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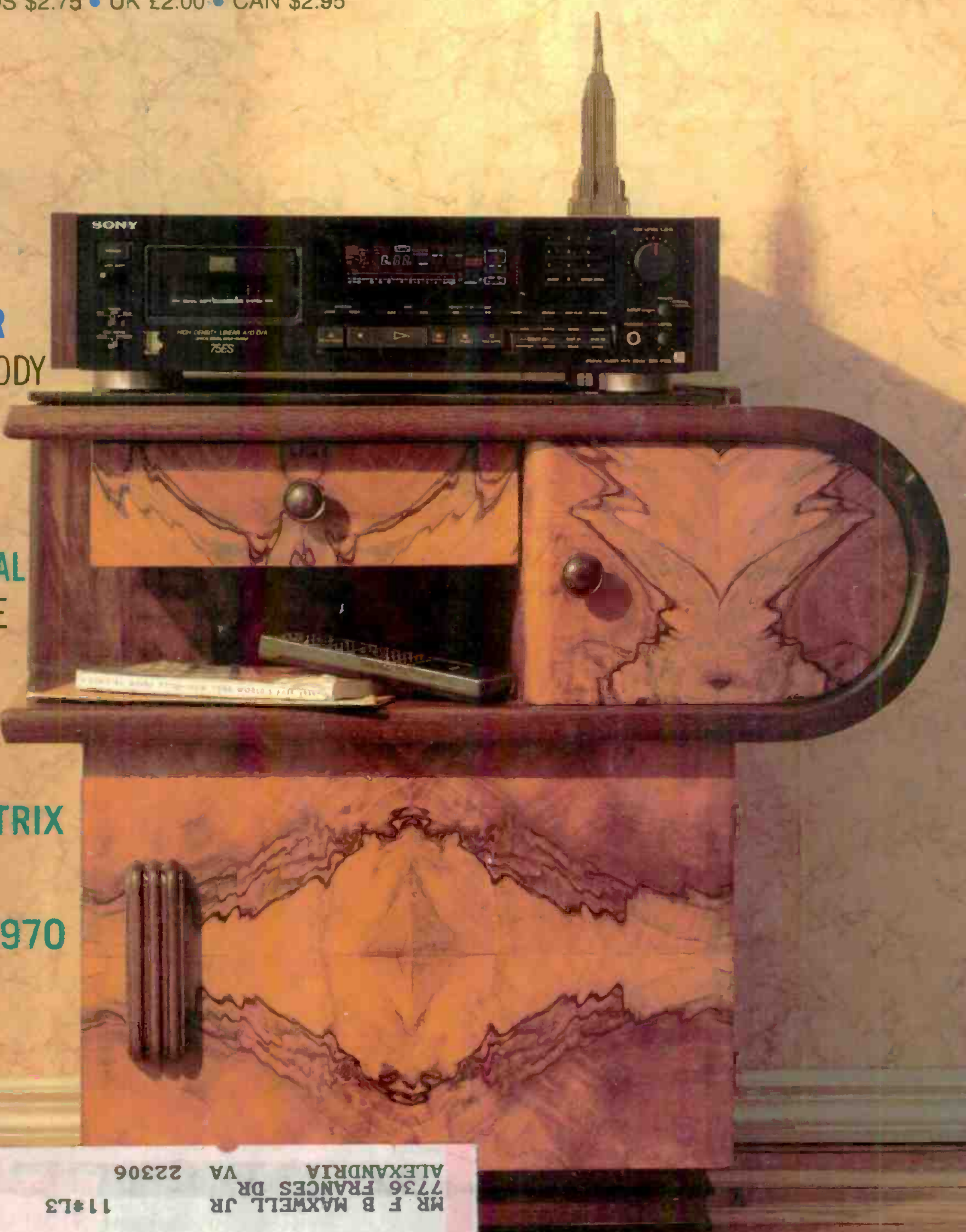


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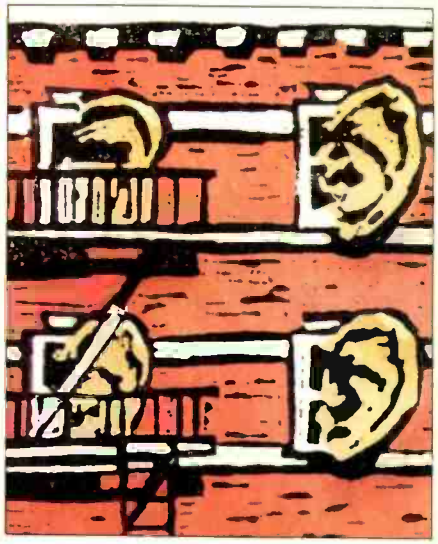

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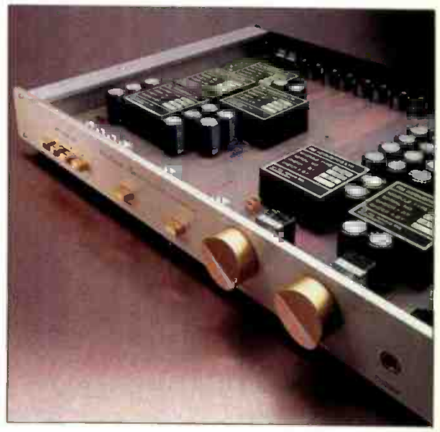

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## DEPARTMENTS



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The Audit Bureau

# SIGNALS & NOISE

## Nonproductive Nonsense

Dear Editor:

I hope you don't have anything else in the hopper remotely like "Productive Producer," the interview by [*sic*] Steven Epstein (June). Pure hype and, just incidentally, one of the dullest, dumbest articles I've ever tried to wade through. Enough already.

J. Lee Anderson
La Jolla, Cal.

## Heart A-Tracking

Dear Editor:

I just finished reading Edward M. Long's review of the Goldmund ST4 linear tracking turntable (August), and I just *had* to write and ask: Is it mere coincidence that the first turntable Goldmund sells complete with a linear tracking arm *happens* to bear the same model designation as the *very first* turntable to be sold complete with a straight-line tracking arm back in the early '70s, the Rabco (Harman/Kardon) ST4? Or is it possibly a tribute to the original?

Ownership of a Rabco ST4 for many years led me to a firm belief in the joys of straight-line tracking. Though the Rabco could probably not hold its own sonically against even mid-priced decks today, it nonetheless treated my precious vinyl collection (becoming more precious with each digitally encoded day) with extreme gentleness. Only a failing a.c. synchronous motor, and the difficulty of finding a modern cartridge which performs well in the Rabco's very massive (by today's standards) arm, has forced my old ST4 into retirement on a closet shelf.

My current table is a tangential tracker; so it is with unadulterated lust, these days, that I pour through reviews of linear machines like the Goldmund. The latest bearer of the legendary ST4 name is priced well beyond my means, but thanks anyway for the cardiovascular stimulation!

Doug Gagliardi
Claremont, Cal.

## Stylus-Ticked

Dear Editor:

In the classified section of your magazine, you direct people to visit their local "independent A/V specialty retailer" when they need to buy equipment. This is, on the whole, good advice.

However, there is one need which nearly all of these retailers are ignoring: Replacement styli for cartridges. I used to buy them from an electronics store, but they no longer stock what I need. I called around the local stereo stores, and they acted as if I had lost my mind when I asked. They tried to get me to buy the entire cartridge. My cartridge costs $189, and its replacement stylus costs $69. There's nothing in the cartridge that wears out, so why should I waste $120 every six months or so?

I wrote to the manufacturer, and they sent me a list of dealers who carried replacement styli. The closest one I could find was 30 miles away, in an area where most windows have bars. But they had one in stock, so I bought it. Now where do I go to get another when I need it?

I know that CDs are basically taking over, but those of us who have collected music over the years have a lot of LPs which we can't afford to replace with CDs, and in some cases couldn't replace if we wanted to. Although we're less likely to buy the greatest playback system, we still need to keep what we have up and running.

In your magazine, I found two advertisements for cartridge stylus specialists. You better believe I'm writing to them right away! This letter is my plea to retailers. Use common sense, and stock what your customers really need!

Allan Flippin
Pleasanton, Cal.

