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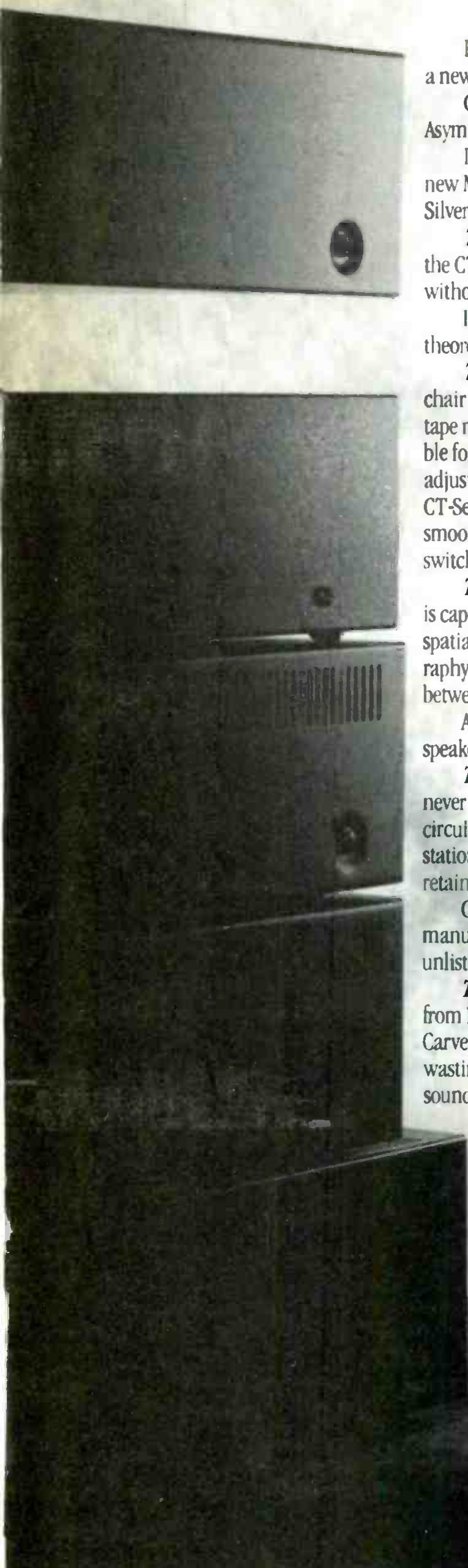

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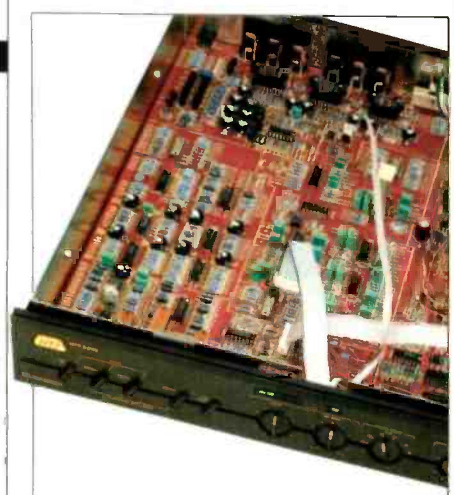

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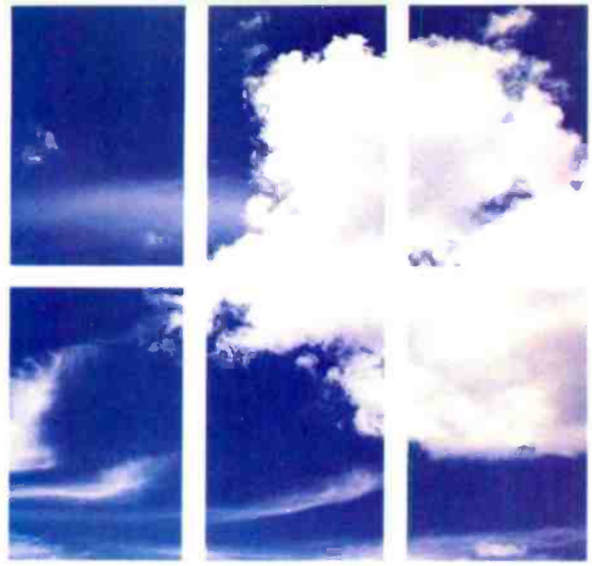

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Gotcha!

Dear Editor:

I was a little surprised to read Irene Lirpa's advertisement—er, letter—in the April issue. How convenient that you should print her "information" in the "Signals & Noise" column. Had you used a little better judgment in letting readers know what's available out there, you could have cited Lirpa World Tours' service as something *you* discovered and included it in "What's New." Better yet, you could have let Ms. Lirpa take out a quarter-page ad in your magazine.

No, I am not involved in any business like Irene Lirpa's, but I *am* a reader of *Audio* who objects to its recent lack of judgment.

Gerry Bokas, Jr.
Royal Oak, Mich.

Editor's Note: Ms. I. Lirpa's name, backwards, is . . . . —*E.P.*

The Unnamed Voice Takes the Mike

Dear Editor:

I was the unnamed public radio engineer quoted by Edward Tatnall Canby in his August 1988 column, and I would like to respond to Stanley Lipshitz's interesting January 1989 letter commenting on the column.

I had not heard of the curious phenomenon elucidated by Mr. Lipshitz in which level differences between left and right loudspeakers translate into timing differences between the ears. Fascinatingly counter-intuitive!

It is not without trepidation that I venture to contradict the redoubtable Mr. Lipshitz. Nevertheless, I cannot agree with his conclusion that a Blumlein recording (one made with a pair of coincident figure-eight mikes crossed at 90°) will give results in every way superior to an arrangement of spaced microphones. Blumlein certainly does provide superb lateral imaging, but not depth—at least to my ears. At NPR workshops at SUNY, Fredonia and the University of Iowa, I participated in experiments in which the same performance was recorded on multi-track tape using several pairs of mikes, so that different microphone techniques could be compared directly. I was present while many of the recordings were made, and so was able to hear what the performance actually sounded like in the hall. In no case did I find that any coincident technique gave the most lifelike reproduction. In all fairness, not everyone agreed with me, but neither was I completely alone in my perception. I do not agree that this is entirely a matter of the reverberant characteristics of the recording. In most cases I found a closely spaced array, such as ORTF (cardioids spaced at 17 cm and angled at 110°) to give the most realistic and pleasing results, combining a fair degree of lateral imaging accuracy with a sense of openness and depth simply not there with the Blumlein (or other coincident) pickup.

What I know about mike techniques I have learned on my own. I came to the field of classical music recording essentially without prejudices (being too ignorant to have any), and enthusiastically tried the first "stereomike" I came across, the highly respected AKG C-24. But I was disappointed with the result then, and have been ever since. As Mr. Lipshitz points out, stereo is a flawed medium not entirely capable of bringing the listener into the concert hall. Since complete accuracy is impossible, I suggest that there is room for valid disagreement about which compromises work best.

Steve Graham
University of Michigan
Public Radio Stations
Ann Arbor, Mich.

Mr. Lipshitz Replies: Mr. Graham is not alone in being unaware of the level/time interchange between loudspeakers and listener's ears in stereo reproduction. This is why I wrote a detailed paper which examines the whole stereo question and substantiates my claims ("Stereo Microphone Techniques—Are the Purists Wrong?" *Journal of the Audio Engineering Society*, Vol. 34, No. 9, September 1986). Some of your readers may be interested in examining this paper or even in ordering the demonstration cassette produced to illustrate my points. (It is available for $10 in Dolby B or C NR from the Audio Engineering Society, 60 East 42nd St., New York, N.Y. 10165.)

Good Blumlein stereo requires microphones with excellent figure-eight patterns. Large double-diaphragm

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The more people I meet in audio, the harder it seems to be to get an objective opinion. This forces me to form my own. . . .

mikes like the AKG C-24 may not be good enough in this respect; I would suggest a reduced angling between 80° and 85°. The Schoeps MK-8 figure-eight capsules are excellent and should be used at 90°. I find "phasiness" on the direct sound objectionable, and there is no way of avoiding it with spaced microphones. I cannot agree that good Blumlein stereo is lacking in "depth," but no stereo technique can provide "lifelike" reproduction, in my view.

The audible differences between coincident and spaced microphone techniques are largely *not* a matter of how these techniques handle the reverberant sound (Blumlein can be very similar to spaced omnis in this respect) but rather of how they handle the *direct* sound. Many people mistake phasiness on the direct sound for ambience.

Yes, indeed, there is room for valid disagreement, since there is no accounting for personal preferences. Try my tape and see what *you* think.

Stanley P. Lipshitz
Audio Research Group
University of Waterloo
Waterloo, Ont., Canada

Watching the "Roadsigns"

Dear Editor:

As an engineer and constant reader of the "Roadsigns" column, I took particular interest in "Take a Balanced View," which appeared in March. In that item, Ivan Berger describes the real benefits of fully balanced (or differential) output/input signal connections for automotive audio systems. He then references an article by John R. Bishop ("An Informal History of Car Amps," May 1988) that states that while some companies do use differential inputs, "they all hook those inputs to unbalanced lines."

I'm writing this note to tell you that at least one company does *not* commit this transgression: Ford Motor Company. Since the 1988 model year, all Ford audio systems with the Electronic Premium Cassette (EPC) radio are fully balanced systems, consisting of balanced drivers in the radio and balanced input circuitry in the amplifier. This includes both Premium Sound and Audiophile sound systems. The action was undertaken for the exact reason mentioned in your article: Improved common-mode rejection.

Keep up the good work. I'm looking forward to my next issue.

Henry Blind
Product Design Engineer
Audio Systems & Applications
Ford Motor Co.
Dearborn, Mich.

Old but Not Outmoded

Dear Editor:

It is only in the past couple of years that I have been able to devote some resources to my favorite hobby—those resources being money and that hobby being, of course, sound systems. As a newcomer, I have found, much to my pleasure, that there is a lot to learn.

Along with my limited experience comes the welcome advantage of an objective view. But the more people I meet in the audio world, the harder it seems to be to get an objective opinion. This, of course, forces me to form my own. It is one of these opinions I would like to share with you, the topic being the turntable.

When I junked the system I listened to in college and began rebuilding, one of the major decisions was whether to incorporate a CD player, turntable, or both. Obviously, if you choose only one, it's easier to build the system. Although I was no world-record album collector, I *had* amassed a number of LPs. But the question still remained. I upgraded my system, purchasing everything except a new turntable, and began buying CDs. Reading the local swap paper one day, I noticed a Linn LP12 for sale. Yes, the infamous Linn. One of the reasons I had not purchased a turntable up to that point was the fact that the price of a good reference table was quite high. Well, I couldn't refuse the Linn's price, so I went out and purchased it. After a little scouring, I even came up with a Syrinx PU2 arm that, by chance, was the one for which the arm board on the Linn was originally drilled.

To make a long story short, my Linn is quite a rival to my CD player. I'm back to buying LPs. And with a reference table like the Linn, its infinite adjustments allow me to tailor the sound to my ear; I'm not forced to listen to what I'm told music should sound like.

Thank God for the CD. It has put affordable reference turntables on the used market. In the future, please don't forget *new* diehard turntable people.

Joe Vastola
Buffalo, N.Y.

Calling All Call Letters

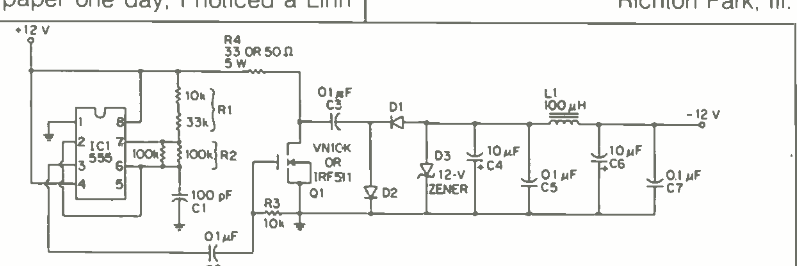
Dear Editor:

In the April 1989 "Audio ETC" column, Edward Tantall Canby incorrectly identified the key station of NBC as WABC. It was actually WEAF, which became WNBC at the time NBC was forced to divest itself of its Blue Network. The network then became known as the Blue Network of the American Broadcasting Company and, later, ABC. *Its* key station was WJZ, which became WABC nearly a decade after ABC's inception. WNBC became WRCA from 1954 to 1960, at which time the call letters reverted back to WNBC, which they remained until a few months ago, when the station ceased operation. The WABC designation to which Mr. Canby refers belonged to the station that became—and remains today—WCBS. Scrabble, anyone?

Eli Segal
Richton Park, Ill.

Erratum

The op-amp power supply construction project on pages 51 to 53 of our May issue contained an error. In the schematic diagram (Fig.1), capacitor C3 was shown in series with diode D2. It should actually be in series with diode D1, as shown in this corrected schematic.



The one disadvantage of owning the Pioneer 6-Disc Multi-play CD Changer.

No, the disadvantage of owning our CD changer system is not the convenient trunk-mounted changer box. That's an advantage. And it's not the fact that you can control it at the touch of a button from inside your car. That's an advantage, too.

It's not the easy-loading magazine that allows you to catalog six of your favorite CD's. It's not the "random play" feature. It's not that you can choose from four Multi-play CD changer systems to meet your music and budget needs. Nor is it the fact that the Pioneer 6-Disc Multi-play magazine works in both home and car players. And it's not even the endless hours of incredible music. Again, those are all advantages.

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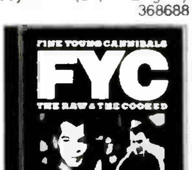

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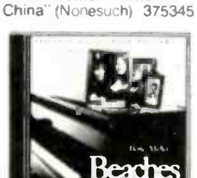

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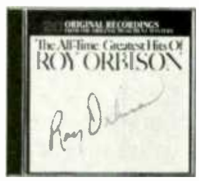

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AUDIOCLINIC

JOSEPH GIOVANELLI

SPARS Codes on CDs

Q. Is there a standard location where the SPARS code can be found on a CD?—Wesley S. Mayeda, Oxnard, Cal.

A. There is no standard place on a CD for the SPARS code. CBS often puts it on the CD box. With PolyGram, you are likely to find it on the disc itself. I have a couple of CDs which don't even have a code. SPARS, by the way, stands for Society of Professional Audio Recording Studios, and the code to which we refer here shows whether the original recording and mastering were analog or digital.

Bypassing the Preamplifier

Q. I have a CD player and a biamped speaker system. I do not wish to use my preamplifier when playing my CDs. Rather, I want to connect the player directly to the inputs of my electronic crossover. In fact, I have tried this; it works well, and there is sufficient volume. However, it is inconvenient to switch cables to the crossover. Should I use Y connectors to hook up the preamp and the CD player to the crossover inputs? Would it be better to use a switch between the preamp and the player?—C. M. Elsbernd, Cincinnati, Ohio

A. As you already have discovered, you can definitely bypass the preamplifier and send your CD signal right to the crossover network. (Personally, I would be unhappy about losing most of the functions found on my preamplifier.) In any case, you *must* use a switch to move the crossover inputs between the outputs of the preamp and those of the player. This can be accomplished by constructing a little box to hold the switch and the various connectors which will be wired to the crossover inputs, the preamp outputs, and the CD player's outputs. You need a two-pole, double-throw switch. One pole is for the left channel, the other for the right. The wipers connect to the crossover inputs, and the appropriate switch contacts are wired to the appropriate equipment outputs. Use a "break-before-make" switch. Place a 1-megohm resistor (wattage not critical) between each output and ground. The purpose of this is to eliminate "clicks" when the switch is moved between sources.

Do *not* use Y connectors. It's a tempting thought, but what is likely to happen is that the preamplifier will attempt to drive the CD player or the CD player will attempt to drive the preamplifier's output, in addition to driving the crossover. At best, this will reduce the amount of signal available to drive the crossover. At worst, bass will be lost and distortion will rise. With some circuits, there is a definite possibility of damage. I refer here to output circuits which are direct-coupled—no coupling capacitors.

Leaving Your CD Player On

Q. Some of the "underground" magazines recommend leaving a Compact Disc player on at all times because it is supposed to sound better after a considerable warm-up of the machine. Because a laser has a lifespan of 2,000 to 3,000 hours, does this on-time decrease the life of the laser or is the laser off until play begins?—Dennis R. Najuch, Medfield, Mass.

A. The laser is not operating except for the time the CD is being played or searched. Therefore, it is possible to leave your player on at all times. I have tried this, but my players, at least, sounded no better to me when I left them on all the time than they did when I listened just after turning the player on. It would be interesting to learn what *you* notice.

Balanced Inputs

Q. What are balanced inputs? I've often seen this term with regard to mixers.—Tripp Davis, Memphis, Tenn.

A. Equipment which you are familiar with probably has unbalanced inputs, i.e., the signal is connected between the input and ground. When the signal is applied between the "hot" lead and ground, this signal forces the voltage on the "hot" lead to move above or below ground potential in accordance with the instantaneous polarity of that signal.

The balanced input is so arranged that neither signal lead is connected to ground. When this input is driven, one input terminal swings above ground while the opposite terminal swings below ground. When the polarity of the signal reverses, the terminal whose polarity swung below ground now swings above ground, and vice versa for the other signal terminal. It is called a "balanced" input because the potential differences between each lead and ground are always equal, though opposite in polarity.

The cable used consists of two conductors and a shield. The shield is connected to ground as you would expect, but it does not carry the signal because ground is only a reference. Carrying the signal is the job of the two center conductors. The shield serves only to keep hum from being induced into the two "hot" conductors.

Meanwhile, the two conductors are wrapped around one another. This serves an important purpose: No shield is absolutely perfect. If the cable we're discussing is in the presence of strong hum fields, some hum voltage will find its way into the two conductors. This hum voltage will be introduced into both conductors more or less equally. It will, therefore, try to swing both conductors either above or below ground *at the same time*. Remember that, in order for a signal to feed a balanced input, the conductors must act in opposite directions. Induced hum won't act this way, but the desired signal will. (I ran 50 feet of unshielded mike cable, using a balanced input. Even without shielding, there was virtually no hum!)

Because of their hum-cancelling ability, balanced circuits are often used where amplifier signals are low and where cable runs are long.

FM Overload

Q. Recently, I connected my FM receiver to a combined FM/TV outdoor antenna. My tuner's signal-strength meter reads full scale. Rather than improving performance, however, using this antenna has produced more distortion. Is it possible that there is too much signal for my receiver to cope with?—Bill Dermer, Brooklyn, N.Y.

A. Based on your description, the most logical conclusion I can reach is that your receiver's front-end is overloaded by too much signal. The signal-strength meter reads full scale, so it is

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impossible to tell how much more signal is being received than is shown on the meter.

You didn't mention it, but another indication of front-end overload is the reception of the same signal at places on the dial other than its correct location. If you have this problem, you have proof that the front-end is overloaded.

Chances are that you can disconnect your antenna and still receive at least one signal, possibly with a full-scale meter reading. This would be another indication that you have front-end overload.

Based on the likelihood of overload, place an attenuator between the antenna lead-in cable and the receiver's antenna input terminals. These attenuators are made for the purpose of reducing the amount of signal arriving at the antenna inputs of TV sets, tuners, or receivers. They are available with various amounts of signal reduction; you will probably require 10 or 20 dB of signal reduction, or attenuation.

If you do not receive at least one signal at an incorrect dial marking, or if signals are totally lost with no antenna connected, it may be that your real problem is multipath distortion. I note that you live in Brooklyn, which means that your antenna may be surrounded by very tall structures. If some of these are higher than the antenna, the FM signals which are distorted are being received more than once. The first time the signal is received, it arrives directly from the transmitter—just as it is supposed to. However, that same signal may bounce off a nearby structure and be reflected back to your antenna. This second signal will arrive slightly later than the direct signal, producing phase discrepancies which can only lead to distortion. To complicate the matter, the signal may be reflected from yet another structure and be received by your antenna at an even later time.

In the event that your problem is the result of multipath reception, you should move your antenna to a different location, if this is practical. Sometimes, just moving the antenna a few inches causes the undesired signal reflections to disappear or become so weak compared to the strength of the direct signal that the sound from the receiver is restored to normal.

TAPE GUIDE

HERMAN BURSTEIN

Dolby NR and Bias Adjustment

Q. I have read that bias setting should be determined with Dolby noise reduction off, and this is the way I have normally established bias settings. A friend who is generally more knowledgeable in such matters than I am has told me that I should set the bias using the NR system that I plan to record with. I have tried his method but have found that recordings often sound somewhat shrill, especially with Dolby C NR, indicating insufficient bias. Which of these is the proper method?—Larry Craven, Raleigh, N.C.

A. There are two creditable schools of thought as to whether bias should be adjusted with Dolby NR on or off. In theory, bias should be adjusted for flattest possible response with Dolby NR off; the use of Dolby NR would then have the least effect on treble response. But as a practical matter, it is often satisfactory to adjust bias with Dolby NR on. I have discussed the matter with an extremely knowledgeable audio engineer, and he said that, at times, he has achieved better results by adjusting bias with Dolby NR on. Apparently, the way to go varies with the deck. On my Nakamichi deck, I find it satisfactory to adjust bias with Dolby on.

Comments are invited.

HX Pro as Noise Reduction

Q. I believe I understand how HX Pro works. Isn't it a secondary form of noise reduction? If you can record high frequencies at a higher level by means of HX Pro, don't the lower frequencies of the program material also get recorded at a correspondingly higher level, with a concomitant increase in signal-to-noise ratio?—R. Haeffele, Bloomington, Cal.

A. With HX Pro, somewhat less treble boost is required in recording than would otherwise be the case, thus lessening the risk of tape saturation. This is because, in the presence of high-frequency energy, the bias is somewhat reduced by HX Pro, yielding better treble response. Therefore, either the recording level can be pushed a bit higher or the same recording level can be used as before but with less danger of tape saturation. Only the first alternative would be equivalent to noise reduction.

Curious About Type II

Q. Please clarify one of life's mysteries for me. My cassette deck has automatic selection of bias and equalization, based on the cassette shell. I find that I can use Dolby NR only with Type I tapes. If I use Dolby NR with Type II, much of the crispness is lost in playback. On the other hand, without Dolby NR, I find no objectionable hiss on most recordings made with Type II tape. What do you suggest?—Larry R. Murray, West Palm Beach, Fla.

A. It seems that you have one or both of the following problems when your cassette deck goes into Type II mode: Either excessive bias is supplied in recording, which reduces high frequencies somewhat (but not to an intolerable extent), or Dolby NR tracking is inaccurate, resulting in treble loss. (Tracking refers to the fact that the level of the encoded signal, in recording, must match the level of the playback signal that is decoded.) Noise-reduction circuits tend to accentuate departures from flat response. Thus, any high-frequency loss due to excessive bias is accentuated by the NR system; this is in addition to losses due to mistracking.

Inasmuch as your deck works properly with Type I tape, including use of Dolby NR, I suggest that you stay with Type I. If you strongly desire use of Type II, try various brands. It may well be that some brands work better than others with the bias and sensitivity settings provided by your deck. At some future time, your deck may need servicing for reasons other than the present problem; have the service shop check its bias and Dolby NR tracking as well.

Improving 78s

Q. I want to improve the sound of my 78-rpm phonograph discs by recording them on tape. Will a DAT system significantly improve their fidelity? If not, what should I use?—Kenneth A. Stone, San Fernando, Cal.

A. A DAT system simply makes a near-perfect copy of whatever it is fed. If low fidelity is put into a DAT unit, low fidelity will come out. DAT recorders cannot improve on the source.

One of the improvements you *can* make in playing and/or taping 78s is noise reduction. There are a few dynamic noise filters on the market. Consult your local audio dealers or refer to back copies of *Audio*'s Annual Equipment Directory (which appears in every October issue).

You will probably want to play around with the frequency response, too. For this, a graphic equalizer or a parametric equalizer can be useful. Again, consult your local dealers and the Annual Equipment Directory or the annual Buyers' Guide published by *Stereo Review*. The graphic or parametric equalizer can also serve for noise reduction, if judiciously used, but is probably not as effective as a dynamic noise-reduction unit, which operates on the principle of cutting treble only when the program material has little treble content.

Hi-Fi with a VCR

Q. Would a Hi-Fi VCR be capable of faithfully recording the material from a good Compact Disc or LP? Would a dbx noise-reduction unit make a significant contribution to sound quality?—Victor S. Zupancic, Kirkland Lake, Ont., Canada

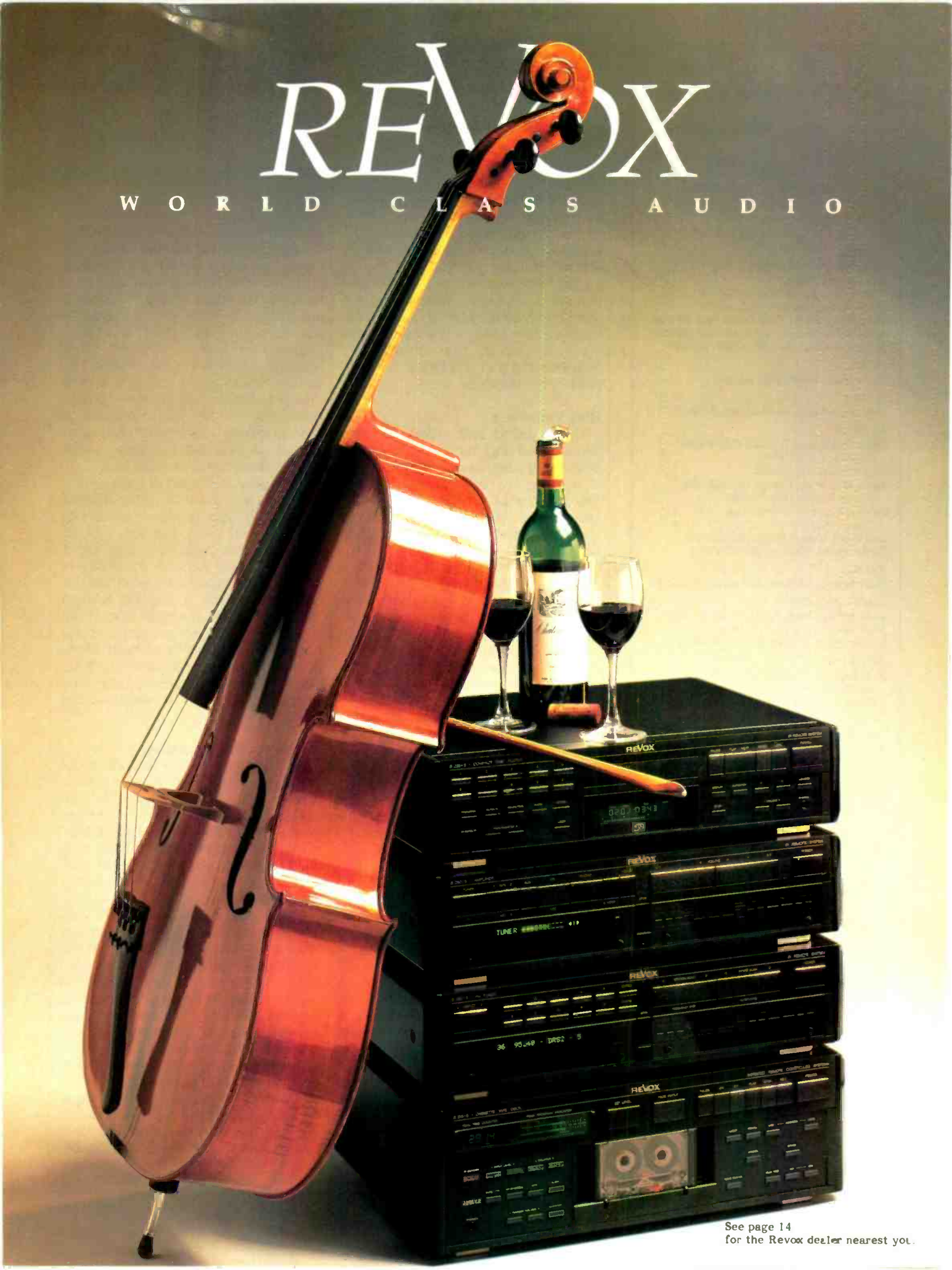
A. With good-quality videocassettes, Hi-Fi VCRs are capable of excellent audio recording in terms of frequency response, distortion, S/N ratio, and tape motion. Therefore, they are able to reproduce CDs and other high-quality sources without noticeable change. Considering that a Hi-Fi VCR achieves an S/N of well over 80 dB, and even as much as 90 dB, it seems that you would gain very little by using dbx NR along with a Hi-Fi VCR.

Frequency Response Requirements

Q. What is considered good high-frequency response? Would frequency response extending to 28 kHz be better than response to 26 kHz? Would a ferrite head or a permalloy head provide better response?—James Bailey, Brenton, W. Va.

A. Flat response, within 1 or 2 dB, between 50 Hz and 15 kHz is ordinarily considered to be of hi-fi caliber for tape decks. Relatively flat response

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.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If bias recommendations change during a deck's production run, either tape formulations or the deck may have changed.

between 30 Hz and 20 kHz is usually all that one might need and hear in 99.9% of circumstances involving music and humans. Response above 20 kHz tends to be gilding the lily. So far as playback is concerned, the head's material is not a key factor—although it can be in recording. What counts principally is how straight and how narrow the head gap is. The narrower and straighter the gap, the higher the possible treble response.

Bias Variations

Q. *My friend and I both own the same brand and model of tape deck, purchased about eight months apart. Comparing the owner's manuals, we find that the bias settings for various tapes differ greatly. Which manual should I follow?*—Cary Charles, North Charleroi, Pa.

A. During the course of producing a particular model of tape deck, a manufacturer usually makes production changes in order to improve performance, to maintain performance while reducing cost, or to correct mistakes. Thus, the proper setting of bias may vary from one production run to another. I believe that you and your friend should each follow your own manual.

If the changes in recommended setting affect only a few tape formulations it may be that those formulations changed between the manufacture of the two decks. If so, the recommendations in the newer manual are more likely to be correct. When in doubt, adjust bias for the most faithful frequency response when recording FM interstation noise at a moderate level.

On the Level

Q. *Whenever I record music with my cassette deck, I have to record the left channel higher than the right in order to obtain equal playback levels. I have tried using different interconnects, different sources (various CD players, a tuner in both stereo and mono, and a Hi-Fi VCR), and bypassing my equalizer—all to no avail. Also, when I switch from forward to reverse in playback, or vice versa, there is a distinct change in the sound level. Please advise.*—Overton Isaacs, Bronx, N.Y.

A. It may be that the record level indicators of your deck's left and right channels are miscalibrated relative to each other. This is usually a simple internal adjustment *for a competent audio technician*. It could also be that the left-channel record electronics, following the point where the signal is taken for the record level indicator, have less gain than the right channel. If the difference in level is not great—say, not more than 3 dB or so—I suggest you live with the problem. Either raise the level of the left channel, as you are now doing, or drop the level of the right channel. Use whatever procedure best enables you to maintain a high recording level (for high S/N ratio) without overloading the tape, which causes distortion and treble loss.

If the playback head of your reversing deck is stationary, rather than of the rotating type, and has two sets of gaps, one for each direction, it could be that one set of gaps has less output than the other. Another possibility is that the playback head, whether stationary or rotating, is in poorer azimuth alignment in one direction than in the other. Azimuth misalignment in playback, with respect to azimuth alignment in recording, causes treble loss. Substantial treble loss can produce the effect of a change in overall sound level.

Single vs. Dual Capstans

Q. *My cassette deck has only a single capstan, yet it has given excellent results. Will my tapes display increased wow and flutter over time because my deck doesn't have dual capstans? Is a dual-capstan drive preferred for optimum stability and shelf life of cassette recordings?*—J. Douglas Schumer, Derby, N.Y.

A. As has been noted here and elsewhere in the past, there is usually more than one good path to a given engineering objective. So far as I know, this applies to the question of dual capstans versus a single capstan to drive the tape. (To take a similar situation, a one-motor deck, if well-engineered, can perform as well as other decks with two or more motors.) Stated directly, a well-engineered deck with a single capstan can provide very good performance in terms of wow and flutter, and can continue to do so for a long period. I see no connection between the number of capstans and the shelf life of a recording. **A**

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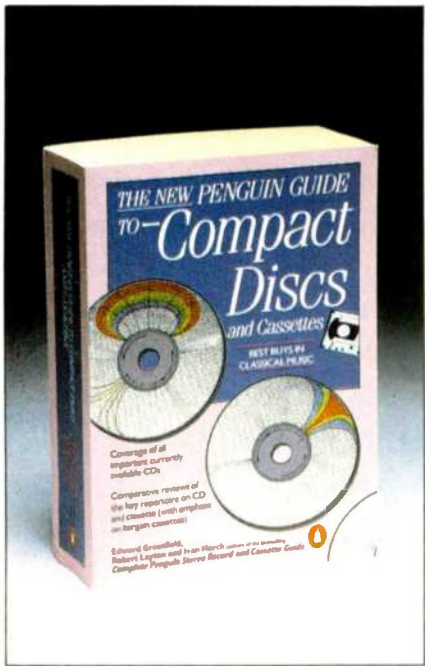

The New Penguin Guide to Compact Discs and Cassettes by Edward Greenfield, Robert Layton, and Ivan March. Penguin, 1,366 pp., softback, $14.95.

The first edition of *The Penguin Guide* was reviewed in *Audio* just a little over two years ago. At the time, few could have foreseen the rapid ascendance of the CD and the concomitant "retirement" of the LP, but that's exactly what has happened. The first *Penguin Guide* reviewed all three formats—CD, LP, and cassette—while the new edition covers only CDs and cassettes. The first also reviewed nearly all CDs available at the time. However, the release rate during the last two years has been so great that the new edition presents "coverage of all important currently available CDs."

A visit to your local record outlet will confirm what is happening; the CD bins are taking over, and this medium has breathed new life into a once ailing industry. With a touch of nostalgia, we might all lament the passing of the LP from the scene, but in our more rational moments, we can only rejoice in the fact that surface noise, rumble, and other mechanical defects are practically a thing of the past.

But all may not be well, for we have gone from a shortage of CDs to overabundance in too short a time. A backlash could set in and spell trouble for the smaller labels. Many of the major classical labels have recently adopted a CD- and cassette-only policy, bringing out LPs only in the case of strong crossover items. In this regard, they have followed the lead set by the smaller labels, many of whom dropped the LP much earlier.

The new *Penguin Guide* follows the same format established by the first edition. It is not much larger in physical size, but a reduction in type size has increased its length by about 40%. The guide is available at most classical record counters. Major listings are by composer, with relatively short final sections dealing with classical collections and recitals. For the most part, the entries are for both CD and cassette; cassette-only entries are primarily for the sake of completeness in listing works of a given composer.

The system of abbreviations is as detailed as it was in the earlier edition. All items are assumed stereo unless specifically stated as mono. If the catalog number for a release is the same in the United States as in Britain (most labels are moving in this direction), the abbreviation "(id)" is used. Works originally recorded in digital are so indicated. CD catalog numbers are listed in boldface, while cassette numbers are in italics. If it fits into the context of the review, the guide's authors indicate the date a release was recorded. This is of great help when placing the production in historical perspective; I only wish it had been done for every listing.

As in the first edition, authors Greenfield, Layton, and March emphasize musical and performance values, with just enough mention of recording and technical quality to make the guide a useful one for the audiophile. While the quality level of a given CD release is virtually constant anywhere in the world, the same, alas, cannot be said about cassettes. Most of the authors' comments about the quality level of a given cassette release might just as well be taken with a grain of salt, so variable may be the production quality from unit to unit. Improvements are on the way, but for now, there is a long way to go.

The guide is a British work, and as such, gives more emphasis to modern British composers than to American composers or those of any other specific national group. This is no problem since the main thrust of the guide is the standard musical fare which truly belongs to one world. Bear in mind that the major classical companies in the States are now foreign owned and pursue virtually the same paths in repertoire, relying on artists and orchestras of international reputation and acceptance.

Some of the copy in the new guide is taken directly from the earlier one. There have been relatively few deletions in the worldwide CD catalog, and, of course, a noteworthy release deserves continuing mention. New releases are compared with older ones, and the old text merges smoothly with the new.

For most users, the chief value of the guide will be in selecting from among many versions of a popular work. The authors are, in fact, at their very best in helping the reader make such decisions. They mention the intrinsic merits of a given performance, and present options based on couplings and technical vintage. A reader contemplating, say, a complete set of Bruckner symphonies will probably be led to von Karajan. A collector who may already have one or two of the works will be presented with the merits of several performances of each work, and can thus make an informed decision while minimizing duplication.

Much the same holds for the major composers, whose works are now replicated nearly to the extent they were on LP. As Bert Whyte wrote in the January issue of *Audio*, there are now 45 CD versions of Vivaldi's "Four Seasons." Mercifully, the authors review only 20 of these, and their reviews are substantially more than passing mention. One clearly gets the message that everything reviewed in the guide has been listened to in its entirety—a monumental accomplishment!

The coverage of opera is especially rich. Because of high production costs, operas are not recorded today with the frequency they were from 1955 to 1970. In those golden days, it was not too difficult to assemble the "dream cast," and many of the productions of John Culshaw for British Decca and Walter Legge for EMI are singled

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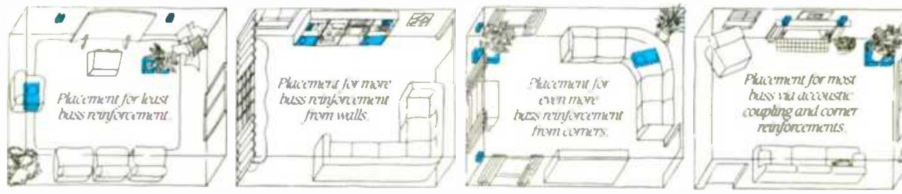
Stereo Review, Sept. '88



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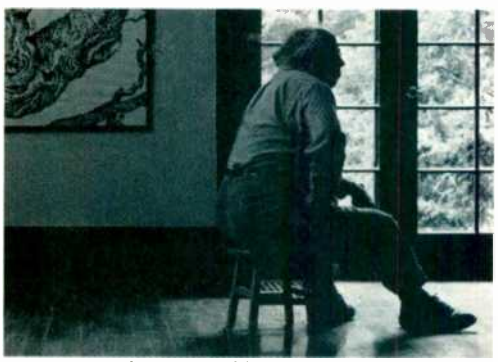

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The New Grove Dictionary of Jazz now stands as *the* reference work on the art form, and it is well worth its high price tag.

out in the guide for highest praise, whether mono or stereo. One by one, these items are making it onto CD, and the market is the richer for it.

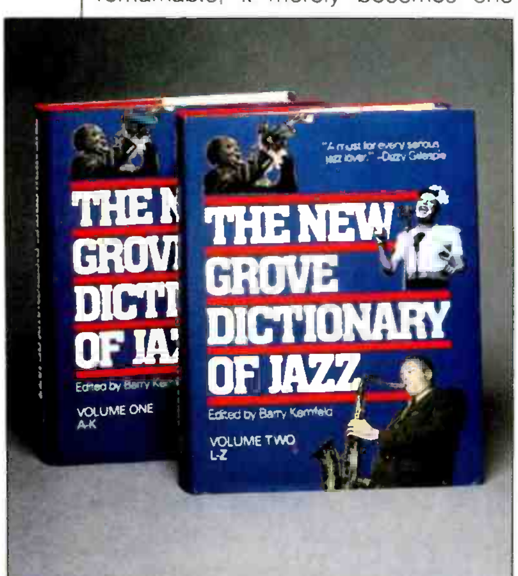
The orchestral side of Wagner's operatic writing, long a favorite of non-operatic conductors, is given detailed treatment, again with the listings drawing from early, middle, and recent releases. Solo piano works of Mozart, Schubert, Beethoven, Chopin, and other masters of the instrument are given relatively succinct, to-the-point coverage—a necessity, perhaps, in a book which truly cannot be all things to all readers.

The authors use a rating system, with three stars representing a first-class performance. A special rosette symbol is reserved for performances of landmark status, and there are not many of these. Typical here are many symphonic and orchestral productions dating from the "golden age" referred to earlier. Budget-priced CDs are indicated as well.

The classical record business is not driven by composers but by artists. As new artists come on the scene, their reputations are made with the core of the classical repertoire. Conductors, pianists, and singers all want to draw from a relatively small part of the available literature as they build their personal careers and, almost incidentally, contribute to the coffers of their record companies. Unless a recording is truly remarkable, it merely becomes one more item on an assembly line, and as such, it must recoup its investment in no more than two or three years. The challenge in responsible record reviewing is to identify those recordings which are good enough to last and then to underscore their specific merits. The reviewers in the new *Penguin Guide* have excelled at this. Avid record collectors would not want to be without *Fanfare*, *American Record Guide*, and the British *Gramophone*, which are the major record review periodicals in the English language. The *Penguin Guide* is an essential work as well, putting the better part of the thousands of CD titles now available at the reader's fingertips.

Perhaps the highest compliment which a reviewer can give the authors, beyond acknowledging their musical and discographic competence, is to state that they truly have a keen sense of what the art of recording is all about and what goes into making a recording—all of which makes for great reading. Highly recommended!

