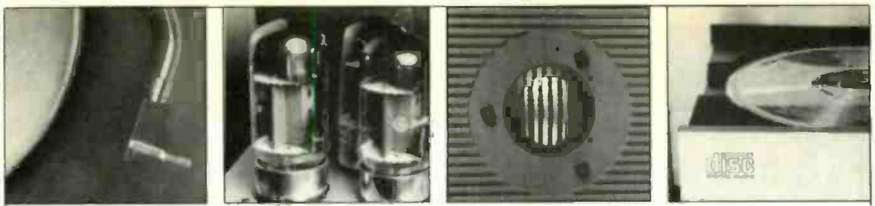

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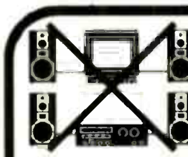

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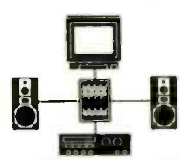

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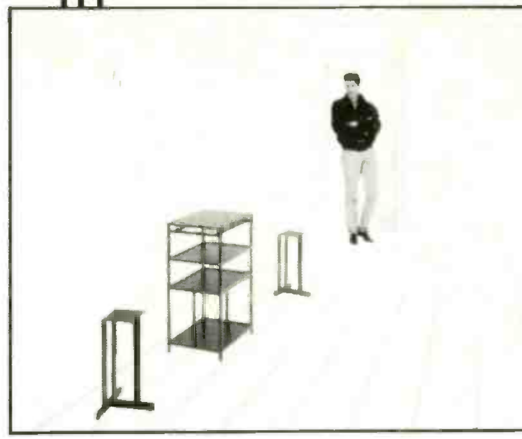

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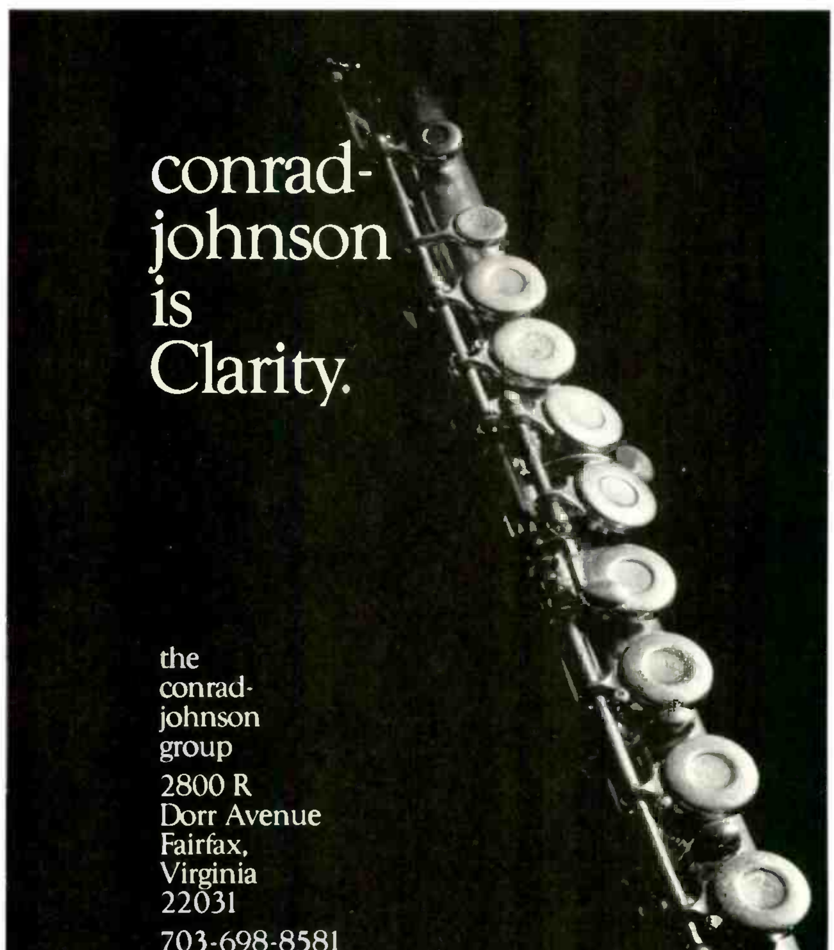

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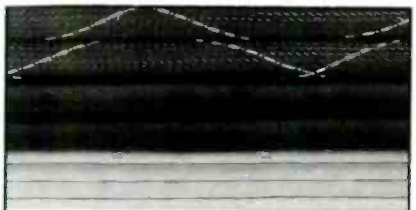

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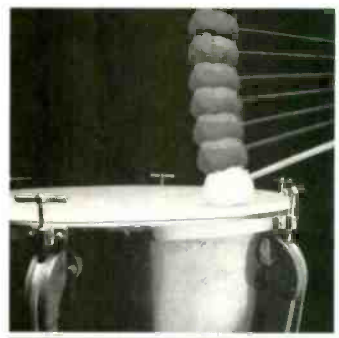

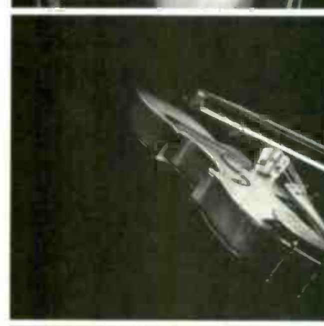

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