## Vintage *Audio*

Dear Editor:

I have 20 years of back issues of *Audio* (1965-1984) which I can no longer keep. Could you announce it in the magazine that such is available and that I would be interested in giving these copies to a school or selling them to an individual.

Tom Rose
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# TAPE GUIDE

HERMAN BURSTEIN

**Recommended Maintenance**

*Q. I have questions concerning the cleaning and demagnetizing procedures for my Nakamichi Dragon cassette deck. The manual suggests using cotton swabs on the parts to be cleaned. It also says to clean the tape guides, which are spring-loaded and can be damaged if one isn't extremely careful. Even though the manual doesn't mention it, would a head-cleaning cassette of high quality cause any damage or wear? I was once told that head-cleaning cassettes, even those of high quality, would cause a deck's mechanism to click. Is this true?*

*What would you suggest for demagnetizing my deck? I use an a.c. wand-type demagnetizer because the manual says that power to the deck must be switched off when demagnetizing. Should I pass the demagnetizer over all the heads, capstans, and guides, or will passing it over the playback head alone be adequate? If a given part is not already magnetized, will the use of a demagnetizer, in effect, magnetize it?*—John Lloyd, Russell Springs, Ky.

A. Cleaning the deck's components (heads, guides, capstans, etc.) with a cotton swab and suitable cleaning fluid—such as 91% isopropyl alcohol, which is frequently recommended—is preferable to using a cleaning cassette in terms of doing an effective job and minimizing the chance of damage. The chief advantage of a cassette cleaner is in reaching parts that are hard to get at, as in some car decks. Nakamichi is a very responsible and well-informed company, and you would be wise to follow their advice.

I am not aware of a click problem with a cleaning cassette.

A wand-type demagnetizer is preferable to a demagnetizing cassette, as it is more likely to do an effective job. Of course, if you do use a demagnetizing cassette, you must have the power on; at the same time, you must make *sure* that the rest of your audio system is turned *off* or that the system's volume is turned *fully down*. Otherwise, the playback head may produce hum loud enough to injure your speakers and perhaps your ears. *All* heads and all other metallic components (capstans, guides, etc.) contacted by the tape should be demagnetized. Be sure to turn on the wand-type demagnetizer while it is at least a couple of feet away from the deck, and be sure to turn it off only when it is again at least a couple of feet away. Otherwise, you may magnetize a head or other component.

"Demagnetizing" an unmagnetized component will not magnetize it.

**Diminished Tape Speed**

*Q. Several months ago I purchased a cassette deck which worked fine until recently. Now the deck will not play commercially recorded tapes at correct speed. The speed is so slow that listening is unbearable. This also happens with blank tapes from one of the major tape manufacturers. I understand that commercially recorded cassettes use tape of lesser quality, but all of these were previously played without difficulty. Your comments will be appreciated.*—Edwin F. Marcano, Rio Piedras, P.R.

A. It could be that your deck has gradually slowed down owing to a cefective motor or other cause. If you play tapes that you recently recorded, you may not notice the effect of this gradual slowdown. But if you play tapes recorded several months ago, the speed error would be very noticeable; similarly, if you play prerecorded tapes, it will be noticeable.

If your deck's speed is now well below 1⅞ ips, tapes recorded and played on this deck will sound acceptable because the speed error in recording will be offset by the speed error in playback. There will, however, be losses in the upper treble because of the diminished speed.

**High-Frequency Distortion**

*Q. I have an annoying problem when dubbing my records onto cassettes. The recording sounds mostly okay except that the high frequencies turn out very distorted. I have tried recording with the treble control turned down; sometimes this works and sometimes it doesn't. Please give me suggestions on how to solve this problem.*—Violet Hurdle, Brooklyn, N.Y.

A. One reason for the distorted highs may be that you are recording at excessively high level, thus saturating the tape. Another reason may be that your deck is supplying insufficient bias current to the record head when recording. If the treble sounds exaggerated as well as distorted, this tends to confirm that bias current is insufficient. Are you by any chance recording Type II tapes (chromium/ferricobalt) with the bias switch in the Type I (ferric) position? Type II requires substantially more bias than Type I. Another possibility is that the record electronics or the record head is being overloaded as the result of the great amount of treble boost supplied by the deck in recording; again, reducing the record level would help here. Your treble control has no effect on the signal being fed to the tape, only on the signal fed to the speakers, so it has no effect on your recordings.

**Losing Balance**

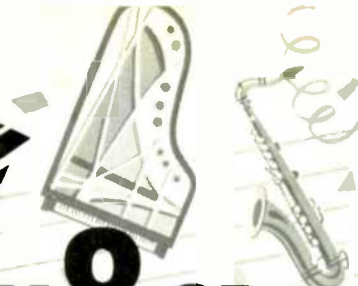
*Q. I recently bought a used three-head open-reel deck, and it works perfectly except for a small problem—at least I hope it is small. When monitoring (off the playback head) something that I am recording, the left channel's level seems to be 1 to 3 dB below the right channel's. The disparity is even greater when comparing source to tape. The left channel sounds okay, but is definitely lower in level. Is there an explanation for this? Will it be expensive to repair?*—Andy Blatt, Staten Island, N.Y.

A. It seems that either or both meters are improperly adjusted in recording and possibly in playback as well. Good open-reel decks usually have internal meter-calibration controls for both recording and playback modes. Assuming your deck has these, this should be a simple matter for a *competent* technician to remedy. It will take him only a few minutes after he gets the deck open; sometimes it takes longer to open and close the deck than to repair it.

However, if your deck lacks the necessary controls, he will have to wire in or replace some resistors, and this can take substantially longer. For proper adjustment, bring a reel of the tape you ordinarily use. And before you take the deck home, have him demonstrate that the deck is now working properly.

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

# ALL this JAZZ

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# AUDIOCLINIC

JOSEPH GIOVANELLI

### Ribbon Tweeters

*Q. I would like to know the advantages and disadvantages of using ribbon tweeters as opposed to dome or cone tweeters.*—Name withheld

A. A ribbon tweeter has a tremendously transparent sound quality; I have yet to hear a cone or dome tweeter work as well. I have not checked it, but it seems to me that the ribbon tweeter would tend to beam the highs, whereas the dome tweeter would disperse them.

Ribbon tweeters are expensive to produce, and those that I have seen have not been acoustically efficient. Thus, if connected as add-ons to existing tweeters, this lack of efficiency could make it difficult or impossible to balance against the other drivers in the system.

Most ribbon tweeters are best at reproducing the higher frequencies. Thus, if they were used to replace more conventional tweeters in an existing system, the crossover networks would no longer cross over at the correct frequency. In that situation, you would probably have to continue using the existing tweeters, adding a second crossover network at perhaps 8 kHz, where the ribbon would take over. This network would roll the existing tweeters off, avoiding response peaks caused by duplication of frequencies in the vicinity of the crossover point. It would also ensure that the ribbon tweeters would not be forced to handle frequencies too low for them.

### Direct Coupling and Loudspeaker Demagnetization

*Q. A power amplifier owner's manual I've read mentions several disadvantages of direct-coupled amp designs, saying that any d.c. offset in the amplifier's output will slowly demagnetize the woofer magnets. I noticed that when I switched my speaker selector on, the woofer cones moved forward very slightly, so I measured the voltage across the amplifier's output terminals: It was about 150 mV.*

*Is the manual I've read correct? If so, what will be the long-term effect of this d.c. level on the speakers?*—Bill Prunkl, Glen Burnie, Md.

A. I really doubt that 150 mV will be sufficient to damage the speakers. Also, the effect of d.c. offset depends on its polarity. While one polarity can weaken the woofer's magnets, the opposite polarity will tend to *magnetize* the woofers rather than demagnetize them.

Some amplifiers have internal adjustments that can be used to null out the offset voltage. Check with your amplifier's manufacturer or a qualified technician to see if your amp's offset can be reduced or eliminated by this or other means.

### Videocassette Life

*Q. How many times, within reason, can I expect to be able to re-record a videocassette before the tape becomes unusable?*—Stephen Goodwin, StonyBrook, N.Y.