John Eargle



The New Grove Dictionary of Jazz, Vols. I and II edited by Barry Kernfeld. Grove, 697 pp. and 704 pp., hardbound, $350 plus $10 shipping and handling. (Available from Grove's Dictionaries of Music, Department CH, 15 East 26th St., New York, N.Y. 10010.)

Jazz is over 100 years old, although the first recordings weren't made until 1917 (Original Dixieland Jazz Band). Only in the last 30 or so years have books and reference works on this music proliferated. This massive and scholarly two-volume work is the most important yet, replacing the groundbreaking *Encyclopedia of Jazz*, first published by Leonard Feather in 1956, and Chilton's valuable *Who's Who in Jazz* (1970). The *Grove Dictionary* joins the classic *Dictionary of Music & Musicians* by George (later, Sir George) Grove, first published in 1890 and now in its sixth edition (1980)—at 20 volumes! Its publishers also offer *The New Grove Dictionary of American Music* (four volumes, 1986) and *The New Grove Dictionary of Musical Instruments*.

In addition to making full use of previous reference works (Feather, Chilton, et al.), this latest Grove edition provides an enormous amount of new material. Its 3,000 biographies include composers, arrangers, musicians, producers, impresarios, discographers, critics, and 300 record companies, past and present. Many discographies and bibliographies are also included, to guide interested readers in further research. The work surveys many important theoretical topics, such as improvisation, harmony, beat, and notation, and examines over 200 musical terms specific to jazz as well as instruments used to make sounds heard only in jazz.

Other important areas not covered by previous works but detailed here are musical procedures, structures, and styles unique to jazz. Brief musical examples of improvisations are shown for some of the most important musicians: Armstrong, Basie, Eldridge, Ellington, Gillespie, Hawkins, Monk, Parker, et al.

Movies incorporating jazz are covered, and a valuable 12-page essay on jazz in films by pioneering collector Ernie Smith is included. James Collier contributes a description and history of jazz in an excellent 26-page essay, and composer/conductor Gunther Schuller has written a good piece on Ellington.

The section on jazz festivals describes more than 200 around the world, beginning with Newport 1954. Nightclubs and similar venues are listed, with almost 1,000 entries, including many historically important though now defunct clubs. Finally, libraries and other archives with collections of jazz books and recordings are listed.

One problem which results when compiling a work such as this from the contributions of over 200 writers from around the world is that several prominent American jazz men and women are omitted while dozens of less important international players are included. In fact, nearly one-quarter of the biographies deal with non-American musicians, recordings, nightclubs, and festivals!

Despite its faults, *The New Grove Dictionary of Jazz* is worth its high price and now stands as *the* reference work on the art form. Like previous Grove editions, it should remain so for many years.

Charles Graham

The search for the ultimate sound system inevitably leads to speaker systems employing electronic crossovers ahead of the amplifiers, since this places the individual drivers under much more direct control than is otherwise possible.

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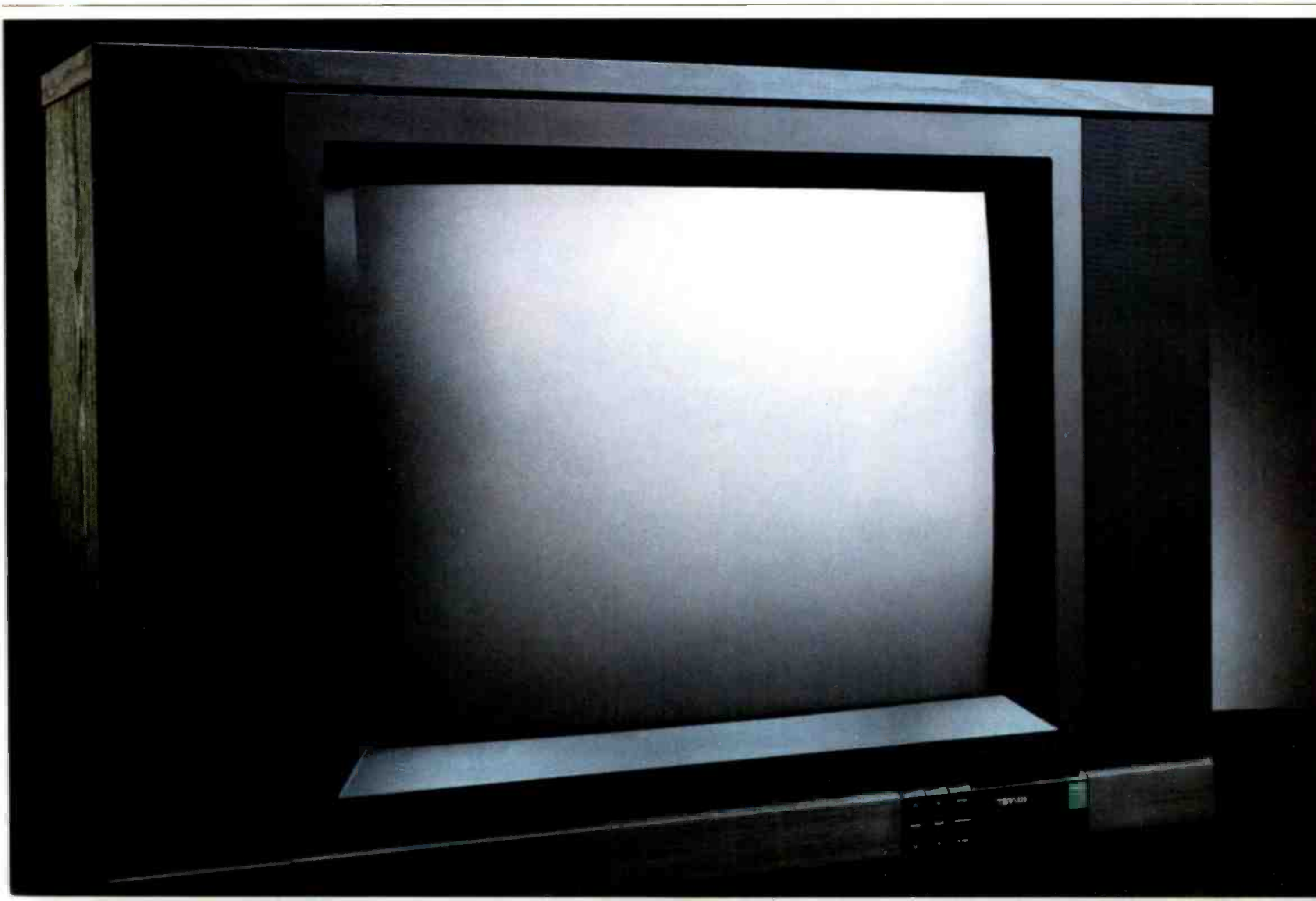

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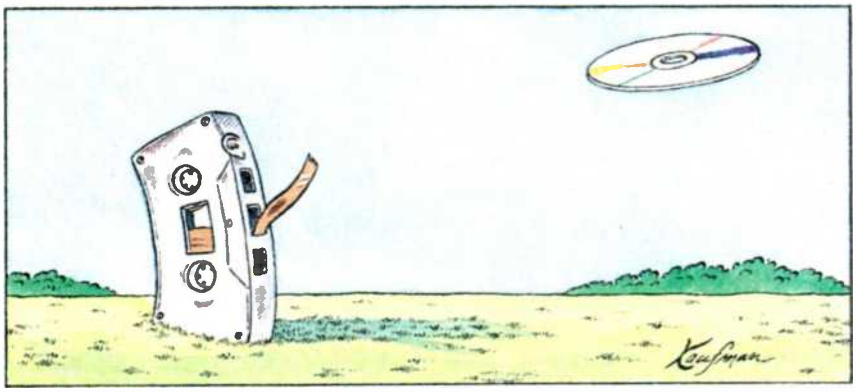


Illustrations: Robert J. Kaufman

Exploring the Solo System

Since the infamous Copy-Code system was defeated by the combined efforts of the Home Recording Rights Coalition and the National Bureau of Standards, there has been talk of another copy-inhibiting system. Known as "Solo," it was developed by Philips of the Netherlands, but there was no public information on what the system would restrict and how it would impose that restriction. During a recent visit to Philips headquarters in Eindhoven, the details of the system were finally revealed, as was Philips' attitude toward home recording.

According to Leo van Leeuwen, managing director of Consumer Electronics Audio at Philips, management at Philips believes that a consumer who has purchased a recording, be it a Compact Disc or an LP, has a right to copy it for his own personal use in a car or portable tape player. Based on this philosophy, and to help resolve the impasse which, to date, has discouraged manufacturers of Digital Audio Tape recorders from officially introducing those machines for consumer use in the U.S., Philips developed Solo.

If a DAT recorder were equipped with the Solo system, anyone using it could make one digital-to-digital DAT recording of any copyrighted CD or prerecorded DAT. While making that recording, the Solo-equipped deck would add copy-inhibit flags to the subcode areas of the tape. If you then tried to make a next-generation digital-to-digital DAT copy from the DAT you made, circuitry within the recorder would detect those subcode flags and prevent further copies from being made.

When word of Solo's development first reached these shores more than a year ago, there were all sorts of rumors as to what it would and would not permit. Now that Philips has clarified the matter, these rumors have been disproved.

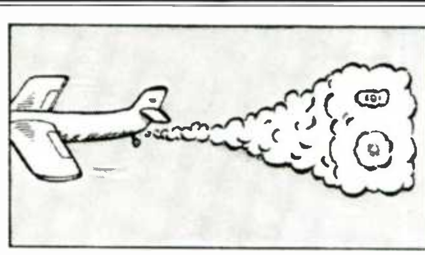
To begin with, Solo will *not* prevent users of DAT recorders from making any number of copies of software using the analog outputs of their CD players and the analog inputs of a DAT recorder. Solo will *not* prevent you from making any number of first-generation digital DAT recordings of the same piece of software in real time. Each of those DAT recordings, however, will have the Solo subcode data encoded in it at the time the recording is made so that no further digital-to-digital recordings can be made from those first DAT tapes, no matter how many of them had been made in real time.

Because the current quasi-standard for DAT prevents even a single digital-to-digital recording from being made from a CD, Solo, in fact, represents a more sensible and consumer-friendly approach to the home taping problem. It prevents mass piracy yet allows the owner of a DAT machine to do assemble-editing—recording several tracks from more than one CD onto a single DAT cassette. This is one of the chief reasons why people currently make analog cassettes for use in their home tape decks or in their car cassette players. Also, in permitting owners to make that single copy, Solo allows those who have spent the considerable amount of money it takes to own a DAT recorder to fully avail themselves of this digital technology—something the current unofficial standard does not permit.

The RIAA has steadfastly maintained that even analog taping of copyrighted material by home recordists is something they won't tolerate. Yet, in the wake of Philips' clarification of their stand on Solo, a rumor arose that Solo would be accepted by the recording industry as a solution to the copyright problem. If true, then the major recording companies represented by the RIAA had actually been stating their maximum position all along, and they were really ready to settle the debate over home recording in general and DAT in particular. More recent reports of abortive conferences between the electronics and recording industries seem to indicate that the intransigence of the software hard-liners continues. This inordinately long debate, which has served no one, seems destined to go on even longer. *Leonard Feldman*

Klipsch Semi-Retires

Speaker manufacturer Paul Klipsch, founder and majority shareholder of Klipsch & Associates, has stepped down from his position as president of the company but retained his position as chairman of the board. His successor as president is P. Woody Jackson, who has been with Klipsch for more than 10 years. We suspect Mr. Klipsch will spend his extra leisure time skywriting "Down with Doppler Distortion" in the beautiful blue skies of Arkansas—or maybe over Cambridge, Mass.



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Quick, Watson, the . . . er . . . Stylus!

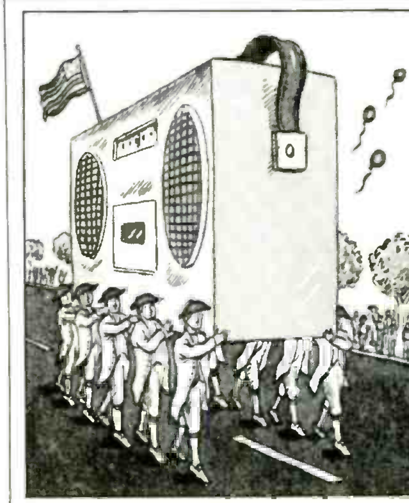
What do you do when your stylus goes? Odds are, your dealer will suggest you replace your entire cartridge. That way, you get the benefit of the latest cartridge technology, and the dealer makes more bucks. However, because cartridges are more heavily discounted than styli, the dealer may not make much more profit on a whole new cartridge than on a stylus alone. His main concern is inventory—cartridges sell faster than styli, so he rarely stocks more than a few of the latter.

But what if you want to keep your old cartridge? One company that does stock styli in depth is the Needle in a Haystack Audio/Video Service Center chain, with branches in Washington, D.C. and its suburbs, in Canton, Cincinnati, Columbus, and Dayton, Ohio, and in Burlington, Mass. The company also has a phone-order operation, which can be reached at (800) 368-3506.

According to Harold Cohen, who owns the Burlington franchise, "We have everything from steel needles (the biggest bargain in the store, at 12 for $3.00) through Fisher-Price, to the most exotic audiophile styli. We even have 78-rpm styli for modern cartridges. We also stock styli for cartridges that were never sold in the U.S., or those that were sold here through nonstandard channels such as credit-card bill stuffers.

"We can identify the stylus needed if you tell us the cartridge or stylus number, or the model number of the phonograph it came from. Or you can send or bring the cartridge or stylus for identification.

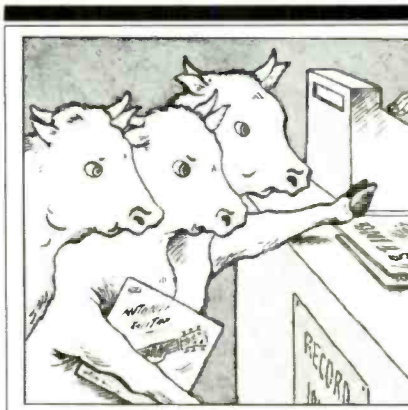
"At this location, we do special things, also. For instance, we worked with Shure on developing special styli for a mastering engineer who's transferring old acetates to CD for the Smithsonian. He needs different stylus sizes, to read whatever portions of the groove are still unworn. It turned out, however, that these styli could not be made at a reasonable price. For another customer, who plays nothing but 78s, we're modifying an old flip-over needle to get a better tracking angle."



Boom-Box Parade

The town of Willimantic, Conn., with a population of only 15,000 or so, has plenty of people to march in its July 4th parade but no band for them to march to. So, since 1985, Willimantic's citizens have carried portable radios and marched to appropriately festive music played by local station WILI-AM.

In the 1988 parade, marchers carried everything from pocket radios to full-sized boom boxes, and there was even a float in the shape of a boom box.



Heard Instinct

Shuffling through a doorway with a crowd always makes me feel like a steer in a roundup. Apparently, I'm not the only one: One of Tower Records' New York City stores has taken to playing the mooing cows from Telarc's *Round-Up* (CD-80141) as customers file through the store's checkout line at closing time.

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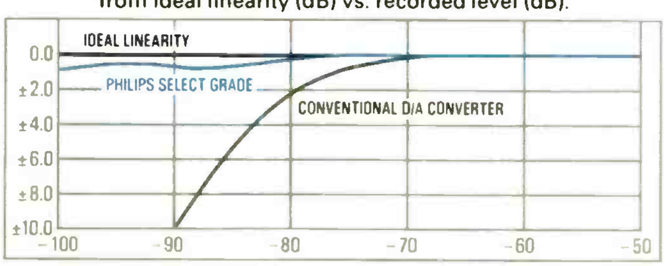
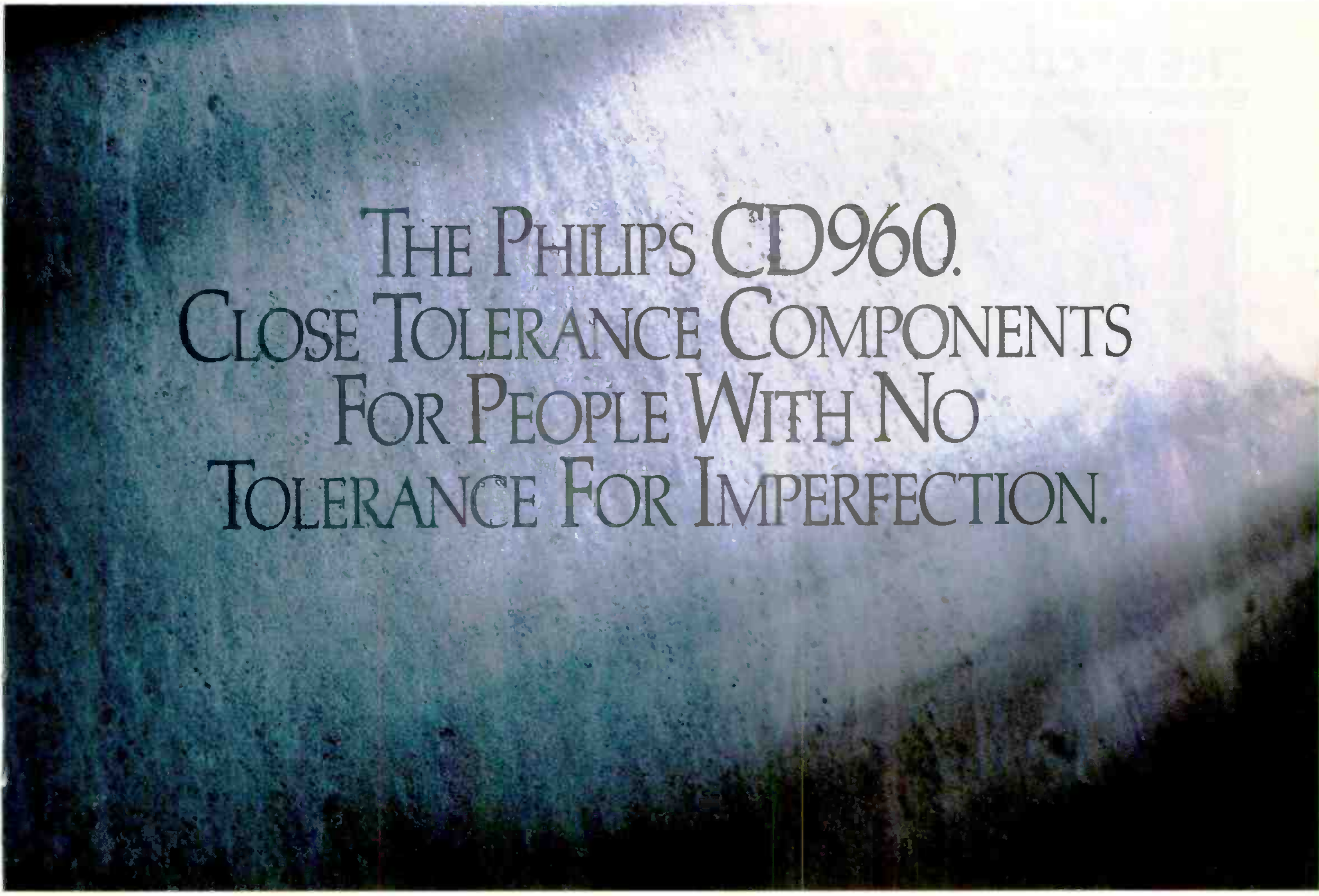
Philips superiority is clear, from this graph showing deviation from ideal linearity (dB) vs. recorded level (dB).





The CD960 compact disc player incorporates only the most uncompromising components because it has been designed by the world's most uncompromising audiophiles: Philips engineers. The same engineering experts who invented compact disc technology.

▪ Superior digital-to-analogue conversion. It comes as no surprise that the heart of the CD960 is the Philips dual 16-bit D/A converter chip. The TD-1541 select version. A chip so refined it substantially improves low-level linearity, flawlessly reproducing even the quietest passages with a clarity never before achieved.

This exceptional D/A converter is mated to a Philips 4X oversampling digital filter for superior performance. Philips pioneered 4X oversampling and our experience with digital filtering is unequalled.

▪ Broadcast standard "Radialinear" transport. Philips commitment to exacting specifications is also evident in the CD960's mechanical construction. It features a high-grade cast alloy chassis. A linear-design motor was chosen to drive the radial pivoting arm for fast track access and exceptional resistance to external vibrations.

▪ Multiple power supplies. To eliminate cross talk, the CD960 incorporates no less than four separate power supply sections. And the 100-watt main transformer is partitioned to further shield against magnetic and power line interference.

From the company that created the compact disc, Philips proudly offers the CD960 for those who won't tolerate anything less than perfection. To audition the CD960, call 1-800-223-7772 for your nearest Philips audio specialist.

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EDWARD TATNALL CANBY

THE RECORD OR THE EGG

Illustration: Robert Bender

I have always thought that the chicken was nature's finest edible creation. I feel much the same about audible audio, so why not put the two together?

True, I eat chicken in parts, the way we get them today, but do I love to see and eat a whole chicken, well roasted! Upside down, two plump legs (no more) pointing skyward, and a hole for a head. Not surprisingly, I go for the whole of audio, too, which is always greater than its parts.

The whole living chicken is a fond memory, pre-Perdue, from the times when every farmhouse had them on the loose, ready to cross the road—straight in front of each passing car. Wings flailing, legs pumping madly, feathers flying in squawking hysteria. Brainless creatures! Why *does* a chicken cross the road? To get to the other side, of course. But never sedately. A chicken's sheer audio is formidable, along with all that visual ruckus.

But an unflustered hen is a friendly soul, stepping elegantly, each claw lifted adagio, eyeing you with a questioning jerk of the head while emitting inane little conversational noises to nobody in particular. I *like* the whole living chicken.

As a journalist, a commentator, I see both chickens and audio with an outsider's fascination. I'm neither a Frank Perdue nor a Bob Carver, nor even a Cole Porter, so it's just as well this column is set off by itself, under those useful initials ETC; because, you understand, I can't keep my professions apart. I like to look at the whole, and the whole of audio extends far beyond electronics—all the way from music theory to Ohm's Law, from Mozart to McIntosh, from Philharmonics to filters D and A. As I see it, all this is on a basis of total equality, from one side of audio to the other. The business of audio has always been music, but now we go ever further, into the newly related video arts.

And so many kinds of music! If it's recorded, synthesized, or reproduced, it's audio. Of course, an audio specialist may concentrate on some minute and highly technical bit of R & D—this is the glory of our advancement. One does this, hopefully, as one pulls off a leg from the roast chicken for detailed analysis in the stomach. A chicken is still a chicken. But the more fragmented our work, the more likely we are to forget the whole bird and amplify the leg. At all costs, we must avoid the supermarket approach—the shiny package of five legs, three left wings, and a disembodied neck. In audio, that simply won't sell.

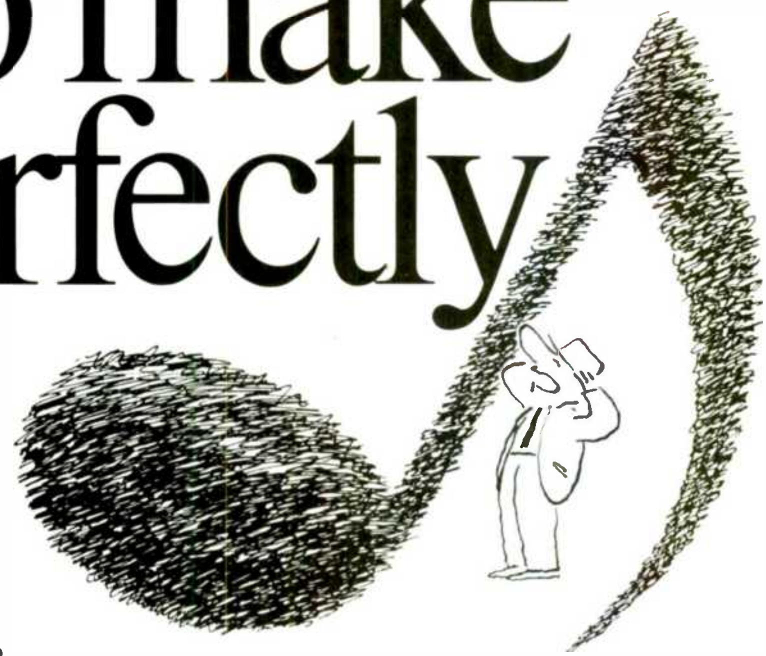
Nor will the monkish approach: Burying yourself in a small electronics corner and forgetting the pesky outside world. If monks and scholars can fall into that, don't think *we* can't. Even with a technical paper at the AES, you still haven't got an audio whole, just a part.

I bought a gadget the other day, a plastic pencil holder the size of my hand, with "ETC" on the outside. Its feature was a magnetic plate that grabs a flat piece of metal which you stick on a wall or window. A total dud. Too many technologies, and two were defective. First, the magnet came unstuck after a day. Then the piece of metal on the wall fell off with a crash. *Wrong adhesive.* I threw it out in disgust.

The monks and scholars live serenely in their isolation, but not the engineering technicians. The consequences of being a too-isolated link in a chain are horrific—shortfalls in perspective! Sometimes, we seem to lose our very hold on reality. The military? Very purposeful people, but they build troop transports that won't transport, missiles that miss, bombers that bomb out. Myopia? Money doesn't seem to help. There are plenty of misguided civilian disasters of the same sort—shortsighted, bogged in detail, minus the larger know-how which might make them effective. Our own area, that audio whole I speak of, is hideously prone to similar catastrophes.

It is a wonder that so much of our assorted products—in all walks of artistic and industrial life, as well as our own—still remains viable, useful, workable, even excellent. A lot of people do have good vision, speaking metaphorically. They can see the whole, and shape it out of the parts. Not only all the hardware, the equipment, but even more remarkably, the sonic "softgear," as I tried to name it a while back. (Software is for computers and should stay there.) *No,* Beethoven really should not be called softgear, but he is obviously a part of the whole audio, through no intention of his own. Music, and all that goes with it, is our softgear, or 99% of it. Cut out the music in audio, and what do you have? A super-fi, high-end recording of your vacuum

Adcom would like to make this perfectly clear.



Regardless of how sophisticated your stereo and video system is, it may never achieve its full performance if plugged directly into an AC outlet. Raw and unprocessed AC power can severely diminish the clarity of audio signals and reduce the resolution of your video picture.

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—Lewis Lipnick, *Stereophile*, Vol. 11 No. 4, April 1988.

Recommended accessory in *Stereophile*, Vol. 12 No. 4, April 1989.

Line Protection: It Pays For Itself

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—Ken Pohlman, *AUDIO*, November 1987.

For a modest investment, the ADCOM ACE-515 enhances both audio and video clarity while protecting your equipment from damaging line voltage disturbances. Once again, ADCOM lives up to its reputation of offering superior performance at a reasonable cost. For complete technical data, please visit your Adcom dealer. You'll discover the ACE-515 is more than an accessory. It's a necessity.

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Cut out the music in audio, and what are you left with? Maybe a super-fi, high-end recording of your favorite vacuum cleaner.

cleaner. It is the musical product that *really* shapes just about everything we do in a practical way. Our farseeing people need to know all about music, every kind, as well as the audio technologies. Not only music but musicians, the acoustic performers and the synthesizer types at the far ends of their joint spectrum. Why else did the systematic Germans invent the *Tonmeister*, equally versed in music and engineering? And why do we increasingly explore the same?

The whole audio is actually a three-legged chicken. There is music (the softgear). There is audio technology (the equipment). And there are *people* (the consumers). The market, as we call it, and all those forces that make markets go. In the larger sense, this is economics. And that's our chicken's third leg, a fat one. Absolutely undetachable from music and audio engineering.

People, markets, economics shape us as relentlessly as evolution shaped the elephant and the giraffe. People are diverse—so must be audio. People demand many products, mass and not-so-mass—we must supply them, each in their practical way. We have "created" a demand for enormous loud sounds inside automobiles—we have the know-how—and the same for the ubiquitous portable cassette player, alias the Walkman (the most familiar of its trade names). But isn't there also the CD? And just *look* what is now available, at considerable cost, on thousands and thousands of CD releases! May I humbly suggest that the percentage of the total market isn't the point; it is the "whole," the complete entity of each separate market, large or small, that matters. Is the CD viable? You bet. And it remains obstinately classical in the large, because that is where this "whole" works best.

I am even less of a pro economist than a trained electronics engineer, but in our larger perspective, how can *anyone* avoid economics? So I often swerve, at my own risk, across our borders into various sorts of economy. Every single recorded or reproduced note of a work by Beethoven is a note in our present economy. If we have that composer with us, it is because many minds have been at work to integrate his sound, so unlikely in its original form around 1800, into our present audio production and listening.

I was amused, recently, to receive a letter from a reader in New Jersey concerning my ostensibly economic Canby Principle No. 2 (revised, as per the April issue), the "Two-Plus" theory. I spoke of monopoly, anathema in this country, and then went on to make up words—*biopoly* and *polyopoly*—which just sprang to mind. Attila Balaton of Summit, N.J., who has studied formal economics (and might even be an Economist) wrote to point out that n the late 1800s, the Classical School of economists had already "derived all the concepts needed to define the condition of different markets and their impact on price fixing mechanisms." These Classic pros, Attila wrote, set up a number of economics terms to cover the situation, the most famous of which, of course, was *monopoly*. Guess what came next? *Duopoly* and *oligopoly*! So it seems that I have reinvented the wheel. That's okay by me, and in fact I am happy to have restumbled on such a long-lasting idea from my own outside perspective. Long live the Classical School!

When things go wrong with the whole in our technical age, there is real disaster, failures of product on a monumental scale. Maybe it is a kind of hidden benefit that our largest corporations can usually take the enormous losses involved and still survive. Smaller companies, in contrast, just crumple up. Or fold. The American system has it this way, whatever you may feel. It is good that we can afford huge risks for enormous projects that may or may not succeed. It is also cruelty for almost everyone involved—except, perhaps, the accountants.

Moreover, there is another somewhat striking feature of virtually all such failed enterprises: They don't blow up with a bang; they just vanish. One day they are there, the next day nobody has ever heard of them—nobody, at least, in the companies' public relations departments. The projects no longer exist. Key people just aren't around anymore. They aren't fired—not so you'd know it. They just go poof. All of which, in subsequent times, makes for an astonishing situation. Out of sight, out of mind. In a few years, nobody inside the company has ever heard of the project! Only those, high or low, who were directly involved and can never forget. It's a waste of energy, I think, to "blame" a large company for this sort of bland cover-up.

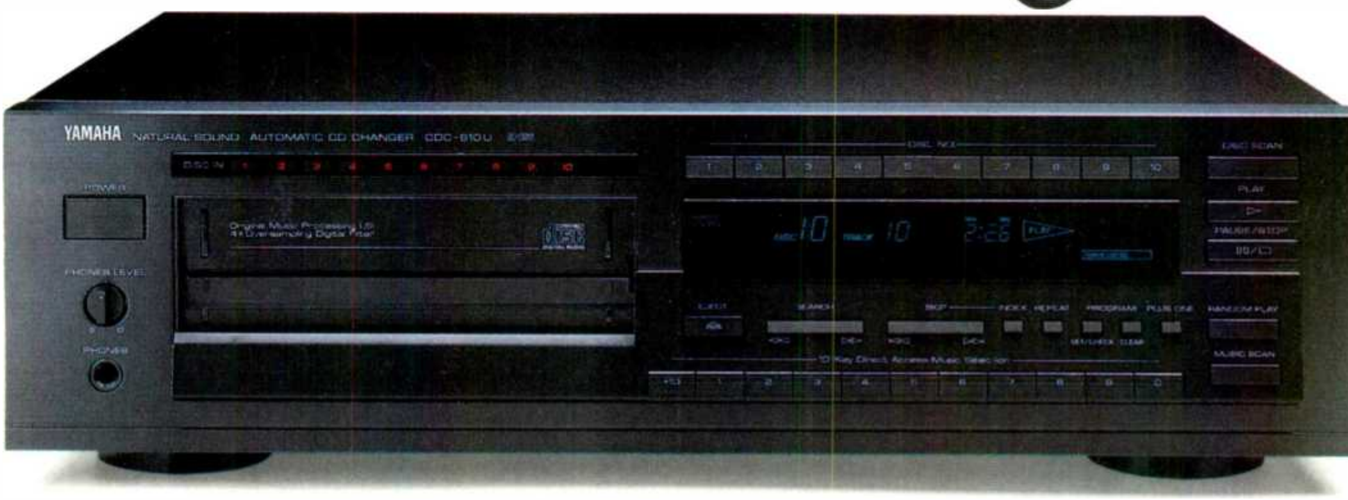
Because these projects are so big, the "wholeness" of the thinking is enormously hard to achieve. Hundreds of workers, mountains of equipment, vast sums of risk money—and who is the genius that can hold it all together? There is obstinacy and inflexibility on high, and there is that old bugbear, hierarchy, so the bright minds below are afraid to tell the boss. I'm merely describing what is familiar to us in the audio world. I do believe (speaking a sort of economics) that today the very soul of our business, our field, is in *small* enterprise. And yet what does every successful small enterprise do? Get bigger.

I think the appropriate word for success in this concept of a whole—the audio whole, in particular—is *fluency*. Fluency means easy communication between all the developing segments, yes. But more than that, it is the ability *to flow*, to adapt, to move easily across professional lines, to fill gaps where they need filling, no matter what (like that adhesive, the wrong adhesive). Also, it means to flow *inward*, adapting and evolving the whole, down to the tiniest detail of engineering. Small companies keep up the flow; big companies freeze. And do not forget the softgear, the ultimate, crucial end-product of all our ventures in audio—now in audio/video. The big corporate failures are like big chickens with deficient parts, a good leg and a bad one, fine white meat and a diseased liver. Not viable! Doomed to die. Inedible.

I have deliberately stuck to great generalities here, but my mind is on specifics. Paradoxically, because the more notorious failed products are really no longer the concern of the present parent companies, whose people hardly know about them, I think an outside view of a few might offend nobody. The past is past.

One of these days, someone will design the ultimate chicken, with the best of intentions, of course. Two swivel heads, for better fuel intake, but without wings or legs. It won't go anywhere, though. Not even across the road.

The first CD changer worth listening to for 10 hours straight.



There are surprisingly few activities the human body can endure for 10 hours straight.

Listening to the CD player you see before you, the CDC-610U, is a delightful exception to the norm.

The first 10-disc CD changer capable of capturing both the attention and the imagination of even the most demanding audiophiles.

For hours on end.

Boasting specs and features that are nothing less than sensational.

Like Yamaha's Hi-Bit Technology with advanced 18-bit 4x oversampling digital filters and high-speed D/A conversion.

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A sound reason to start collecting magazines – Yamaha's 10-disc magazine, YCM-10 – the handy way to organize your CD collection.

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Arguably the simplest, most versatile remote control to ever accompany a CD player.

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But be forewarned.

One listen and you could be hearing about it for a long, long time.

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"At their price, they're simply a steal" **Audiogram Magazine**

Monitor 10B — $349.95 ea.

Considered one of the worlds' best sounding loudspeakers and, in the words of Audiogram magazine, "At the price they are simply a steal." The Polk 10B utilizes dual trilaminate polymer drivers coupled to a built-in subwoofer for accurate bass response and superior dynamic range. A 1" dome tweeter perfectly complements the other drivers to insure outstanding reproduction of every type of music.

Monitor 7C — $274.95 ea.

Basically a smaller, less expensive version of the Monitor 10B. By offering superlative performance whether mounted on a shelf or a speaker stand, the 7C is a highly versatile addition to any audio system. How good does it sound? Audio Alternative magazine said, "It is amazing."

Monitor 5B — $214.95 ea.

Similar in design and performance to the Monitor 7C, however it utilizes an 8" subwoofer (rather than 10") and is more compact. The 5B represents one of the best values of the entire Monitor Series.

Monitor 5Jr. + — $169.95 ea.

Called the best sounding speaker of its price in the world regardless of size. It achieves life-like three-dimensional imaging which 10 years ago was not available in any bookshelf speaker at any price.

Monitor 4.5 — $122.45 ea.

Shares most of the high technology components and rewarding musical performance of the larger Polk speakers at a surprisingly low price. A critically tuned bass duct insures high efficiency and great bass performance despite its convenient compact design.

Monitor 4A — $99.95 ea.

Identical to the 4.5 in a smaller cabinet. Audio critic Lawrence Johnson called it, "an all around star of great magnitude." The 4A's affordable price means that no matter how small your budget, you can afford the incredible sound of Polk!

Matthew Polk's Vision: Superior Sound for Everyone

Polk Audio is an American company that was founded in 1972 by three Johns Hopkins University graduates who were fanatical audiophiles with a common vision. They believed that it was possible to make speakers that performed as well as the most exotic and expensive systems at a fraction of the price. Starting with only $200, they began by designing and manufacturing the Monitor Series loudspeakers. The Monitor Series combined the advantages of American high technology and durability with European styling and refinement. Over the years an unending stream of rave reviews, industry awards, and thousands of enthusiastic Polk customers have established the Monitor Series as the choice for those looking for both incredible sound and an affordable price. There is no better value in audio equipment today than a Polk Monitor series loudspeaker.

Uncompromising Standards at Every Price

A limited budget does not mean a limited ability to appreciate fantastic sounding music. That's why we put our best engineering efforts and only the finest materials into every Polk product regardless of price.

Every Polk Monitor Series speaker uses the same trilaminate polymer cone technology as the flagship SDA-SRS 1.2. Every Polk Monitor utilizes a 1" polymer dome tweeter, and most use exactly the same tweeter found in the SRS 1.2. All Polk Monitors employ costly multi-component crossover networks and ¾" thick high density, non-resonant cabinets. Pick up a Polk Monitor 4A, then pick up a comparably priced but larger speaker from a different manufacturer. You'll notice that the Polk is heavier, more solidly built, and sports a superior fit and finish. Now compare the sound. We are sure you'll agree with Musician magazine, which said Polk Monitors are: "Vastly superior to the competition."

Matthew Polk with his incredible sounding/affordably priced Monitor Series loudspeakers. Front row (L to R) **Monitor 5Jr. +, Monitor 4A, Monitor 4.5** Back row (L to R) **Monitor 10B, Monitor 7C, Monitor 5B**

The Thrilling Sound of Polk Monitors

Polk Monitors achieve open, boxless, three-dimensional imaging surpassed only by the SDA's. Their silky smooth frequency response assures natural, non-fatiguing, easy to listen to sound, while their fast transient response results in music that is reproduced with life-like clarity and detail. In addition, dynamic bass performance, ultra-wide dispersion, high efficiency and high power handling are all hallmarks of Monitor Series performance.

There is a Polk Monitor Perfect for You

Each time you advance through the six Monitor Series models, you'll immediately hear a remarkable improvement in efficiency, bass response, and output volume. They are designed so that a smaller Polk played in a small room will sound nearly identical to a larger Polk played in a large room. A larger Polk in a small room will, of course, play that much louder with even better bass. No matter what price range fits your budget, there is a spectacular Polk Monitor Series speaker waiting to fulfill your sonic dreams.

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The Speaker Specialists ®

Where to buy Polk Speakers?
For your nearest dealer, see page 112

BERT WHYTE

PUT ON YOUR HAPPY FEET

Illustration: Robert Zimmerman

From the earliest days of the high-fidelity era, audiophiles have indulged in the fine art of "tweaking," in order to enhance and improve the performance of their audio component systems. Audiophiles quickly learned that tweaking was most sonically and musically rewarding when applied to the elimination or suppression of the various omnipresent resonances, vibrations, and extraneous noises that can degrade performance.

Except for a few modern designs, speaker enclosures are usually a prime source of resonances. Early audiophiles often went to the expense and trouble of building enclosures with sand-filled walls or constructing them of brick or concrete. When the vinyl LP record was the only game in town, some people would tweak their playback systems by employing the brute-force/high-mass philosophy of mounting their turntables on ¾-inch steel boilerplate bolted to a cubic yard of granite. Or they would take the route of elaborate isolation of the turntable by means of springs with pneumatic or hydraulic shock-mounting.

Not much of this kind of tweaking goes on these days. In fact, since the ascendancy of the CD, it is said that one reason diehard analog enthusiasts hate CDs is that CD players are not amenable to tweaking.

However, the laws of physics have not changed, and resonances and vibrations are still very much with us in the current audio scene. Notwithstanding this, most of today's tweaking activity involves component interconnect cables and speaker wire. I hardly need mention that this is a very controversial subject. Extravagant claims of superior performance when using certain wires and cables are made on the basis of purely subjective evaluation. These assertions are challenged by the more conservative scientific and engineering people, who contend that unless the claims can be verified by double-blind testing or objective measurements, they are invalid. Needless to say, there have been many mud-slinging exchanges between the two groups, with plenty of such epithets as "tin-eared," "hidebound," "dreamers," etc. bandied about. Alas, the arguments will continue to rage, for at least in the case of wires and cables, no one has been able to devise a test that will satisfy all parties.

Today's audiophiles are well aware of the detrimental effects of resonances and vibrations, especially with respect to structure-borne and airborne acoustic feedback, that can cause problems in turntables, CD and cassette players, loudspeakers, and even preamplifiers and amplifiers. Over the years I've ardently championed any device, material, or procedure that would keep the relentless attacks of resonances and vibration on music signals at bay. Perhaps I am unduly sensitive to acoustic phenomena which affect music reproduction in the home. But, in my view, the cumulative effects of the multiple resonances originating in an audio component system produce an acoustic overlay or veiling, an unpleasant sonic coloration that significantly degrades the purity of music signals. Although resonance is a vitally essential element in determining the sound quality of musical instruments, it cannot be tolerated in an audio component system.