A. There's no definite answer. The number of recording and playback cycles to which a tape can be subjected depends on its quality and on the cleanliness and condition of the VCR's drum and tape path. I have one cassette I've been using for years, and which I have doubtless run at least 100 times. I do find that there are significant dropouts at its start, but if I wind past the first 10 feet of tape, quality is fine again. I suspect that the greater wear at the start is occasioned by cueing before playing and/or copying portions of the tape.

### Auto Radio Background Noise

*Q. I have a 1984 Corvette. When playing a tape, the system sounds fine. The radio, however, has background static. I have had the radio in for repair twice, tried a new antenna, and have added a signal booster and a filter. The background noise is still there.*

*Less expensive radios in our other cars don't have this problem. Any advice or suggestions you can offer would be gratefully appreciated.*—D. J. Batka, Roswell, Ga.

A. I have very little to go on regarding the background noise you mentioned. Is this sound heard only when listening to AM? Is the sound present regardless of whether the engine is on or off?

Given the information you presented, I have no way of knowing if the problem is in your radio, the car's ignition system, or in the antenna transmission line. You mentioned changing antennas. Did you check the transmission line (the cable that connects the antenna to the radio) to see if it is "open" or shorted? If this cable is damaged, the best antenna in the world will be ineffective. Have you listened to your radio while playing it in the service shop? You would at least know that it worked there.

(*Editor's Note:* A Corvette's plastic body provides less shielding than a conventional car's metal one, so radio interference is a common problem. Check with other Corvette owners in your area to see which local stereo installers have coped successfully with this situation.—*I.B.*)

### Note

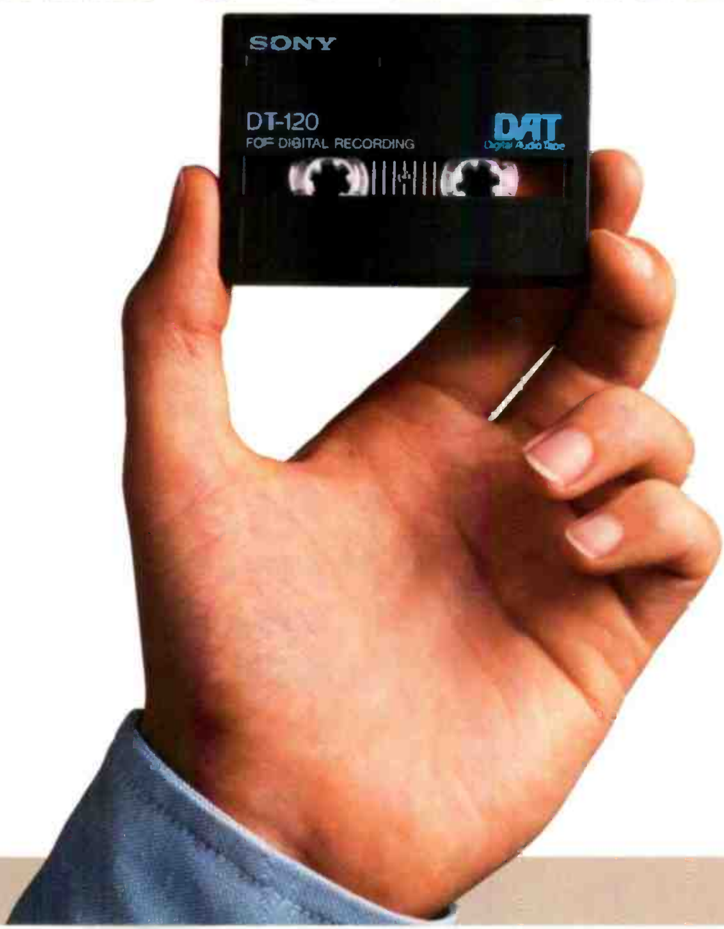
Whether or not I use a particular letter in "Audioclinic," *every* letter is answered. This one-on-one correspondence with readers is one of the things that makes *Audio* the unique publication that it is.

I enjoy answering all of your questions. It is not possible for me to inspect a system while attempting to work through each problem. I suppose you can say that each answer is really a guess. But this isn't "Twenty Questions"—I get only one shot at the answer. To make my guesses more accurate, I need all the help you can give me, *right from the start.* So when writing, try to give me as much information about your problem as you can. Sometimes the thing you don't think is important is just what I need to answer you correctly. I'd rather that you send me too much information than too little.

It would also be helpful if you would let me know whether or not we can publish your name in connection with your question. In this regard, I never do publish a question without letting the reader know that in advance. If my correspondence doesn't mention using your question, you can assume that it won't appear in print. You can be sure, however, that the fact that I don't select a given question does not mean I take less care when answering you than I do when answering a question that will be published.—*J.G.*

**If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1633 Broadway, New York, N.Y. 10019. All letters are answered. Please enclose a stamped, self-addressed envelope.**

# SONY ANSWERS THE THREE BIG QUESTIONS ABOUT DAT.



# WHY.

**Why do I need Digital Audio Tape? Why are people making such a fuss over this new format? Isn't Compact Disc the answer to all my audio needs? Isn't the analog audio cassette destined to continue forever? The questions may sound simplistic, but they're well worth asking. Because any new format merits special attention. And because the answers shed light not merely on DAT, but on Compact Disc and the future of audio at large.**

## THE DIGITIZATION OF AUDIO.

Music lovers can be forgiven if they think of Compact Disc and digital audio as one and the same thing. So powerful and so successful has the Compact Disc been, that many consider the digital revolution to be an accomplished fact. But in fact, CD is simply the first successful component of the digital age. Which means it was the first to introduce millions of Americans to the overwhelming benefits of digital audio. These include frequency response that's uniformly flat. A hundredfold decrease in distortion. Wow and flutter so low, they can't even be measured. And most important of all, dynamic range approaching that of a live concert.

The CD introduced digital disc playback to the home. In effect, making your CD player the digital turntable. In like fashion, many more digital components are on their way. We've already seen the dawn of Digital Signal Processing (DSP) preamplifiers and soon we'll see Digital Audio Broadcast (DAB) tuners. And it's no coincidence that more and more components are offering direct digital-to-digital interface. Digital Audio Tape (DAT) fits perfectly into this larger pattern, bringing all the sonic benefits of digital audio to tape recording and playback. And just as analog cassettes coexisted with LP's, DAT will coexist with CD — "sister" formats of the digital age.

## THE DAWN OF DIGITAL RECORDING.

Far from being a recent development, digital recording actually preceded the Compact Disc. After all, professional digital recorders were needed to create the master tape for every Compact Disc. In fact, the modern age of digital recording dates back to the introduction of Pulse Code Modulation (PCM) processors in the 1970's.

During those years, Sony realized that the extraordinary recording bandwidth of professional VCR's could be used to record stereo sound encoded as PCM digital signals. Sony reasoned that encoding the sound in this way would result in tremendous sonic benefits — the same benefits


Holding up to 2 hours of CD-quality sound, the DAT cassette is a mere 47% the size of a standard analog cassette.

familiar to any CD enthusiast today. The first result of Sony's thinking was the world's first home digital component, the Sony PCM-1 in 1977. When connected to an ordinary home VCR, the PCM-1 made possible audio recording of unprecedented quality.

## GATHERING STEAM.

The PCM-1 was quickly followed by the world's first processor for CD mastering, the Sony PCM-1600, in 1980. (To this day, more CD's have been mastered on Sony 1600 Series processors than on all other brands combined.) Next came the world's first portable

## THIS COMPARISON IS NO COMPARISON: ANALOG CASSETTE VERSUS DAT.

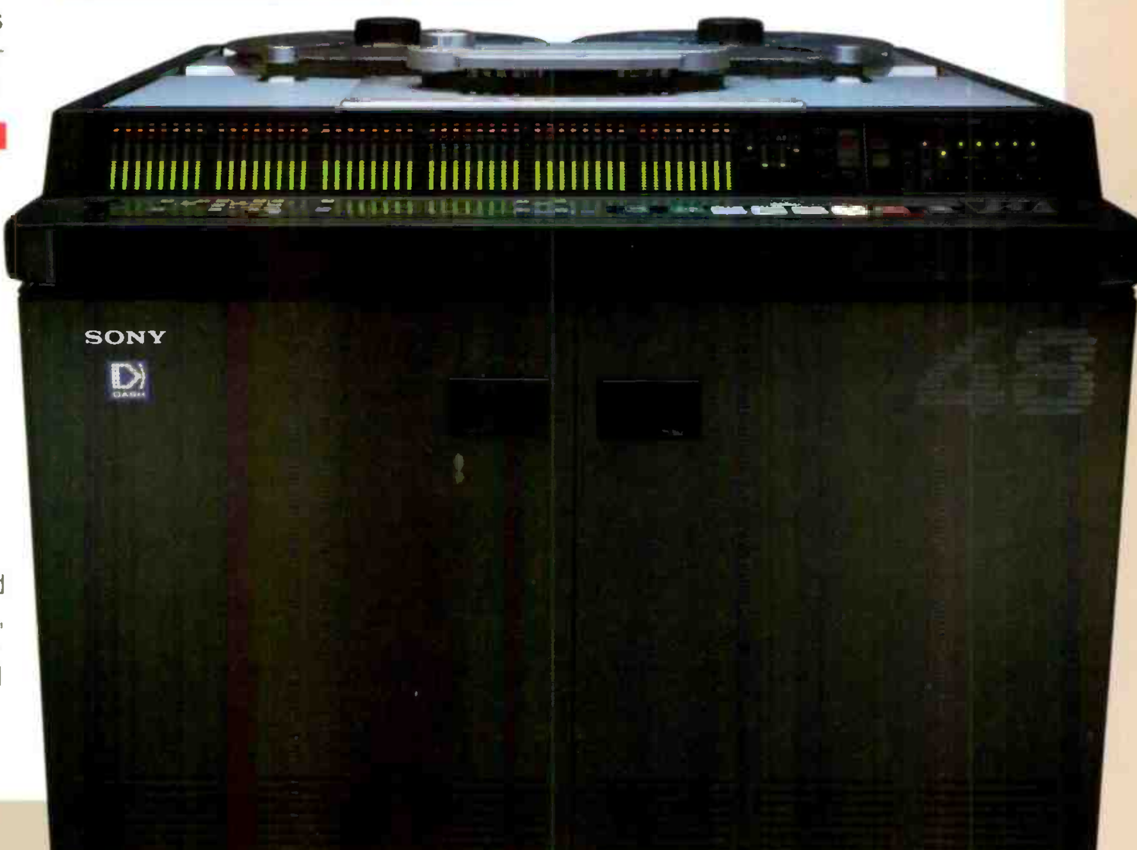
| | DAT (R-DAT) | ANALOG CASSETTE |
|---|---|---|
| Sampling frequency | 48 kHz | — |
| Quantization | 16-bit linear | — |
| Frequency Characteristic | 2~22,000 Hz | Approx. 25~20,000 Hz |
| Dynamic Range | 96 dB or more | 65 dB (noise reduction on) |
| Distortion Factor | 0.005% or more | 0.5% |
| Wow and Flutter | Less than measurable limit | Approx. 0.018% |
| Recording Time | 2 Hours (standard mode) | Max. 2 Hours |
| Tape Width | 3.81mm | 3.81mm |
| Tape Speed | 8.15mm/s (standard mode) | Approx. 4.8cm/s |
| Track Width | 13.591pm | 600pm |
| Cassette Size (W x D x H) | 73 x 54 x 10.55mm | 102.4 x 63 x 12mm |

digital system, the legendary PCM-F1 in 1981. Its digital-to-analog conversion circuitry was to influence the design of the first generation of CD players, introduced the following year. The trail of development soon led to the professional DASH-format open-reel decks that reign at today's top recording studios. Sony's 2-track, 24-track and 48-track recorders constitute the world's best-selling professional digital series.

## THE COMING OF DAT.

With professional digital recording an accomplished fact by the early 1980's, Sony embarked on developing an easy-to-use consumer digital recording format. Unlike the PCM processors, which recorded digital audio onto videocassettes, this would be a dedicated audio format. It would have to be small, to accommodate portable and autosound applications. It would have to support a variety of time, track number and search functions. And it would have to equal the audio performance of the newly-introduced Compact Disc.

Sony met these goals in 1982 with a proposed format using the rotating head-drum technology of VCR's. The prototype was called Rotary-Head Digital Audio Tape, or R-DAT for short.



Sony's 48-track studio digital recorder, the PCM-3348.

But Sony did not take R-DAT directly to market. From our experience with Compact Disc, we understood that universal standardization is vital to a format's success. Sony knew that R-DAT hardware and software had to be interchangeable from manufacturer to manufacturer and country to country.

So Sony met with 83 other hardware, music and blank tape companies in the international Digital Audio Tape Conference. The conferees evaluated R-DAT versus competing tape technologies. They tested. They probed. And they gave the go-ahead for full-scale development of the R-DAT format. Their efforts resulted in the DAT format we know today.

Before anyone could agree on a worldwide standard for rotary-head DAT, someone had to build the first prototype. That someone was Sony.

## THE CURTAIN GOES UP ON A NEW ERA IN DIGITAL.

By April of 1987, Sony was marketing the new DAT recorders to consumers overseas. Soon Sony professional DAT machines were being sold to recording studios worldwide. Next Sony DAT duplication systems were introduced to help record companies establish the library of prerecorded DAT software. Now DAT is ready for the most important evaluation of all. Yours.

# HOW.

How does DAT work? How on earth does it capture 2 hours of CD-quality music on that miniature cassette? How did they get DAT to work in a car or portable player? And how did they overcome the challenge of tape wear and tear? The answer is surprisingly simple. DAT takes two familiar technologies and combines them in an unfamiliar way: the digital audio technology of the Compact Disc and the helical-scan recording technology of the VCR. Here's how.

## THE KEYS TO DIGITAL SOUND.

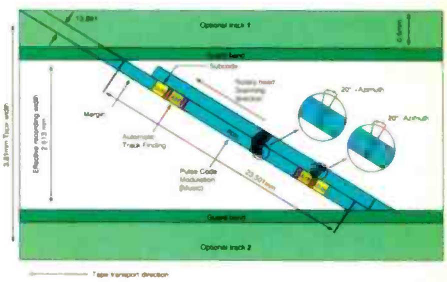
Behind every digital audio format there stand two key parameters that — before anything else takes place — largely determine sound quality. They are the quantization scheme and the sampling rate. Thus, the CD gets its spectacular dynamic range directly from 16-bit linear quantization. And the full, 20,000 Hz frequency response of CD is the direct result of the 44.1 kHz sampling rate.

The news is that the DAT format retains exactly the same 16-bit linear quantization and exactly the same 44.1 kHz sampling rate as CD. So you can expect the same spectacular sound from a DAT recorder as you're now getting from your CD player. In addition, the 44.1 kHz rate enables record companies to release DAT titles from the same masters they use for CD. The DAT format also offers a 48 kHz sampling rate for recording from live and analog sources. And the option of the 32 kHz sampling rate facilitates a Long-Play Mode — giving you up to four hours of FM-quality music on a single DT-120 cassette!

The 44.1 kHz sampling rate does more than endow DAT with CD-quality sound. Along with direct digital inputs, it enables DAT to perform the amazing process of digital-to-digital recording.*

## THE CHALLENGE OF GETTING THE MUSIC ON TAPE.

While the digital specs of DAT undoubtedly assure high quality, they also require a recording bandwidth that's immense. A little arithmetic shows that while good analog decks have a bandwidth of 22,000 Hz, DAT requires much, much more. With a 48 kHz sampling rate, with each sample requiring 16 bits, and with two channels of sound to record simultaneously, the data rate is 48,000 x 16 x 2, or 1,536,000 bits per second. Which means a DAT recorder must have a bandwidth of at least 1,536,000 Hz!




As does a VCR, DAT records the signal onto the tape in a series of diagonal tracks. Different azimuth alignment for A and B heads minimize crosstalk. As in 8mm video, Automatic Track Finding (ATF) eliminates the complexity of a separate control track.