To help ameliorate sonic anomalies, much tweaking is done using various kinds of isolation feet or dampers. These are made of a variety of absorbent materials such as butyl, neoprene, raw silicone rubber, Sintra (rigid foam), Ear-Isodamp, Sorbothane, Kydex, and Isotec. Here again, some rather enthusiastic subjective claims as to the devices' efficacy in suppressing resonances and vibrations are not usually verified by objective measurements. In spite of the lack of verification in the lab, I have used a number of these devices. In varying degrees, they do seem to work, albeit not dramatically, in providing a cleaner signal.

As you can imagine, hi-fi editors receive many unsolicited audio accessory devices and products. Frankly, a large percentage of them are little more than gimmicks. Their makers promise improved performance of several sonic parameters; after evaluation, the improvements turn out to be rather nebulous or nonexistent. Moreover, these products are rarely accompanied by any kind of test data. In spite of this, once in a while one finds some gold among the dross.

Recently, I received a quantity of isolation feet called Sims Silencers made by Sims Vibration Dynamics of Redmond, Washington. I expected these to be just another ho-hum version of a device already glutting the audio mar-

"McIntosh . . . no other transistor amplifier is capable of reproducing as well."

"All the sounds, even those different one from another, remain separated and distinctive. There results a sensation of contrast, precision, and uncommon clarity.

. . . A close analysis of different frequencies reveals an extremely deep bass, very rich in spatial detail . . . The upper bass region is very linear testifying to an extraordinary richness of information. The very structured mid-range contributes enormously to listening pleasure.

The feeling of power is never refuted and instead of stunning the listener, the 7270 recreates an audio environment of a majesty that *no other transistor amplifier is capable of reproducing as well.*" Need we say more?

—REVUE DU SON, foremost French stereo magazine.

For a copy of the REVUE DU SON and information on the McIntosh MC 7270 Amplifier and other McIntosh products write:

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Resonance is a vital element in determining sound quality of musical instruments, but it cannot be tolerated in an audio component system.

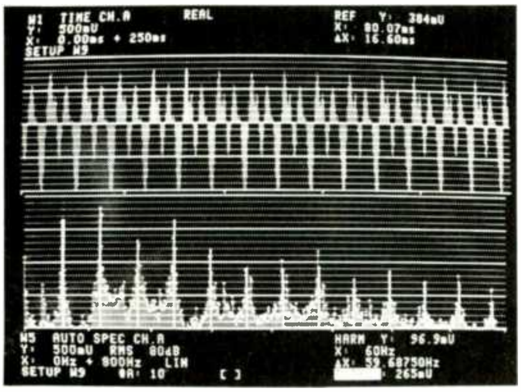
ketplace. I was pleasantly surprised to find that fairly extensive documentation of test measurements on the product had been furnished as well. Even more cheering was that when I placed the Sims Silencers underneath a turntable, they worked with remarkable efficiency, having very salutory effects on the perceived quality of the sound. The anti-resonance/vibration performance indicated by the accompanying test data and graphs was fully supported by the audible evidence of my subjective impressions.

Sims states that the Silencers should be placed underneath the chassis of an audio component, not underneath the rubber feet that are an integral part of the component. The Silencers are 2 inches in diameter and 1 inch thick. A heavy half-inch-wide aluminum compression ring surrounds the proprietary damping compound, which Sims calls NAVCOM, an acronym for Noise and Vibration Counter Measure. NAVCOM is a black, viscoelastic long-chain polymer, an amorphous rubber-like substance with a dense, close-knit grain structure. It has a very low modulus of elasticity and a natural resonant frequency well below the lowest frequencies of the audio bandwidth. It is very difficult to compress—so much so that one Silencer will support up to 35 pounds. NAVCOM is effective over a frequency range of 10 Hz to 30 kHz. Transient vibrations and impulsive shock energy are blocked by its molecules and dissipated as heat.

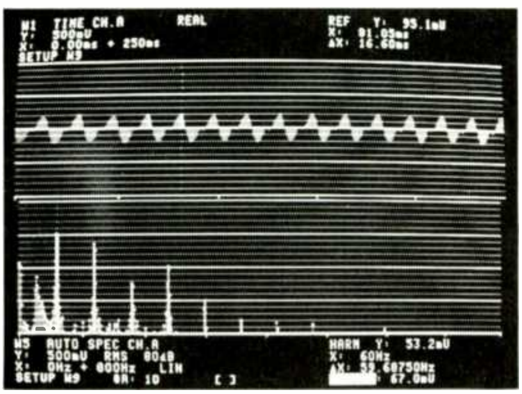
Sims has conducted interesting experiments to verify the vibration-damping qualities of NAVCOM. In one rather crude, but dramatic, test, a bench grinder was mounted on a lab table, and a glass of water was placed on various competitive isolation feet and on a Sims NAVCOM Silencer. When the bench grinder was operated, the vibration agitated the surface of the water, to varying degrees, in the glasses supported by the other feet but left the water unruffled in the glass mounted on the NAVCOM Silencer.

Sims sent me graphs of test results for, among others, butyl, neoprene, and Sorbothane plus their NAVCOM. The tests were made to calculate vibration modal amplitudes and decay time for each damping material. A high-resolution FFT spectrum analyzer generated the test impulse for each sample under analysis, and a Bodysonic vibrotactile transducer reproduced the test impulse for recording. The pickup sensor was a Pennwalt high-polymer accelerometer placed on top of each sample. The Bodysonic was placed on a test stand, which was on a wood parquet over concrete floor. The test computer repeated each test 16 times and calculated an average value. Each resulting graph illustrates the amplitude of the generated wave (as a function of maximum change in decibels) versus the decay time (in milliseconds).

It was a rare and pleasant experience to encounter an accessory device whose sonic contributions were backed up by measured data.



B & K's reference test of vibration effects without isolation.



B & K test of vibration effects using Sims NAVCOM damping material.

These graphs were most informative and revealing. Of the seven materials tested along with NAVCOM, all showed the sharp, transient, high-amplitude spikes of the initial impulse and then attenuation of the spikes at a rate and over a time period reflecting the damping qualities of the specific material. The NAVCOM graph was amazing—perhaps a tiny ripple representing the initial impulse, and virtually no decay time.

The impressive NAVCOM graph correlates well with what I heard. With the NAVCOM Silencers in place, it was immediately apparent how much cleaner music sounded, regardless of the source. The bass was notably tighter and better defined, while the midrange and top end exhibited more detail. The sound was far more open, with more air around the instruments, and there was a better perception of depth along with a more precise and stable stereo image. It was obvious that cumulative effects of various resonances and vibrations emanating from my system's components had been causing an acoustic veiling, superimposed on the music signals.

Steve Sims, in a phone conversation, told me of still another way to "gild the audio lily"—placing loudspeakers on a wooden platform laminated with NAVCOM. He also told me he had obtained some new measurements on NAVCOM, through tests independently conducted by the Seattle office of test instrument manufacturer Bruel & Kjaer.

Shorty thereafter, I received the Bruel & Kjaer test data and a platform for my Duntech Sovereign loudspeakers. The platform is of two half-inch-thick pieces of particleboard (nicely finished in rosewood to match the speakers) with a quarter-inch-thick sheet of NAVCOM laminated between them. Two husky friends placed my 376-pound speakers on the Sims platforms, whose undersides are fitted with eight floor spikes apiece. Of course, floor spikes have been used underneath speakers for some time, as an aid in getting cleaner bass. But inevitably, the energy that is transmitted to the floor is refected back through the spikes into the speaker, though perhaps at a reduced level. The Sims speaker platform's NAVCOM laminate prevents this. The results were that another acoustic veil had been stripped from music. The improvement in midrange and treble articulation was quite remarkable, and bass response was so very natural and free of coloration.

The Bruel & Kjaer tests employed their Model 2032 FFT spectrum analyzer. The setup was the same Sims had used—that is, generating a test impulse and sending it to the sample material, with an accelerometer picking up the vibrations and returning them to the analyzer. Results from two tests, photographed from the B & K 2032's display screen, are shown here. Each top trace is of a signal in the time domain, 250 mS long, that is passing through the material under test. Each lower trace is the fast Fourier transform of the signal, showing the amplitude in the frequency domain, with the band of interest from 0 to 800 Hz. Both test photos represent suppression of vibration as measured in G forces. In the notations on the lower right of each graph, note that the bottom figure is the result of the test, expressed in milligravities. The first graph is a reference, run with no isolation whatever. You can see the prominent spikes in both the time and frequency domains. They measure 265 milligravities. The other test presented here was for NAVCOM, and it shows suppression of vibration all the way down to 67 milligravities. Obviously, there is a strong correlation between this measured data and what I heard.

Thus, it is possible to tweak a system with certain devices and have the improvements you hear verified by generally accepted measurement standards. Fortunately, tweaking with Sims Silencers is relatively inexpensive; a set of four lists for $68. The Sovereign version of the Sims NAVCOM speaker platform, 20¼ × 34¾ inches, costs $395 for a pair. Smaller platforms will range in price from $225 to $295.

Information on dealers who handle Sims products is available from Sims Vibration Dynamics, 2797 152nd Ave. N.E., Redmond, Wash. 98052.

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HOW HOT ARE CDs?

New measurements of CDs show peak levels that challenge both tape and recordists.

HOWARD A. ROBERSON

To get the best analog tape/recorder performance, recordists should know the distribution of the music's spectral peaks throughout the audio band. In the article "Basics of Tape Performance" (September 1982), I referred to two sources of information on musical spectra. A figure in that article showed the levels rolling off at about 6 dB per octave above 1 or 2 kHz. This appeared to be fortuitous, because the MOL limit (maximum output level for 3% distortion) of cassette tape fell at about the same rate, and the spectral roll-off started from the same frequency.

Although the spectral shape was a good match for analog recording, the figure was in error. I concluded that the original sources did not include a wide enough range of musical material in one case and used a poor microphone location in the other. Considering all types of music, I could see that the high-frequency roll-offs in the spectra I was using were unrealistic. Where, then, could I get good musical spectra without spending hours making measurements of actual performances?

I decided it would be worthwhile to measure third-octave spectra from a good assortment of CDs. I selected a total of 40, most of which had received enthusiastic reviews for performance and sound quality (Table I). Music from the baroque, classical, Romantic, and other periods was selected, with an assortment of overtures, arias, and organ music. Some pop/rock and movie music was included as well. For the most part, the classical CDs are listed in the Table in order of composition.

Test Procedures

My test plan was to find the highest momentary peak levels in 30 third-octave bands (25 Hz to 20 kHz) over the duration of each piece. Peak levels of any varying musical waveform are continually changing. I wanted to get and hold the highest peak level that occurred anywhere in the music in each of the 30 third-octave bands. I used an Ivie IE-30A RTA in its "Accumulate" mode to do this. The musical transients were long enough for the RTA to capture the actual peaks within a dB or so. Maximum peak levels at the highest frequencies were caused by cymbal crashes. The highest bass levels were from organ or bass drum, except for the cannon in the "1812" Overture.

I plotted the accumulated peak levels of the CDs and of four FM pop/rock stations in each third-octave band; I then tabulated my readings. Because of variations in level from CD to CD and some changes in the measurement chain, the plotted band levels did not have a common reference. My examination of all band levels revealed that all CDs were relatively flat in the region from 200 Hz to 1 kHz. I tabulated the band levels for each CD referred to the average of its levels in the 200-, 250-, 315-, 400-, 500-, 630-, 800-, and 1000-Hz bands. Then I was able to make direct comparisons on the spectral shapes from one disc to the next.

Figure 1 shows the range of peak levels in all bands of the 40 CDs, relative to their average levels in the reference region from 200 Hz to 1 kHz. The top curve shows the highest peak levels recorded from each band, relative to the average reference-region levels of all the CDs tested. This curve shows how high the relative level might be in

TABLE I

Compact Discs evaluated for peak levels.

CD No.	Label & Catalog No.	Composer & Artist	Title & Orchestra	Portion Tested
1	Argo 411613-2-ZH	Mozart Brown	Sinfonia Concertante, K.364 Academy of St. Martin	All
2	Telarc CD-80108	Mozart Mackerras	Eine Kleine Nachtmusik, K.525 Prague Chamber Orchestra	All
3	Telarc CD-80070	Vivaldi Ozawa	The Four Seasons Boston Symphony Orchestra	"Spring"
4	Deutsche Gram. 410024-2-GH	Schubert	"Death and the Maiden" Quartet Amadeus Quartet	All
5	Orfeo C-045901-A	Mozart Jochum	Symphony No. 39 Bamberg Symphony Orchestra	All
6	Telarc CD-80114	Mozart Previn	Quintet for Piano and Winds, K.452 Vienna Wind Soloists	All
7	Telarc CD-80114	Beethoven Previn	Quintet for Piano and Winds, Op.16 Vienna Wind Soloists	All
8	Philips 411471-2-PH	Tchaikovsky Marriner	Serenade in C for String Orchestra Academy of St. Martin	All
9	London 414203-2-LH	Berlioz Dutoit	Symphonie Fantastique Montreal Symphony Orchestra	Mvts. 4 & 5
10	Telarc CD-80047	Tchaikovsky Maazel	Symphony No. 4 Cleveland Symphony Orchestra	All
11	London 410116-2-LH	Dvorak Solti	Symphony No. 9 Chicago Symphony Orchestra	All
12	Telarc CD-80051	Saint-Saens Ormandy	Symphony No. 3 ("Organ") Murray, Philadelphia Orchestra	All
13	Telarc CD-80071	Debussy Slatkin	La Mer St. Louis Symphony Orchestra	All
14	Telarc CD-80039	Stravinsky Shaw	"Firebird" Suite Atlanta Symphony Orchestra	All
15	Chandos CHAN-8309	Elgar Gibson	Froissart Overture Scottish National Orchestra	All
16	Telarc CD-80041	Tchaikovsky Kunzel	"1812" Overture Cincinnati Symphony Orchestra	All
17	Telarc CD-80088	Bach Murray	Toccata and Fugue in D Minor	All
18	Telarc CD-80123	Bach/Dorsey Dorsey	Italian Concerto (from *Bachbusters*)	All
19	Philips 412790-2-PH2	Bach	Brandenburg Concerto No. 2 I Musici	All
20	Philips 412790-2-PH2	Bach	Brandenburg Concerto No. 5 I Musici	All
21	Telarc CD-80116	Von Suppe Kunzel	Light Cavalry Overture Cincinnati Pops Orchestra	All
22	Telarc CD-80116	Reznicek Kunzel	"Donna Diana" Overture Cincinnati Pops Orchestra	All
23	Telarc CD-80116	Offenbach Kunzel	Orpheus in the Underworld Cincinnati Pops Orchestra	All
24	Telarc CD-80116	Rossini Kunzel	William Tell Overture Cincinnati Pops Orchestra	All
25	Harmonia Mundi HMC-901149	Charpentier	Motets (for one or two voices) Nelson, Jacobs, Concerto Vocale	All
26	Philips 412631-2-PH	Simon Estes	Spirituals	All
27	Philips 411148-2-PH	Mozart Te Kanawa	Arias Davis, London Symphony Orchestra	1-5
28	Archiv 410647-2	Handel Pinnock/ Preston	Dettingen Te Deum English Concert/ Westminster Abbey Choir	All
29	Telarc CD-80083	Wagner Marriner	Die Meistersinger, Act I Minnesota Orchestra	Prelude
30	MMG MCD-10025	Waldteufel Kunzel	Music of Waldteufel Cincinnati Pops Orchestra	All
31	MMG MCD-10005	Sousa Kunzel	Peaches and Cream Cincinnati Pops Orchestra	All
32	Telarc CD-80094	Various Kunzel	Star Tracks Cincinnati Pops Orchestra	All
33	Warner Bros. 25264-2	Dire Straits	Brothers in Arms	All
34	Fantasy FCD623CCR2	Creedence Clearwater Revival	Chronicle, Vol. I	All
35	A&M CD-3735	The Police	Synchronicity	All
36	Columbia CK-35047	Air Supply	Love & Other Bruises	All
37	Phila. Intl. ZK-38539	Patti LaBelle	I'm in Love Again	All
38	Sparrow CDP-41039	Deniece Williams	So Glad I Know	All
39	Epic E2K-37037	The Clash	Sandinista	1st of 2 CDs
40	Telarc CD-80106	Various Kunzel	Time Warp Cincinnati Pops Orchestra	All

Measuring peak spectra of 40 CDs showed me that each type of music presents a different challenge.

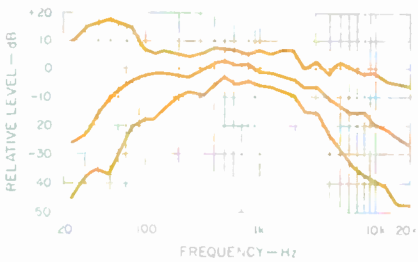


Fig. 1—Range of peak levels, in all bands, for 40 CDs. Highest recorded peak levels for any CD are shown at top, followed by average peak levels for all 40 discs (middle), and minimum peak levels for any CD (bottom). Levels are shown relative to average level, from 200 Hz to 1 kHz, of all 40 discs.

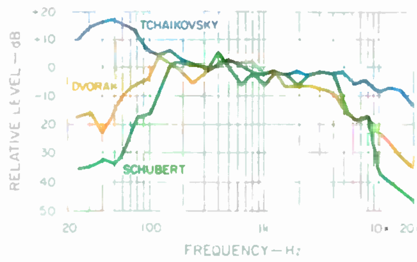


Fig. 2—Spectra of three CDs, ranked by bass content. Tchaikovsky's "1812" Overture had the highest content of the discs surveyed; Dvořák's Symphony No. 9 had median bass levels, and Schubert's "Death and the Maiden" Quartet had least bass. Plots are positioned to put their average levels (from 200 Hz to 1 kHz) on the 0-dB reference line.

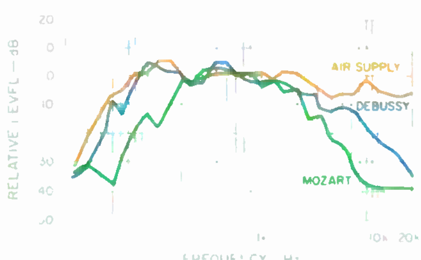


Fig. 3—Spectra of three CDs ranked by treble content, showing highest treble content (Air Supply, Love and Other Bruises*), median treble content (Debussy, "La Mer"), and least treble content (Mozart, Quintet for Piano and Winds).*

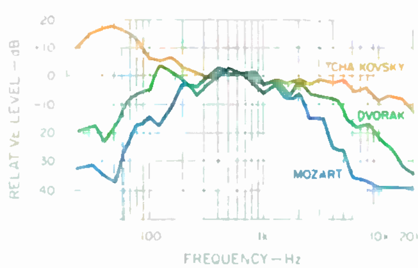


Fig. 4—Spectra of three CDs ranked by bass and treble content, showing highest bass and treble content (Tchaikovsky, "1812" Overture), median content (Dvořák, Symphony No. 9), and least bass and treble (Mozart, Quintet for Piano and Winds).

any one or more of the bands. The middle curve shows the average of all peak levels measured in each band; note that this curve rolls off noticeably above and below the reference region. The bottom curve shows the lowest peak levels measured from any of the 40 CDs in each third-octave region. This minimum-peak-level curve shows that there is some music with little bass or high-treble energy.

Figure 2 shows the spectra of three specific CDs, ranked by bass content. The cannon in Tchaikovsky's "1812" Overture definitely generated the most bass of any CD in my test group. I judged the Dvořák Symphony No. 9 CD to have the median bass level of the group and Schubert's "Death and the Maiden" Quartet to be the CD with the least bass. A similar process was used to generate Fig. 3—for the maximum-, median-, and minimum-treble CDs—and Fig. 4, covering the same rankings for both bass and treble. The figures detail something which we all know to be true, if we consider all types of music: There is a wide range in the amount of energy in both the low- and high-frequency ends of the total music spectrum.

Spectral Envelopes

After generating these figures, I decided to try classifying the 40 peak-level spectra on hand. Using transillumination, I traced the original spectrum plots onto graph paper. I started with the plot for CD No. 1 (Mozart's "Sinfonia Concertante") and plotted its spectral envelope. The envelopes for all other CDs were checked for possible matches. I found a number that were very similar to the Mozart disc and a few which corresponded satisfactorily, if I was willing to allow differences of a dB or two. All this music was from the baroque and classical periods, except for some vocal works.

Figure 5 shows this spectral envelope. (The CD numbers are given in the caption, so you can refer to Table I.) To get a better feel for how to meter such music, I measured the average (VU) and peak levels for pink noise, with a response shaped to match the spectral envelope. I aligned the highest level in this envelope exactly with the zero reference to show that the highest levels would be indicated accurately with peak-responding meters. The envelope curve in Fig. 6 covers seven CDs and quite a variety of music. This envelope matched peak third-octave levels for Berlioz, Dvořák, and Tchaikovsky Symphonies, Reznicek's "Donna Diana" Overture, Debussy's "La Mer," Dorsey's *Bachbusters*, and four FM pop/rock stations. This envelope has more low- and high-frequency energy above 2 kHz than the one in Fig. 5.

The envelope in Fig. 7, for three works with organ, shows the major influence of the low organ notes, the highest levels of which are centered around 50 Hz. The organ in *Time Warp* is excerpted from "Also Sprach Zarathustra" by Strauss. Although the levels were highest below 70 Hz, the low-frequency peak levels were easy to meter correctly. The envelope of Fig. 8 covers Stravinsky's "Firebird" Suite and four overtures. The highest levels were from the bass drum, but there was considerable energy across the entire audio band. Some care was needed to catch the peak levels from the drum beats, but it was a relatively small adjustment and easily made.

Figure 9 shows the spectral envelope generated by the music of Waldteufel and Sousa. Both of these CDs have sudden bass drum peaks (visible on the envelope). My checks indicated that if a recordist were setting input gain based on signal levels elsewhere in these recordings, his levels would probably be about 2 dB high on these drum peaks. The music from *Star Tracks* and *Brothers in Arms* (Fig. 10)

When the spectrum of peaks in the music matches the tape's MOL curve, record levels can safely be high.

had a wide and quite flat peak spectrum before a roll-off at around 10 kHz. Accurate metering was easy with these sources.

Figure 11 revealed a close correspondence in peak spectra among six pop/rock CDs. Because of the general steadiness in the peak level and the wide high-level spectrum, the recordist would probably set the level *slightly* low. On the other hand, the cannon shots in Tchaikovsky's "1812" Overture (Fig. 12) would be very hard to meter correctly, and thus overrecording would be very likely.

Metering, EQ, and MOLs

Peak-responding meters on most decks are fast enough (less than 20 mS) to show typical musical transients, but they read the signals before record equalization, with its high-frequency boost, is applied. As a result, some high-frequency distortion and saturation might be occurring without the meters giving any warning of it. Because of the general level roll-off in the higher frequencies for all music, however, there usually would be little change in the peak meter indications even if the meters were reading the equalized signal. Indications for average-responding (VU-type) meters were usually 8 to 10 dB below those for typical recorder peak-responding meters.

When the levels were measured with an absolute-peak meter, which can display fast transients, they were at least 14 to 15 dB above the indications on the VU meters. Because of the very short duration of these instantaneous peaks (less than 200 µS), distortion would probably not be heard if they were slightly above the MOL limit. These figures, however, should help emphasize that when using a VU-type meter, the recordist must allow at least 10 dB of headroom to get low-distortion recording.

The fall-off in tape MOLs above 1 kHz is well known. If there was no record (or playback) equalization, the high-frequency MOLs would drop relatively little—but the noise would go up. The cassette format is locked into 70- and 120-µS equalizations. A small number of decks allow switching equalization separately, regardless of tape type; this can be helpful, as I will show later. Open-reel recorders, at tape speeds of 3¾ and 7½ ips, may

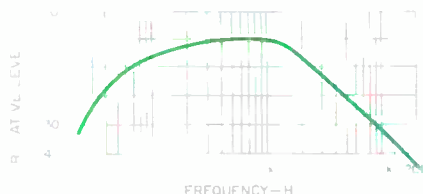


Fig. 5—Peak-level spectral envelope, with highest level used as 0-dB reference, for classical and baroque music plus vocal solos and choral works. The discs are listed in Table I as CDs 1 to 8, 19, 20, and 25 to 28.

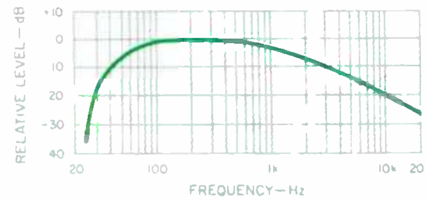


Fig. 6—Peak-level spectral envelope for symphonies, overtures, and other classical works (CDs 9, 10, 11, 13, 18, 22, and 29) plus pop/rock FM stations; see text.

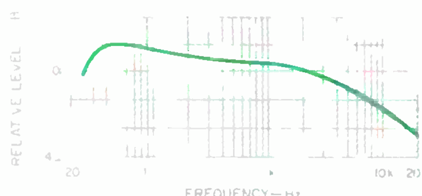


Fig. 7—Peak-level spectral envelope for works with organ (Saint-Saëns, Symphony No. 3; Bach, Toccata and Fugue in D Minor, and Strauss, "Also Sprach Zarathustra"), listed in Table I as CDs 12, 17, and 40.

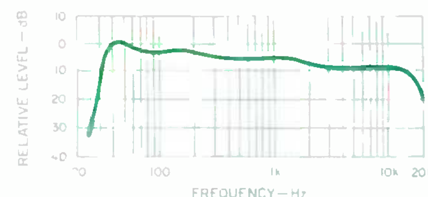


Fig. 8—Peak-level spectral envelope for overtures (CDs 15, 21, 23, and 24) and Stravinsky's "Firebird" Suite (CD 14).

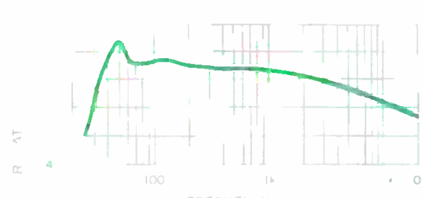


Fig. 9—Peak-level spectral envelope for music of Waldteufel and Sousa (CDs 30 and 31). The peak at 50 Hz is from bass drum beats; see text.

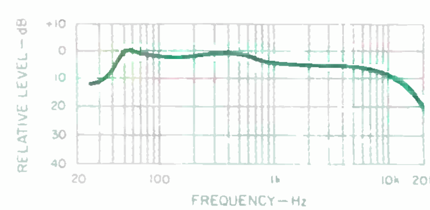


Fig. 10—Peak-level spectral envelope for music from Star Tracks *and* Brothers in Arms *(CDs 32 and 33).*

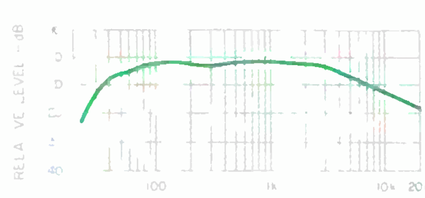


Fig. 11—Peak-level spectral envelope for pop/rock music (CDs 34 to 39).

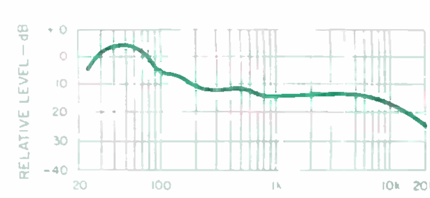


Fig. 12—Peak-level spectral envelope for Tchaikovsky's "1812" Overture (CD 16).

use as much record-equalization boost as do cassette recorders. At the higher tape speeds, particularly 30 ips, the required boost for open-reel recording is significantly less.

Figures 13, 14, and 15 show the range of MOLs, without noise reduction, using a Nakamichi CR-7A deck for the 35 tapes covered in my last tape survey (November 1987). The dashed lines at the low-frequency ends of the curves show the drop in MOLs from 100 to 50 Hz for the typical deck. The best decks, in this regard, have about a 2-dB drop, and the worst decks have about a 10-dB reduction in MOLs from 100 to 50 Hz. At 40 Hz, the reduction in performance for all decks is even greater. The Type I MOLs are shown in Fig. 13, the Type IIs are in Fig. 14, and those for Type IV are in Fig. 15. In these figures, the top curve for each tape type is for the best MOLs, and the bottom curve is for the worst MOLs.

When I replotted some of this MOL data, I had to conclude that there was too great a discontinuity between the distortion levels shown at frequencies up to 1 kHz (where I measure third-order harmonic distortion) and from 2 kHz up (where the tape's frequency limits force me to use third-order twin-tone IM measurements; see sidebar). The reference level I had been using for the twin-tone IM tests was based on the rms levels of those tones, as specified by an IEC Standard I was using. However, DIN Standard 45 403, for nonlinear distortion measurements, clearly states that peak level is the proper reference. Careful examination of distortion products, with a spectrum analyzer, provided real-world confirmation. The peak level of twin tones, with each one at the same level, is 6 dB higher than a single tone and 3 dB higher than the twin-tone rms level.

Figures 16, 17, and 18 show the effect of this necessary adjustment with the twin-tone IM MOL curves raised 3 dB. (Twin-tone IM data, in the earlier survey, should be increased 3 dB as well. Relative tape rankings remain the same.) The little jog that remains with Type II (middle) and IV (bottom) tapes is correct for the standard 70-μS equalization. The dashed line above the Type II and IV MOL curves, above 1 kHz, shows the MOL increase that 120-μS equalization would yield.

DISTORTION TESTS & ANALOG RECORDING

In general, measuring harmonic distortion is straightforward. There are many low-distortion sources these days, and analyzers are available in a number of formats. Tape noise in analog recording, however, makes it difficult to get reliable distortion data unless the recorded flux level is above 50 nWb/m or so. If 3% distortion is the criterion, the levels will be much higher and harmonic distortion is easily measured—particularly at lower frequencies.

The distortion in analog tape recording is primarily third-order, and the third harmonic is the most prominent in the playback of a single recorded tone. Accurate assessment of third-order distortion, in general, requires flat record/playback response out to the frequency of the third harmonic. When the record levels are high enough to cause 3% distortion, however, the response on a typical deck begins falling off by 1 kHz. Data taken at higher frequencies is valid for assessing *harmonic* distortion, but third-order distortion involves more than simple harmonics. Complex musical energy around the same frequency and at the same level would cause many combinations of sum- and difference-frequency distortion products. In other words, measuring the harmonic distortion of a single tone is not adequate for assessing nonlinear performance with music—except at lower frequencies.

A two-tone test signal can be used for tests out to the response limits of the deck, as its difference-distortion products remain in band. The third-order difference products for two tones f_1 and f_2, are:

$$f_3 = 2f_1 - f_2 \text{ and}$$

$$f_4 = 2f_2 - f_1.$$

Another way of stating these frequency relationships is:

$$f_3 = f_1 - (f_2 - f_1) \text{ and}$$

$$f_4 = f_2 + (f_2 - f_1).$$

There are also two sum products:

$$2f_1 + f_2 = 3f_1 + (f_2 - f_1) \text{ and}$$

$$2f_2 + f_1 = 3f_2 - (f_2 - f_1),$$

which show their frequency grouping with the third harmonics.

Figure B1 shows the waveform of a 500- and 600-Hz twin-tone signal. Each individual tone was four divisions high, peak to peak, but the combination is almost eight divisions high. This doubling of peak levels holds true for all combinations of frequencies. Figure B2 is the spectral display of the fundamentals and the distortion in the playback from a Nakamichi CR-7A deck. The level reference is the peak level of the two tones, which is 6 dB above the level of each fundamental.

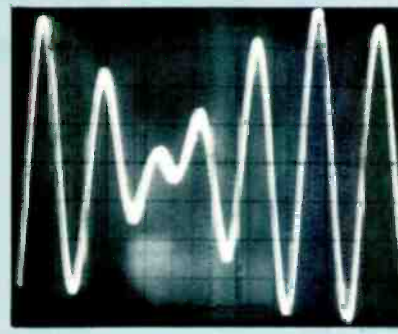


Fig. B1—Waveform of 500- and 600-Hz test signal.

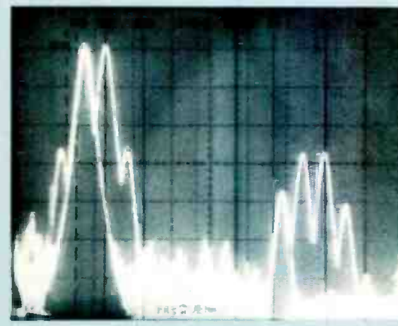


Fig. B2—Third-order distortion products. At left are 500- and 600-Hz fundamentals, flanked by third-order difference products. At right are third harmonic of 500-Hz fundamental (1,500 Hz), third-order sum products of 500 and 600 Hz, and third harmonic of 600 Hz (1,800 Hz). Scales: Horizontal, 200 Hz/div.; vertical, 10 dB/div.

Two sweeps were actually made with the analyzer: One with just the 500-Hz signal and the other with both tones. Notice that the 1,500-Hz third-harmonic distortion product stays the same in level when the second tone is added. Also note how much higher the difference and sum distortion products are in comparison to the harmonic distortion product. The great difference between the amplitudes of the harmonic and IM distortion products is due to the 6-dB increase in the effective recording level when the second tone is added. When single-tone and twin tone *peak* levels are the same, the overall third-order distortion levels are the same. As the test-tone frequency increases, the levels of the third-order harmonic and sum distortion products are reduced more and more, relative to the level of the difference-frequency products.

With close spacing between the fundamentals, f_1 and f_2, their output levels will be almost identical, as will the levels of f_3 and f_4, the third-order difference frequencies. As a result, distortion tests are possible almost to the very response limit of the deck. Music is made up of many more frequencies than just two, but twin-tone testing allows exercising a deck's entire audio band. *H.A.R.*

To avoid audible distortion, even from single peaks, the record level reductions listed here are a must.

I thought that the MOL curves should provide a level-limiting curve for the spectral envelopes. I did have some question about what happened at all frequencies with broadband signals. I used a Type I tape with the Nakamichi CR-7A deck and ran a compression test with pink noise. The first test here used flat pink noise (20-kHz roll-off), with the input level adjusted in 1-dB steps from −10 to +20 dB relative to meter zero. I used a special dual attenuator, with one section increasing input level and the other section decreasing playback level. In this way, the level to the RTA was constant except for effects from compression.

The bottom trace of Fig. 19 shows the result of this test. The flat upper edge of the trace shows the flat frequency response obtained when recording at −10 dB; the bottom edge shows the response when recording at +20, where output was actually lowered due to compression/saturation. Notice how much greater this effect was at the highest frequencies than at 2 kHz and below.

For the next test, I used equalization to shape the pink noise to match the MOLs for the particular tape and recorder in use. The top trace of Fig. 19 shows the result of adjusting the input over the same meter range, from −10 to +20 dB relative to meter zero. With this shaping of the "music" to match the MOL limit across the whole band, the compression was very much the same in each of the 30 third-octave bands, as shown by the close parallel between the upper and lower edges of the trace.

The next step was to overlay the MOL curves on the eight spectral envelopes (from Figs. 5 through 12) for guidance on what record levels would be possible. The guidelines given here assume the meters are peak responding, with the level first set to match the 400-Hz MOL figure. In this case, there would be a downward level adjustment to prevent *any* part of the envelope from protruding above the MOL limit.

Figures 20 and 21 demonstrate how I did this. The top curve in each of these two figures is the best MOL curve for Type I tapes from Fig. 16. The bottom curve in Fig. 20 is the peak-level spectral envelope from Fig. 7. Notice how low the recording level would have to be set to prevent distortion at 40 Hz. Figure 21 shows that there is a better match to the deck/tape's MOLs with the envelope from Fig. 11. The actual limit occurs slightly above 15 kHz. Pushing the level higher, until this envelope intersected the MOL curve at 15 kHz, would not generate much in-band *harmonic* distortion products. But there would be high-level, third-order, difference-tone *IM* distortion products that would be in band.

Table II lists the required dB corrections in maximum meter readings relative to the 400-Hz MOL limit, to prevent noticeable distortion anywhere else in the entire band. The Table shows where the MOL limit occurs and gives the results for both the best and the worst MOLs shown in Figs. 16, 17, and 18. The envelopes in Figs. 5 and 6 show a concentration of energy in the middle of the music spectrum. The required adjustments, in most cases, are relatively small. The high level of the low organ notes (Fig. 7) requires a sizable reduction in the overall recording level to limit distortion. The spectrum is flatter in Fig. 8, but the required reductions are also large in all cases.

The high-level drum beats at 50 Hz (Fig. 9) would be hard to catch, and a large level reduction is required here also. The reductions are somewhat less with the envelope shown in Fig. 10, but they are important, reaching limits at one end of the spectrum or the other, depending on the shape of the MOL curve. The pop/rock CDs (Fig.

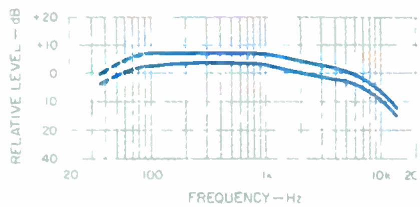


Fig. 13—Range of MOLs for 3% distortion for 13 IEC Type I tapes. High-frequency MOLs shown are referred to rms level of twin-tone signal re: Dolby level; see text.

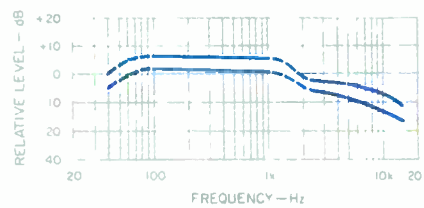


Fig. 14—Same as Fig. 13 but for 15 Type II tapes.

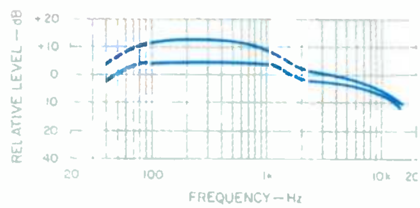


Fig. 15—Same as Fig. 13 but for seven Type IV tapes.

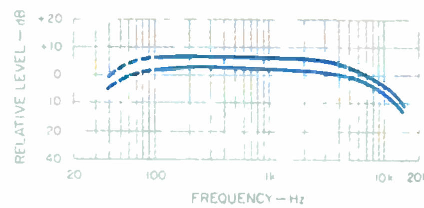


Fig. 16—Range of MOLs for 3% distortion for 13 IEC Type I tapes. High-frequency MOLs shown are referred to peak level of twin-tone signal re: Dolby level; see text.

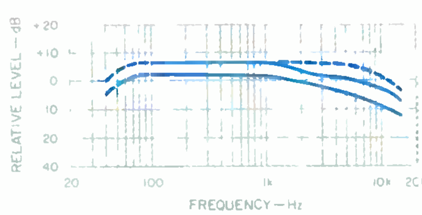


Fig. 17—Same as Fig. 16 but for 15 Type II tapes.

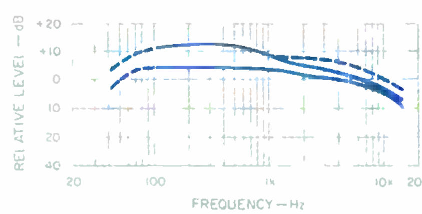


Fig. 18—Same as Fig. 16 but for seven Type IV tapes.

11) have peak band levels that are flat for most of the audio band but roll off at the extremes. For this type of music, the recordist needs to make some downward adjustment, but less than would be necessary for a number of other types of music. The required compensation for the cannon shots in the "1812" Overture (Fig. 12) cannot be defined as accurately as for the other envelopes. But it appears that the maximum meter level should be about 10 dB lower than the 400-Hz MOL limit for the tape/recorder used.

If the audiophile sets his goal to be the prevention of 3% distortion at *any* time, *even on a single peak or two*, the adjustments of level listed in Table II are *musts*. For lower quality decks, the reductions should actually be greater. If we consider how great some of the reductions should be, it is quite discouraging. It just won't seem right to set the levels to less than meter zero on peak-responding meters, and even lower on VU-type meters. Some of the envelopes require this, however, and the distortion *will* be low. Let me suggest that the envelopes and Table II provide guidelines which point out where distortion will start with increasing record levels. By all means, the recordist should listen carefully, for it may be difficult to accept noise that goes with really low distortion.

Interesting details can be gleaned from the Table. For example, notice that with Fig. 11 the limit for Type II and IV tapes is *not* at the frequency extremes but at 2.5 or 3.0 kHz. Notice also that in many cases—and especially when using the Type IV tapes—a greater adjustment is needed for the tapes with the *best*, as opposed to the worst, MOLs. This is the result of the shape of the MOL curves: The best MOL curves drop off noticeably from low to high frequencies, but the worst MOL curves are relatively flat.

The use of 120-µS equalization with Type II and IV tapes (see Figs. 17 and 18) did not provide as much of an advantage as I had thought it would. There was really no advantage in an equalization change for the envelopes in Figs. 5, 6, 7, 9, and 12. The improvement in record level for high-MOL Type IVs was 3 dB for the envelope of Fig. 8 and 3.5 dB for the envelope of Fig. 10. The improvement was about 2 dB for both Type II and IV tapes with the envelope of Fig. 11.

All of the preceding material relating to tape/recorder performance has been for operation without noise reduction. What will noise reduction do to help remove at least some of the limitations discussed here? First, let's take a look at what Dolby C NR might do. In the past, I have shown many high-level

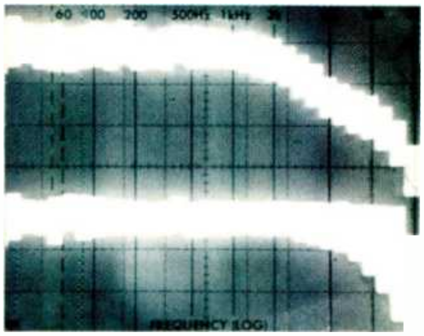


Fig. 19—Compression test using Type I tape on Nakamichi CR-7A. Record level was varied in 1-dB steps from −10 to +20 dB. With normal pink noise (bottom trace), response was flat at low recording levels (upper edge of trace) but compressed at higher levels (lower edge), especially at higher frequencies. With pink noise shaped to match the MOL curve (top trace), frequency response of uncompressed signals (upper edge) and saturation-compressed signals (lower edge) was almost the same. Vertical scale: 5 dB/div.

responses, especially for swept sine waves, that evidenced obvious and worthwhile headroom extension with Dolby C NR. After learning more about the limitations of falling high-frequency MOLs, I had to wonder about the extent of the effects of this NR in actual recording. The first thing I did was to check what the meter indications were for a Dolby-level calibration tape and then for pink noise at the same rms output voltage. The Dolby level from the tape read correctly at meter zero, but the deck's peak-responding meters bounced between +4 and +7 dB with the pink noise.

I then looked at record/playback response—with Dolby C NR, over a range of levels with pink noise—both flat and with response shelved at −5 dB above 3 kHz. While looking at playback after rewinding, I switched the NR in and out, both to see the result with NR and to check what the encoder responses were at these levels. There was some anti-saturation shaping of the encoder response, starting just above Dolby level.

Figure 22 shows record/playback responses using pink noise with a very high record level. The responses shown in the top trace resulted from using flat pink noise. The response without NR is the middle portion of this trace. Dolby B NR caused a somewhat greater roll-off at the highest frequencies, but Dolby C NR secured a very obvious reduction of the roll-off. The responses shown in the bottom trace

TABLE II

Required corrections to maximum record level allowable (400-Hz MOL reference) to limit distortion.

		TYPE I		TYPE II		TYPE IV	
Fig. No.	MOLs	Freq. of Limit	Corr., dB	Freq. of Limit	Corr., dB	Freq. of Limit	Corr., dB
5	Best	1.0 kHz	−0.5	1.0 kHz	0.0	1.5 kHz	−3.0
5	Worst	1.0 kHz	−1.0	1.0 kHz	0.0	1.2 kHz	−0.5
6	Best	200 Hz	−0.3	200 Hz	0.0	1.5 kHz	−1.5
6	Worst	100 Hz	−1.0	200 Hz	0.0	200 Hz	0.0
7	Best	40 Hz	−8.0	40 Hz	−7.5	40 Hz	−8.5
7	Worst	40 Hz	−8.5	40 Hz	−7.5	40 Hz	−7.5
8	Best	15 kHz	−8.5	40 Hz	−7.5	13 kHz	−10.0
8	Worst	40 Hz	−8.5	40 Hz	−7.0	40 Hz	−7.5
9	Best	50 Hz	−7.5	50 Hz	−7.5	50 Hz	−9.0
9	Worst	50 Hz	−7.0	50 Hz	−7.0	50 Hz	−7.0
10	Best	15 kHz	−6.0	50 Hz	−3.5	11 kHz	−7.5
10	Worst	15 kHz	−5.0	50 Hz	−3.5	50 Hz	−3.5
11	Best	15 kHz	−4.5	2.5 kHz	−2.5	3.0 kHz	−7.0
11	Worst	15 kHz	−2.0	3.0 kHz	−1.5	2.5 kHz	−1.5
12	Best	40 Hz	−10.0	40 Hz	−10.0	40 Hz	−10.0
12	Worst	40 Hz	−10.0	40 Hz	−10.0	40 Hz	−10.0

Pop/rock proves fairly easy to record well, while the "1812" Overture would be hard to meter properly.

are from using pink noise rolled off to match the tape/recorder MOL curve. The record level was increased to match that for flat pink noise. Even with this rolled-off signal, switching to Dolby C NR is somewhat helpful here. I should note that these tests do not re-create any particular music condition and just indicate the benefit of anti-saturation.

In a tape deck having dbx II NR, the compansion system's zero-gain point should be set at about −10 dB or perhaps slightly lower. When this is done, dbx II NR would help in preventing high distortion with most of the spectral envelopes shown. For some recorders in particular, however, dbx II NR has shown rather high distortion and rolled-off response in the region of low organ notes and bass drum beats. Post-playback equalization might help correct the roll-off in some of these cases.

Some readers might like to find where the 400-Hz, 3% distortion point is just by looking at the playback waveform. Figure 23 shows how this can be done. There are two overlaid waveforms: The good sine wave is from the signal source, and the squashed one is from the deck playback. To show this, you need a signal source (around 400 Hz is best) and a two-channel oscilloscope. The oscilloscope should have combination synchronization so that both the source and playback waveforms (which are read at slightly different times) can be aligned.

The source-waveform gain is set to make it fill the full eight divisions. The gain for playback is adjusted to make its waveform match the source waveform as exactly as possible over the straighter portions, with some vertical positioning perhaps needed for accurate alignment. The distortion is quite close to 3% when the playback waveform is squashed half a division at both top and bottom. This is not an *exact* indication, but it will help to define reference levels.

It is good for the recordist to know where on the meters the low-frequency (250 to 400 Hz), 3% distortion limit is for each of the tape formulations used. This article is a first try at obtaining a better understanding of the range of peak-level spectral envelopes for many types of music. With continuing examination of additional CDs, I may

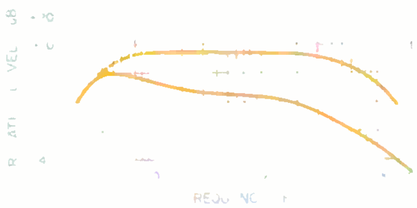


Fig. 20—Comparison of peak-spectrum envelope of organ music (Fig. 7) with Type I, best MOL curve shows that low-distortion recording limit occurs at 40 Hz.

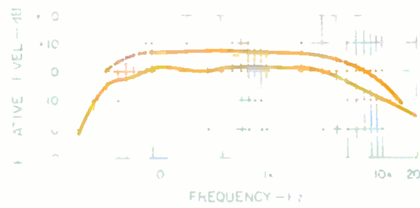


Fig. 21—Comparison of peak-spectrum envelope for pop/rock music (Fig. 11) with Type I, best MOL curve shows low-distortion limit at 15 kHz.

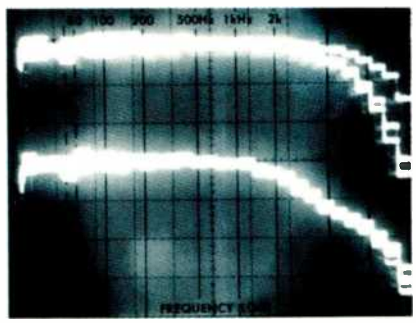


Fig. 22—Effects of Dolby NR on response at +20 dB recording level for flat pink-noise input (top trace) and MOL-shaped pink noise (bottom trace). Where traces split, at right, upper portion is with Dolby C NR, middle portion is without NR, and lower portion is with Dolby B NR; see text. Vertical scale: 5 dB/div.

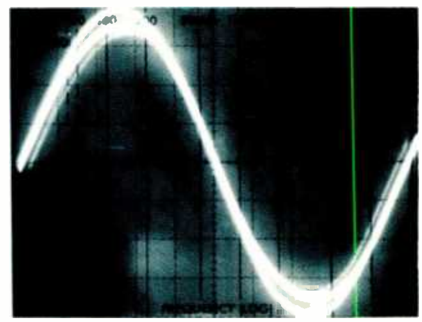


Fig. 23—Shape of playback sine wave with low distortion (larger trace) and with 3% distortion (smaller trace); see text.

find a need for other envelopes. On the other hand, the envelope in Fig. 7 is somewhat similar to that of Fig. 9, and the levels of the envelope in Fig. 12 are close to matching those at the frequency extremes in both Figs. 7 and 9.

The MOL curves which have accompanied my *Audio* tape tests are based on a 3%, third-order distortion limit, measuring harmonic distortion for the lower frequencies and twin-tone difference distortion for the higher frequencies. Of course, 3% is certainly *not* a low level of distortion. In some of my own listening, I thought that the results were much better when I limited the record level to what would amount to about 1% distortion, as indicated on peak-responding meters; this level limit would be 5 dB lower than the MOL criterion. Now that I have looked at the various spectral envelopes, I will be more discerning about what to expect. What I thought was my 1% distortion, peak-meter limit may really be close to a 3% limit for momentary peaks at any point in the band.

I do hope this discussion will help recordists become more aware of the challenges provided by various types of music. In digital recording with either R-DAT or PCM, the exact spectral shapes are less important, but good recording practice is still required to ensure that sudden peaks do not drive the system into overload. Primarily, these guidelines should help you find the best record-level settings for the various possible analog tape/recorder combinations.

Build An Indoor FM Antenna

One of the biggest barriers to good FM reception is the lack of a proper antenna. The wire dipole that comes with most receivers and tuners seldom does the job, so here is how to build something with a little more gain and greater versatility. Tethered to the tuner by coaxial cable, this antenna can be moved about the room to find the spot for ideal reception, and it can be put neatly out of the way when not in use.

I have found this antenna to be much more sensitive than the usual wire dipole. Perhaps this is due to the fact that it is free-standing. A wire dipole must be fastened to a wall, which is sure to degrade its performance. The same antenna position doesn't always work for different stations, however, even when they share the same transmitting antenna. Moving the antenna just a few feet can make a big difference. Since the antenna described here is so easy to move around, you can usually find a position where reception is good and noise-free.

Years ago, all FM stations used horizontal polarization, which made it necessary to use a horizontal antenna for reception in order to avoid a loss in signal strength of 10 to 20 dB. Now most stations use circular polarization, which works with both horizontal and vertical antennas.

The antenna shown here is a variation on the vertical quarter-wave type. Usually, the ground plane is horizontal, but here the rods that form the ground plane have been pointed downward. This increases the impedance from 50 to 70 ohms, which is better suited to FM tuners and allows the rods to serve as a tripod to support the antenna's base.

The antenna itself is of the same kind of rod as the legs. I used collapsible replacement antenna rods, which are available from most radio/TV supply shops. In fact, any metal rod that can be worked into the configuration shown will serve the same function. The minimum length required, however, is 28 inches.

The base of the antenna is a small project box—a plastic case with a metal cover. These are available from Radio Shack. Also required are a coaxial chassis connector, type F-61, and a solder lug.

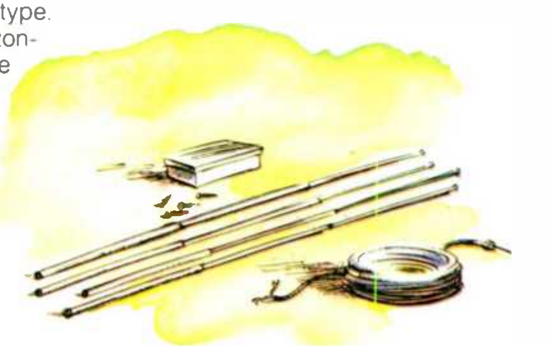
You will need a drill to complete this construction project. First, make a hole in the center of the plastic project box's bottom. Screw the antenna rod in

Illustrations: Gary Hovland

PARTS LIST

- 4 Replacement antenna masts (e.g., Radio Shack #15-232, if still available, or #270-1405).
- 1 Plastic project box with metal cover (e.g., Radio Shack #270-230 or #270-231).
- 1 Chassis-mount F-61 coax connector (e.g., Radio Shack #278-212).
- 1 75-ohm coaxial cable with F connectors, length to suit (e.g., Radio Shack #15-1531, 16 feet; or #15-1534, 25 feet).
- 1 75/300-ohm balun transformer (e.g., Radio Shack #15-1253); needed only for tuners without 75-ohm inputs.
- 1 Solder lug; if unavailable use solderless ring tongue (e.g., Radio Shack #64-3030, #64-3070, or #64-406).
- Miscellaneous: Short wire, 4 washers (optional).

A complete kit of parts is available for approximately $12 (plus sales tax for New York residents) from: Rivera, 1845 52nd St., Brooklyn, N.Y. 11204. Supplies of kits at this price are limited, however, so send a self-addressed stamped envelope, and Rivera will advise you of updated prices and delivery dates, where necessary.



RICHARD J. KAUFMAN

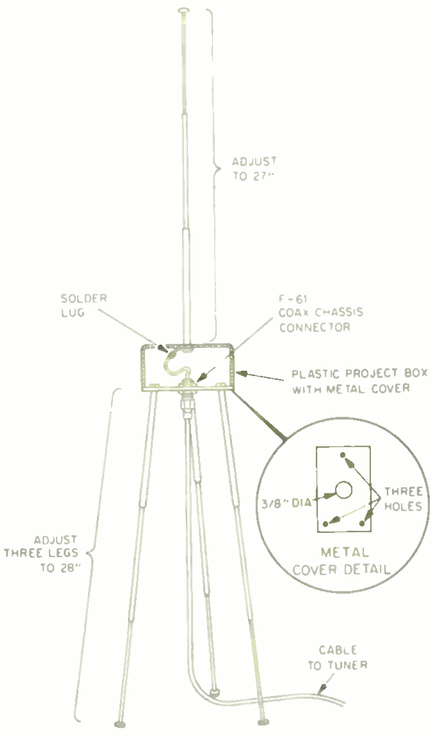


Fig. 1—Construction diagram.

place, with its retaining screw and the solder lug inside the box. It helps to bend the solder lug before passing the screw through it, to allow clearance for the wire that will have to be attached. It's also not a bad idea to use washers on the screw.

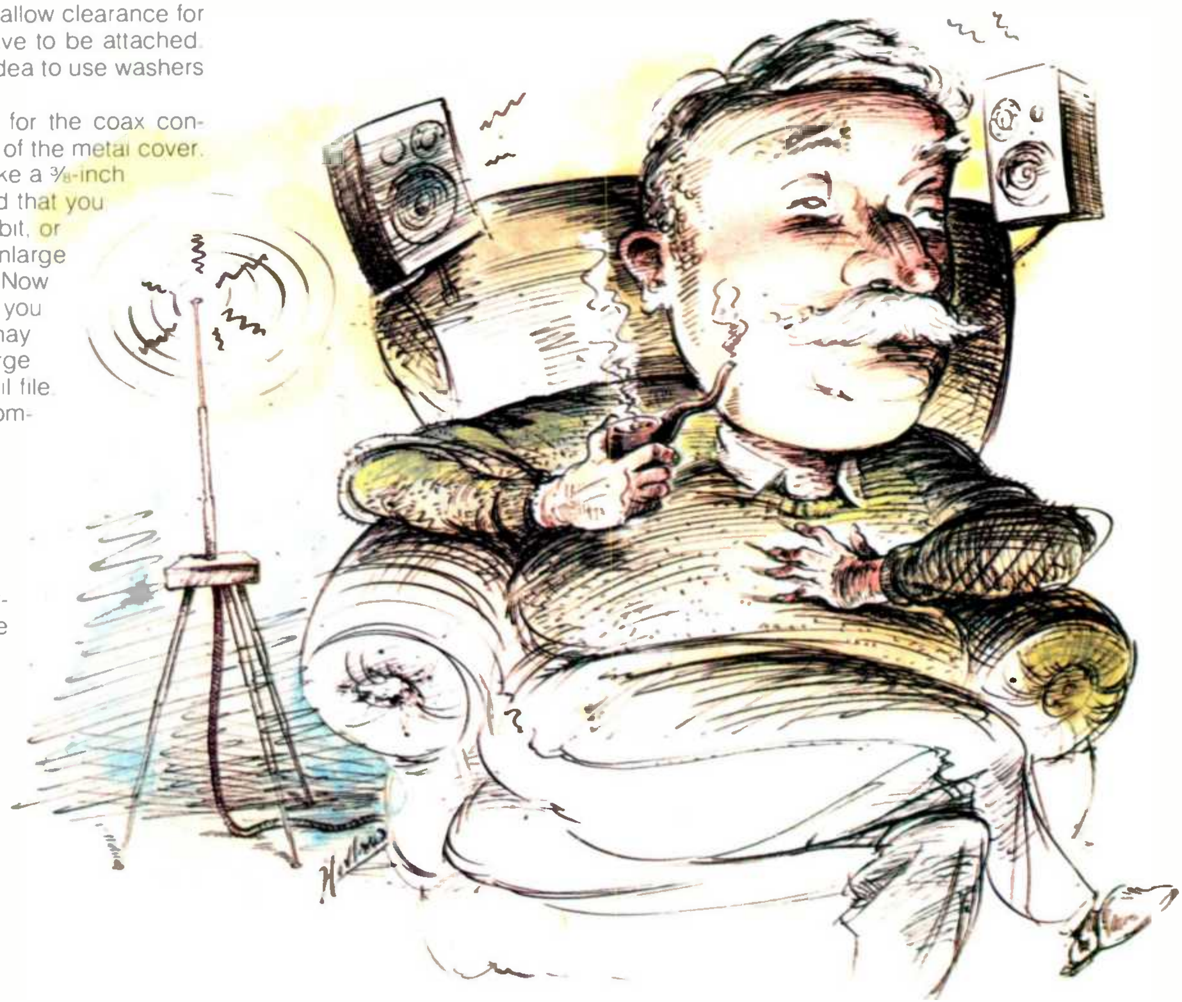
Next, drill a hole for the coax connector in the center of the metal cover. You will have to make a ⅜-inch hole. It is suggested that you start with a ⅛-inch bit, or thereabouts, then enlarge the hole to ¼ inch. Now use a ⅜-inch bit. If you don't have one, it may be possible to enlarge the hole with a rattail file. When the hole is completed, smooth the edges with a file.

Next, make three holes for the legs—one in the center of a short side, the other two in the corners of the opposite side. Be sure to allow sufficient clearance, both inside and outside the case, when selecting where to drill these holes. Use a punch to "dimple" the metal before drilling. This keeps the drill bit from walking away from the spot you selected and choosing its own place for a hole. If you don't have a punch, you can use a hammer and a nail—just be sure to tap lightly.

Now pass the coaxial connector through the ⅜-inch hole and secure it with the nut that came with it. (The nut should be on the inside of the box.) Attach the legs securely. Solder the shortest possible piece of wire to the solder lug on the antenna rod and to the solder tab of the coax connector. (Solder assures a secure connection and prevents corrosion from degrading the electrical contact.) Secure the cover with the four screws provided with the project box.

Extend each leg to a length of 28 inches and the antenna rod to 27 inches, as shown in Fig. 1. Gently force the legs apart, bending the metal cover until the legs splay out just enough to provide a stable base.

The coax cable should come down to the surface on which the antenna rests before beginning its horizontal run; this prevents interference with the antenna. If your tuner or receiver has 75-ohm inputs, use them. Otherwise, you will need a balun transformer even though it slightly decreases signal strength. You may also find that minor adjustments to the rods' length will improve performance. In general, if your rods allow such telescoping, lengthening the rods will yield good results on lower numbered stations, while shorter rods will perform better on the higher numbered ones. In my location, one length—29 inches for the legs, 28 inches for the antenna—works well for all the stations I listen to. **A**



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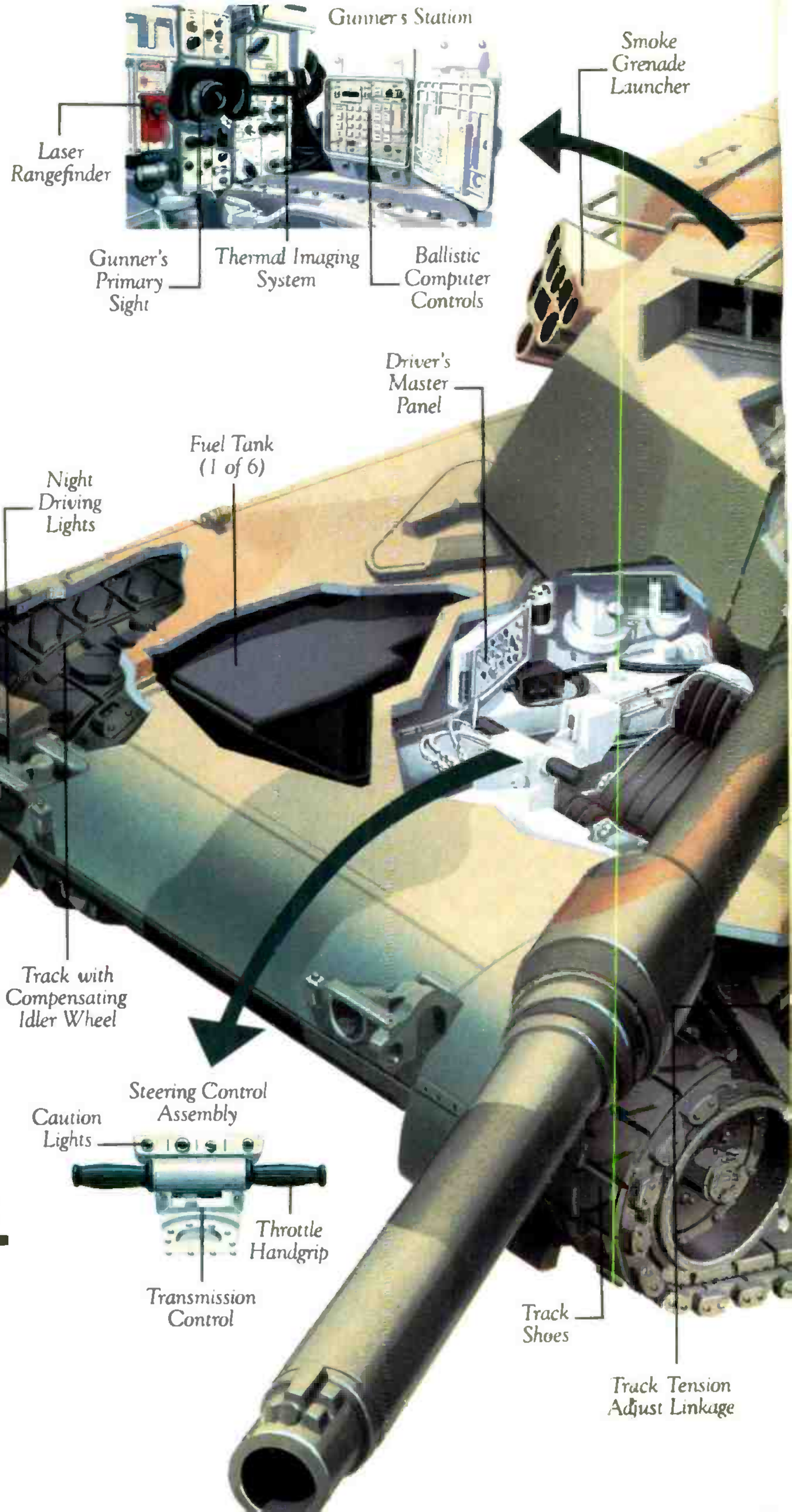

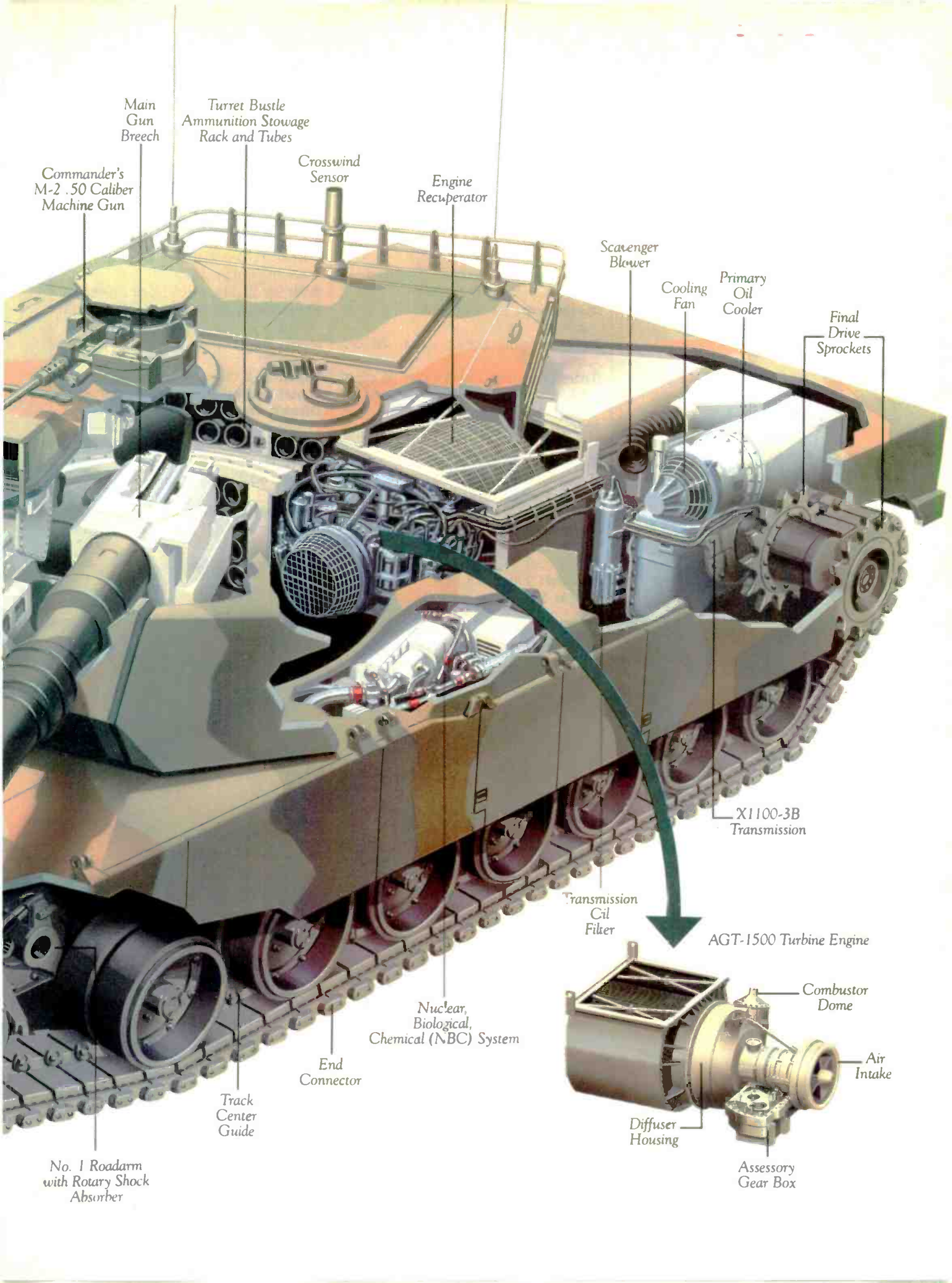
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No. 1 Roadarm with Rotary Shock Absorber

1

MOTIF MC8 PREAMP AND MS100 AMP

Manufacturer's Specifications

Preamplifier

Frequency Response: 5 Hz to 100 kHz, +0, –1 dB.

RIAA Equalization Accuracy: ±0.25 dB, 20 Hz to 20 kHz.

Distortion: Less than 0.1% THD or IM.

S/N: Low-gain phono input, 76 dB; line, 86 dB.

Gain: Low-gain phono input, 35 dB at 1 kHz; high-gain phono input, 54 dB at 1 kHz; line, 27 dB.

Phono Overload: Low-gain input, 150 mV.

Rated Output: 5 V rms.

Maximum Output: 10 V rms.

Output Impedance: Less than 200 ohms.

Dimensions: 19 in. W × 3½ in. H × 12¼ in. D (48.2 cm × 8.8 cm × 31.1 cm).

Weight: 9 lbs. (4.1 kg).

Price: $2,250.

Power Amplifier

Power Output: 100 watts per channel, 20 Hz to 20 kHz, at less than 1.0% THD or IM, both channels driven into 8-ohm load.

S/N: 96 dB below full rated power.

Frequency Response: 20 Hz to 20 kHz, +0, –0.25 dB.

Input Sensitivity: 1.5 V for full rated power.

Gain: 25.5 dB.

Input Impedance: 100 kilohms.

Dimensions: 19 in. W × 7 in. H × 18½ in. D (48.2 cm × 17.8 cm × 47 cm).

Weight: 55 lbs. (24.9 kg).

Price: $3,250.

Company Address: conrad-johnson design, 2800R Dorr Ave., Fairfax, Va. 22031.

For literature, circle No. 90

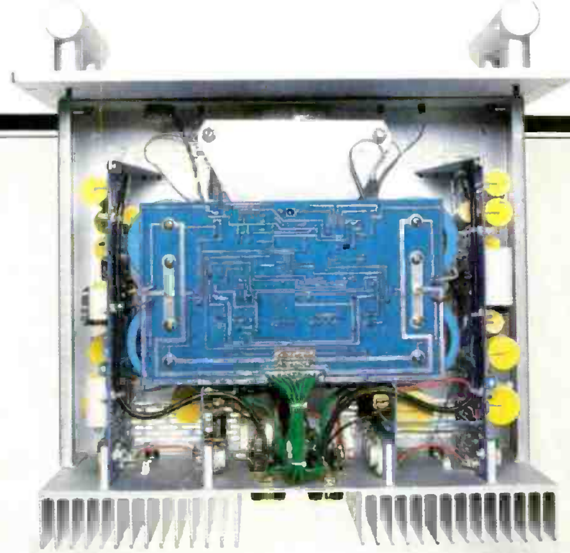
The MS100 and MC8 are among the top pieces of audio electronics manufactured by Motif, of conrad-johnson design. The MC8 preamplifier is an all-FET design which is unusual in at least one sense: It does not use any electrolytic capacitors in its circuitry—even in the power supply. The MS100 power amplifier is rated at 100 watts per channel into 8-ohm loads and uses a combination of junction and MOS-FET devices in the amplifier signal path.

A closer look at the MC8 preamp reveals that it is of the "minimum frills" school of design, eschewing the use of tone controls and other elaborate user features. Front-panel controls, from left to right, are a signal-selector switch, a three-position tape-monitor switch, a switched-resistor attenuator balance control, and a volume control. On the rear panel are a ground binding post and two sets of phono input jacks, one for MM and the other for MC, with a two-position toggle switch to select between them. The remaining signal jacks, for the high-level inputs and outputs, are to the left of the phono input jacks; an a.c. line cord is at the extreme left. There is no power switch on the MC8, as it was designed to be left on all the time for best sound. The power draw off the a.c. line is negligible.

Inside, we find a blue, one-sided p.c. board that seems to be dominated by large, proprietary film capacitors. This p.c. board takes up virtually all the internal area. An enclosed power transformer is mounted on the board, in the right rear corner. A power line fuse is mounted nearby, and the a.c. line cord is soldered right to terminals on the board. Parts appear to be of good quality. A number of jumpers on the component side of the board have been bent away from the straight path between their p.c. holes in order to miss hitting nearby metal contacts, such as the front-panel switches. The signal in/out jacks are Tiffany and are wired to the p.c. board with 300-micron, linear-crystal, solid silver wire.

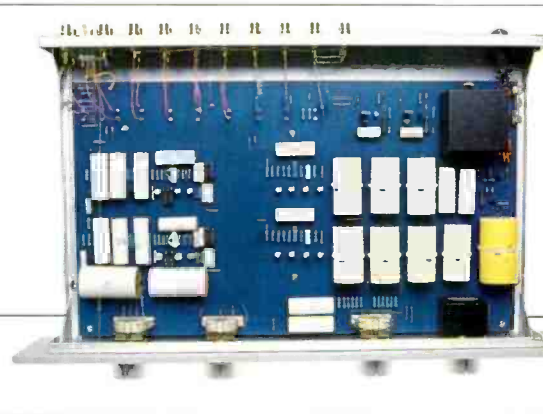
Chassis construction of this preamplifier is relatively simple, consisting of a bent piece of aluminum that forms the rear, bottom, and inner front panel. Little triangles of the same thickness material are spot-welded into the four bend corners to reinforce and give rigidity to the resultant structure. Another piece of material is bolted to the outside bottom of the chassis, by the four bumper feet; it is shy of the full width on both sides by about ½ inch. The top cover is a bent piece of the same material used for the chassis and forms the top and sides of the preamp, extending underneath about ½ inch. This cover is held on by four brass countersunk screws that bolt to the chassis bottom. The bottom has the appearance of one plane of material, a nice touch. A quarter-inch piece of aluminum, 3½ inches high and rack width, is used for the front panel.

Turning to the MS100 power amplifier, the front panel has a rotary on/off switch, a power-on LED, a pair of LED indicators to signify maximum power has been reached in each channel, and a pair of beefy and attractive handles. The rear panel is mostly heat-sink but has an area in the middle of about 4 × 6½ inches that has, mounted from top to bottom: A pair of Tiffany signal-input RCA jacks; a row of four fuse-holders for the positive and negative power-supply feeds for each channel's output stage; two pairs of five-way binding posts for speaker connection, and the power cord and line fuse.



The metalwork of the amplifier is composed of five major pieces. The bottom piece is bent up to form the bottom, a little less than half of the sides, and a half-height inner front panel. The rear facet of the bottom piece is mostly open, with a narrow lip all the way around. The top piece is similar, and both top and bottom pieces have slots for ventilation. The rear panel is composed of two identical but mirror-imaged heat-sink pieces with two vertical ledges on each, perpendicular to the inside surface, for mounting output and driver transistors. These heat-sinks are attached to the top and bottom pieces via machine screws into Pemm nuts on the rear surfaces of these pieces. A rack-width aluminum front panel, 7 inches high × ⅜ inch thick, completes the package and is mounted to the top and bottom pieces by long Allen-head machine bolts that go through the handles into Pemm nuts on the inner front panels.

Within the amplifier are a plethora of interesting, beefy parts. In the center front is a humongous toroidal power transformer, 6¼ inches in diameter and 3 inches high. On each side of the transformer, and to the rear, are two pairs of large, 59,000-µF, 75-V filter capacitors. On top of these capacitors is a fairly large p.c. board that contains voltage regulators and amplifier start/stop control circuitry, along with the circuitry for the maximum-power indicators on the front panel. The filter capacitors are connected, via their terminal screws, into heavy traces on this board; these power traces lead along the back edge of the board and end up as distribution points for all ground connections and for positive and negative power for the output stages. On the outside of the filter capacitors, running from front to back, are the two main amplifier circuit boards. These



The MS100 amp is full of interesting, beefy parts, including a humongous toroidal power transformer and large filter caps.

Table IA—Gain, MC8 preamp.

	Gain, dB			
	Left Channel		Right Channel	
	INSTR.	IHF	INSTR.	IHF
MM to Tape Out	34.3	33.8	34.2	33.8
MC to Tape Out	55.5	55.0	55.3	54.8
MM to Main Out	61.9	61.8	61.9	61.8
MC to Main Out	83.1	83.1	82.9	82.9
AUX to Tape Out	0	−0.45	0	−0.45
AUX to Main Out	27.6	27.4	27.5	27.4

Table IB—Sensitivity, MC8 preamp.

	IHF Sensitivity	
	Left Channel	Right Channel
MM to Tape Out	10.1 mV	10.2 mV
MC to Tape Out	890 μV	910 μV
MM to Main Out	405 μV	405 μV
MC to Main Out	34.5 μV	35.5 μV
AUX to Tape Out	525 mV	525 mV
AUX to Main Out	21.2 mV	21.2 mV

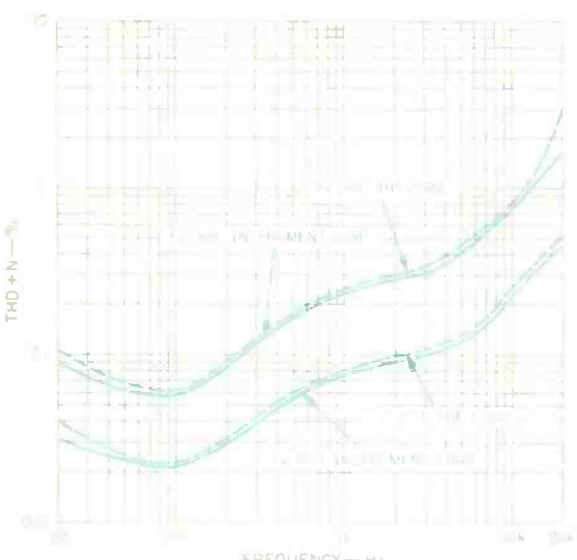


Fig. 1—THD + N for MM phono section of MC8 preamp, measured at tape out.

mount to the heat-sink ledges in the rear and to vertical mounting brackets at the front. On the inner heat-sink ledge are mounted shorter p.c. boards for the rest of the output stages. As in the preamp, the amplifier circuit p.c. boards are loaded with large conrad-johnson film capacitors for various coupling and bypass duties. Under the p.c. board, mounted atop the filter capacitors, are two large relays for turn-on/turn-off sequencing, the rectifier bridge for the main output stage supply, and a small "keep alive" power transformer for powering the on/off control circuitry.

Circuit Description

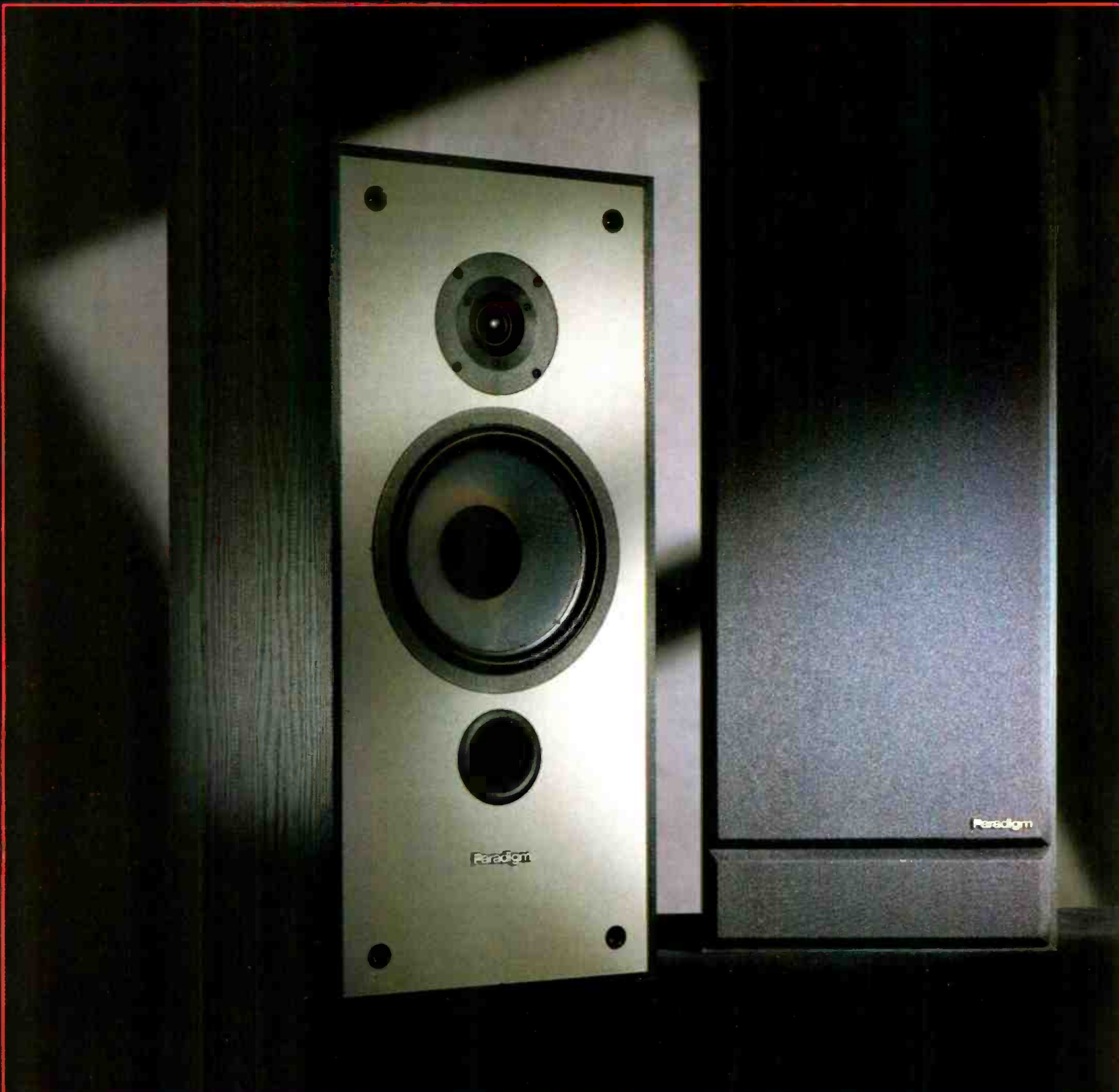
We'll look into the preamp circuitry first. The overall signal-flow topology is quite usual, with the selected source going into the center-contact position of the three-position tape-monitor switch. The two tape input sources, in addition to going to the main signal-selector switch, go to the two other positions of the tape-monitor switch, thus allowing you to monitor the output of either connected tape recorder or the selected signal source. The output of the tape-monitor switch goes on to the balance control and then to the main volume control. The balance control, in this unit, is a stepped attenuator that lowers gain in one channel while keeping the other channel's gain unchanged. The volume control is a nice dual Alps unit. The values of the balance control attenuator and volume control, both 100 kilohms, cause a line input impedance of about 50 kilohms. The output of the volume control feeds the output amp, which always feeds the output jacks. There are two sets of phono input jacks on the rear panel. The MC set directly feeds the MC pre-preamplifier. The switch between these sets of jacks selects the output of the pre-preamp or the MM phono input jacks. The wipers of this switch feed the main phono equalizer stage.