## VCR TECHNOLOGY TO THE RESCUE.

How does DAT derive its vastly increased bandwidth? From the helical scanning, rotary-head technology of VCR's. All conventional audio recorders use stationary heads that record linear tracks as the transport drives the tape past the heads. In analog cassettes, the tape moves past at a stately 1-7/8 inches per second (ips). Open-reel analog decks achieve higher quality by moving faster — anywhere from 7-1/2 ips up to 30 ips for professional recorders.

In contrast, DAT uses a rapidly spinning rotary head drum that records thousands of diagonal tracks. Typically spinning at 2,000 rpm, the drum lays down tracks with an effective tape-to-head speed of over 120 ips — more than four times faster than the finest professional analog decks. This high "writing" speed is the foundation of the DAT format. It makes possible DAT's unique combination of recording capability, spectacular sound, and amazing compactness. It also gives the head drum a flywheel effect that makes DAT particularly immune to the shock and vibration that can interfere with car stereo and portable audio systems.

DAT's diagonal tracks are themselves a study in microscopic precision. Each track is less than one tenth the thickness of a single human hair. The tracks fill the tape with information of such high density that each square inch holds 114 million bits of data. That's the equivalent of 7,100 typewritten pages in every square inch of tape!

## ERADICATING ERRORS.

Considering recorded tracks of such amazing density, you might think that tape dropouts and tape wear would be formidable concerns. Thanks in part to Sony technology, the DAT format automatically overcomes the problem of tape irregularities. DAT records a vast quantity of redundant information that can be called upon at any time to identify and fill even large gaps in the music. All told, DAT incorporates twice the error-correction capability of CD. And as with CD, error correction doesn't just approximate the original data. It usually reconstructs that data completely.

## EASY ACCESS.

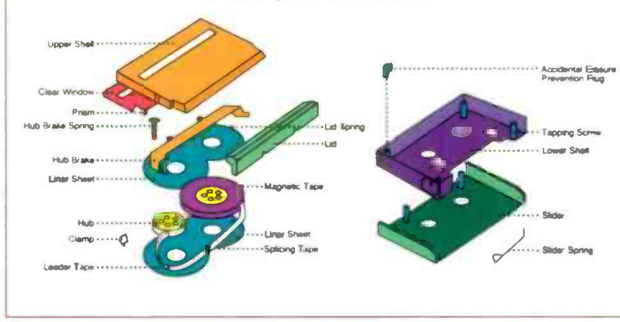
Part of CD's undeniable allure is its remarkable access functions. The CD's time display and track number functions are made possible by digital subcodes placed onto the disc alongside the music. In much the same way, DAT offers similar subcodes for elapsed time, track number, Start ID, Stop ID, and Skip ID — giving you CD-like ease of access to your music. As you would expect, prerecorded DAT cassettes come with subcodes already in place. But because DAT is a also recording format, you can also place, erase and adjust the order of these operational subcodes on the tapes you record. And of course, these operations will not affect the integrity of the music.

A. Rotary Drum

B. Magnetic Heads

C. Guide Rollers

**Cutaway of DAT cassette**

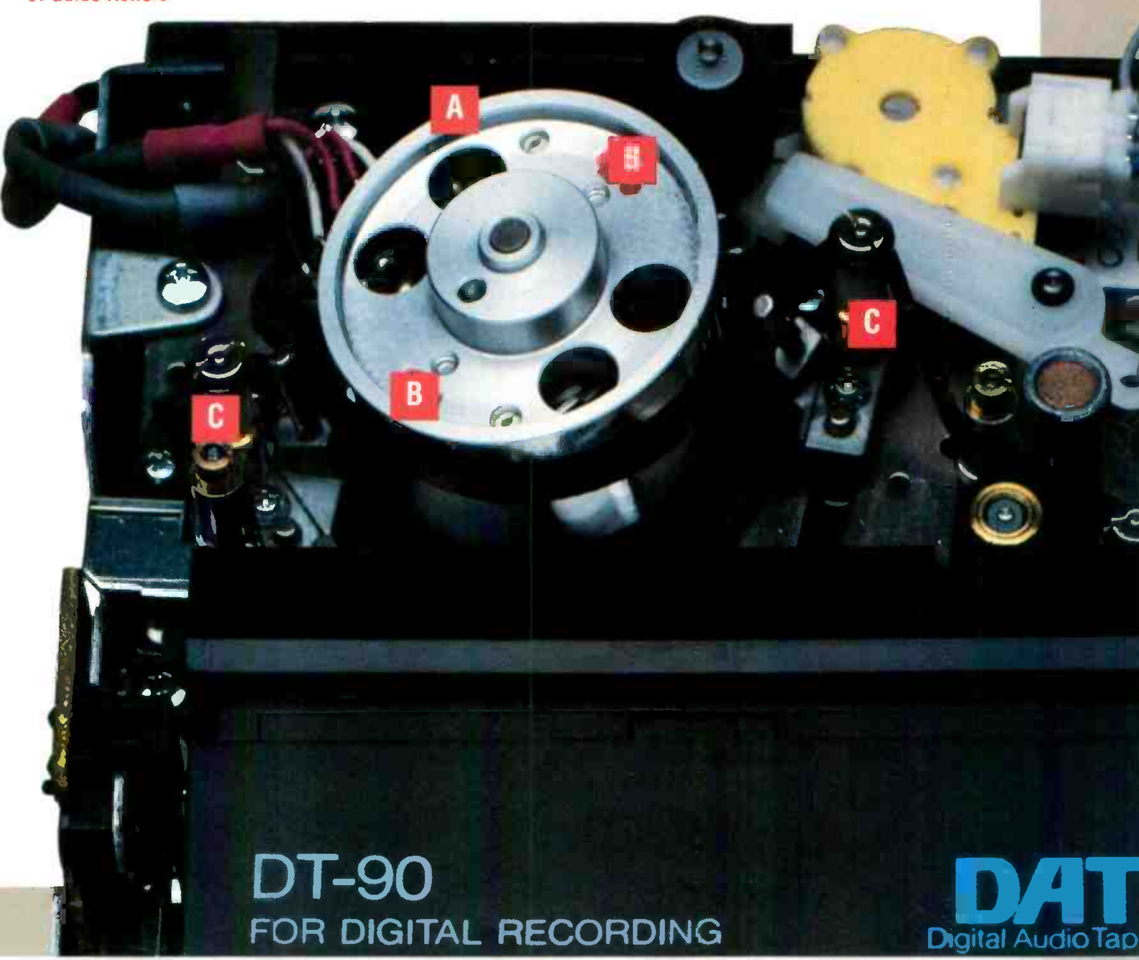



The DAT cassette shell features an erasure-prevention slider, a full complement of recognition holes, and extraordinary physical protection of the tape itself.

## A MASTERPIECE OF MINIATURE ENGINEERING.

Perhaps the most impressive aspect of the DAT format is the cassette itself. A technological triumph in its own right, the DAT cassette can hold up to 10.8 billion bits of musical data. Yet it's 47% smaller than the standard audio cassette. The secret is that the metal particles that hold the magnetic signal have been reduced to sub-microscopic size.

The design of the DAT cassette protects these invisibly small particles from the ravages of dust, dirt and fingerprints. When ejected from the deck, the tape shell snaps shut, sealing off not only the tape, but the reel hubs and guidepost holes as well. In this way, the cassette shell prepares DAT for the rigors of car and portable use.



# WHERE.

Where is the DAT format headed? Where will I be able to play my DAT cassettes? And where will I find prerecorded DAT? Many newcomers to the new format assume DAT is just for recording superlative tapes for playback at home. And while the new home DAT recorders will unquestionably meet such high expectations, these machines represent only the first chapter of the DAT story. Even at this early date, Sony can give some strong indications of what the future holds in store.

## THE JOYS OF PLAYBACK.

Many would-be DAT owners believe that the only tapes they'll play on their machines are the ones they've recorded themselves. So you may be surprised to learn that a growing band of audiophile record labels have discovered that DAT represents an excellent playback medium for their digital recordings. So such trend-setting jazz labels as GRP and DMP are releasing many of their best titles on DAT. Influential classical labels, such as Capriccio, Chandos and Sony's own Sony Classical™ label are doing the same.


**Audiophile record labels have begun to introduce their best digital recordings in the DAT format.**

Sony is supporting these efforts in two important areas. We've created the world's first professional DAT duplication decks to produce prerecorded software. Next, we've installed a brigade of these duplicators in Sony's ultra-modern Digital Audio Disc Corporation plant in Terre Haute, Indiana. There, they form America's first DAT duplication facility, a resource not simply for our own record label, but for custom duplication available to anyone. Clearly, the DAT story encompasses not only hardware, but software, as well.

## DAT: GOOD FOR YOUR SYSTEM.

As DAT has neared introduction on the U.S. consumer market, audiophiles have seen tantalizing glimpses of home high fidelity DAT recorders. With their awe-inspiring specifications, the first crop of DAT home decks have led music lovers to expect great things. These expectations will not be disappointed. With DAT, you'll experience sound quality on a par with today's best CD players. You'll have a choice of analog or digital inputs and outputs for the highest quality interface now and in the future. And you'll run the whole show by remote control.

As implemented by Sony in the DTC-700 and DTC-75ES, home DAT brings with it the expertise we've earned throughout 15 years in digital recording. You can hear it in our proprietary High Density Linear Converter™ system. You can see it in our high-speed loading. And you can experience it in our ultra-stable 4-motor transport. Which means Sony decks not only define DAT, they also refine it.

## DAT: RIGHT AT HOME AWAY FROM HOME.

But home decks certainly do not represent the full extent of DAT hardware. The fact is, DAT was designed at the outset for music on the go. For one thing, the flywheel effect of DAT's rotating head drum makes for amazingly stable tape playback during the shakes, jars, and jolts of mobile operation. Then there's the DAT cassette itself. Its minuscule size was specifically chosen to facilitate the creation of car and portable players. And its sealed design helps protect the tape even when the environment is full of smoke, dust, dirt and grit. All told, DAT is convincingly well-suited to the widest range of audio recording and playback applications.

## THE DRIVING EXPERIENCE.

With DAT, not only can you enjoy your tapes at home, you can play them back in the car. So you can drive while listening to the tapes you love, with the exacting standards of digital audio. Sony's new DTX-10† shows all the hallmarks that have made Sony the number one choice in car CD. This head unit looks for all the world like a conventional cassette receiver. Yet it contains a full-function DAT player, an AM/FM tuner, and even control capability for a Sony DiscJockey® 10-disc changer. Sony fit all these abilities in a single DIN-size chassis that will fit the dashboard of almost any car.

## YOU CARRY IT AWAY — AND VICE VERSA.

Where is the perfect place to enjoy DAT? Wherever you happen to be. Portable DAT recorders make digital tape as versatile as analog tape. Of course, portable DAT is a natural for Sony and the TCD-D3† DAT Walkman® recorder is just what you'd expect from Sony. Quite simply, it's the world's smallest, full-function DAT recorder. Which means it's got microphone inputs and Sony's HDLC Analog-to-Digital Converter built right in. The TCD-D3 even gets two hours of battery life on a one-hour charge. Which typifies the thoughtful engineering of all Sony DAT machines.

## YOU CAN'T HAVE GREAT TAPE RECORDING WITHOUT GREAT TAPE.

An indispensable part of the DAT format is the blank DAT cassette. And Sony wouldn't think of introducing the new hardware without the DT-60, 90 and 120 blank cassettes to go with it. At the heart of these DAT cassettes are Sony Crystal Art magnetic particles that you'd need an electron microscope to see — but not to hear. Sony's UST coating places these particles across the tape surface with amazing uniformity. And Sony's proprietary HD & R binder system keeps them there. The sum total of which makes Sony DAT cassettes fully prepared for the rigors — and the glories — of Digital Audio Tape recording.

## POISED FOR THE FUTURE.

There can be no doubt that DAT is much more than an interesting new piece of hardware. DAT represents the culmination of years of development in digital recording. DAT promises a wealth of exciting new opportunities in music recording and playback. And DAT embodies the next major step in the digitization of audio.

For more information on the format that brings tape recording into the digital age, call 1-201-SONY-DAT during East Coast business hours. And speak to the people best qualified to answer your digital questions. Sony. The Leader in Digital Audio™.

Sony TCD-D3 DAT Walkman Recorder ▼


Sony DTX-10 Car DAT Player/Tuner /Preamp ▼


▶ Sony DTC-75ES DAT Recorder

## HOME: SONY DTC-75ES DAT RECORDER

- High Density Linear Converter™ system
- Four-motor tape transport with digital direct drive
- 2nd-generation DAT circuitry with digital Large Scale Integrated circuits (LSI's)
- Choice of 2- and 4-hour recording and playback on a DT-120 tape
- Supplied Remote Commander® wireless remote control
- Optical, coaxial, and analog inputs and outputs
- 60-track programming
- Automatic Music Sensor™ track selection
- User programmable subcode functions

## CAR: SONY DTX-10† DAT PLAYER/TUNER/PREAMP

- Complete head unit with DAT playback, AM/FM tuner, and DiscJockey CD changer control in a single, standard DIN-sized chassis
- Compatible with Long-Play mode
- 8x oversampling digital filter with dual 18-bit D/A converters
- 2nd generation proprietary digital LSI
- 3 motor transport
- Automatic power loading
- Automatic Music Sensor™ track selection, Intro Scan, Repeat Play and Skip ID play
- Multi-function, switchable illumination display
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## PORTABLE: SONY TCD-D3† DAT WALKMAN® RECORDER

- World's smallest and lightest DAT recorder with built-in Analog-to-Digital Converter
- Sony's HDLC A/D converter
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- Digital and analog inputs and outputs
- Built-in mic inputs
- Compatible with Long-Play mode
- Cue and Review at 25x normal speed
- Automatic Music Sensor™ track selection
- Automatic and manual start ID's
- Supplied AC adaptor/charger
- Optional car bracket
- Optional wireless remote control
- Back-lit LCD display

## TAPE: SONY DT-60, 90 AND 120 DAT BLANK CASSETTES

- Crystal Art metal particles a mere 0.17 microns long achieve the highest information density of any tape format
- Sony's UST coating process for maxi-mum uniformity, minimum tape dropouts
- Proprietary HD & R (High Dispersion and Reliability) binder system for improved durability, play after play
- Professional-quality back coating for smooth, stable tape running
- High precision shell


Miracles of magnetic engineering, Sony DT-60, 90 and 120 blank tapes are definitive expressions of tape recording technology.



Features and specifications are subject to change without notice.

* DAT products sold by manufacturer-authorized outlets incorporate the Serial Copy Management System, which will not prevent you from making a direct digital-to-digital copy from a digital source, but from such copies will prevent a second direct digital-to-digital copy from being made.

† Models DTX-10 and TCD-D3 available January, 1991.

SONY

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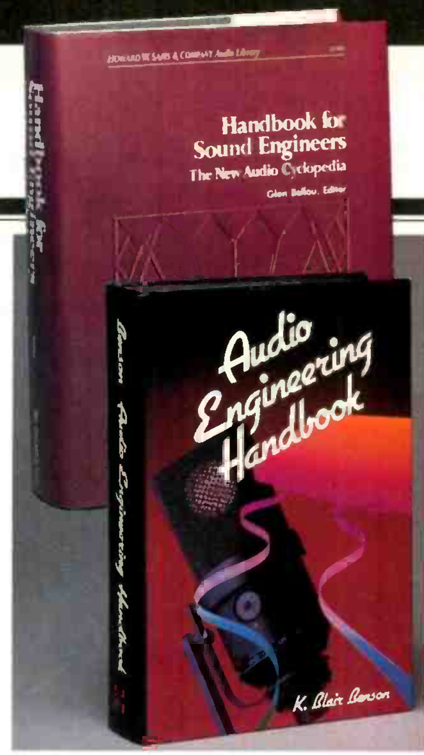



*Handbook for Sound Engineers* edited by Glen Ballou. Howard W. Sams & Company, 1,247 pp., hardback, $79.95.

*Audio Engineering Handbook* edited by K. Blair Benson. McGraw-Hill Pub. Co., 1,040 pp., hardback, $83.50.