The MC pre-preamp appears to be a single, high-transconductance, N-channel junction FET, connected in common-source mode with drain and source resistors sized for a voltage gain of 24×. This stage inverts the signal, whereas the rest of the preamp does not. If you want to preserve absolute polarity in your system when using the MC pre-preamp, it would be a good idea to reverse the polarity of the connections on the system phono cartridge.

The main phono stage is a three-junction FET circuit using N-channel devices. The first stage is a common-source-connected configuration that is capacitor-coupled to the second stage through a series resistor. This second stage is also connected in the common-source mode. The drain, or output, of the second stage is direct-coupled to a third stage, which uses the third device as a source follower. A feedback network, composed of two parallel RC networks in series, is connected from the output of the third stage back to the aforementioned series resistor, which couples the first and second stages. This feedback loop rolls off the open-loop gain of the circuit, presumably in a manner like the RIAA curve. Another feedback loop, again consisting of two parallel RC networks in series, is connected from the output of the third stage back to the source of the first stage, thus making the overall phono circuit a noninverting, feedback RIAA equalizer.

The output amplifier is a four-device circuit using, again, N-channel junction FETs. The first stage is a common-source-connected arrangement that is direct-coupled to a source follower. The output of this source follower is capacitor-coupled to a second common-source stage, which is also connected directly to a source follower. The output of this last device is capacitor-coupled to the main output jacks through small buffering resistors. Local feedback is used in each of the common-source stages, and an overall feedback loop is applied from the output source follower back to the input source, thus creating a noninverting flat amplifier.

....remarkable!



par.a.digm [par'adim] *noun: serving as an example or model of how something should be done.*

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The tracking of the MC8's dual Alps volume control was outstanding. Its two channels tracked each other within ±0.25 dB.

Fig. 2—Phono equalization error for MM mode (A) and MC mode (B).

Table II—Phono section noise, referred to input. In MM mode, with all source impedances (0 and 100 ohms, and IHF MM), noise in wideband and from 20 Hz to 20 kHz exhibited a $\frac{1}{f}$ characteristic. In MC mode, the same was true only for 0-ohm source impedances.

Bandwidth	Source Impedance, Ohms	Referred Input Noise LEFT	Referred Input Noise RIGHT
MM MODE			
Wideband	0	2-2.5 μV	2-2.5 μV
20 Hz to 20 kHz	0	1.7 μV	1.2 μV
400 Hz to 20 kHz	0	0.42 μV	0.41 μV
A-Weighted	0	0.45 μV	0.43 μV
Wideband	100	2-2.5 μV	2-2.5 μV
20 Hz to 20 kHz	100	1.7 μV	1.2 μV
400 Hz to 20 kHz	100	0.43 μV	0.41 μV
A-Weighted	100	0.46 μV	0.43 μV
Wideband	IHF MM	2-2.5 μV	2-2.5 μV
20 Hz to 20 kHz	IHF MM	1.6 μV	1.4 μV
400 Hz to 20 kHz	IHF MM	0.65 μV	0.64 μV
A-Weighted	IHF MM	0.64 μV	0.63 μV
MC MODE			
Wideband	0	2.5-3 μV	2.5-3 μV
20 Hz to 20 kHz	0	1-1.5 μV	1.5-2 μV
400 Hz to 20 kHz	0	125 nV	130 nV
A-Weighted	0	140 nV	160 nV
Wideband	100	2.5-3 μV	2.5-3 μV
20 Hz to 20 kHz	100	1-1.5 μV	1.5-2 μV
400 Hz to 20 kHz	100	125 nV	145 nV
A-Weighted	100	140 nV	170 nV

Interestingly enough, the power supply starts out with a power transformer feeding a full-wave bridge rectifier that is terminated in a capacitor input filter. What is unusual is that this filter capacitor is not your usual 50- to 500-μF electrolytic but a 30-μF film unit. Unregulated d.c., at this point, is +76 V and feeds the input of a solid-state regulator. The output of this regulator, +65 V, in turn feeds two more regulators that reduce and further regulate down to +45 V, in order to supply separately regulated voltages to each channel. The regulator circuitry used here is of the favorite conrad-johnson variety, consisting of a constant-current-connected transistor feeding a zener-diode reference, which in turn feeds the input of a Darlington-connected emitter-follower pair whose output is the regulated voltage. An emitter-followed voltage divider off of each channel's regulator feeds about +15 V to the MC pre-preamp stages. Needless to say, the regulator circuitry is appropriately bypassed with conrad-johnson film capacitors.

There is no turn-on/turn-off muting circuitry in this preamp, as there is no power switch; the intention is to leave the unit on all the time. Since the MC8 preamp does produce significant transients at turn-on and turn-off, I recommend that the system power amp be left off when the system is not in use. If your power goes out while listening, turn off the power amp to prevent the turn-on surge from reaching the speakers when the power comes back on. I unplugged the preamp with my amp on and active, and it produced a big "blap" in my poor woofers, bottoming the suckers right out.

The circuitry of the MS100 amp is not the usual solid-state variety at all. It doesn't have a complementary-differential, or even a straight-differential, front-end. The input device is an N-channel junction FET connected in a common-source configuration. The input signal is coupled to the gate of the FET through a 2-μF film capacitor and a small series resistor. The resistance between the FET side of the capacitor and signal ground is 100 kilohms, thus setting the amplifier input impedance at that value. The drain supply for this stage is an adjustable isolation regulator that essentially divides down a regulated +25 V and feeds the reduced voltage to a Darlington-connected emitter follower, the output of which feeds the drain of the first stage through a suitable resistor. This isolation regulator is suitably bypassed, with conrad-johnson film capacitors. The output of the first stage is direct-coupled to another N-channel junction FET connected as a source follower. The 100-kilohm input resistor and the two junction FET source resistors are returned to a regulated −25 V. This second stage is, in turn, direct-coupled to the gate of an N-channel MOS-FET connected as a common-source amplifier that functions as the last voltage amplifier and swings the entire output voltage—and more. Return for the source of this stage is to actual ground. The supply voltage for this stage is a regulated +175 V. Drain load is a low 2 kilohms, implying a stage current of some 40 to 50 mA. Considerable source feedback is used in this stage, reducing the maximum attainable stage voltage gain to about 13× or 14×. The operating point of the last voltage-amplifier stage is set by the variable isolation regulator that feeds the first stage.

The last voltage-amplifier stage is capacitor-coupled to the driver for the output stage, which is a complementary set of MOS-FET devices operated as source followers working with an unregulated supply of ±50 V. Output of this driver stage is direct-coupled to the output stage itself, which also has complementary MOS-FET devices connected as source followers and is operated from the unregulated ±50 V supply. The composite output devices are made up of three paralleled TO-3 MOS-FETs, totalling six output devices per channel. Two separate, adjustable voltage dividers—one fed from regulated +25 V and the other from regulated −25 V—feed the appropriate driver-transistor

The curve of THD vs. level was unusually flat. This is rarely seen in any amp, tube or solid state.

Table III—Left-channel phono overload vs. frequency and load.

	MM Mode			
	Instrument Load		IHF Load	
Frequency, Hz	INPUT, mV	OUTPUT, V	INPUT, mV	OUTPUT, V
20	19.0	8.7	9.6	4.0
50	24.7	8.7	11.8	4.0
100	38.0	8.7	18.3	4.0
300	89.0	8.5	43.5	4.0
700	140.0	8.3	71.0	3.9
1k	158.0	8.1	80.0	3.9
3k	260.0	7.7	132.0	3.8
5k	370.0	7.4	189.0	3.6
7k	475.0	6.9	247.0	3.5
10k	605.0	6.0	320.0	3.2
15k	715.0	4.5	395.0	2.6
20k	680.0	3.3	420.0	2.1
	MC Mode			
	Instrument Load		IHF Load	
Frequency, Hz	INPUT, mV	OUTPUT, V	INPUT, mV	OUTPUT, V
20	1.7	8.7	0.88	3.9
50	2.2	8.7	1.06	4.1
100	3.3	8.6	1.6	4.1
300	7.75	8.5	3.8	4.0
700	12.0	8.2	6.1	3.9
1k	13.5	8.0	7.0	3.9
3k	22.7	7.7	11.3	3.7
5k	32.0	7.3	16.8	3.7
7k	40.0	6.8	21.5	3.5
10k	56.0	6.3	27.8	3.2
15k	68.0	4.7	34.0	2.6
20k	63.0	3.5	38.5	2.2

Table IV—Output amplifier noise of MC8, referred to input, vs. bandwidth for clockwise (CW) and worst-case (WC) volume control settings. For this preamp, worst-case setting was 6 dB down from full clockwise. Source impedance was 1 kilohm.

	Referred Input Noise, µV			
	Left Channel		Right Channel	
Bandwidth	CW	WC	CW	WC
Wideband	3.8	8.8	3.8	7.4
20 Hz to 20 kHz	1.68	2.7	1.6	2.83
400 Hz to 20 kHz	1.15	2.63	1.15	2.65
A-Weighted	1.1	2.53	1.1	2.5

gates through 221-kilohm resistors. This allows the adjustment of both idling current and d.c. centering of the output amplifier. Each channel's output stage is bypassed locally with a parallel combination of 0.15- and 30-µF conrad-johnson film capacitors for both positive and negative supplies. The output of the amplifier is coupled to the hot, or positive, speaker connector through a parallel-connected inductor and resistor. The usual series RC network is connected from the amplifier output to ground. Overall negative voltage feedback is taken from the output back to the input device's source connection, thus creating an overall noninverting topology. The amount of loop gain is not very high, by design, and thus the amount of overall negative feedback is on the order of 20 dB.

The three voltage regulators mentioned are of the typical conrad-johnson design, utilizing a constant-current-operated bipolar transistor feeding a zener diode that, in turn, feeds Darlington-connected emitter followers whose output is the regulated d.c. voltage. Numerous conrad-johnson film capacitors bypass various points in each of these voltage regulators.

The power supply and on/off circuitry of the MS100 are a little more elaborate than those found in the usual amplifier topology. Special considerations must be given to turning on a circuit like this, in order to prevent speaker-damaging surges. A small "keep alive" supply is always on when the amp is plugged in. This supply consists of a small power transformer feeding a full-wave bridge rectifier and charging a filter capacitor through a small fuse. The front panel's power switch connects this ever-present d.c. to a circuit that applies power to one of the contactor relay coils through the two thermal switches mounted on the heat-sink. The contacts of this relay then connect the a.c. line to the primary of the main power transformer. This transformer has two secondaries, one of which feeds a full-wave bridge rectifier and capacitor input filter that develops about +240 V. This voltage feeds the input to the +175 V regulator. Thus, the last voltage amplifier comes on at this time and charges up the coupling capacitors to the driver and output stage.

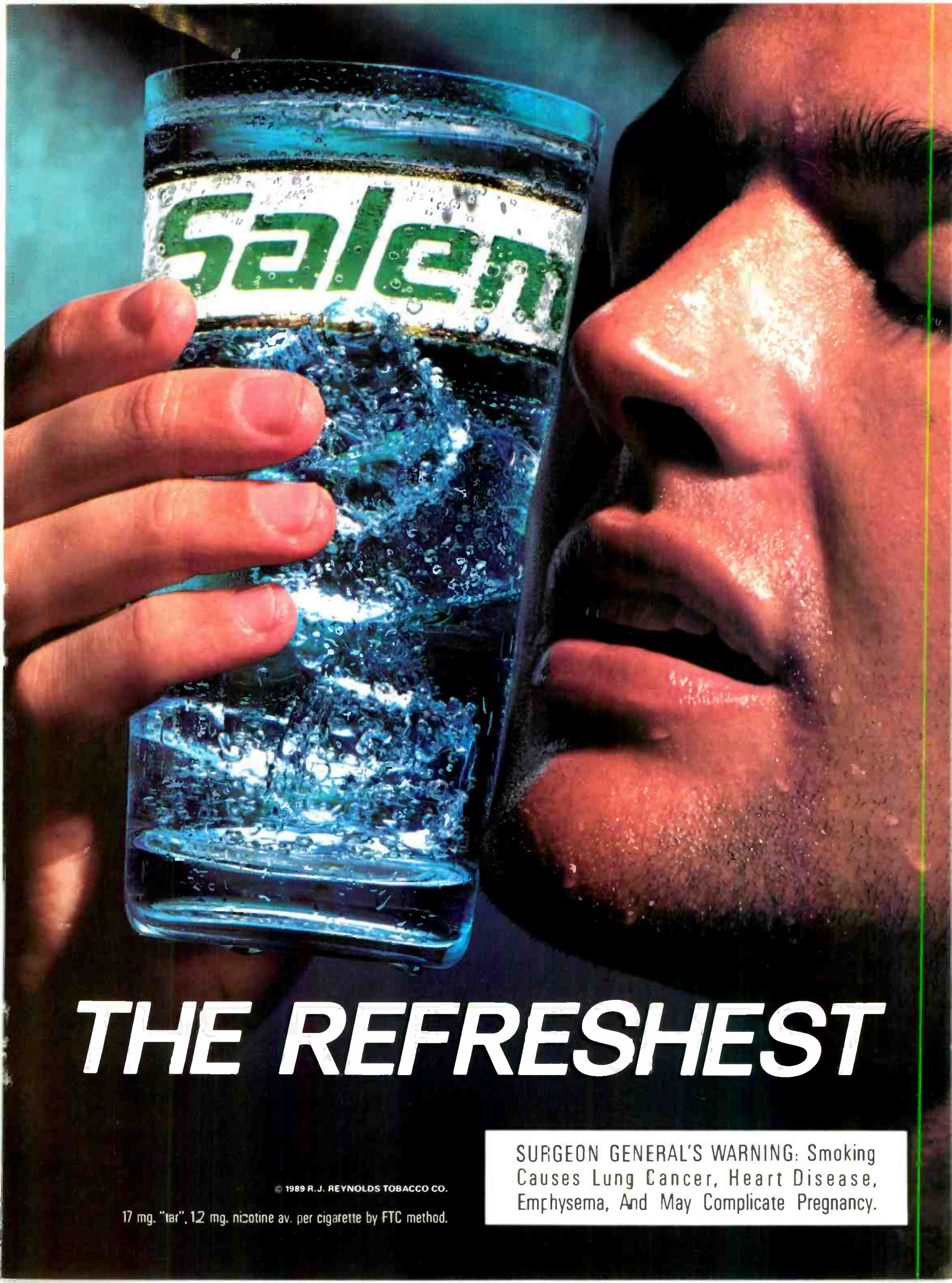
Now let's go back to the rest of the control circuit that becomes active when the power switch is turned on. A time-delay circuit starts a capacitor charging up, and, after several seconds, that capacitor causes a unijunction transistor to fire and consequently to fire an SCR. This energizes the coil of the second relay. The contacts of this relay then connect the other secondary of the main power transformer to a full-wave bridge rectifier connected to the main filter capacitors. This unregulated ±50 V supply has one bridge rectifier and paralleled capacitors for a total of over 100,000 µF for each supply. Both output amplifiers are operated from this common supply. Lastly, the positive and negative 25-V regulators are activated at the turn-on of the ±50 V supply, thus activating the amplifier front-end circuitry.

Preamplifier Measurements

The MC8 was measured first. Gains and IHF sensitivities appear in Table I. Output impedance, at tape out, was about 600 ohms, while impedance at main out was more like 135 ohms.

Referred input noise for the phono equalizer is shown in Table II for a variety of bandwidths, source impedances, and the MM and MC operating modes. IHF S/N ratio was about −76.4 dB in MM mode and was closer to −70 dB in MC mode.

Phono overload versus frequency, for both MM and MC modes, is shown in Table III. The data given is for the left channel, which was the worse of the two by about 10%. Overload was either the onset of negative peak clipping or of slewing near the negative peak, as observed visually on a 'scope. An ideal phono preamp would have constant maxi-



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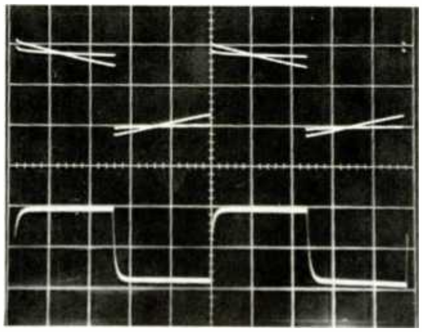

Fig. 3—MM phono response to pre-equalized square waves of 40 Hz (top trace) and 10 kHz (bottom trace), for both instrument and IHF loading. The effects of the change of load are more visible in the top trace. Scales: Vertical, 200 mV/div. (top) and 50 mV/div. (bottom); horizontal, 5 mS/div. (top) and 20 µS/div. (bottom).

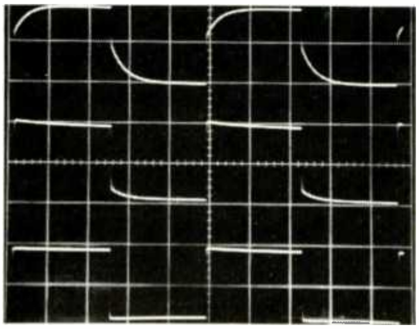

Fig. 4—MM phono response to pre-equalized 1-kHz square wave at three input levels. Scales: Vertical (top to bottom), 2 V/div., 0.5 V/div., and 50 mV/div.; horizontal, 200 µS/div.

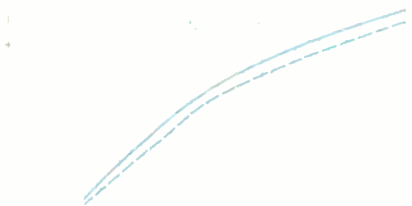

Fig. 5—Line-section THD + N vs. output level for IHF and instrument loads.

mum output level at overload, as a function of frequency, and this overload would be caused by output clipping and would be independent of output loading. The circuit measured here falls short of this ideal—as do most I have measured. The circuit is loaded down quite a bit by IHF loading, and the output level attainable at high frequencies falls off considerably. Taken realistically, the 1-kHz figure of 158 mV of input acceptance is pretty good. I imagine, for a worst-case scenario, a pickup which delivers 10 mV at standard cutting level and puts out peaks 20 dB higher, or 100 mV at 1 kHz. This is less than the input overload capability with IHF loading, which is equivalent to using a tape recorder whose input impedance is 10 kilohms. In practice, this is not likely to be a problem, as there are very few 10-mV pickups. One situation to watch out for, though, would be the use of an MC step-up transformer or the MC pre-preamp with a high-output MC cartridge and the use of a tape recorder whose input impedance is as low as 10 kilohms.

Figure 1 shows the phono circuit's THD + N as a function of frequency for output levels of 1 and 3 V rms. In general, distortion at low levels remains satisfactorily low all the way to the upper midrange frequencies, but as levels increase, higher distortion figures intrude lower into the frequency range.

Phono equalization error for MM and MC modes is shown in Fig. 2. Related to equalization accuracy are the square-wave photos in Fig. 3. Shown here are two frequencies, 40 Hz and 10 kHz, with instrument loading (91 kilohms in parallel with 200 pF) and IHF loading (10 kilohms in parallel with 1,000 pF). The increased tilt with IHF loading at 40 Hz (top trace) is caused by the fact that, with this 10-kilohm loading, the low-frequency corner made by the phono output coupling capacitor against the load at tape out (where these measurements are made) moves up to about 8 Hz.

One of my favorite ways to look at high-frequency, out-of-band signal handling in RIAA equalizer circuits is to apply a pre-equalized square wave to the circuit under test without any high-frequency band limiting. This test is admittedly severe and seemingly unrealistic, but it may have some sonic relevance. When pickups mistrack, especially MC ones, out-of-band energy—sometimes of considerable magnitude—may occur. This could cause a musical transient generation and the blocking of some musical detail. A 1-kHz square wave is applied to the MC8's MM phono input at different levels. The three traces in Fig. 4 are for increasing output levels, from bottom to top. The bottom trace is for 50 mV/div., which is a pretty small output signal. Note this waveform's nice and accurate flat top and bottom. This shows that the frequency response of the circuit (equalization accuracy) is very good, which it is in the audio band. The middle trace is at 500 mV/div., a typical working level when playing records. Here, the top and bottom of the waveform are different, with the bottom exhibiting some high-frequency roll-off. Finally, in the top trace, at 2 V/div., high-frequency compression is evident in both halves of the waveform, although to different degrees. Compression is evidenced in the top trace by the reduced change of amplitude coming into the leading edges of the top and bottom of the waveform, as compared with the amplitude of the

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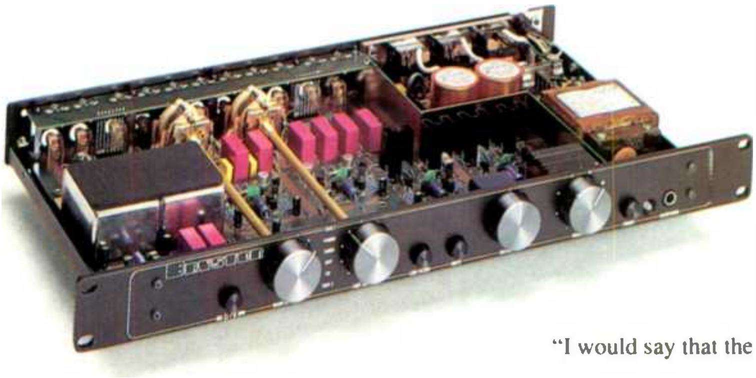

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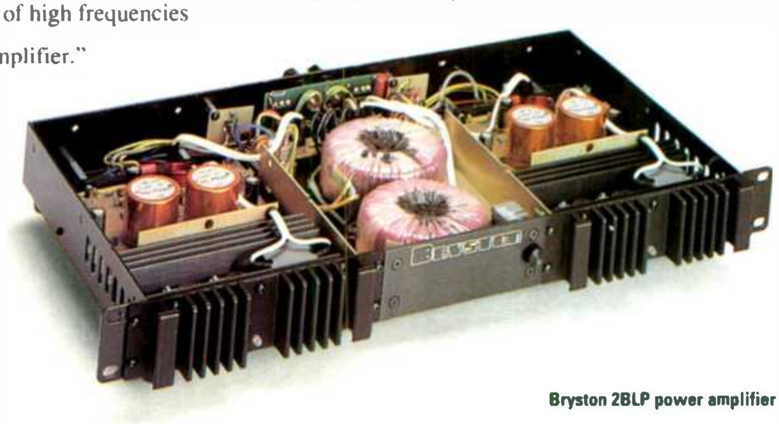
Audio Magazine, U.S.A.



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The MS100 power amp is a nice, musical-sounding component, with a slightly laid-back perspective in the upper frequencies.

Table V—Line amplifier crosstalk (right to left channel) at three control settings, for MC8 preamp with 1-kilohm termination in undriven input. Low-frequency measurements, e.g., 20 and 50 Hz for condition A, were dominated by noise, not crosstalk.

Frequency, Hz	Crosstalk, dB Condition A	Condition B	Condition C
20	−86.5		
50	−86.5		
100	−86.0	−77.5	
300	−82.7	−66.7	
700	−76.6	−59.4	
1k	−73.7	−56.4	−55.5
3k	−64.4	−46.8	−46.0
5k	−60.0	−42.5	−41.7
7k	−57.0	−39.5	−38.8
10k	−53.9	−36.4	−35.6
15k	−50.5	−33.0	−32.2
20k	−48.0	−30.5	−29.5

Condition A: Volume control full clockwise, balance control at center.
Condition B: Volume control full clockwise, balance control two clicks toward driving channel.
Condition C: Volume control at worst-case setting, balance control two clicks toward driving channel.

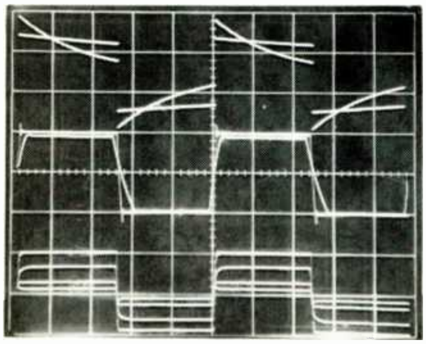


Fig. 6—Line-section square-wave response. Top trace is at 20 Hz, with IHF and instrument loading (traces superimposed). Middle trace is at 20 kHz, 10 V peak to peak, with instrument and IHF loadings superimposed. Bottom trace is at 20 kHz, instrument loading, for various volume control positions; see text.

Scales: Vertical, 1 V/div. (top and bottom) and 5 V/div. (middle); horizontal, 10 mS/div. (top) and 10 μS/div. (middle and bottom).

steady-state portions further into each top and bottom of the wave. I don't mean to single out the MC8 as an example here. Many phono preamps exhibit this behavior in varying degrees, and we will be seeing more examples of this in future reviews.

Interchannel crosstalk was measured for the phono section in both MM and MC modes. In general, crosstalk was asymmetrical, with less isolation (more crosstalk) in the right-to-left direction. In the poorer direction (right to left), crosstalk was similar in the MM and MC modes when the undriven channel's input was terminated (with 0 ohms for MM or 100 ohms for MC). It was greater than −70 dB from 20 to about 500 Hz, rising to −63 dB at 5 kHz and to −60 dB at 20 kHz. In the MM mode, using the IHF MM dummy source, crosstalk was similar to that with the 0-ohm termination up to about 1 kHz but then became worse, peaking up to −47 dB at 10 kHz, which is the resonant frequency of the dummy source. All phono crosstalk was found to be "in phase," which means that the crosstalk of leakage has the same polarity or direction as the driving channel when a pre-equalized pulse or square wave is used. Crosstalk performance of the MC8 was pretty good in the phono mode and, of itself, should not cause any degradation of the stereo image.

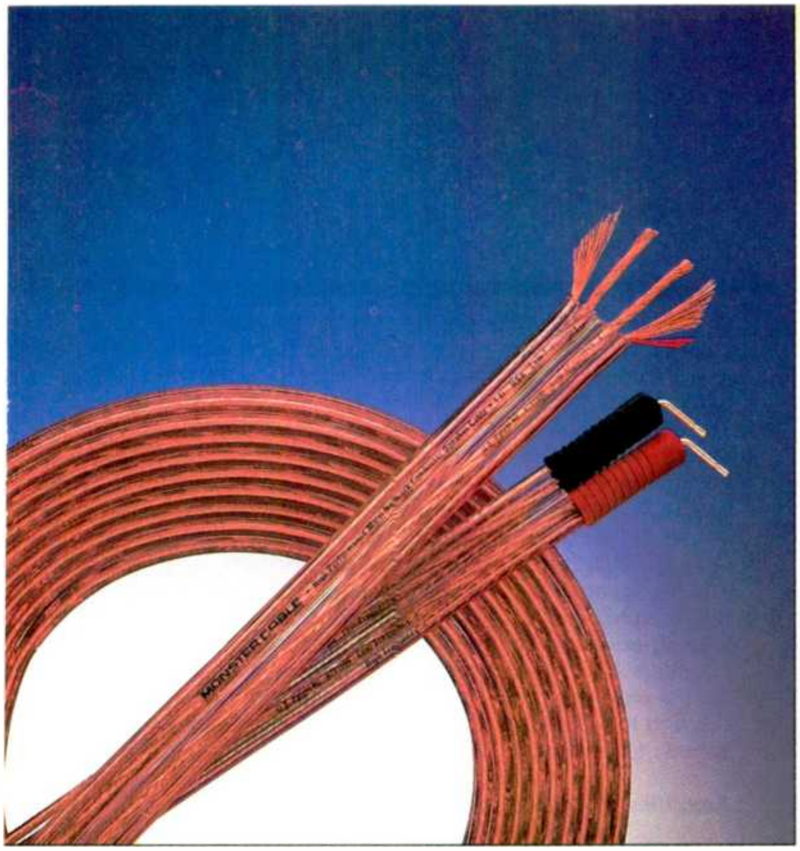
Turning now to the line section of the MC8, gain and IHF sensitivities are listed in Table I. Output amplifier noise, referred to input, is shown in Table IV for several bandwidths and conditions, including two volume-control positions. Most circuits have lowest noise when the source impedance to the amplifier is the lowest, which occurs when the volume control is either turned down or all the way up. The worst-case source impedance occurs when the volume control is about 6 dB down from maximum; the referred input noise is usually the highest under these conditions. The IHF S/N ratio for the output section was −83.6 dB in both channels.

The output section was generally quite capable, being able to drive the IHF load at up to 5 V rms over the whole audio band. There was little difference in THD + N from its performance when driving a higher impedance load, as shown by Fig. 5. Distortion was fairly constant in level over the audio frequency range and was dominantly second harmonic in nature.

Table V shows crosstalk versus frequency for three combinations of balance and volume settings. Results were very similar in each direction; the right-to-left direction is shown in the Table. The most potentially troublesome of these conditions might be with the balance control off center by two or more clicks. Crosstalk gets as high as about −30 dB at 20 kHz, and this might start to degrade stereo imaging. Crosstalk in the line section was in phase.

Tracking of the dual Alps volume control was absolutely outstanding: Channel-to-channel tracking, as a function of attenuation or volume control position, was within ±0.25 dB down to −60 dB and +0.25 and −0.4 dB down to −75 dB. For its five off-center positions, the balance control reduced level by 1.65, 3.1, 4.4, 5.5, and 7.1 dB in whichever channel was attenuated.

Output amplifier rise- and fall-times, as a function of level and loading, are detailed in Table VI. Oscilloscope pictures



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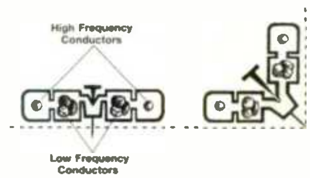

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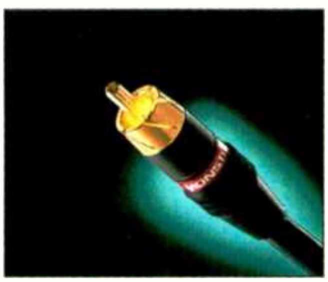

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Surprisingly, the preamp was quieter through its MC than its MM inputs, although I preferred the sound of the latter.

Table VI—Rise- and fall-times vs. level and loading for output amp section of MC8 preamp. Time measured was transition between 10% and 90% of peak-to-peak amplitude. Volume control set full clockwise. Slewing indicated by asterisk (*).

Output Level	Instrument Load Rise-Time, µS	Instrument Load Fall-Time, µS	IHF Load Rise-Time, µS	IHF Load Fall-Time, µS
2 V peak to peak	0.5	0.5	0.5	1.1*
5 V peak to peak	0.5	1.0*	2.5*	4.5*
2 V peak to peak, volume control at −6 dB	0.8	0.8	0.8	1.2*

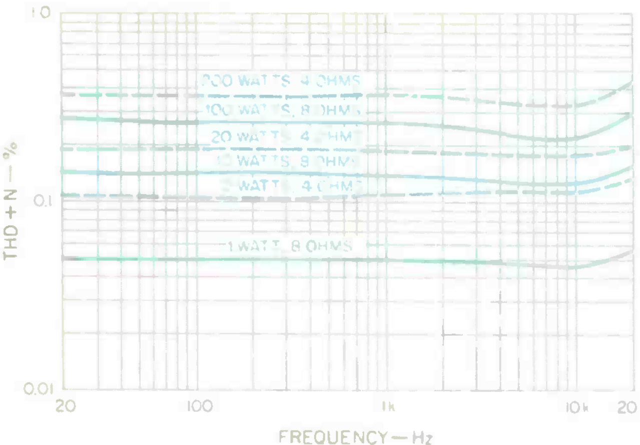


Fig. 7—THD + N vs. frequency for MS100 amp, at various power levels, into 4 and 8 ohms.

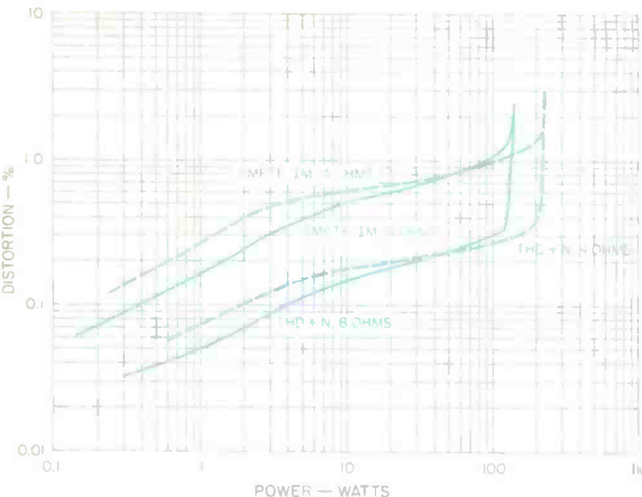


Fig. 8—SMPTE IM and THD + N vs. power for 4 and 8 ohms. THD + N is for a 1-kHz test signal, with distortion products measured from 400 Hz to 80 kHz.

of square waves through the output amplifier for various conditions are shown in Fig. 6. The top trace illustrates the low-frequency tilt that occurs with IHF (10-kilohm) loading, as opposed to 91-kilohm loading on a 20-Hz square wave. The middle trace is for a 20-kHz square wave at 10 V peak-to-peak output with instrument and IHF loading. Slewing is taking place here for both loadings, and the noticeably longer time for the negative-going transition with IHF loading is due to the single-ended, source-follower output FET being cut off during this time period. The bottom trace—for a 20-kHz square wave with instrument loading and with various volume control positions—shows how the small-signal, leading-edge shape changes as a function of volume control position. The biggest signal amplitude is for the volume control wide open, the next largest amplitude is at about −6 dB, and the smallest is at about −20 dB, where the control is likely to be used a lot.

Amplifier Measurements

The MS100 was first run at one-third rated power, or 33.33 watts per channel, for one hour. Its heat-sinks got hot, but not excessively so, and the unit did not thermally cut out during the one-hour preconditioning period.

Voltage gain with 8-ohm loads was 25.4 dB, close to the 26-dB gain of most power amps I've run across. IHF sensitivity (the input voltage required to produce 1 watt into 8 ohms at 1 kHz) was 152 mV.

The front-panel overload indicators come on at 95 to 100 watts into 8 ohms. Their indication is independent of loading, as they measure the output voltage that corresponds to the 8-ohm rated power of 100 watts.

THD + N, as a function of frequency, loading, and output power, is shown in Fig. 7. Data is for the right channel, which had slightly higher distortion than the left. THD at 1 kHz, and SMPTE-IM distortion versus power and load, are plotted in Fig. 8. Of note here is the unusual flatness of THD level with frequency. This is rarely seen in any power amp—tube or solid state. The nature of distortion residue in this amp is dominantly even-order and is illustrated in Fig. 9 for 10 watts output at 1 kHz into 8 ohms.

The IHF S/N ratio—A-weighted noise below 1 watt into 8 ohms—was 77.8 dB and 82.5 dB in the left and right channels, respectively.

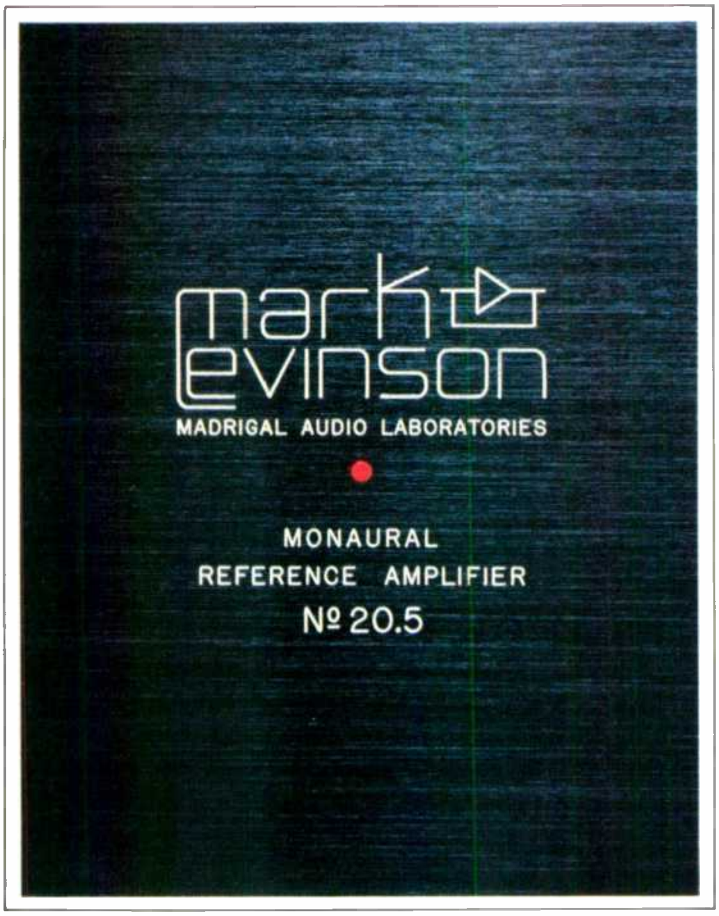
Crosstalk versus frequency was worse in the left-to-right direction. It was greater than −80 dB up to several kHz, decreasing to −75 dB at 10 kHz and −64 dB at 20 kHz.

Damping factor versus frequency is shown in Fig. 10 for both channels of the MS100. The results are very close for the two channels.

The stability of the output stage's idling current, as measured by the a.c. power-line draw, was very good with this amplifier, varying from about 1.24 amperes at cold turn-on to about 1.3 amperes after blasting the amp into 4 ohms for a while with the heat-sinks *hot*.

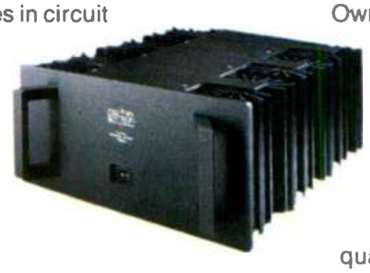
Frequency response at 1 watt into 8 ohms was down 0.2 dB at 10 Hz, 0.05 dB at 20 Hz and 20 kHz, and 1.3 dB at 100 kHz. Square-wave performance of the amp is shown in Fig. 11. The top trace is for 10 kHz into 8 ohms at about 10-V peak-to-peak amplitude. The middle trace is for 2 µF paralleled across 8 ohms; ringing is nicely controlled here. The

THE EVOLUTION CONTINUES



ENGRAVING – January 1989

In the three years since the introduction of the Mark Levinson No. 20 Monaural Reference Amplifier, advances in circuit topologies and components available to the Madrigal design staff have made it possible to produce a new reference. The No. 20.5 Monaural Reference Amplifier is an ultimate statement of our craft and a benchmark for future designs.



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Together, the MC8 preamp and MS100 amp sounded open, spacious, and very musical, providing good revelation of inner detail.

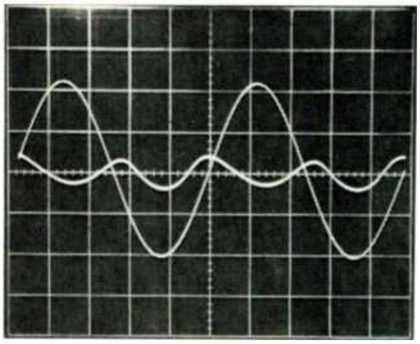

Fig. 9—Response to 10-watt, 1-kHz sine wave. Distortion products (predominantly even harmonic) are superimposed.

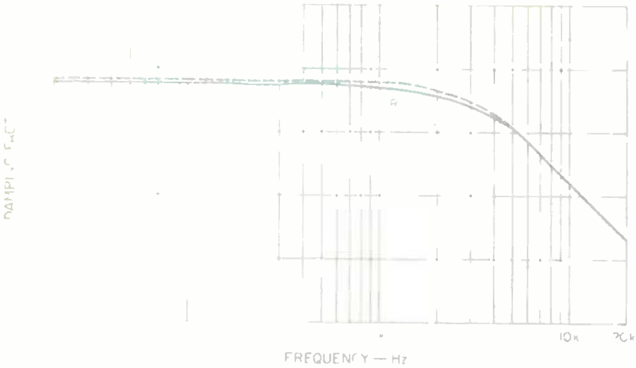

Fig. 10—Damping factor vs. frequency for 8-ohm load.