The mammoth *Handbook for Sound Engineers* is subtitled "The New Audio Cyclopedia," an obvious and purposeful reference to Howard Tremaine's *Audio Cyclopedia* of earlier years. The preface, however, makes no mention of the earlier volume. The 31 chapters of this new handbook have some correspondence to the 25 chapters of the second edition of Tremaine's work, but changes in emphasis reflect the passing years and changing technology. The handbook groups its chapters into seven parts: "Acoustics" (eight chapters), "Electronic Components for Sound Engineering" (four chapters), "Electroacoustic Devices" (two chapters), "Audio Electronic Circuits and Equipment" (eight chapters), "Recording and Playback" (three chapters), "Design Applications" (four chapters), and "Measurements" (two chapters). The text and illustrations of the large (7½ x 9¾ in.) pages are well produced, making for excellent legibility.

F. Alton Everest wrote the first six chapters of "Acoustics": "Fundamentals of Sound," "Pyschoacoustics," "Acoustics of Small Rooms," "Common Factors in All Audio Rooms," "Acoustical Design of Audio Rooms," and "Recording Studio Design." These 150 pages contain much helpful information presented in the lucid style for which the author is well known. Propagation of sound, refraction, diffraction, and the inverse-square law are among the fundamentals discussed. The hearing mechanism; critical bands; delay effects; room characteristics; studio construction criteria; heating, ventilation, and air-conditioning systems; reverberation; absorption; diffusion, and designs of specific studios are among the many subjects receiving careful attention. A few additional words should have been written in the first or second chapter to warn of the limitations of a spectrum-level reference when the noise energy has a slope. Very good information and guidance is supplied on planning, design, and construction.

"Rooms for Speech, Music, and Cinema" by Rollins Brook and Ted Uzzle covers the characteristics and design of large rooms. Considering the limited space (44 pages), I found the coverage very satisfactory for such broad subjects. I did feel, however, that more discussion was needed on cinema surround-sound systems. The acoustics of outdoor performance sites would benefit from at least a chapter section, but they didn't get that. The final chapter in Part 1, "Acoustics of Open Plan Rooms," provides pertinent and cogent comments on the design of such office spaces, although success is not as easily attained as implied.

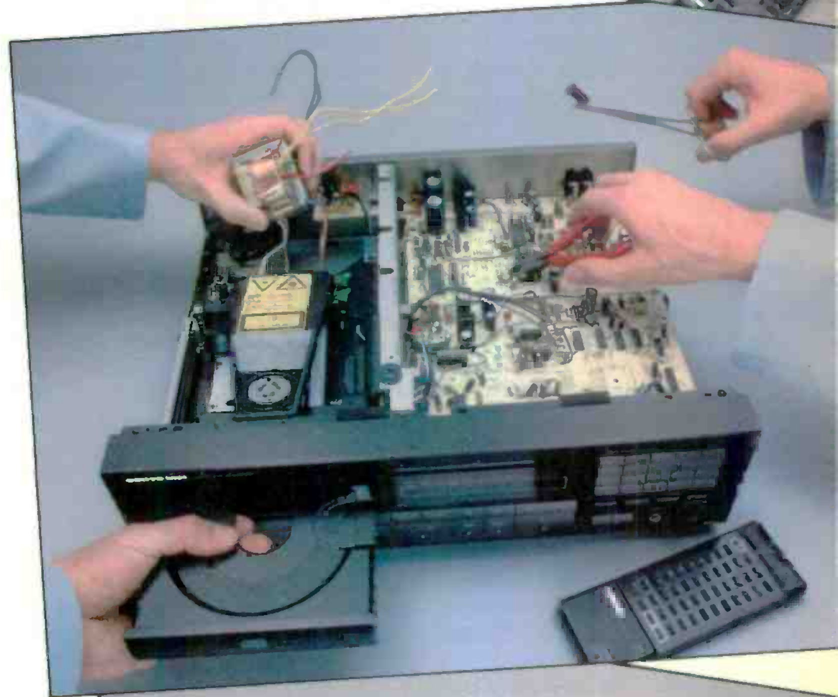
The four chapters on "Electronic Components for Sound Engineering" which make up Part 2 cover "Resistors, Capacitors, and Inductors," "Transformers," "Tubes, Discrete Solid-State Devices, and Integrated Circuits," and "Heat Sinks, Wire, and Relays." Author Glen Ballou has used the space well, and the reference material is probably sufficient for many. Other sources may be needed, however.

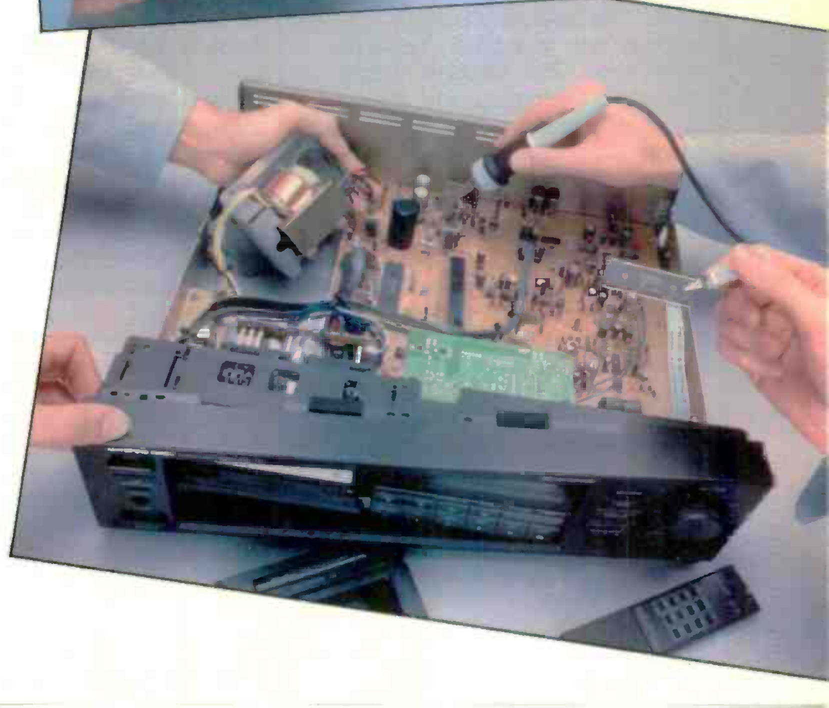
The electroacoustic devices covered in Part 3 are grouped under "Microphones" and "Loudspeakers, Enclosures, and Headphones." The 90 pages written by Glen Ballou cover the many types of microphones and convey useful information on specific models. Electret, PZM (Pressure Zone Microphone), and wireless microphones are among the types of units covered, with valuable details on PZM usage and well-chosen criteria for selecting wireless systems included. Pickup patterns and responses of specific models are described. Actual usage of microphones is covered to some extent, and the recommendations will guide those with limited experience.

Clifford Henricksen wrote the section on "Loudspeakers, Enclosures, and Headphones." It starts with several pages on speaker measurements and standards—an important inclusion. The section on electromagnetic motor configurations and associated elements is essential reading for those who ought to know what's going on in there. Cone drivers, diaphragms, and suspensions are covered. Various types of enclosures, their design, and Thiele-Small parameters are discussed. Information is provided on compression drivers and various types of horns. The systems section is wide in its coverage, but depth is lacking on some points. Electrostatic and piezoelectric speakers and headphones get just a couple of pages each.

Part 4, "Audio Electronic Circuits and Equipment," constitutes one quarter of the handbook: Over 300 pages are allotted to its eight chapters. The information in the 52 pages on amplifiers, by Gene Patronis, Jr. and Mahlon Burkhard, is certainly worthwhile, with sections on the transfer function, feedback theory, and operational and power amplifiers. I felt, however, that automatic mixers got too much emphasis in the preamp section, and some large schematics were of limited interest. The next chapter (by Ballou) is a short one on the basic types and characteristics of attenuators. The "Filters and Equalizers" chapter (also by Ballou) starts with 30 definitions and short explanations. Good coverage on passive equalizers includes constant-k and m-derived filters, but, from my viewpoint, the section on active filters is too short and too much space is given to schematics of marginal interest. Parametric and transversal equalizers are not discussed—curious and unfortunate omissions. The short chapter on "Delay" (by Burkhard) could stand some expansion, but many facets of the subject get good basic explanations.