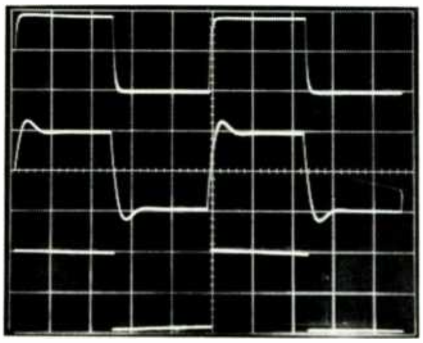

Fig. 11—Amplifier response to square wave. Top trace is 10 kHz with 8-ohm resistive load. Middle trace is 10 kHz with 2-μF capacitance across 8-ohm load. Bottom trace is 40 Hz with 8-ohm load. Scales: Vertical, 5 V/div.; horizontal, 20 μS/div. (top and middle) and 5 mS/div. (bottom).

bottom trace is for 40 Hz into 8 ohms, and low-frequency tilt is satisfactorily low.

Peak current delivery into a 1-ohm load was examined with the IHF tone-burst signal used to determine dynamic power output. With one channel driven, the MS100 put out a clean ±32 to ±33 amperes peak.

Lastly, I measured dynamic and clipping headroom. For 8-ohm loads, the results were 1.14 and 1 dB, respectively. This unit is not rated for 4-ohm loads, but assuming a power rating of 200 watts into 4 ohms, dynamic and clipping headroom would be 0.6 and 0.2 dB, respectively.

Use and Listening Tests

Equipment used to evaluate the Motif amp and preamp included an Oracle turntable fitted with a Well Tempered Arm and Koetsu Black Goldline cartridge, a California Audio Labs Tempest CD player, a Nakamichi 250 cassette deck, a Technics 1500 reel-to-reel recorder, a Cook-King reference tube phono preamp, a Sumo Athena preamp, and YBA_1, YBA_3, and Counterpoint SA-20 power amps driving Siefert Research Magnum III speakers.

I have used the MS100 more than the MC8 preamp. It is a nice, musical-sounding power amp with a slightly laid-back mid- and high-frequency perspective. When using the MS100 to drive a pair of Apogee Divas at a friend's house, I was amazed at how good this amp sounded with those speakers. Listening extensively to the Motif amp and preamp together on my own setup, I found the combination's sound—for CDs and other high-level sources—very musical and listenable. The sound was open and spacious, with good revelation of inner detail. With CDs, critical listening comparisons between the MC8's line section and the pair of passive, switched attenuators I use as my system's volume control revealed a slight softening and loss of detail when going through the line section. For a number of CDs, I preferred the sound going through the MC8's line section. At times, for certain musical sources, the sound tended to be a touch strident, but I blame the sources for this.

Listening to records through the MC8 preamp wasn't quite as satisfying as with some other solid-state preamps I have used recently. The sound was a little bland and uninvolving but was otherwise okay. For this reason, I would have to say that I like the power amp better than the preamp. I did prefer the preamp's sound in the MM mode over the quieter MC mode—even with noise on the verge of intruding.

I have one slight beef with the volume control as supplied on the preamp. In its full-attenuation position, the knob's index line points straight down. I'd prefer that the knob turn only as far counterclockwise, from its straight-up position, as it turns clockwise. As it is, the volume control looks like it's way down when high-level sources are played—and the pointer is actually about 30° farther counterclockwise than it would otherwise be. This is, however, just nit-picking, and a few minutes with an Allen wrench would fix it. The equipment operated flawlessly. The only other comment I have is one I made in the circuit description, about turn-on and turn-off surges in the MC8. In summary, I have enjoyed using both the MC8 and MS100 and recommend that prospective purchasers give these pieces a listen. *Bascom H. King*

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2

TANDBERG 3080A FM RECEIVER

Manufacturer's Specifications

FM Tuner Section

Usable Sensitivity: Mono, 9.8 dBf (0.85 µV at 75 ohms).
50-dB Quieting Sensitivity: Mono, 14.7 dBf; stereo, 37.2 dBf.
S/N: Mono, 78 dB; stereo, 75 dB.
Frequency Response: 30 Hz to 15 kHz, +0.5, −1.0 dB.
THD at 50-dB Quieting: 0.3%, mono or stereo.
THD at 65 dBf: 0.15%, mono or stereo.
Intermodulation Distortion: 0.2%, mono or stereo.
Capture Ratio: 1.0 dB.
Adjacent-Channel Selectivity: 14 dB.
Alternate-Channel Selectivity: Greater than 90 dB.
Spurious-Response Rejection: Greater than 96 dB.
Image Rejection: Greater than 90 dB.
AM Suppression: Greater than 70 dB.
Subcarrier Rejection: 90 dB.
Stereo Separation: Greater than 40 dB, from 60 Hz to 10 kHz.
Muting Threshold: 20.8 dBf (3.0 µV at 75 ohms).
Stereo Threshold: 28.7 dBf (7.5 µV at 75 ohms).

Amplifier Section

Power Output: 80 watts per channel, 20 Hz to 20 kHz, into 8 ohms; 100 watts per channel, 20 Hz to 20 kHz, into 4 ohms.
Rated THD: 0.05%.
Frequency Response: High level, 5 Hz to 100 kHz, +0, −3 dB; MM and MC phono, 20 Hz to 20 kHz, ±0.5 dB.
S/N (A-Weighted): High level, 87 dB; MM phono, 74 dB; MC phono, 72 dB.
Input Sensitivity: High level, 16 mV; MM phono, 0.19 mV; MC phono, 15 µV.
Maximum Input Level: High level, 5 V; MM phono, 250 mV; MC phono, 20 mV.

General Specifications

Power Requirements: 115/230 V a.c., ±10%; 50/60 Hz; 56 to 600 watts.
Dimensions: $17\frac{1}{8}$ in. W × $5\frac{3}{8}$ in. H × $13\frac{15}{16}$ in. D (43.5 cm × 13.7 cm × 35.4 cm).
Weight: 26.4 lbs. (12 kg).
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For literature, circle No. 91

Tandberg receivers have always been noted for their high performance and their excellent construction and industrial design. I can remember owning a Tandberg open-reel stereo tape recorder long before stereo became popular. I also have a fond recollection of a visit to Tandberg's factory in Oslo, Norway, where I had the honor of meeting Mr. Tandberg, the founder of the company, just 10 days before his untimely death. For reasons too complex to get into here, after Tandberg's death the company's fortunes began to decline although the engineering level remained high. Following a succession of management changes in the U.S. subsidiary, Tandberg of America, distribution of the company's products in this country has been recently taken over by Ortofon. I am happy to report that the Tandberg approach to receiver design has not been abandoned. This powerful Model 3080A is very much in the tradition of the Tandberg products that have been admired for many years all over the world.

Tandberg has chosen to omit an AM section in this receiver, concentrating instead on good FM performance and on an amplifier section which has power ratings high enough for the wide dynamic range of today's digital program sources. Up to 16 FM station frequencies can be memorized by the 3080A's frequency-synthesized tuning system. Manual tuning is possible, of course, as is automatic search, during which the tuner seeks the next usable signal up or down the FM band.

One of my pet peeves concerning tuner design has been eliminated in the tuner section of this receiver. I always object to having the mute on/off function tied to the mono/stereo selection. I feel that if I want to listen to a weak stereo signal—no matter how noisy it may be—I should be able to do so. Tandberg engineers must have agreed, for they provided separate mono/stereo and mute switches on this receiver. Another fine feature is the ability to listen to one program source while recording another.

The power amp section, like some of Tandberg's most recent integrated and separate power amp designs, employs no overall negative feedback, yet manages to obtain a distortion rating that is well below audibility up to and beyond rated output levels.

This is the first Tandberg receiver I have ever tested that comes packed with a multipurpose remote control. This master remote, the RC 3000, is designed to operate many different units in the Tandberg 3000 series. Just about every front-panel control function you'd normally adjust during operation can be accessed from the remote. In addition, the remote can be used to access presets by number, so you don't have to scan through the preset numbers using the up and down buttons on the front panel itself. One little trick regarding the remote control stumped me until I read the owner's manual carefully. The remote's volume-control button worked immediately, but when I tried to operate other pushbuttons—for tuning or tone control adjustment, for example—it was as if the remote or the receiver's sensor had dozed off. The reason: Since the remote operates many Tandberg components, it's necessary to press the button labelled "Receiver" before functions other than volume control will operate. What's that they say about reading the owner's manual when all else fails?

Control Layout

A tiny pushbutton at the lower left of the front panel turns on the receiver. To the right are a headphone jack, "A" and "B" speaker selector buttons, and rotary controls for bass, treble, and balance. A row of larger pushbuttons, just above and across the middle of the panel, includes three buttons associated with storing and recalling station presets and "Record" and "Program" buttons for choosing the program source to be recorded and the source you want to hear (both cycle through the sources in sequence—you don't select a source directly). There are also a tone-control "Defeat" button, a mono/stereo button, a separate mute button, up and down search buttons used in FM tuning, and an "Auto/Man" button that selects the desired tuning mode. When FM muting has been selected, or when automatic search tuning is called for, LEDs above those buttons will illuminate.

Along the top of the front panel are a small window that displays preset information, two rows of LEDs that indicate which program source is being recorded and which is being listened to, and a larger display window that shows selected FM frequency, reception of a stereo signal, signal strength, and center-of-channel tuning. Tuning can be done in increments of 100 kHz. The master volume control is at the extreme right of the front panel.

The receiver's rear panel is equipped with a 75-ohm antenna connector, for which a suitable male plug is provided, as is a matching transformer for 300-ohm antennas. Separate pairs of input jacks are provided for MM and MC phono cartridges, as is a grounding terminal. Six additional pairs of jacks handle "Tape 1" and "Tape 2" play and record, AUX, and CD inputs. The "Tape 2" input and output jacks are suitable for, and are additionally labelled for, DAT or for audio signals from and to video recorders. Barrier-strip speaker terminals at the right of the rear panel accommodate two sets of stereo speakers.

Tuner Measurements

When the receiver is first turned on, a protection circuit causes a delay of approximately 12 S, allowing the "Zero

The tuner section's stereo separation was outstanding, not just at 1 kHz but at 100 Hz and 10 kHz too.

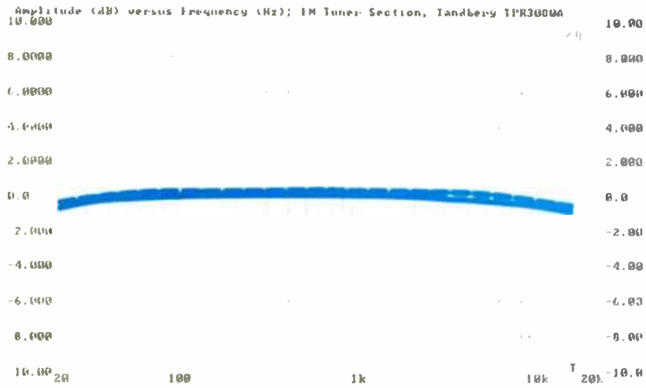

Fig. 1—Frequency response, FM tuner section. Note vertical scale of 2 dB/div. Right-channel (dashed) curve has been displaced for clarity.

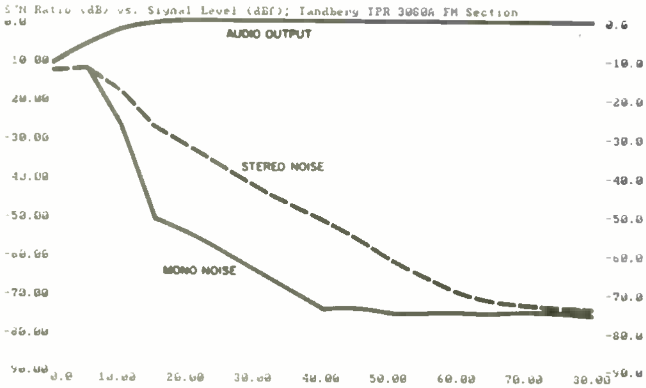

Fig. 2—Mono and stereo quieting characteristics.

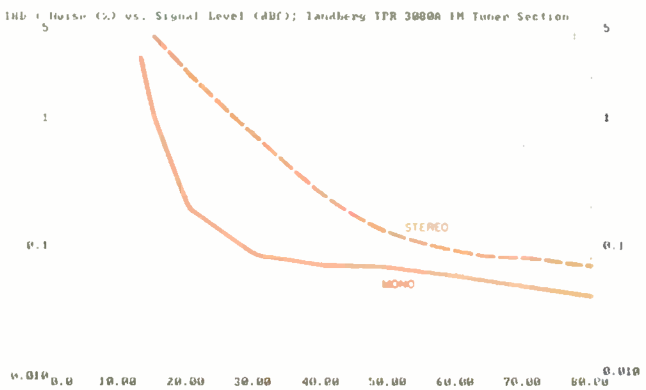

Fig. 3—THD + N vs. signal strength for a 1-kHz modulating signal.

Feedback" stages to stabilize before any sound is heard. Initially, the receiver functions are set up as follows: The FM section is tuned to the last station you listened to; the letter "F" shows in the small window at the left of the panel; tone controls are defeated, with an LED above the tone-defeat button indicating that fact, and the receiver is in the manual-search tuning mode.

I checked the performance of the FM tuner section first. Frequency response is shown in Fig.1 for both channels. (The right-channel curve has been deliberately displaced above 0 dB for the sake of clarity, since response in both channels was identical.) Response at 15 kHz was down only −0.8 dB, while at 20 Hz it was off by −0.4 dB. Figure 2 shows the quieting characteristics of the tuner as a function of incoming signal strength. The uppermost curve is the audio output under conditions of 100% modulation at 1 kHz. The bottom curve represents the residual noise with modulation turned off, while the dashed curve depicts residual noise in stereo. In mono, 50-dB quieting was attained with input signals of only 14.5 dBf, while in stereo mode, 38 dBf of signal was required to achieve the same level of quieting. S/N ratios at 65 dBf of input signal fell a bit short of the figures claimed by Tandberg. I measured 75 dB for mono and just short of 72 dB for stereo signals.

Figure 3 shows how THD + N decreases with increasing signal strength. From these curves, I am able to determine usable sensitivity. Mono usable sensitivity (the point at which THD + N equals 3%) measured 13 dBf. Stereo usable sensitivity measured 17 dBf. At strong signal levels, mono THD + N decreased to between 0.04% and 0.06%, while stereo THD + N measured between 0.07% and 0.09%. The modulating signal used to plot these curves was 1 kHz at 100% modulation.

To determine THD + N figures at other modulating frequencies, I set the signal level at a constant 65 cBf and plotted THD + N versus frequency (Fig. 4). You may notice a discrepancy between the 1-kHz readings in this figure and the readings in Fig. 3, all of which were made at 1 kHz. The THD + N was lower this time, owing in part to further warm-up of the receiver and to more careful tuning for minimum distortion before the test began. Now, THD + N in mono at 1 kHz was 0.037%, while in stereo, it measured 0.059%. At 100 Hz and 6 kHz, mono THD measured 0.035% and 0.09%, respectively; in stereo, at those same frequencies, THD + N was 0.056% and 0.081%.

Figure 5 shows stereo frequency response (solid curve) and channel separation (dashed curve). Separation at 1 kHz measured very high—more than 52 dB. At 100 Hz and 10 kHz, the other two test frequencies measured according to the IHF/IEEE Standard, separation was about 50 dB in both cases. All of these results are outstanding for any stereo FM tuner, let alone a tuner section in an all-in-one receiver. In Fig. 6, I used my spectrum analyzer, sweeping linearly from 0 Hz to 50 kHz, to determine separation and crosstalk for a 5-kHz signal modulating one channel only. The tall spike represents the desired output from the modulated channel, while the shorter spike contained within it, representing the 5-kHz output from the unmodulated channel, shows a separation of around 47 dB. (Each vertical division in the display represents 10 dB of amplitude differ-

Regardless of frequency, amplifier-section THD stayed at the same low values—even beyond the rated power levels.

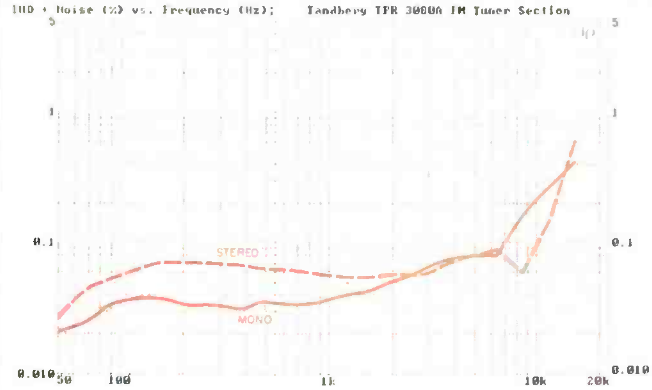

Fig. 4—THD + N vs. frequency for 65-dBf signal input.

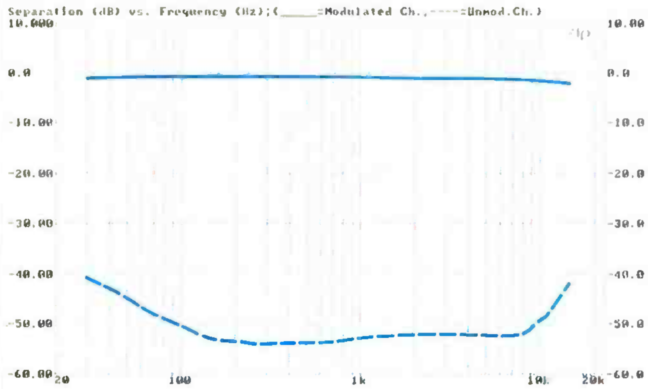

Fig. 5—Frequency response and stereo separation. Note change of vertical scale from Fig. 1.

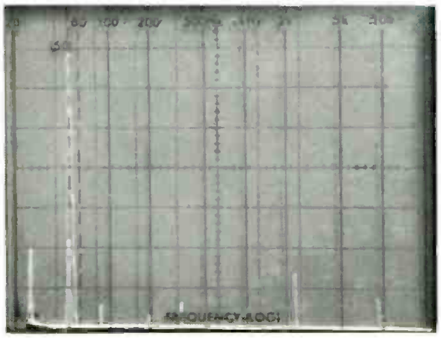

Fig. 6—Separation and crosstalk components for a 5-kHz modulating signal.

ence.) Shorter spikes to the right, observed at the output of the unmodulated channel, represent minute amounts of harmonic distortion, the 19-kHz pilot signal (down about 62 dB relative to full modulation), and sideband components on either side of the suppressed 38-kHz subcarrier.

Additional measurements made for the FM tuner section pretty well confirmed Tandberg's other published specifications. Alternate-channel selectivity measured 93 dB. Capture ratio measured 1.1 dB. Image and spurious-response rejection were both in excess of 100 dB. AM suppression measured 68 dB. Muting threshold was between 20 and 23 dBf, or close enough to the 20.8 dBf claimed.

Amplifier Measurements

The power amp section of the Tandberg 3080A easily delivered its rated output of 80 watts per channel, with both channels driven simultaneously. What's more, using 8-ohm loads, there was virtually no difference in harmonic distortion readings at any audio frequency; THD remained at just about 0.08% (Fig. 7). The same flat response occurred when I measured THD + N versus frequency for 115 watts into a 4-ohm load; distortion here remained at about the 0.06% level. Note that this power level is 15 watts above the maker's rating.

Figure 8 shows how THD + N varied with increasing output levels for frequencies of 20 Hz, 1 kHz, and 20 kHz. With 8-ohm loads, THD + N at the rated output of 80 watts per channel measured 0.016% at 1 kHz and 20 Hz, and about 0.04% at 20 kHz. With 4-ohm loads, THD + N for the rated output of 100 watts per channel measured 0.0165% at 1 kHz, 0.02% at 20 Hz, and 0.029% at 20 kHz.

Figures 9 and 10 show two types of IM distortion. For SMPTE-IM distortion, plotted against power output in Fig. 9, I measured 0.073% at rated output into 8 ohms, and 0.076% at rated output into 4 ohms. CCIF-IM, or twin-tone, distortion was plotted against power output in Fig. 10. With 8-ohm loads, CCIF IM measured 0.011% at rated output, while for 4-ohm loads, CCIF IM was 0.0098% at rated output.

Dynamic headroom of the amplifier was 1.6 dB. The greatest damping factor I was able to read was limited by the very small, but still significant, resistance of the 12-gauge connecting cable between the speaker terminals of the receiver and the input terminals of my Audio Precision

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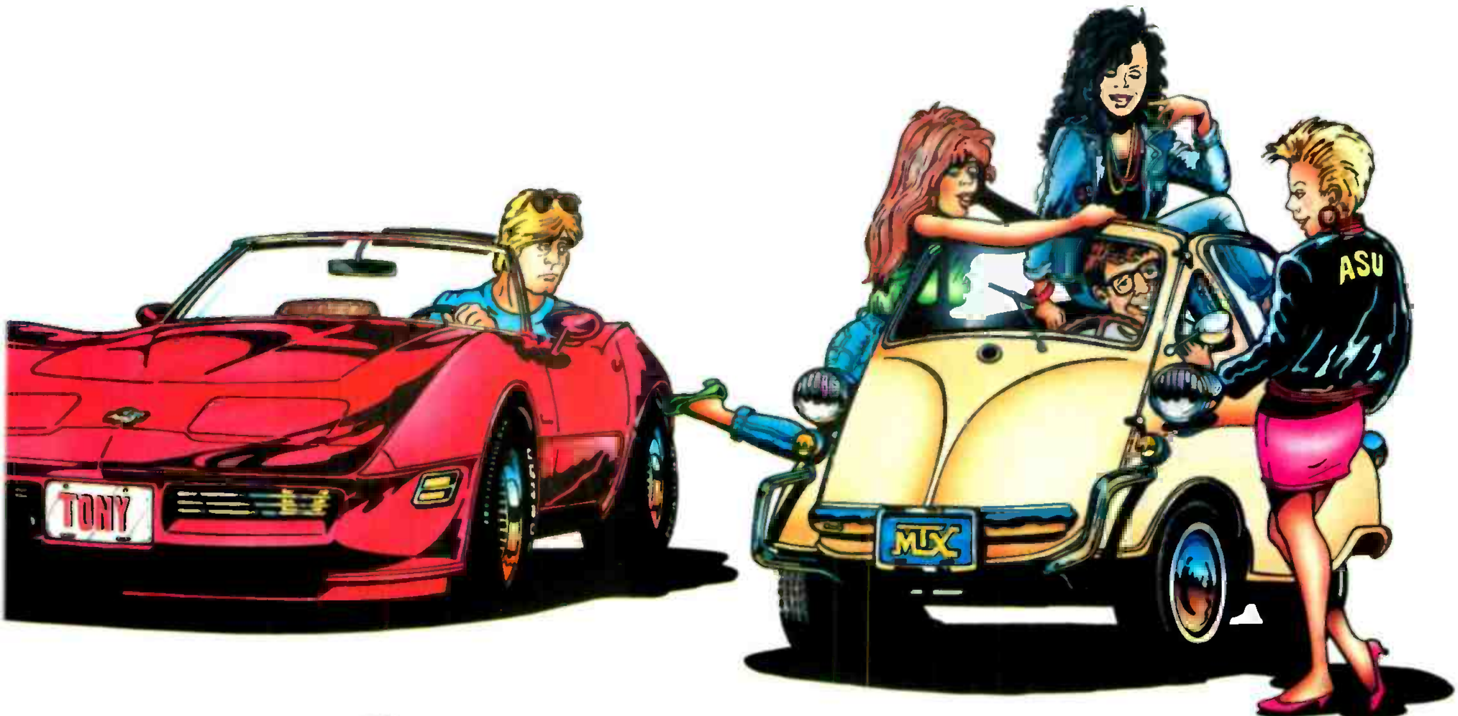

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Listening to small brass groups can reveal subtle forms of IM, but I heard no such distortion from the Tandberg 3080A.

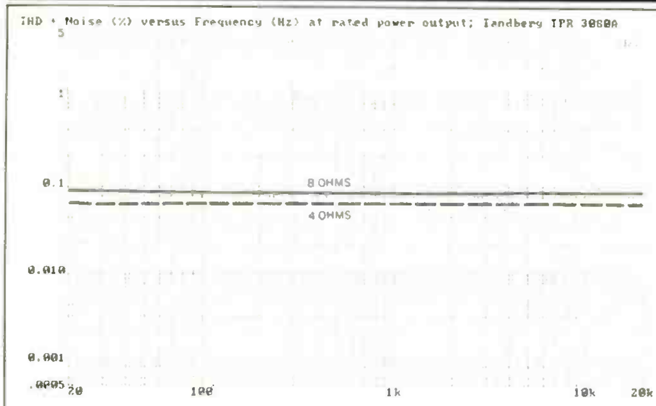

Fig. 7—Amp THD + N vs. frequency; 8-ohm performance (solid curve) measured at full rated output of 80 watts per channel; 4-ohm performance (dashed curve) measured at 115 watts, 15 watts above rated output.

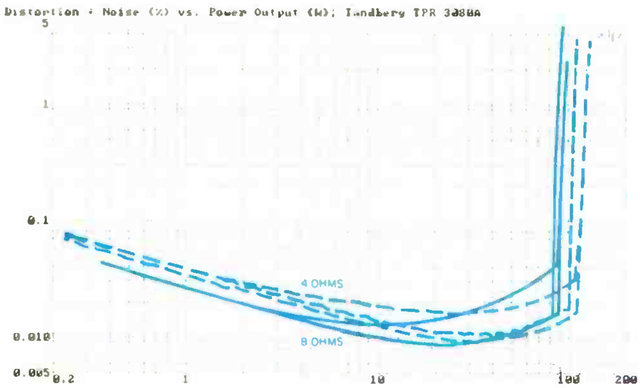

Fig. 8—THD + N vs. power output per channel into 8- and 4-ohm loads, for 20 kHz, 1 kHz, and 20 Hz (top to bottom for each load). The 8-ohm curves for 20 Hz and 1 kHz are nearly identical.

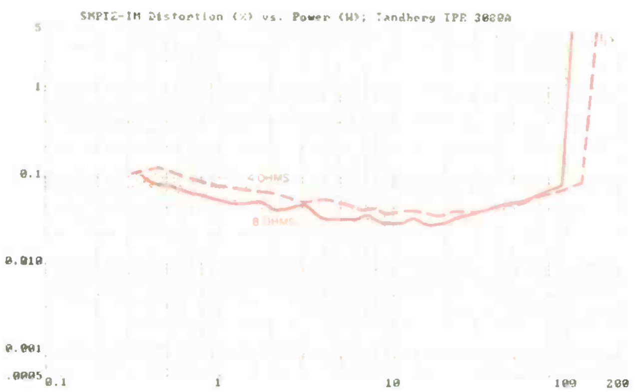

Fig. 9—SMPTE-IM distortion vs. power output for 8- and 4-ohm loads.

test instrument. Nevertheless, I did manage to read a damping factor of 500, referred to 8 ohms, at the prescribed test frequency of 50 Hz.

Sensitivity measured 0.6 mV for the MM phono inputs and 24 µV for the MC inputs, as against 0.19 mV and 15 µV claimed by Tandberg. I suspect that Tandberg may not be quoting sensitivity using the same standard reference levels that I do. The output level that I use for determining input sensitivity of any amplifier input is 1 watt. I measured an input sensitivity of 13 mV for 1 watt output at the high-level inputs, which is close enough to the specified 16 mV.

Phono overload was on the low side, measuring only 70 mV for the MM inputs, as against 250 mV claimed, and 6 mV for the MC inputs, as against 20 mV claimed by Tandberg. I normally expect a product of this overall quality to be able to handle at least 100 mV via the MM inputs and at least 10 mV via the MC phono inputs.

The A-weighted S/N ratio for the high-level inputs measured 82.1 dB for the left channel and 81.4 dB for the right, referred to 1 watt output with an input of 0.5 V. While these results fall short of the 87 dB claimed by Tandberg, they are nevertheless more than acceptably high. The S/N figures for the phono section were somewhat more disappointing. For the MM phono inputs, S/N measured only 70.7 dB for the left channel and 70 dB for the right. These results are referred to 1 watt output, with 0.5 mV applied to the inputs. As for the MC inputs, using a 500-µV input signal and again adjusting the output to produce 1 watt into 8-ohm loads, S/N measured 71.6 dB for the left channel and 71.5 dB for the right. These MC results are very close to those claimed by Tandberg, but what surprises me is that the S/N ratio for MM phono not only falls far short of claimed performance but is actually poorer than that measured for the MC phono inputs. If you plan to use a turntable, I would suggest that you equip it with a moving-coil cartridge rather than with a moving-magnet type, if only because of the better signal-to-noise ratio you will obtain.

Figure 11 shows the maximum boost and cut range for the bass and treble tone controls of this receiver. The frequency sweep was deliberately extended beyond the audible range, to 10 Hz and 100 kHz, to see if maximum boosts resulted in a continuous rise of output at subsonic and ultrasonic frequencies. Happily, they did not. Note the peak bass boost at around 35 Hz and the downward slope of the curve below that frequency. At the treble end of the spectrum, maximum boost is observed at around 40 kHz,


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The Model 3080A is a superb "European alternative" for audio enthusiasts who seek a receiver that performs as well as many separates.

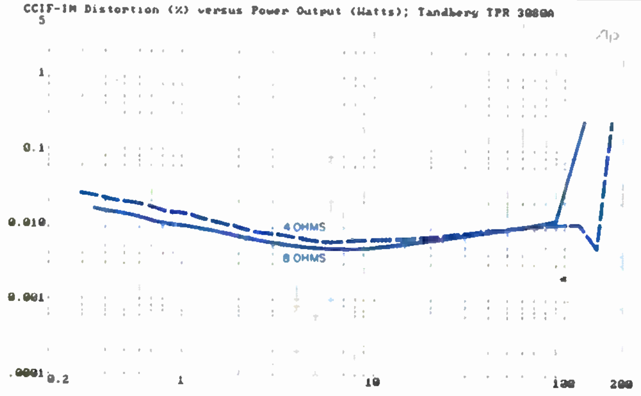

Fig. 10—CCIF-IM (twin-tone) distortion vs. power output for 8- and 4-ohm loads.

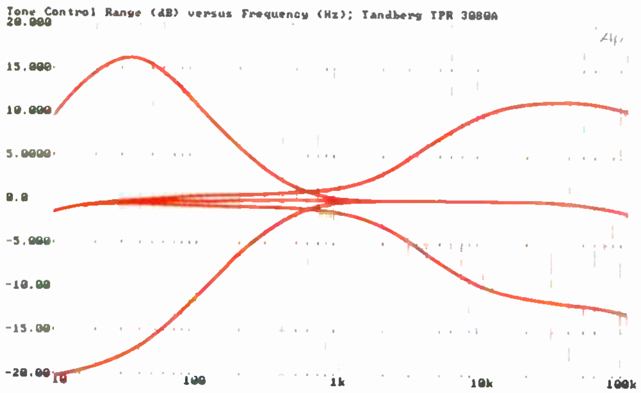

Fig. 11—Bass and treble tone-control range.

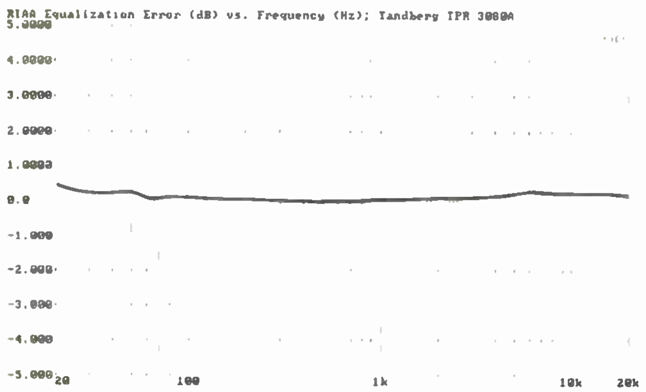

Fig. 12—Deviation from RIAA equalization.

after which the curve also takes a downward trend. If the design had not been executed this way, using extreme boost settings of the tone controls might result in inordinately high levels of rumble when playing phonograph records and in injury to tweeter elements.

Figure 12 shows how accurate the RIAA equalization was in my sample. The curve represents deviation from perfect RIAA equalization. Maximum deviation was only +0.35 dB at 20 Hz and around +0.2 dB at 6 kHz. At most other frequencies, RIAA accuracy was far better.

Use and Listening Tests

As I mentioned earlier, the flexibility of being able to select one program source for recording and another for listening is a welcome feature. Setting the presets was easy enough, though it's a bit of a nuisance having to "step through" all preset numbers to get to, say, preset 16—unless you use the supplied wireless remote. Of course, you can always place your favorite stations into lower numbered presets, if you wish. The "Center" tune light illuminated when I was very close to the minimum distortion point for a given FM signal, but I would have liked a somewhat more definitive signal-strength indicator instead of the single LED that glows dimly for weak stations and brightly for stronger ones. Muting threshold was set just where I like it, but stereo threshold was set a bit too low, in my opinion. There's no point in allowing the stereo decoder to take over at signal levels below 20 or 30 dBf; stereo reception is simply too noisy at such low levels. Of course, if this bothers you (as it did me), you have the option of pressing the mono button to get rid of the background noise.

Aside from logging around 48 usable FM signals with my outdoor antenna connected to the receiver—and some 38 using an amplified indoor antenna made by Terk Technologies (reviewed in February 1989)—much of my listening was done using Compact Disc source material. I listened to both pop and classical discs, including three new Telarc releases. One of these, *Empire Brass* (CD-80159), features that brass ensemble in selections from Leonard Bernstein's *West Side Story* as well as selections from George Gershwin's *Porgy & Bess*. I find that listening to brass instruments playing in a small group reveals the more subtle forms of IM distortion that often are produced by some amplifiers. I detected no such distortion components while auditioning this Tandberg receiver. For a fuller orchestral work, I chose another Telarc release, in which the featured selection was Dvořák's Symphony No. 7 in D Minor, with André Previn conducting the Los Angeles Philharmonic (CD-80173). Orchestral balance seemed just right, with instrument placement rock-steady. Finally, for a more contemporary sound, I listened to selections from another Telarc disc, *Naturally* (CD-83301), featuring Mel Lewis and the Jazz Orchestra performing Thad Jones' jazz compositions and arrangements. My conclusion: The Tandberg 3080A handles just about any type of musical material with no trace of audible distortion and with excellent tonal balance and phase accuracy. For the audio enthusiast seeking an all-in-one receiver which performs as well as many separates—and better than some—Tandberg still remains, as they like to say, a superb "European alternative."

Leonard Feldman


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3

SHURE HOME THEATER SOUND HTS 5300 SURROUND DECODER

Manufacturer's Specifications

Frequency Response: Front left, center, and right, 20 Hz to 20 kHz, ±0.5 dB; subwoofer, −3 dB at 80 Hz with 12-dB/octave roll-off; surround, 50 Hz to 7 kHz, −3 dB (per Dolby Surround specifications).

Input Sensitivity: 0.25 V.

Maximum Input and Output Levels: 4.0 V.

Range of Input-Balance Control: ±9 dB.

Range of Output-Level Trim Pot: 20 dB.

Impedance: Input, 75 kilohms; output, 5.5 kilohms.

Distortion: Main channels, 0.1%; surround channels, 0.3%.

S/N Ratio: 90 dBA re: 1 V, with volume controls centered.

Signal Polarity: Noninverting at all outputs.

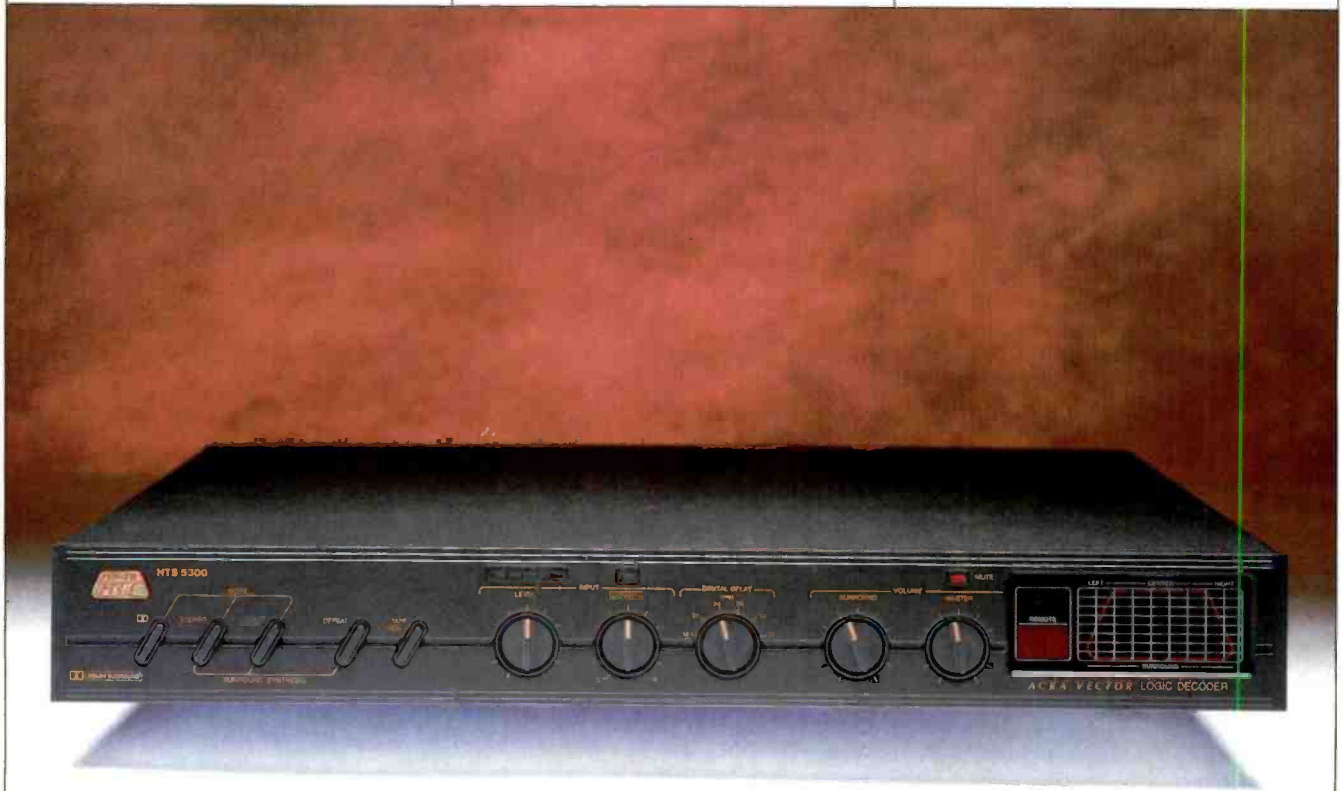
Surround Delay: 16 to 36 mS, in 4-mS steps.

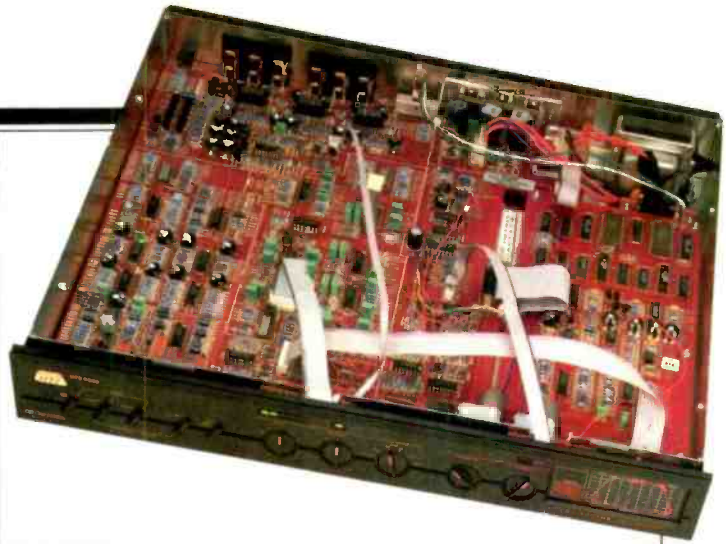
Dimensions: $16\frac{13}{16}$ in. W × $2\frac{3}{8}$ in. H × $15\frac{1}{16}$ in. D (42.7 cm × 6 cm × 38.2 cm).

Price: $1,250.

Company Address: Shure HTS, 222 Hartrey Ave., Evanston, Ill. 60202.

For literature, circle No. 92





The HTS 5300 is the surround-decoder part of the Shure HTS Theater Reference System. The complete $9,600 system contains all that is needed for a surround-sound installation except for sources and miscellaneous accessories. Besides the decoder, the system includes three HTS 50SPA power amplifiers, one HTS 50CF center-front loudspeaker, one HTS 50SW subwoofer, and four HTS 50LRS loudspeakers. The latter four speakers are used for the main left and right stereo channels and the two rear surround channels.

My testing was restricted to the decoder, but it is worthwhile to discuss the entire Theater Reference System. This is truly the result of a system design approach: It is *not* a collection of already available components stuck together just to have all the parts. The configuration, of course, revolves around what the decoder does with the proper sources, but I'll go into more detail on that later. At this point, I'll restrict my comments to stating that the decoder's outputs consist of the normal stereo pair plus one each for center-front and subwoofer and a pair for the surround channels. The three two-channel power amplifiers drive the six speakers.

The typical home surround system has been somewhat of a hodgepodge, with amplifiers and speakers used from previous systems—perhaps with additional purchases made to get all the channels needed. Often, the new amps and speakers are not the same as the original ones, for various reasons. As far as I know, Shure HTS is the only manufacturer which offers a complete system with correlated designs. The discussion that follows will not only detail what it consists of but should also help explain the interrelationships among the components of a surround system.

The HTS 50SPA is a signal-processing power amplifier with switch-selectable operating modes to match the speaker complement; it delivers 100 watts per channel. Each of the two channels has a level control with useful decibel scaling and a six-position "Operational Mode" rotary switch. The knobs are rounded discs with large slots which reject casual diddlers but accept large coins or a strong thumbnail for turning. The first five settings are "Flat," "LRS," "LRS$_x$," "CF," and "CF$_x$." The sixth position is "SW" for channel 1 and "Bridged" for channel 2.

In "Flat," the amp's rated response is ± 0.5 dB from 20 Hz to 20 kHz, and there is no processing in the signal path except for a defeatable clipping-protection circuit. The "LRS" setting switches in an 80-Hz low-frequency cutoff for use with the HTS 50LRS (left/right/surround) loudspeakers in a system with a subwoofer. The "LRS$_x$" position, on the other hand, is for the same speakers in a system without a subwoofer. In this case, the response extends down to 60 Hz. The "CF" output has an 80-Hz roll-off to match the response of the HTS 50CF (center-front) loudspeaker in a system with a subwoofer. With "CF$_x$" engaged, the center-speaker response is extended down to 55 Hz for a nonsubwoofer system. The output of channel 1 in the "SW" mode matches the HTS 50SW subwoofer, covering only the frequencies from 33 to 80 Hz and adding a controlled low-frequency boost. The "Bridged" setting of channel 2 reconfigures the amplifier into a single-channel unit delivering 250 watts into 8 ohms. In this mode, the channel 1 selector determines the response of the amplifier, matching it to any of the HTS 50 loudspeakers. The amplifier has circuitry to limit cone excursion, which is particularly important in this mode. Having the ability to instantly configure response to suit specific applications is very appealing to me: Unwanted energy is not fed to any particular speaker, and all of the amp's power is available for the band selected. The amplifier can, of course, be used with any brand of speaker, though preferably with its mode switch in the "Flat" position, which provides only overload protection.

All of the HTS 50 loudspeakers are rated to handle 200 watts peak program material and 100 watts nominal amplifier power. With each of these speakers, the HTS 50SPA amplifier reduces system distortion by controlling cone ex-

Shure HTS seems to be the only manufacturer to offer a complete surround *system* of correlated decoder, amp, and speaker designs.

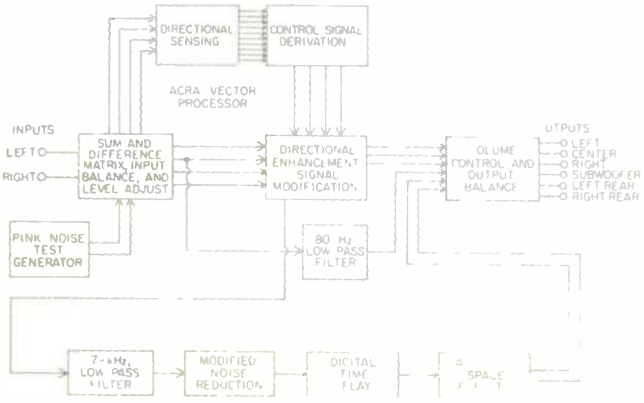


Fig. 1—Block diagram of signal processing in the HTS 5300.

cursion at low frequencies and very high sound levels. All speakers have double magnet systems to reduce interference with TV picture convergence and purity. "In a high-performance home theater sound system, the loudspeaker used in the center-front position is subjected to the most rigorous performance demands, particularly in regard to output capability," says the company.

The HTS 50CF center-front speaker has two 6½-inch low-frequency drivers and a single 1-inch, soft-fabric, damped-dome tweeter. The response of the HTS 50CF runs from 55 Hz to 18 kHz in a system where subwoofers are not used, so the amplifier is set for extended response ("CF_x").

The HTS 50LRS, used for the left and right surround speakers, is generally similar but has only one low-frequency driver—which is sufficient because of the lower power demands of the surround channels. This speaker's response goes from 60 Hz to 18 kHz in systems where the amplifier is set at "LRS_x" because there is no subwoofer. Both the center-channel and surround speakers play only the frequencies above 80 Hz when a subwoofer is used; the amplifier channels are set to "CF" and "LRS," respectively. The HTS 50CF and HTS 50LRS speakers have two-way, fourth-order crossovers with corrections for impedance equalization and midband response. The HTS 50SW subwoofer has a 12-inch transducer mounted in a fourth-order vented box. Combining this with the second-order, high-pass 33-Hz filter of the HTS 50SPA (that is switched in when the amplifier is in "SW" mode) yields sixth-order dynamic tuning. The amplifier also has a second-order, low-pass filter at 80 Hz; the total 80-Hz filtering is fourth-order when the HTS 5300 decoder's subwoofer output is used.

Acra-Vector Decoder Circuitry

Figure 1 is the block diagram of the HTS 5300 decoder's signal processing. This latest Shure HTS Acra-Vector decoder has 80% more sensing points than previous models, for smooth and accurate imaging. Acra-Vector logic emulates the Dolby Stereo theater decoder and uses directional-enhancement (steering-logic) circuits which recover the original four recorded channels with a high degree of separation between adjacent channels. On complex source material, the HTS 5300 is more capable in the "proper enhancement of multiple simultaneous sound sources," says the manufacturer. The HTS 5300 has independent control signals for enhancement of left-right, center-surround, and similar signal oppositions. As a result, according to the company, there can be "simultaneous enhancement of two opposite directions at one time." Low-level directionality is also more accurately detected.

The HTS 5300's digital time delay has twice as much memory as the previous Shure HTS decoder; this has reduced noise up to 9 dB in the surround channels. The decoder uses the Shure HTS Acoustic Space Generator for "clean, spacious theater and concert hall ambience extraction" and a "full spatial field with a minimum of surround speakers." Sonic performance has been improved by extending the headroom at high frequencies. The HTS 5300's front panel has Shure's Image Analyzer display, which shows sound fields in high contrast. A built-in precision test generator steps automatically from channel to channel for easy balancing of speaker levels.

Control Layout

At the left end of the front panel are five thin, bar-type pushbutton switches. The first three are interlocked "Mode" buttons for Dolby Surround (indicated with a double-D symbol), "Stereo," and "Mono." The next button, "Defeat," is tied with a line and a "Surround Synthesis" label to the "Stereo" and "Mono" buttons. "Defeat" does not affect the Dolby Surround mode, which, of course, is normally the best match for sources that have been specifically encoded for Dolby Surround. "Stereo" and "Mono" select synthesized surround sound to go with any stereo or mono sound source, unless "Defeat" is on. The last of the five buttons, "Tape Mon," switches to recorder input connections.

In the center of the panel are two rotary "Input" controls ("Level" and "Balance") and a six-position "Digital Delay" rotary switch. Above "Level" is a horizontal, five-LED level meter. From the left, the first four LEDs are green; the last one is red, indicating maximum allowable input level. "Balance" has a single green LED above it which turns on when there is center/monaural energy and the control is set correctly for good Dolby Surround separation. The pot has no center detent, nor should there be: The control adjusts for out-of-balance sources within limits of ±9 dB.

The "Digital Delay" switch has positions for "16," "20," "24," "28," "32," and "36" mS. This is a very good range for delay, and I have commented before that processors with a 30-mS limit would be compromised in some large rooms. Delay settings do not have to be precise, and this decoder's 4-mS steps are quite acceptable. Further to the right are two rotary "Volume" controls, "Surround" and "Master." Above the latter pot is the red LED that shows when the remotely controlled "Mute" is on. To the right of the "Master" pot is the infrared "Remote" receptor, and above this receptor is a green LED that flashes to confirm reception of the remote's commands. All panel designations are in gold and are easy to read against the black panel. Large, gold index lines on the four rotary pots and the rotary delay switch make it easy to see these controls' settings from a considerable distance.

—**Leonard Feather,** Celebrated Jazz Critic for the L.A. Times, Washington Post News Service and Author of many books including *"The Jazz Years—Earwitness to an Era."*

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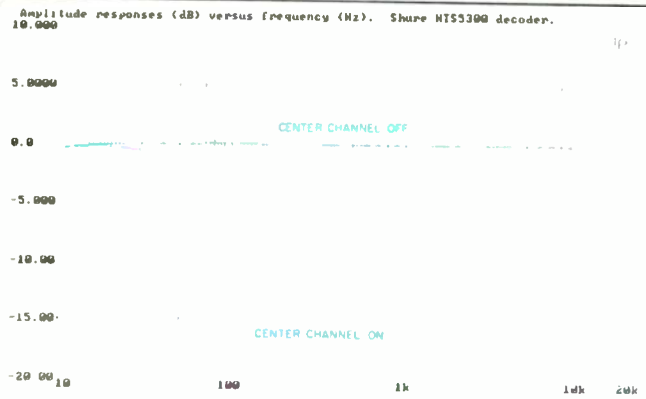

Fig. 2—Frequency response of main stereo channels with a mono input. The high-frequency reduction with the center-channel output on is deliberate; see text.

Further to the right, at the end of the panel, is the very useful Image Analyzer display, exclusive to the Shure HTS decoders. The display consists of shaped red LEDs that form a trapezoid. A center bar at the top illuminates when there is center-positioned energy. To the left and right are shoulder-shaped bars that turn on with left and/or right signals. Completing the figure are a rounded "L" at the bottom left and a backward rounded "L" at the bottom right. Both of these will turn on when the source has surround-type information. This display conveys immediately whether the source is strictly monaural, stereo, and/or has surround artifacts to be utilized. The varying intensity of each LED bar indicates the strength of each directional component of the signal.

The remote control is simple, having just "Master Volume," "Surround Volume," and "Mute" controls. The volume controls are long bars at an angle, which makes them easy to actuate when the control is held in the right hand. The bars are rockers: Pushing down on the grooved left ("–") end reduces volume, and pushing on the smooth right ("+") end increases it. A push of "Mute" will cut off all outputs or restore them; pushing either volume bar will also disable the mute. Actuation of any remote-control function illuminates a bright green LED near the transmitting end of the remote. If "Mute" is held in for 3 S, the HTS 5300 test generator is turned on. Then, a Noise Sequence circuit for speaker balancing automatically steps the generated test tone (from left to center to right to surround, and repeating) for adjusting levels as needed. Another push of "Mute" turns the sequence off.

Seven trim pots are available from underneath the unit. At the left front is "Mono Enhance," for modifying the factory-set mono enhancement if desired. Access is obtained near the back panel to the pots for "Front" ("L" and "R"), "Surround" ("L" and "R"), "Center," and "Subwoofer." Next to each access hole is an arrow indicating rotation direction to increase level. These trim pots can be very important if one or more amplifying channels lack any means of controlling volume.

On the back panel, from right to left, the first jack is for an optional "Wired Remote." Next is a pair of gold-plated stereo phono jacks for "Input," two pairs of "Tape" jacks labelled "Send (Record)" and "Return (Play)," "Outputs" jack pairs for "Front" and "Surround," and individual jacks for "Center Output" (top) and "Subwoofer Output" (bottom). A white line from the "Center Output" jack guides the user to a three-position slide switch ("Off," "Lo Cut," and "On"). It is important that this switch be set correctly because it affects how the signals are processed to the main speakers as well. Above this switch is a "Remote Sensor" jack for use with the optional remote-extender accessory, an infrared remote sensor that can be sited to pick up instructions from the remote control where the HTS 5300 itself would not be in the user's direct line of sight.

I removed the top and side cover to get a look at the inside construction. There were two large p.c. boards, one covering two-thirds of the chassis area and the other most of the remaining one-third. Support for the two boards was good, and they were less springy than I thought they would be. The power transformer, mounted in the small space not used by the boards, was just warm to the touch after hours of operation. Immediately, I was impressed by the large number of quality components in a very orderly layout. There were a number of transistors as well as many ICs. Parts were all identified, and many of the trim pots were also labelled by function. Most pot adjustments were held in place with a spot of glue, helping to ensure long-term stability.

Most interconnections were made with multi-conductor cables, some with plugs and some soldered. I could not see the foil side of the boards, but my examination of component leads and holes on the top showed that solder flow was excellent. There was one fuse in clips. Because of its sheet-metal side rails, the chassis was quite rigid, even more so with the cover back in place.

The reader should be aware that the HTS 5300 does not have a power switch, though I do not see this as a potential problem for most users. If desired, the decoder can be plugged into a switched outlet on a preamp, integrated amp, or receiver.

Measurements

Let me first point out that all of the measurements were made *after* all of the listening and viewing.

Figure 2 shows main-channel frequency responses with a mono input. When the center-channel output was off, response was basically flat, down 0.1 dB at 20 Hz and 0.9 dB at 20 kHz. Output was down 3 dB at 3.1 Hz for both channels and at 30.0 and 39.0 kHz for left and right, respectively. When the center channel was on, the response of the main channels with the mono input was definitely far from flat. Note how its level, just about 0 dB at the lowest frequencies, falls off steadily with increasing frequency until reaching a shelf at about –17 dB for frequencies above 1 kHz. Briefly I was puzzled, but then, the light: When the center channel is on, it *should* be carrying the in-phase energy (especially the higher frequencies), and the stereo channels *should not*. This is one more example of the HTS system's automatic level and response compensation.

Enter No. 28 on Reader Service Card

Shure's latest Acra-Vector logic decoder has 80% more sensing points than prior models, for smoother and more accurate imaging.

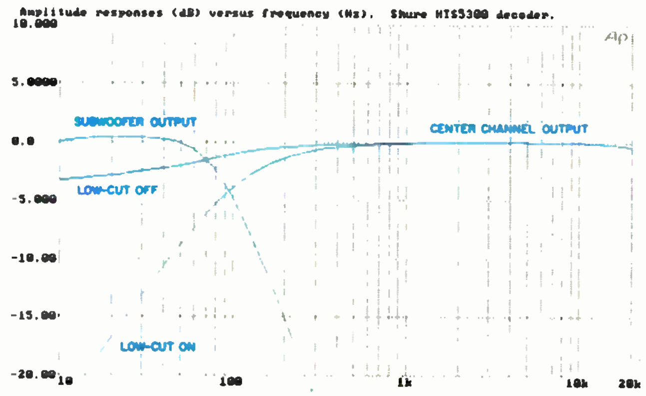

Fig. 3—Frequency response of center and subwoofer channels; see text.

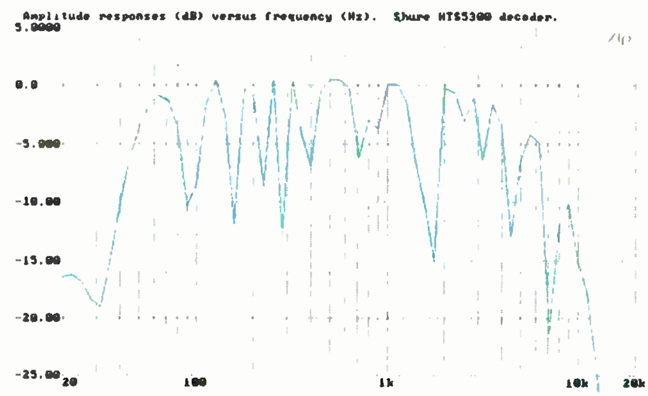

Fig. 4—Frequency response of surround channel, with left and right inputs of opposite polarity. The comb-filter effects shown are normal for such signals, but channel response is essentially flat, as seen by the envelope of the curve peaks.

Figure 3 shows the responses of the center and subwoofer channels. The response of the center channel with the rear-panel "Lo Cut" switch off was down 2.5 dB at 20 Hz and down 0.9 dB at 20 kHz; the droop at the lowest frequencies was purposeful, to make the total (center plus left and right) acoustical power flat with the Shure HTS speakers. This would be easy to equalize, if needed, with loudspeakers of other brands. The center-channel response is also shown with the rear-panel "Lo Cut" switch on. The roll-off below 200 Hz could be of benefit if a limited-response speaker is used for the center channel, particularly with a subwoofer. The response curve for the subwoofer channel shown in the figure has a roll-off above 80 Hz at a rate of 12 dB/octave. I could have trimmed the output down to the same maximum level as the other curves, but I didn't take the time to do that. The surround channels have no output unless nonidentical signals are fed to the right and left main inputs, and phase differences between these signals normally produce comb-filter effects. This is shown in Fig. 4, for which left and right input signals of opposite polarity were used. Frequency response can be roughly gauged from the envelope of the curve's peaks, but the apparent surround-channel response varies with the mix of signals in the main channels. After observing several such mixes, I'd say that surround-channel response is about 3 dB down at 40 Hz and 7 kHz.

Input sensitivity at 1 kHz was 250 mV for the maximum acceptable input level (the point at which the red LED of the level indicator just lights) and with the input-level control at maximum. Input clipping appeared at 3.9 V and output clipping at 4.9 V. The signal-to-noise ratio was 90.6 dBA for the main channels and 92.1 dBA for the surround channels, with a 1-V reference. Figure 5 shows the THD + N for the main channels, 0.04% or less across the entire band at 1 V input and output. The surround-channel figures reached 0.06% over much of the band, but this is really quite good and well within specification.

The input impedance was 72 kilohms, and the output impedance was 5.4 kilohms. The input impedance is a good figure and was not affected by the setting of the input-level pot. The output impedance, however, would be on the high side if used with an amplifier having an input impedance of 10 kilohms or less. The Shure HTS 50SPA amplifier's input impedance is 100 kilohms, which is plenty high for the 5.4 kilohms of the decoder output. The two sections of the input-level pot tracked almost perfectly, staying within ±0.2 dB over its 20-dB range. The sections of the "Master" volume control tracked each other within 1 dB, from wide open to more than 80 dB of attenuation—*outstanding*.

A check of the output-level trims on the bottom panel revealed that each was factory-adjusted to its maximum setting and that close to 20-dB attenuation was possible with each. Exact Dolby Surround input balance with a mono input (null in the surround outputs) was achieved with the control at a little past 12 o'clock. The best null was close to 60 dB deep at 1 kHz, although the adjustment was touchy and the level bounced around. Typically, the nulls were 35 to 45 dB deep across the frequency band, which is very good. The separation between the main left and right channels was between 45 and 64 dB. (The lower figure was measured using a higher-than-normal level.) I tried a test videocassette that Shure had supplied. With a good level from the left-channel speaker, I heard substantially nothing from the right-channel speaker and a very low level from the surround speakers.

The delay adjustment range was from 16 to 36 mS in 4-mS steps. Each setting was accurate within 0.3 mS. The polarity was the same as the input at all channel outputs. The input-level meter's green LEDs turned on at −29, −18.8, −12, and −6 dB relative to the red LED turn-on at 0 dB. The red LED turned on with a 90-mS, 5-kHz tone burst when the continuous level was set 1 dB above turn-on. Decay time was about 230 mS for the bottom LED to just

The Image Analyzer display conveys at a glance if the source is monaural, plain stereo, or has usable surround characteristics.

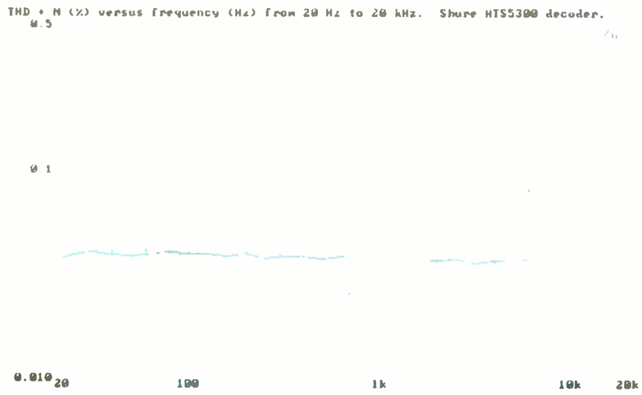

Fig. 5—THD + N for main channels.

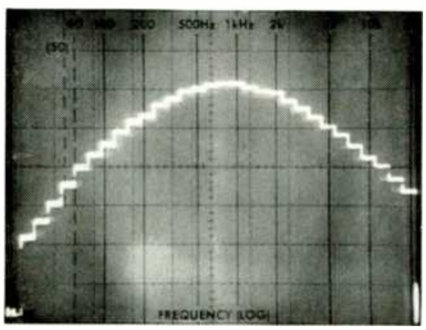

Fig. 6—Third-octave spectrum of speaker-balancing test signal generated by the Shure HTS 5300; see text.

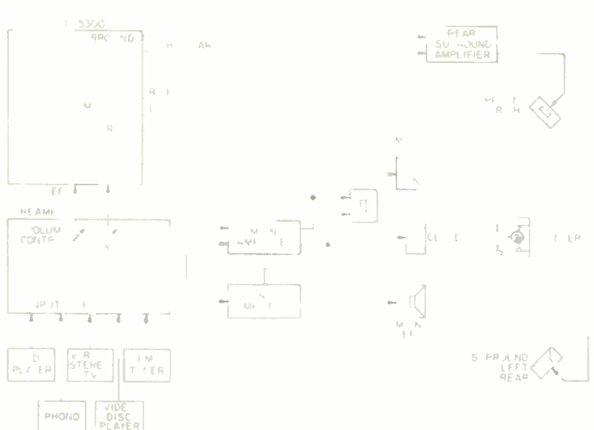

Fig. 7—Listening setup used in evaluating the HTS 5300.

turn-off. Clipping, with a test tone, was 5.5 dB above the red LED's threshold. This simple meter will give good indications of level, although it does not respond to the shortest peaks. Shure recommends input level be set for just occasional red flickering, and this instruction should be followed.

Figure 6 shows the third-octave spectrum of the HTS 5300 test signal used for balancing speaker levels. The noise is broadband but is peaked in the middle of the band. This is actually good, because it minimizes sonic differences from speaker to speaker caused by response deviations at the frequency extremes.

Use and Listening Tests

The evaluation system, including the Shure HTS 5300, is shown in Fig. 7. Input and output connections were made in a jack field, which facilitated making a change to my reference Yamaha DSP-1 processor without too much delay. A Yamaha AVC-50 amplifier was used for input switching of the various sources: A Yamaha TX-900U AM/FM tuner, a Magnavox FD1041 CD player, a Sanyo VCR-7200 Beta VCR, an Akai VS-555U VHS VCR, and a Yamaha LV-X1 videodisc player. For power amplification, I used the second section of the AVC-50 for the main stereo channels, a Lafayette amplifier for the center channel, and two channels of a Yamaha four-channel M-35 for the surround channels. The speakers were two JBL 4301s (main stereo), a JBL 216 (center), a self-powered Triad Design HSW-300 (subwoofer), and two Dynaco A25s (surround). Because I used the Triad Design self-powered subwoofer, which has its own left/right bass summing network and crossover, I did not use the HTS 5300's subwoofer output. The Akai VCR was used as the stereo-TV decoder. A 26-inch Zenith TV was the video monitor.

The owner's manual concentrates on how to interface the HTS 5300 with the rest of the Shure HTS Theater Reference System, but many of the instructions are easily applied to other equipment. To make certain there is no confusion, the manual has a section on interfacing with other equipment, including cautions on making certain that polarity is correct. There are brief but lucid instructions on setting the delay time to match specific listening rooms, a short but helpful section on program sources, and a list of film releases that have been surround-encoded.

By naming the division responsible for surround products Home Theater Sound and by making "HTS" part of the model designations for these products, Shure emphasizes that home video/movie viewing is primarily what the system is designed for. Each year, more and more movies are released with Dolby Stereo encoding, which shows as Dolby Surround encoding on videodiscs and videocassettes for the home user. My viewing and listening concentrated on movies, but I also listened to CDs and FM stations.

For an X/Y display of the left/right input signal, I used an oscilloscope. I set the HTS 5300's delay at 24 mS to match my listening room. I confirmed the manual's statement that aiming of the remote control was noncritical. I even pointed the remote behind me and directly to the sides, and it worked reliably.

I tried a few stereo TV shows but found little of sonic interest. On CBS, *TV 101* had all of the dialog, even for off-

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The peak in the middle of the broadband test signal makes it easier to balance speakers having different frequency response limits.

The complete HTS Theater Reference System would include the HTS 5300 decoder (shown here with remote control and remote extender), three of the HTS 50SPA amplifiers, four of the small speakers shown at the left, one center-channel speaker (middle), and one subwoofer (right).

screen action, right in the center. This sonic result was confirmed by the straight line at 45° on the 'scope and by the center-bar illumination in the decoder's panel display. The music and effects had some stereo spread but substantially no surround. When I watched a mono Celtics/Nets basketball game, the mono synthesized mode was best; my enjoyment increased after I raised the surround level to get to a good crowd-noise level. Overall, results for stereo TV with the Shure HTS 5300 were superior to those with the reference Yamaha DSP-1.

The first movie I tried was *Wall Street* (HBO simulcast), with Michael Douglas, Charlie Sheen, and Daryl Hannah. It was Dolby Surround encoded, and stereo spread in the music and effects was good. Surround information was just occasional (indicated better on the Shure HTS unit than on my 'scope), but it was used effectively. The dialog was strongly and, in the main, realistically centered. The 1987 movie, *The Whales of August*, with Lillian Gish and Bette Davis, was tried in the videocassette version. The sound was mono, but "Mono" synthesized surround did not improve the listening. On the other hand, a cable broadcast of *Jeremiah Johnson*, the 1972 mono-sound movie starring Robert Redford, was significantly improved with the same setting. Dialog was well centered, and surround effects were worthwhile.

When the rest of the family decided that they wanted to watch *Ben-Hur*, with Charlton Heston, on Showtime, I agreed reluctantly: What would be possible from an old 1959 movie? And it's so long! Unenthusiastically, I selected Dolby Surround and waited for confirmation that a synthesized mode would be needed. In a very short time, I realized that surround sound was alive and well and living in a 30-year-old movie. The dialog was clearly defined in position, on or off the TV screen, and there was even a shifting of sonic position between actors within the same scene. The 'scope showed the straight line for the monaural character of the talking but changed its tilt anywhere from straight up and down for all the way left (off screen to the left) to horizontal for all the way right.

Music and effects in *Ben-Hur* had continual stereo information, and the surround-sound quality allowed setting the level high without any detectable speaker localization. During the chariot race, the cheering by sections of the arena crowd for their respective heroes was positioned around the room. The storm after the crucifixion scene was very effective, especially the thunder—although it was somewhat distorted. The soundtrack had some other limitations, such as compression of the cymbal crashes in the music at the end of the movie. There were jumps in the positioning of the dialog, but the great majority of the time, the change in localization matched the change in the scene. The panning mixer missed the timing just a few times in a very long movie. Despite my initial skepticism, *Ben-Hur* gave an emphatic demonstration of what is possible with a good source and a good decoder.

I switched to videodiscs as sources and picked *Ladyhawke*, with Matthew Broderick, Rutger Hauer, and Michelle Pfeiffer (Warner Home Video). This is one of my favorites, and the sound quality is excellent. The sounds of Broderick's escape from prison right at the start of the movie were more detailed and had better clarity than I have noticed with any other system. Surround sound was very good throughout, both for music and effects. Dialog was very clear and was never spread in character. I would have preferred some shifting of dialog position to go with the picture, but the 'scope and analyzer displays showed that the source did not provide any such information. In a previous "Equipment Profile," I had commented on another system's popping in one part of a scene of *Ladyhawke* and suggested that the problem might have been with the videodisc. However, the HTS 5300 showed no such negative artifacts from beginning to end of the selfsame disc.

Back to the Future, with Michael J. Fox and Christopher Lloyd (MCA Home Video), delivered very good surround on the music and effects using the Dolby Surround setting. The skateboard chase and the car take-offs and landings were particularly good. Again, I would have preferred at least some panning of the dialog, but none was in the source.

For movies, the results with the HTS 5300 were noticeably superior to those with the DSP-1.

I then turned my attention to Compact Discs. *Carols from Winchester Cathedral*, with the Winchester Cathedral Choir directed by Martin Neary (ASV CD QS6011), had a fairly smooth sound field with stereo surround synthesis, but it was noticeably better with Dolby Surround. Bach's Brandenburg Concerto No. 1, from the I Musici set (Philips 412790-2 PH2), was slightly better with stereo surround synthesis than with Dolby Surround. Both were certainly superior to stereo without surround. Delay settings from 20 to 28 mS were all good for these two CDs; delays longer than 28 mS yielded a more spacious sound, but it was not as smooth.

Mozart's "Posthorn Serenade," performed by the Prague Chamber Orchestra with Sir Charles Mackerras (Telarc CD-

Some recordings of music fared best with the Dolby Surround setting, others with stereo surround, but all benefited.

80108), was best with Dolby Surround. "Tam O'Shanter" by Malcolm Arnold, from *Scottish Overtures* with the Scottish National Orchestra and Sir Alexander Gibson (Chandos CHAN 8379), seemed equally good using Dolby Surround or stereo surround synthesis. Some cymbal crashes were far better than they would have been with normal stereo. I wanted to make the surround sound more live (reverberant) with these two CDs, but there was no way to do that.

Time Warp, with Erich Kunzel and the Cincinnati Pops (Telarc CD-80106), produced strong surround indications on the HTS 5300 panel display. It wasn't surprising that Dolby Surround was a good choice for a number of the pieces. "Ascent," by Don Dorsey, was one of the best from this collection. Leonard Bernstein's *West Side Story* (Deutsche Grammophon 415254-2 GH2) has limited surround information, and the music remained too much front-centered no matter what I tried. Emmylou Harris' *The Ballad of Sally Rose* (Warner Bros. 25202-2) had good surround indications, and Dolby Surround was the preferred mode.

For the carols and the Bach Concerto, I had slight but firm preferences for the DSP-1 processor's "Chamber" program setting with adjusted reverberation. The HTS 5300 could not generate the liveness I wanted for the Mozart and Arnold works, although I could get it with the DSP-1's "Hall" programs. Various DSP-1 modes were also preferred for the *West Side Story* and Emmylou Harris CDs.

On FM broadcasts, the HTS 5300 kept vocals and announcements centered when I listened to rock music. It did not make announcements sound odd, as music-oriented reverberation systems do. In many cases, reverberation on announcements is quite acceptable, so I would be inclined to use such reverb systems on those classical recordings that would benefit from sound-field manipulations not possible with the Shure HTS unit.

The Shure HTS 5300 decoder provided the best localization of dialog and effects for movies, in any format, of all surround processors tested to date. Setting the level for good surround sound without distracting localization was less critical than it was with Shure's previous models. The HTS 5300 did not generate any spurious artifacts from any of my sources, as has occurred with other units. It provided very satisfying sound fields with certain CDs and FM music, but it was not a match for the reference Yamaha DSP-1, with most music, in generating realistic hall illusions.

The complete Shure HTS Theater Reference System offers possible advantages to the dedicated movie fan. Although the system's price is high, it is not necessary to buy all of its components, and the cost of the HTS 5300 is in the same price range as other decoders. If the prospective user's emphasis is on theater sound in the home, this Shure HTS processor should definitely be considered.

Howard A. Roberson

TWO TEST CDs

AUDITORY DEMONSTRATIONS AND ANECHOIC ORCHESTRAL MUSIC RECORDING

Sources

Auditory Demonstrations is available from the Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, N.Y. 11797; $20 postpaid.

Anechoic Orchestral Music Recording is available from Denon, 222 New Rd., Parsippany, N.J. 07054; $52.95 postpaid; Calif. and N.J. residents must include applicable state sales tax.

The readers of *Audio* are certainly more analytical in their listening than most. There was a time, not too many years ago, when numerous readers were drawn to using test LPs to help align and otherwise optimize their turntable/cartridge combinations. You could always improve the system with a better cartridge, or through better isolation of the turntable and the fine-tuning of tracking and anti-skating adjustments.

The CD ended all of that. You can always get better performance by buying a better CD player or ancillary digital processor, but there are absolutely no adjustments you can make on a given player to improve it. Not even the most expensive CD rings or special conical feet will make any improvement in the performance of a system as stable and internally controlled as digital-to-analog conversion with robust error correction.

There are, of course, many test CDs containing tones and signals intended primarily for use by manufacturers in the design and check-out stages of production. They are also used by equipment reviewers to verify manufacturers' specifications. But the two discs reviewed here are not of that kind. Rather, they are intended to demonstrate and elucidate many of the psychological aspects of how we hear. The first of these is called *Auditory Demonstrations*, and it was co-produced by the Acoustical Society of America, Northern Illinois University, and the Institute for Perception Research in Holland. The second disc, *Anechoic Orchestral Music Recording*, was produced by Denon of Japan. Both discs are packaged in slip cases, complete with detailed booklets explaining what the tests are all about and what the listener should be alert for. The discs are available only from the manufacturers.

Auditory Demonstrations is based on a set of demonstration tapes produced at Harvard University in 1978. These were immensely popular and were soon distributed in their entirety. In 1984, the Acoustical Society of America set about to reissue the material, adding new items where appropriate. A working group—consisting of Thomas Rossing of Northern Illinois University, the Institute for Perception Research, and other interested parties of the Acoustical Society—devoted about three years to the project. All the demonstrations were done anew, and many were digitally synthesized for the lowest possible distortion and background noise. The result is a near-masterpiece. Those of us who have, over the years, heard sine waves on LPs or cassettes have cringed at the effects of noise, flutter, and wow. Here, there is none of that. The performance will be limited only by the noise floor of your living room—and if that is too high, you can always use headphones.

The CD contains 39 demonstrations, and its total running time is 65:25. The major sections deal with critical bands, loudness, masking, pitch perception, timbre, beats, and various binaural effects. All sections except the last can be played over either loudspeakers or headphones; the last, of course, must be heard over headphones for full appreciation. All examples are explained by to-the-point narration.

In this review, I will not cover each test but, rather, will discuss those which, in my opinion, relate most immediately to the listening of recordings at home.

Most readers are aware that music played back at low levels sounds bass-shy. The reason for this is explained by subjective loudness contours (Fig. 1A). The contours indicate that at lower levels, low frequencies must be considerably stronger than mid-frequencies if they are to be heard at an equal subjective level. For in-

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Most test CDs are made for checking equipment. These two illustrate and explain many psychological aspects of the way we hear.

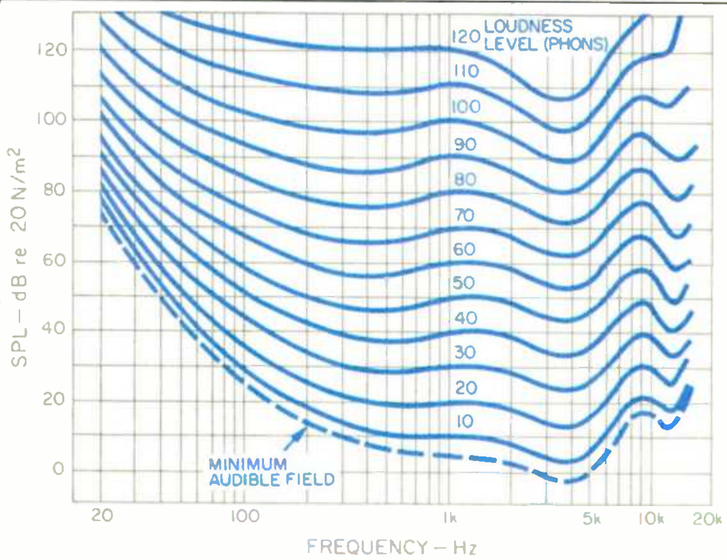


Fig. 1A—Equal-loudness contours, showing how average human hearing sensitivity varies with frequency and level. (After Robinson and Dadson.)

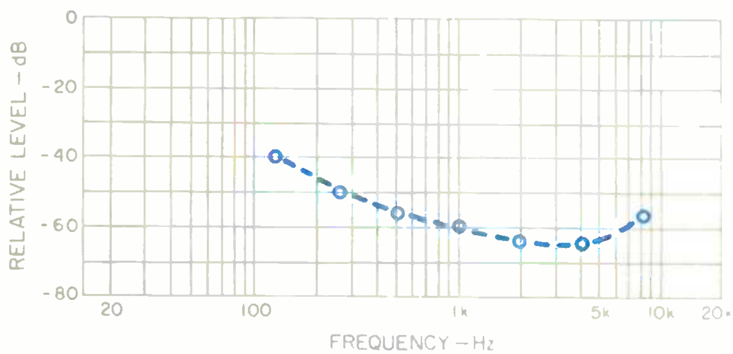


Fig. 1B—Author's response to test of equal loudness near threshold.

stance, at the threshold of hearing, if two tones are to be of equivalent loudness, a 30-Hz tone must be some 50 dB greater in level than a 1-kHz tone.

The basic research in loudness contours was carried out by Fletcher and Munson during the 1930s. Later tests, made in the 1950s by Robinson and Dadson, relate more closely to how we hear in a normal stereo context. In effect, *Auditory Demonstrations* lets the listener plot his own loudness contours in the region of threshold. The test consists of setting a mid-band reference tone so that it is barely audible. If your listening space is noisy for any reason, use headphones for this test.

Having set the calibration tone accordingly, you then hear "stair-stepped" levels going downward in 5-dB increments, beginning at 125 Hz and repeating at 250, 500, 1000, 2000, 4000, and 8000 Hz. You are told to write down the number of stair-stepped tones you hear at each frequency. For example, assume that you hear only four steps with the 125-Hz tone and six steps with the 250-Hz tone. This means that your hearing threshold is 10 dB more acute at 250 Hz than at 125 Hz. In fact, this is what most people will hear, and a quick reference to the equal loudness contours (on page 21 of the disc's accompanying booklet) will show that this is the case. Moving on to 500 Hz, if you hear seven steps, your threshold at 500 Hz is another 5 dB more acute than at 250 Hz. And so the test goes.

Typically, there is nothing surprising here. You will probably find that you hear the same as just about everyone else. The real satisfaction you will get from this exercise simply comes from knowing that you have tested yourself and found that you belong in the middle of that big bell curve! My own response to this test is shown in Fig. 1B. My hearing threshold—as observed in my listening room, with its low residual noise floor—fairly matches the lowest contours of the Robinson-Dadson curves in Fig. 1A.

In a practical sense, the test tells us that there may be large subjective differences between music played back at a good, room-filling level and the same music played back at low levels. There are certainly more variations in home listening levels than you would discern between front and rear seats in a concert hall. Accordingly, many manufacturers of preamps and receivers have routinely included loudness controls. These are equalization networks which add bass boost as the playback level is turned down. The correction provided by this is, at best, only an approximation of what might be required, but it is certainly a step in the right direction.

A corollary to this is the bass boost which most people prefer in the automotive listening environment. Here, there is masking due to low-frequency road noise, and most listeners prefer the bass boost simply because it raises the signal above the masking spectrum.

While most of us are in close agreement on what constitutes equal loudness across the frequency band at a given mid-band reference level, we are not all in agreement as to what is meant by the terms "twice as loud" and "half as loud." In general, it has been observed that a 10-dB increase in level will be judged as a doubling of loudness, while a 10-dB decrease in level will be judged as a halving of loudness.

The test presented here consists of 20 short noise bursts. Each burst is preceded by a reference burst, and

Played backwards, a signal that seemed to contain no reverberation turns out to have quite a bit of it.

Table I—Reviewer's response to loudness scaling test.

Noise Burst Number	Relative Loudness Rating Multiple*	Rating, dB**	Actual Level, dB
1	4	+20	+15
2	½	−10	−5
3	¼	−20	−20
4	¾	−5	0
5	½	−10	−10
6	8	+30	+20
7	2	+10	+5
8	3	+15	+10
9	⅓	−15	−15
10	¾	−5	0
11	½	−10	−10
12	5	+22	+15
13	7	+28	+20
14	¾	−5	−5
15	2	+10	+10
16	½	−10	−15
17	¾	−5	−5
18	¼	−20	−20
19	1½	+5	+5
20	2½	+15	+15

* Reference (no level change) is 1.
** Based on 10 dB as representing doubled loudness.

the listener is asked to make a judgment about the loudness of the test signal with respect to the reference burst. Any convenient grading scale may be used. In my response to this test, I simply judged the test signals, relative to the reference signal, as half as loud, three times as loud, and so forth. The results are shown in Table I. Note that most of my subjective level judgments were within 5 dB of the actual level changes, but three of my level judgments proved to be off by up to 10 dB.

There is no special knack in taking such a test, and it is likely that even naive subjects will do quite well. Some evidence suggests that acclimation will improve your overall accuracy, but it is amazing how well listeners agree on what "twice as loud" really means!

The total range of levels in this demonstration is 40 dB. In taking this test, you will be impressed by both how loud and how soft those signals can be. In fact, I don't think most listeners would want their music to vary over a range of levels much greater than those presented here. Bearing this in mind, you may wonder if CD's maximum signal-to-noise ratio of 90 dB or greater is truly necessary. As a matter of fact, such wide system dynamic range *is* necessary, for the following reasons:

Even if music itself is normally "contained" within a range of about 40 dB, its softest passages must be heard against a noise floor some 25 to 30 dB lower in order to be realistic. At high levels, another 10 to 15 dB must be available for handling short-term transient signals. This gets us to a requirement of 85 dB, which is not too much less than the range that the CD actually handles.

Stated in a different way, the noise floor of a good concert hall may be about 15 dB (weighted to take the ear's reduced sensitivity to low-level bass into account), and the maximum orchestral peak levels at seats toward the front of the hall may top out in the range of 105 dB SPL (unweighted, as the ear's response is fairly flat at these levels). This is a total range of about 90 dB, and we should be grateful that the system can accommodate it.

Further examples on the disc point out the fact that the ears will "manufacture" fundamental frequencies from an ensemble of overtones when the fundamentals are, in fact, absent. This is the phenomenon which enables us to hear music with reasonable satisfaction even when it is played over a tiny loudspeaker. Related to this is our ability to recognize acquaintances over a normal telephone connection, even though it has little response below about 300 Hz.

Another demonstration shows the ability of the ear to place normal reverberation, or room sound, into context. Speech samples and a hammer stroke are recorded in an anechoic room (no reverberation), a conference room (slight reverberation), and a highly reverberant space. In the anechoic room, there will be no evidence of reverberation. Even in the conference room, a listener is not readily aware of reverb. But in the highly reverberant space, the listener is quite aware. The three examples are then played backwards. Again, in the anechoic space, the listener is aware of no reverberation. In the conference room, however, the listener is quite aware of reverb preceding the reversed speech signals. And certainly in the third example, the listener is aware of reverberation preceding the reversed speech.

The big difference here is observed in the recording made in the conference room. In real time, the reverberation effects are masked by the direct speech signals reaching our ears first. We have adjusted to this over time and take no note of it. When the same recording is played in reverse, there is nothing to mask the reverberation component, and it sticks out quite clearly.

The relevance here is to our music listening rooms. We would not want to listen to music or speech in an anechoic room, as a moderate amount of room reflection is desirable. Most of us are hardly aware of any reverberation at all behind the voice of a radio announcer, as reproduced in our listening room. But as the test shows, a reversed recording would show just how much reverb is really there. When we play recorded music, we are largely unaware that our listening rooms are putting "reverberation on top of reverberation," yet that's exactly what is happening.

The final two demonstrations to be discussed require stereo headphones. The first relates to perceived directionality at low frequencies. For the most part, our directional cues come from transient and high-frequency information, for which the chief mechanism for assigning directionality is a sound's relative levels at our two ears. At low frequencies, phase relationships provide directional cues, and even continuous sine waves can be localized. In the test on this CD, a 500-Hz signal is presented to the ears, leading in phase by 45° in one ear and then leading by the same amount in the other ear. The listener clearly assigns directionality to the signal with the leading phase. The same experiment at 2000 Hz leads to no such conclusion.

The last example involves the ability of the ears to sort out different signals coming from various directions. In one test, a pulsed 500-Hz tone is heard against a noise floor, both heard only in the left ear. The 500-Hz tone is stair-stepped downward in 3-dB steps, and

I'm surprised no one has tried anechoic recordings of large-scale orchestral forces before. That's the chief value of Denon's CD.

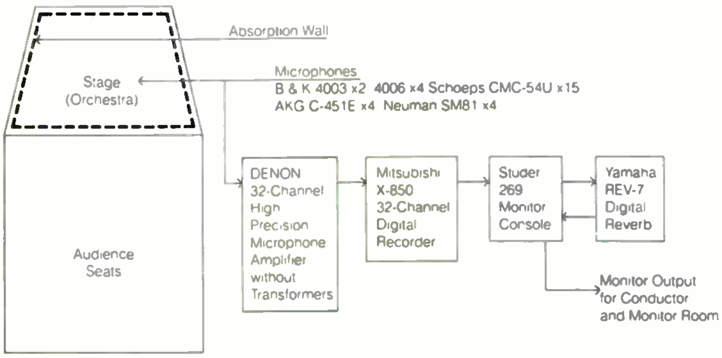


Fig. 2—Setup for Denon's anechoic recording.

the listener is asked to identify the last tone he can hear. Then, the noise signal is switched to the right ear, and the procedure is repeated. This time, the listener can quite easily hear the tone as it is reduced to even lower levels at the left ear, inasmuch as the masking signal (the noise) and the tones are now perceived as coming from different directions. Several variations of this phenomenon are presented.

The relevance here has to do with normal stereo listening. The spatial relationships in stereo help us sort out musical and textural details. In mono, these are often lost, as everything is perceived to be coming from the same direction. Our ability to sort out signals according to direction is one of our best assets—both in the home listening experience and in the concert hall.

The Denon CD, *Anechoic Orchestral Music Recording*, is the result of successful efforts to create, indoors, an anechoic environment large enough to accommodate a symphony orchestra. The accompanying booklet describes how the stage of a concert hall was blocked off from the hall itself, and how all wall and ceiling boundaries in the orchestra enclosure were made absorptive; see Fig. 2. The playing is by the Osaka Philharmonic Orchestra, and the musical examples and excerpts are taken from the classical and Romantic eras. Total running time of the disc is 64:58.

As an interesting aside, performing in the anechoic environment was such a difficult task for the players that they were all outfitted with headphones so they could monitor themselves with both direct and artificially reverberated sound during actual recording!

Realizing the necessity for picking up a completely "dry" signal which truly represented the section-by-section "power response" of the ensemble, 32 microphones were deployed over the orchestra, and each microphone was fed to a separate track on a digital multi-track recorder.

Ideally, we would want to play back the 32-track tape via 32 amplifiers and loudspeakers, each placed in its appropriate position on stage. In so doing, we would virtually simulate an orchestra on stage, and we could make subjective judgments ad infinitum. Perhaps Denon will make the 32-track tape available for such purposes, but in the real world of stereo. a two-channel mixdown had to be made for general application. With some care in setting up the loudspeakers on stage, many aspects of stage-to-hall transfer characteristics can be measured using this program material. For example, the suitability of a new venue for concerts or symphonic recordings could be evaluated, at least preliminarily, with this disc.

Another section of the Denon disc gives examples of the dry orchestral recording as "treated" to the simulated acoustics of the Vienna Musikvereinsaal, the Amsterdam Concertgebouw, and Boston's Symphony Hall. These examples place the orchestra a little too far in the reverberant field for my taste.

Another very useful section of this disc shows the effects of various stereo microphone philosophies. Enough microphones were deployed so that these techniques could be re-created after the multi-track recording was made. Some of the techniques demonstrated are: Omnidirectional, single-point stereo pickup; omnidirectional, single-point stereo pickup with time-coherent (delayed) accent mikes; unidirectional, single-point stereo pickup; multi-microphone pickup, and multi-mike pickup delayed for time coherence with rear microphones.

For the most part, these examples show only subtle differences. If such a comparison were made in a live recording environment, we would expect greater difference, since these basic microphone arrays respond quite differently to room sound. In any event, there is considerable tutorial value here.

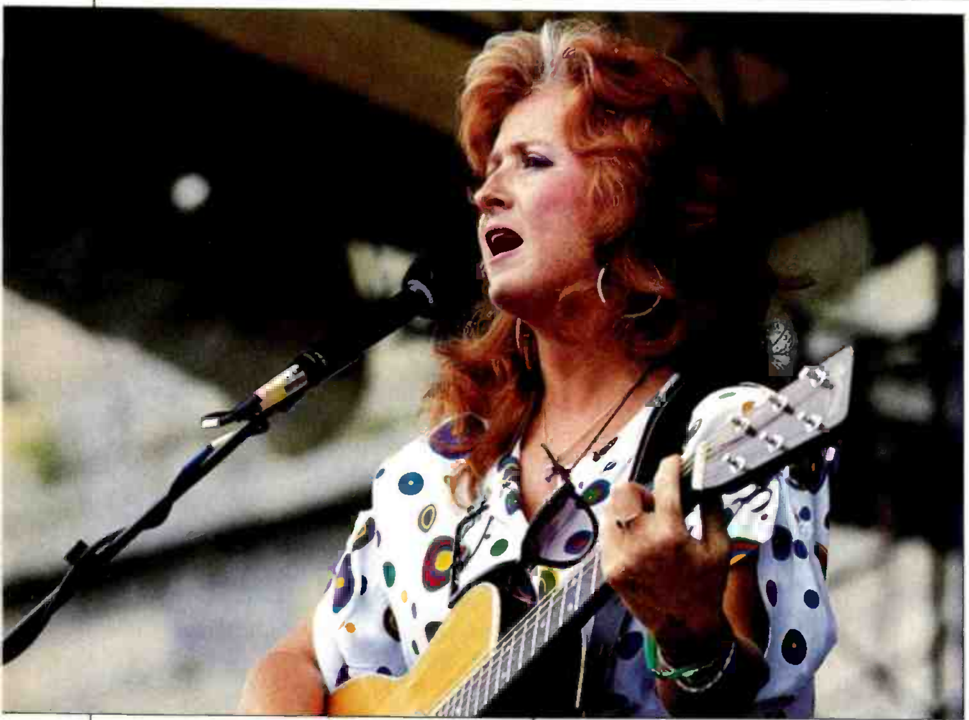
The last section of the Denon disc contains various tones and signals which will be useful in field evaluation of room reverberation and other acoustical characteristics.

The chief value in this disc is, of course, the anechoic examples, and I am surprised that no one has attempted it before. My only quibble is that there was ample room on the disc to have included many examples of chamber music and so on, for evaluating smaller performance and recording venues. Such examples have been recorded before, but I am not aware of any of them having made their way onto CD.

The analytical listener will want to acquire both discs. What is to be learned from them goes way beyond just a few listenings. They are a must for any audio educational activity.

John Eargle

TOP-RAITT



Nick of Time: Bonnie Raitt
Capitol CDP-91268-2, CD; 42:59.

Sound: B Performance: B

Nick of Time, Bonnie Raitt's first album for Capitol, *could* be called a return to form—but it really isn't. Working with producer Don Was of the group Was (Not Was), Bonnie has cut one of the few albums of her career in which she is not overwhelmed, intimidated, or manipulated by her producer. Instead, *Nick* has been fashioned to fit within Bonnie's multi-faceted persona and to display her eclecticism. Her slide-guitar-driven, sassy and bluesy side has never been captured better, or been better recorded, than on the John Hiatt song "Thing Called Love," the most radio-friendly song she has cut. Bonnie Hayes' "Love Letter" looms as a follow-up. Raitt's wistful side is best shown on the softly acoustic "Nobody's Girl," the sad but sultry "Too Soon to Tell," and "I Ain't Gonna Let You Break My Heart Again," on which Bonnie's sweet voice is backed only by a cocktail-style piano played by Herbie Hancock.

I feel certain that, to Bonnie, the key songs here are her two originals, which bookend the album. "Nick of Time," opening the show, is a disarmingly honest song about reaching middle age and being aware that old age is just beyond. It truly is a touching work. The closer, "The Road's My Middle Name," features The Fabulous Thunderbirds on a fun thing that summarizes how Bonnie perceives this persona she's constructed, contradictions and all.

This is a good, good album—one of Raitt's best and certainly one of her truest. Don Was proves a sympathetic producer. If there is a real flaw, it is that Bonnie plays too comfortably; she doesn't really stretch very much here. Then again, as a label debut, the idea of the album is to reestablish Bonnie Raitt as an active and viable force. That goal has been met.

Here's hoping *Nick of Time* does well enough to encourage Bonnie Raitt to do it again real soon, and to take a slightly riskier path. *Michael Tearson*

Mystery Girl: Roy Orbison
Virgin 91058-2, CD; 38:15.

Sound: B Performance: B+

Yes, Roy sings beautifully here. That is first and foremost. Though a lot of heavy-hitters contributed songs, production, and support to this, his first album of new material in nearly a decade, it is always Orbison's show and sound. The opener, "You Got It," rocks briskly and has a "Pretty Woman"-like finish. However, the real hot rocker of the set is "(All I Can Do Is) Dream You," which is something of a revelation since, despite "Pretty Woman," it is the ballads which people remember Roy for. Speaking of ballads, there are some real good ones here—the deliberate "A Love So Beautiful," the dreamy "Windsurfer," "In the Real World," the closing "Careless Heart," and the Bono/The Edge composition "She's a Mystery to Me."

As impressive as Roy is throughout the album (and make no mistake, he sings here as he never has before), he doesn't really have to stretch to make the songs work. They have been carefully manicured to fit into his style and don't force him to venture into strange territory.

The best example of this sort of artistic tailoring is the Elvis Costello song "The Comedians." When Elvis recorded it on his *Goodbye Cruel World* album, it was in 5/4 time, with a difficult herky-jerky melody, lyrics I'd describe as complex and intimidating, and a glorious chorus. From that version, Elvis totally rewrote the song, keeping only the chorus and one verse line. The new "Comedians" has a vivid fairgrounds storyline about a ferris wheel

Photograph: ©David Gahr

Lyle Lovett

Photograph: ©1988, Ebet Roberts

and a bitter betrayal. The language now is simple and direct. Outside of the word "comedians," the only words of more than two syllables are "whispering" and "carousel." Replacing the impenetrable 5/4 arrangement is a beguiling bolero-style melody very reminiscent of "Running Scared." Most importantly, the song has been regrooved right to the heart of Orbison country, as a perfect, operatically swirling vehicle for the man.

Although *Mystery Girl* was completed shortly before Roy Orbison's sudden death last December, it is hard for me to listen to this CD as a posthumous release. The "greatest hits" albums make better post-mortems. This is much more a new beginning that was tragically cut short. *Mystery Girl* is a vital work which succeeds on its own terms. *Michael Tearson*

Lyle Lovett and His Large Band
MCA MCAD-42263, CD; DDD; 41:13.

Sound: A Performance: B

Lyle Lovett and His Large Band is half big band blues, half country(ish) music. Thus, though the all-digital recording sounds best on CD, it plays better on LP or cassette, where you listen to one side at a time and consciously decide to flip the album over. The two halves are *that* separate.

The first half opens with a seemingly extraneous Clifford Brown blues riff that has been included to set up Lyle's entrance at the beginning of the second track, "Here I Am." From this piece's collection of oblique and bizarre observations, the side meanders its way through a set of bluesy little numbers played by a piano- and horn-driven band that also features Francine Reed's hot, jazzy vocals—smoky nightclub stuff that is very wry and often very funny. These are songs that do not look you square in the eye.

Then there's the country side, on which the principal weaponry is Paul Franklin's steel guitar and Mark O'Connor's fiddling. You would expect a song called "I Married Her Just Because She Looks Like You" to be yet another gimmick country song with a glib twist. It isn't. Given the scenario that the title spells out, it is a sincere kiss-off to a woman better left behind. Next up is a deadpan-straight read of Tammy Wynette's "Stand By Your Man," which is both a very weird song for a guy to sing and a total flip side to "I Married Her. . . ." "Which Way Does that Old Pony Run" is a wonderful song about a cowboy who has outlived his era, and "Nobody Knows Me" is a quiet, sad, contemplative song about how a love went awry, featuring John Hagen's lovely cello work. The finale, "Once Is Enough," features Mills Brothers-style harmonies and a hot acoustic-guitar lead by DesChamps Hood, completing the album's cycle back to wry blues.

The sound is superb, subtle, and smoky on the big band blues material and more direct on the country and folk stuff. The sound fits the music, and that spells fine production.

I don't think this album is quite up to either of its predecessors, *Lyle Lovett* and *Pontiac*, but the best stuff is at least as good as anything on either of those worthies. Lovett has such a unique and versatile vision that he is clearly miscast as a country performer; he embraces far too much territory for such narrow pigeonholing. He deserves a wider audience, and with the recent wave of critical approval, he may well get it.

His dilemma, if it may be termed one, is that he appears to have exhausted his backlog of songs. From here on, he has to write them one record at a time. But I think Lovett can pull it off. My money rides with the little guy from Houston with the big haircut.

Michael Tearson

3: Violent Femmes
Slash/Warner Bros. 1-25819, LP.

Sound: B+ Performance: C−

As in George Orwell, *3* is four. That is, *3* is the fourth album from those wacky, existential funsters from the Midwest, Violent Femmes. If that strikes you as hip intellectual humor, you'll enjoy the album. The rest of us will go back to watching Rocky and Bullwinkle.

After the unanimous round of applause six years ago for the first Violent Femmes album ("Lou Reed tackling Gershwin," burbled one critic), the band has gotten progressively whinier and self-absorbed. Against spare in-

Violent Femmes

Fisherman's Blues only delivers an apprentice prophet, who parts two clouds and then tells knock-knock jokes.

strumentation that wouldn't have been out of place backing poets in beatnik coffeehouses in 1960, vocalist/songwriter Gordon Gano gripes about how he can't get to sleep because he's thinking of some girl, or how a girl isn't returning his phone calls, or how he hopes the girl who dumped him has gotten fat. There's a teaspoon of wit at work, but no more and nothing else—no irony, no symbolism, no nothing. When Gano whines that he can't sleep because he's thinking of some girl, that's all there is to the song: Insomnia. Geez, at least "Be-Bop-a-Lula" tackled this subject with teenage angst.

Lots of songs here whine on to no apparent destination, but at least one of them, the vaguely calypso-ish "Outside the Palace," develops the whining into something more: A lonely man's reverie, a recitation of things he's seen and things he knows as he stands at a crossroad. This song intimates thoughts unspoken, hints at the life behind the words. Too many of the rest are like watching *thirtysomething*.

Frank Lovece

Fisherman's Blues: The Waterboys
Chrysalis VK 41589, CD; AAD; 54:36.

Sound: B– Performance: C+

American folk music largely stems from English, Scottish, and Irish roots. Now, The Waterboys—after a long absence, an overhaul in personnel, and a change in record companies—return to take us full circle: A Scottish singer/songwriter in an Irish setting re-creating the sensibilities of American folk. Or trying to, anyway.

On *Fisherman's Blues*, Waterboy *auteur* Mike Scott does give the impression he could hum the soundtrack from every western John Ford ever made, but in trying to get down with the reg'lar people, he only reaffirms that true naiveté is quaint, and fake naiveté, well, ain't. Scott's strength has always been a moody lyricism as simultaneously full of details and white space as an Aubrey Beardsley drawing. Here, he practically goes country. I'm not sure, but I think I heard him singing about how his hound dog died and his woman done left him.

Actually, several women do leave him in the course of this album. On the best cut, a bouncy ditty full of cyanide and vinegar called "And a Bang on the Ear," Scott runs down a seemingly autobiographical list of ex-lovers and unrequited romances, getting back at each with an honest, spiteful message of love and kisses and the hope that somebody whacks them on the side of the head.

Unfortunately, too little such emotion spews forth, and much of the album is either overinflated ego ("We Will Not Be Lovers"), forced folk ("Has Anybody Here Seen Hank?"), or twee attempts to tug at tradition's heartstrings ("Jimmy Hickey's Waltz," "When Ye Go Away," the Irish folk jig "When Will We

Be Married?" and, in the worst example of straining for respectability, "The Stolen Child"—music by Mike Scott, words by William Butler Yeats). To make sure we Americans know he's sincere, Scott even throws in a few bars of Woody Guthrie's "This Land Is Your Land" at the end.

Though The Waterboys have grown from three to about 200 members—or so it seems, for there are 10 on the album cover and 18 listed in the credits, not counting guest vocalists—the sound has remained fairly consistent. As in the previous *A Pagan Place* and *This Is the Sea*—two of the most critically well-received albums of the mid-1980s—The Waterboys' sound here is organic, a natural force. Even when cheerful, the music swirls and whirls like dark clouds, ominous and beautiful at once. It's music that demands the voice of God. Yet all the album gives us is an apprentice prophet, parting two clouds and then telling us knock-knock jokes. *Frank Lovece*

Dylan & The Dead: Bob Dylan and The Grateful Dead
Columbia CK 45056, CD; 43:59.

Sound: C Performance: C–

Recorded at stadium dates during their summer of '87 joint tour, *Dylan & The Dead* is an enjoyable trifle, but it is far from a revelation for fans of either Dylan or The Dead.

Dylan & The Dead is an enjoyable trifle, but it is far from a revelation for fans of either Dylan or The Grateful Dead.

The Grateful Dead's love of Dylan's work is a matter of record; they have regularly performed many Dylan songs in their live shows for years. As a backing band for him, they wend their way through the paces, but they don't flash much fire here. In fact, they often sound lackadaisical and sloppy. This is far from the best work of either Dylan or The Dead.

Certain selections must be considered inevitable, notably the closers "All Along the Watchtower" and "Knockin' on Heaven's Door." Others—like "Joey," "I Want You," and especially "Queen Jane Approximately"—are genuine surprises.

Technically, this is an acceptable piece of work. But the performance is not all that hot—or very special.

At the time of the tour, Dylan stated that there would not be a live album to commemorate it. Except as yet another way to resurrect and redo old warhorses, there was not much reason to release this recording at all. Dylan might be trying to buy time after his successful stint as a member of the Traveling Wilburys. Let's hope, if that *is* the case, he'll use this time to get serious in the studio. *Michael Tearson*

TRAIN DEPARTURE

Photograph: Nevin Shalit

Different Trains/Electric Counterpoint: Steve Reich
Nonesuch 79176-2, CD; DDD; 41:47.

Sound: A Performance: A

On the surface, "Different Trains," one of the two works on Steve Reich's newest album, is his most radical departure to date. But in reality, this composition draws from the earliest development of his style as well as from his childhood memories of train travel between Los Angeles and New York. These early trips serve as a metaphor of passage and symbolize a shared past with the holocaust victims of World War II, who were shipped by train across Europe to the concentration camps.

To establish this place in time, Reich collected voice recordings of holocaust victims, his governess, and a Pullman porter, and he used their spoken pitches as the melodic basis for the string lines played by The Kronos Quartet. In this regard, "Different Trains" recalls Reich's "Come Out" and "It's Gonna Rain," in which he created tape loops out of spoken-word fragments, generating flanging effects, melodies, and rhythms from the interplay of the loops as they moved out of phase with each other.

On "Different Trains," Reich used a digital keyboard sampler to trigger the voices, along with recordings of sirens, train whistles, and other train sounds, a technique which has become familiar on rap records. But Reich used these patterns to generate the melodic material for Kronos. They pick up on the spoken melodies of phrases like "From Chicago to New York" or "They tattooed a number on our arm" and shift them through different instrumental patterns as their lines intersect with each new spoken phrase.

The result is a driving, relentless work, with Kronos as the train. Part I, set in "America—Before the War," is full of optimism and exuberance. Part II takes us to "Europe—During the War," with a commensurate shift into chaos, anxiety, and fear. The final movement, "After the War," is both melancholic and full of the strains of rebirth and rediscovery.

There are times when "Different Trains" begins to veer toward a gimmicky, minimalist rap record with the stutter of repeating voices. But the subtlety of Reich's writing and the power of Kronos' performance, with its unerring precision and nuance, always pulls the album back from the abyss.

"Electric Counterpoint" was written for guitarist Pat Metheny, who multitracks 11 guitars and two electric basses in the third of Reich's "Counterpoint" series. Metheny deftly navigates Reich's canon form, as patterns rise and fall through the mix of multiple lines and the occasional chordal pattern scans the scene like a searchlight.

"Electric Counterpoint" has an intricate austerity and cleanliness of line that is endlessly fascinating, while "Different Trains" is a harrowing, often exhilarating journey. *John Diliberto*

Legend of the Seven Dreams: Jan Garbarek
ECM 1381, CD; DDD; 54:51.

Sound: B+ Performance: A–

Jan Garbarek has shifted, over the years, away from the post-Coltrane modal excursions of his early work. He's gone past the impressionistic, neoclassical jazz of his late '70s music and into a more environmental, moody sound that climaxed on 1987's *All Those Born with Wings*, a contemplative album for multiple reeds, synthesizers, and percussion, all played by Garbarek.

Legend of the Seven Dreams picks up where *All Those Born with Wings* left off, but this time with some old companions along for the trip. It's an album produced in a contemplative studio environment, where the detailed ambience and wistful imagery are established from the start on "He Comes from the North."

Based on a Lapp melody, the 13-minute suite proceeds with hypnotic insistence through moments of child-like lyricism and primal memories. Garbarek's soprano saxophone is hauntingly sweet, but Nana Vasconcelos' insistent berimbau rhythm roots the piece in the earth with a cyclical pulse. They move from one section to the next like a motion picture dissolve, Garbar-

Jan Garbarek

ek's soprano fading into a Vasconcelos vocal chant that's arranged in canonic rounds with digital delay.

The village feel of "He Comes from the North" gives way to the hallucinatory techno-stomp of "Aichuri, the Song Man." Playing a processed tenor saxophone and electronic percussion that sounds like slow-motion Burundi drums, Garbarek creates a mutated bagpipe choir that phases in a swirling drone.

Like most Garbarek records, *Legend of the Seven Dreams* has an overriding atmosphere that links all the music, whether it's the Eastern themes of "Tongue of Secrets," the gothic jazz of "Brother Wind," or the tango feel of "Voy Cantando."

Rainier Bruninghaus plays a harpsichord synthesizer patch on the latter two pieces, lending a baroque bombast to "Brother Wind," while "Voy Cantando" reminded me of Lurch playing harpsichord tangos on *The Addams Family* TV show.

The addition of Vasconcelos, Bruninghaus, and bassist Eberhard Weber lends some needed vitality to Garbarek's moody tone poems. They combine for a time-lost, ceremonial dirge on "Tongue of Secrets," conjuring up dark, discarded tombs and ancient relics with their ambient pulses. Weber's bass solo on "Send Word" is one of his typical, bittersweet refrains, prowling the bottom like a desolate soul on one of the more straight-ahead jazz tracks.

Garbarek has always been an innovative saxophonist, combining lyrical invention with passionate bursts of frenzy. The frenzy is clearly on the wane in *Legend of the Seven Dreams*, but the lyricism remains long after the music is over. *John Diliberto*

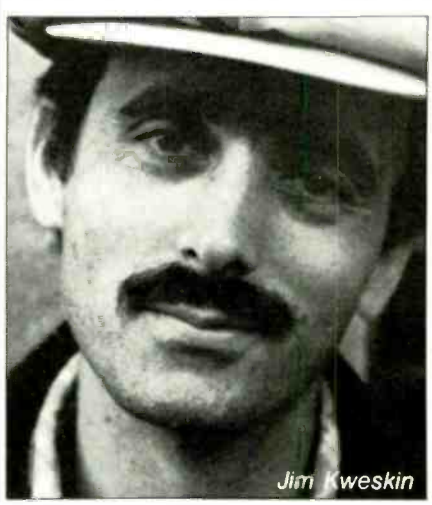
Jug Band Blues: Jim Kweskin & The Jug Band with Sippie Wallace and Otis Spann
Mountain Railroad MR-52672, LP. (Available from Chameleon Music Group, 3355 West El Segundo Blvd., Hawthorne, Cal. 90250.)

Sound: B– Performance: A

If there is going to be a more astonishing lost master tape found this year, I can't wait to hear it. It's going to have to go a *long* way to top *Jug Band Blues*! This record was made in the late '60s, when The Kweskin Jug Band was the best at their game. The lineup included Kweskin, banjo wizard Bill Keith, fiddle legend Richard Greene, Fritz Richmond on washtub bass and jug, plus the then-married Geoff and Maria Muldaur. Supplementing this core group was Otis Spann, perhaps the greatest blues piano player, while fronting it all was the wonderful blues singer Sippie Wallace. These tapes are the stuff of which history is made.

This record includes Sippie's most famous songs, "Mighty Tight Woman" and "You Got to Know How," along with blues standards like "Black Snake Blues," "Jelly Roll Blues," and "Nobody Knows the Way I Feel This Morning" plus a wild run at "Everybody Loves My Baby" to close the set. There's also a very funny tribute called "Muhammed Ali."

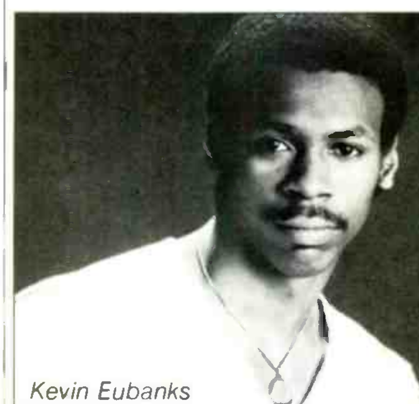
The sessions have the friendly, informal, and relaxed feel of a delightful, no-pressure situation. There is some hiss from the master tapes, but it is no big deal, especially considering the importance of these performances and how much pure fun they contain.



Jim Kweskin

No question about it, *Jug Band Blues* is a wonderful album that exists thanks to a collection of happy accidents. I do wish, though, that the label had provided more information about the session—places, dates, songwriters—in their packaging. But if the very idea of a collaboration between Sippie Wallace, Otis Spann, and The Kweskin Jug Band piques your curiosity at all, don't miss this record.

Michael Tearson



Kevin Eubanks

The Searcher: Kevin Eubanks
GRP GRD-9580, CD; DDD; 52:58.

Sound: A Performance: A

Searching for a voice has led guitarist Kevin Eubanks into some wrong turns. But it seems that with his new album, *The Searcher*, he is settling into a confident groove of pop-oriented jazz that continues in the direction set by last year's *The Heat of Heat*.

Relying mainly on acoustic guitar played crisply with a plectrum and accompanied by a straightforward rhythm section of keys, bass, and drums, Eubanks achieves a fluid, full-bodied sound all his own. Occasional laid-back electric guitar and Mark Ledford's scat vocals/voice percussion embellish this new-found identity. Synth strings are used sparingly on two cuts. Picks include the melodic twists of "The Story Teller," the swirling, syncopated scales of "In Search of the Searcher," and the unaccompanied guitar duet, "Poem for a Sleeping Child." Digitally recorded, Kevin Eubanks' *The Searcher* is a big, clean-sounding CD. Good playing, good songs, good job. *Michael Wright*

BY GEORGE!

Illustration: Rick Tulka

Enescu: Symphonies 1 to 3, Suites 1 to 3, Chamber Symphony, Suite Châtelaine, "Vox Maris," Concert Overture, Romanian Poem, Romanian Rhapsodies 1 and 2, String Octet, Wind Dixtuor, Sinfonia Concertante, Voix de la Nature. Various Romanian orchestras; Iosif Conta, Mihai Brediceanu, Ion Baciu, Remus Georgescu, Constantin Silvestri, and Horia Andreescu, conductors.
Marco Polo 8.223141 to 8.223147, seven CDs; AAD; 60:20, 67:38, 67:07, 64:39, 56:18, 54:17, and 64:42.

By now, many of you will have encountered an almost bewildering variety of new releases on the Marco Polo label. This adventuresome line focuses primarily on orchestral music written between 1850 and 1920 but ventures beyond these dates when there is good reason to do so. The greater part of the catalog is recorded in Czechoslovakia, Yugoslavia, and Romania, although some albums stem from sessions done in West Germany and Hong Kong. Marco Polo is the offspring of Hong Kong Records (based there) and its exceptionally motivated founder, Klaus Heyman. The label typically goes in for complete surveys of the symphonic output of composers like Respighi, Anton Rubinstein, Castelnuovo-Tedesco, Bantock, Bloch, Johann Strauss (50 CDs, eventually!), Janáček, Martinu, and a basketful of others. The best-known Marco Polo CD is a generous sampler of the orchestral music of Anatoly Liadov, recorded in Ljubljana and offering the haunting tone poem, "Enchanted Lake."

So this is a repertoire label, as we see when we peruse the profusion of 19th- and early 20th-century works in the catalog. A good example, musically and technically, of Marco Polo's activities is this set of seven individual CDs devoted to the works of George (*dzhor-dzeh*) Enescu (1881 to 1955)—or Enesco, as he was more often called outside of his native Romania.

Do you know this composer beyond that once-egregious A-Major "Romanian Rhapsody"? His nationality may have provided an indelible element in his emotional and compositional makeup, but it was neither a limitation on his tonal language nor a cheap "out" when more traditional musical inspiration fled. In fact, judging from these works, he rarely was at a loss for good rhythmic, melodic, and harmonic ideas. Although he began Fourth and Fifth Symphonies, Enescu did not finish them. This handful of albums, then, documents all of his orchestral works except for a "Ballade" for violin and orchestra and the "Tragic Overture." For good measure, it throws in the marvelous "String Octet" and an almost symphonic chamber work for winds, the 1906 "Dixtuor."

There is an attractive, bright sheen to Enescu's instrumentation that floats above a whole palette of darker timbral hues: Sombre woodwind chords, massive bass and cello strokes, and firmly cemented marriages of all the low instruments. Where a superficial hearing certainly suggests a composer with roots in the eastern end of Europe, the inventive departures from conventional Slavic or Germanic development—and there are constant such flights of imagination—could only come from a man with his head in Parisian clouds. George Enescu began his musical career at the ripe old age of 4 by studying with a prominent gypsy violinist who had also absorbed a solid classical technical education. He also studied with the likes of Hellmesberger, Fauré, and Massenet. The man could and did play anything from memory, including full orchestral scores, and never pursued just one element of an active musician's life. Initially most renowned as a violinist, he was an equally proficient organist, pianist, conductor, cellist, and, as we hear in these seven worthwhile CDs, composer. He worked in Paris and Romania all his life.

This is gorgeously crafted music and is recorded with exceptional consis-


Alicia de Larrocha

[redacted]

tency and spaciousness—except for the First and Second Symphonies, which have decidedly constricted sound. Still, these recordings were no small task when you learn from the credits that a number of orchestras, conductors, and halls were called upon for this sizable project. Marco Polo's very busy annotator, Keith Anderson, who also lives in Hong Kong, has provided a good overview of the composer's life and commentary on each work. The production is seamlessly edited and gives accurate impressions of generally fine rooms and of the placement of instruments in each piece. A worthwhile album, each of these, but if you must limit yourself to just one, start with the disc that has the "Village Suite," "Suite Châtelaine," and "Voix de la Nature" (8.223145). I simply cannot imagine that, having heard this as an hors d'oeuvre, you will pass up the chance to make a full meal of Enescu. *Christopher Greenleaf*

Albéniz: Iberia, Navarra, Suite Española. Alicia de Larrocha, piano.
London 417-887-2 LH-2, two CDs; DDD.

In the Grammy Awards' convoluted categories, this recording of "Iberia" won for "Best Solo Performance Without Orchestra." Alicia de Larrocha virtually "owns" this music—it's in her blood—and over the years, her performances of it have been considered near-definitive. During the analog era, London/Decca made some excellent recordings of de Larrocha playing this music. Now, in this two-CD set, we can marvel at her virtuosity in these brilliant new digital recordings.

Decca engineer John Dunkerley has evidently found a new venue for piano recording, the Concert Hall of the University Music School at Cambridge, England. This hall has a warm, spacious ambience that supports and enhances the rich resonance of the piano without blurring or diffusing its brilliant definition. Dunkerley has so expertly positioned de Larrocha's Steinway and his microphones that he can encompass the enormous dynamic range of "Iberia," which, in the score, is rather optimistically marked from quintuple "p" to quintuple "f"! From the massive sonority of the bass, to the richly reso-

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The Falla Guitar Trio's "West Side Story Suite" is loose and airy. Their read is not too glibly pop or too seriously classical.

nant and highly projected middle register, to the sparkling transients of the upper register, this is one of the most extraordinarily natural and realistic piano sounds I have ever heard from a recording.

Pianist de Larrocha's performance is amazing, from her great dynamic expression to her immaculate touch, and even the most complex passages always are clean and never smeared. This is especially apparent in this highly rhythmic music, with its intimidating runs and trills.

The major piece here is "Iberia," with the "Suite Española" and the rarely played "Navarra," which Albéniz originally intended to use as the last section of "Iberia," also included. Perhaps the most famous part of "Iberia" is the third section, "El Corpus Christi en Seville" (familiar to many in its orchestral transcription). The awesome dynamics of this music and its pianistic complexities are splendidly realized by de Larrocha. Incidentally, if you attempt to play back this music at anywhere near realistic levels, you had better have robust loudspeakers and powerful amplifiers.

Musically and sonically, this is one of the most outstanding recordings of piano on CD. *Bert Whyte*

West Side Story, Pulcinella, Jazz Sonata. Falla Guitar Trio.
Concord CCD-42013, CD; AAD; 43:44
Sound: A Performance: A

Leonard Bernstein's royalty checks must be pretty good these days, what with the number of guitarists who are recording transcriptions of his music for one, two, and three guitars. On the disc reviewed here, the Falla Guitar Trio undertakes its trio transcription of the Bernstein and the Stravinsky plus one original composition.

The trio format gives the ensemble room to breathe on the "West Side Story Suite." Their reading is loose and airy, and manages to avoid sounding either too glibly pop or too seriously classical. Comparison with the recent, much more intense version by Carlos Barbosa-Lima and Sharon Isbin presents an interesting contrast (Concord CCD-42012). The Trio even occasionally breaks into vocal embellishments on "Mambo." Stravinsky's "Pulcinella" also translates well to the guitar trio form, with the exotic, dissonant harmonies becoming stunningly delicate things of beauty when heard through this intimate voice. The highlight, however, is member Dusan Bogdanovic's "Jazz Sonata," a buoyantly enthusiastic piece which combines post-modern compositional ideas with jazz idiom.

The recording is crisp, with excellent placement of the guitars right, left, and center and just enough presence to distinguish the different coloration of each performer without letting the "room" get in the way—a common problem with guitar records.

Conductor Bryden Thomson has London's Philharmonic playing Bax's unfamiliar "Festival Overture" at the top of their form.

The Falla Guitar Trio strikes a nice balance between commercial appeal and the search for new repertoire and provides an excellent, sensitive performance. Now let's find something other than "America" to play. *Michael Wright*

Bax: Symphony No. 6, Festival Overture. London Philharmonic Orchestra, Bryden Thomson.
Chandos CHAN-8586, CD; DDD.

Even if you are not an Anglophile, there is a rich lode to mine in the music of a few 19th- and a number of 20th-century British composers. Most of this music is cast in the late-Romantic mold, embellished occasionally with a few modern touches.

Sir Arnold Bax, who died in 1953, is one of the more interesting, if generally neglected, British composers. He was fairly prolific and wrote seven symphonies, many tone poems, and music in other forms.

Chandos Records, that enterprising British company, has made something of a specialty of recording Bax's music. They have recorded six of the symphonies and many of the tone poems, mostly under the baton of conductor Bryden Thomson with the London Philharmonic and Ulster Orchestras. Bax's Sixth Symphony is a highly dynamic work, with intricate and interesting orchestration. The First Movement's big, imposing structure makes some very grandiose statements in brass and percussion. The Second is fairly lyrical and a bit introspective at times, while the Scherzo and Finale are combined in a movement notable for its propulsive energy and dynamics, though it ends with a quiet Epilogue. Bax's early "Festival Overture" is a generous filler, and it is a brash and brassy work full of orchestral fire and bombast. Bryden Thomson has the London Philharmonic playing this unfamiliar music at the top of their form.

The recording was made in All Saints Church in Tooting, London, which to my taste is a bit too reverberant. However, Chandos frequently records in this hall and manages to provide a big, clean sound with plenty of definition and impact.

If you are in the mood to venture beyond the standard symphonic repertoire, you'll find this interesting and rewarding music. *Bert Whyte*

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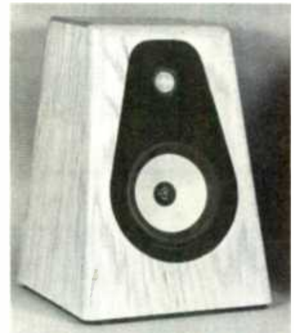

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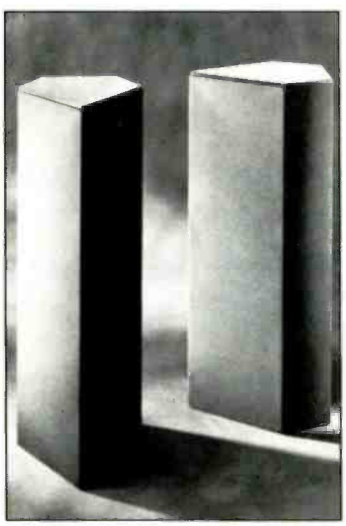

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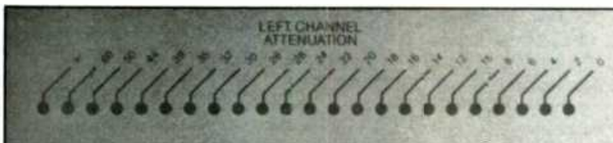

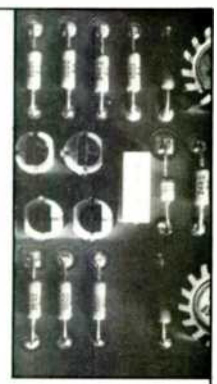

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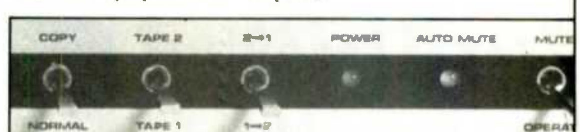

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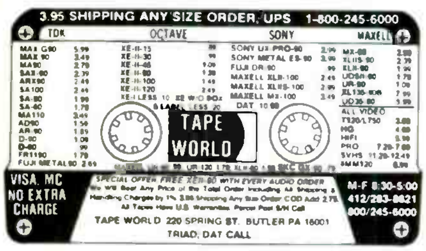

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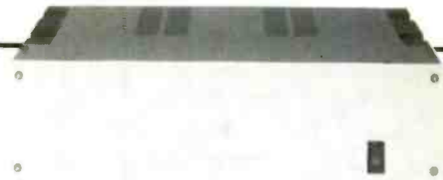

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