The next three chapters are by Glen Ballou, starting with "Power Supplies." It provides good overall understanding of power-supply designs and charac-





**Ballou's handbook offers a great deal of information and guidance, presented very well indeed by several of the noted authors.**

teristics, including batteries. "Constant- and Variable-Speed Devices" describes basic motor types, but coverage is lacking on turntable and tape-recorder drive specifics, such as speed control, servos, and designs for tension control. (Later chapters do have some information.) The next chapter is on "VU and Volume-Indicator Meters and Devices." The exposition on what makes a VU meter is quite clear, but a contradiction shows up in a paragraph title, "Peak-Reading VU Meters." This would be the place to discuss the standards in IEC 268-10, but no mention is made of them here.

"Consoles and Systems" is the last chapter in this part, and an impressive 127 pages it is. Steve Dove presents a lot of information in a lucid, tutorial style that more technical authors should emulate. He builds the topic by discussing the essential elements, including the history that led to particular choices. Subjects include op-amps, grounding, switching, input design, transformers, equalizers, mixing, monitoring, the console system, and console automation and computers.

Part 5, "Recording and Playback," starts with 108 pages on "Disk Recording and Playback" by George Alexandrovich. This chapter is an excellent combination of breadth and depth, providing many useful details on heads, cutting, manufacturing, turntables, arms, cartridges, mastering, preamps, noise reduction, and test records. The section on digital disc recording and playback, however, is rather short. The 43-page chapter on "Magnetic Recording and Playback," by Dale Manquen, is well written. It covers transports, tensioning, guiding, heads, noise, losses, tape, electronics, and other subjects. I do wish the subject matter had received twice the number of pages. The 14-page "Digital Recording and Playback," by the same author, also seemed constrained by lack of space, and the information on the CD is quite limited.

Part 6, on "Design Applications," has four chapters. Chris Foreman's "Sound System Design" is the first one, and its 94 pages emphasize system design for large rooms. Sections on equalization and other signal processing, test equipment, grounding and shielding, wiring, and troubleshooting add to the value of this chapter. A worthwhile inclusion is the brief coverage of design software. Just nine pages for "Systems for the Hearing Impaired," by Rollins Brook and Lawrence Philbrick, left me somewhat frustrated, but the basic information provided will help those of limited experience. "The Broadcast Chain," by Douglas W. Fearn, gives a rather cursory look at lines, transmission, specifications, and receivers in its 16 pages, but that may be enough for sound engineers. That is also true for the 25 pages of "Image Projection" by Ballou, covering lenses, still and motion pictures including soundtrack pickup, and projection techniques.

Part 7 has two chapters on "Measurements." Don Davis presents a good collection of background, guidance, and specific instructions in the 43 pages of "Audio Measurements." The author puts emphasis on TEF analysis, based on Richard Heyser's work, in preference to using FFT analyzers. "Fundamentals and Units of Measurement," by Ballou, has the expected weight on sound in its 36 pages, but information is included on electrical and general physical units.

The index for the *Handbook for Sound Engineers* is 21 pages long, too short for a book of 1,247 pages. The tables of contents for the chapters are quite detailed, more so than with most similar books, and that does help. Some chapters had fairly extensive references and bibliographies at the end, but others had no listings. In general, the references were not as up-to-date as I expected. This volume offers a great deal of information and guidance, sometimes presented very well indeed by particular authors. Overall, I felt a weighting toward sound reinforcement systems, although much of the material can be applied in other areas of sound. The price is high, but the cost per helpful bit would be quite reasonable for many.

The *Audio Engineering Handbook* has 17 chapters, an index, and a detailed table of contents. It covers six categories: Fundamental concepts of sound, hearing, and acoustics; audio-signal spectrum and transmission; digital and analog processing and recording; sound pickup, amplification and reproduction; program production, and measurements and standards.

"Principles of Sound and Hearing," by Floyd E. Toole, is the first chapter, and its 71 pages provide an excellent tutorial on fundamentals. English and metric units are both given, which is very helpful. Coverage of the subject is broad, with sections on comb filters, propagation, room modes, psychoacoustics, timbre, perceptual dimensions, ear functions, stereophonic imaging and localization, precedence effect, binaural discrimination, sound quality, listening tests, and hearing conversation. The depth of presentation is good.

"Audio Spectrum," by Douglas Preis, discusses time and frequency domains, introducing fundamental concepts of signals along with the associated math. Spectra, Fourier analysis, transforms, types of signals, linear distortion, minimum-phase systems and responses, and much more are presented. The reader will find rewards in the study and understanding of this material. Basic understanding from this well-written text is quite possible without complete comprehension of equations and the concepts expressed.

"Architectural Acoustic Principles and Design Techniques," by Richard G. Cann and K. Anthony Hoover, covers subjects that would benefit from more than the 44 pages given. There is, however, good information on absorption, noise-reduction coefficients, reverberation, transmission loss, and other subjects. Material on mechanical systems, isolation, and vibration add to the value of the chapter. The typographical error, "special handling Lucy 3-17-88" (page 3.11), was more amusing than distracting.

"Digital Audio" covers a great deal in its 82 pages. The first part, "Digital Techniques" by P. Jeffrey Bloom and Guy W. McNally, starts with discussion of digital signal fundamentals, performance targets, and the human receiver. A/D conversion, anti-aliasing, sample and hold, dither, and other subjects are covered succinctly. Professional applications include S-DAT and R-DAT, editing, and processing; motion-picture technology and transmission systems get space as well.

The second part, "Processing Circuits and Components," was written by Leonard Sherman and Jerry Whitaker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**Ballou's book has more for the pro on studios and reinforcement, while Benson's digs into the fundamentals and math.**

and has a brief but adequate description of A/D and D/A conversion, sample-and-hold designs, delta modulation, companding, and special effects.

The fifth chapter, "Broadcast Transmission Technology" by Donald L. Markley and James R. Carpenter, supplies basic information on AM and FM theory and systems as well as TV stereo. Discussions of modulation methods and designs, transmission, and reception will improve the understanding of many audio engineers.

The first and largest part of the 94-page "Microphones and Amplifiers" chapter is on microphones and was written by Jon R. Sank, the microphone reviewer for *Audio*. Pressure microphones of all varieties are covered, along with velocity or pressure-gradient, bidirectional ribbon, and others. Unidirectional principles and the various configurations are detailed.. A number of miscellaneous microphones are covered, including Calrec, wireless, zoom, and noise-cancelling. Ronald D. Streicher and Wesley L. Dooley wrote the section on stereo microphone techniques. The text is brief but to the point, with helpful, perceptive comments. Many configurations are covered, including two-microphone coincident, X-Y cardioid, spaced omnis, Blumlein, and M-S.

Daniel R. von Recklinghausen uses the 30 pages on amplifiers to good advantage. Many design elements are included in discussions of various circuits. Power amplifiers get attention for dissipation, efficiency, load effects, and other factors. A lot of information and guidance is contained in this brief section.

"Sound Reproduction Devices and Systems," by Katsuaki Satoh, starts its 94 pages with operational analysis of transducers. Fundamentals of direct radiators, details on dynamic types, and coverge on suspensions and other elements help to clarify important facets. Public-address speaker systems receive fairly extensive coverage. General design guidelines, an electronic adjustment table, and other specifics are quite helpful. The section on headphones has operational analyses with equivalent circuits.

"Analog Disk Recording and Reproduction," by Gregory A. Bogantz and Joseph C. Ruda, presents good coverage in its 39 pages. Characteristics, standards, objectives and challenges, and reproduction equipment are discussed, albeit briefly. Record tracking and various types of distortion are well detailed, but recording equipment would benefit from more space.

"Digital Disk Recording and Reproduction," by Hiroshi Ogawa, Kentaro Odaka, and Masanobu Yamamoto, delivers a good collection of tutorial and reference information in its 46 pages. Specifications, error correction, control codes, and the use of CIRC (Cross-Interleave Reed-Solomon Code) for both encoding and decoding are among the subjects included. The Compact Disc system will be better understood after the material on it has been read. CD-ROM and LaserDisc systems receive brief coverage.

I liked the broad coverage of "Analog Magnetic-Tape Recording and Reproduction" by E. Stanley Busby, Jr., but I wished for more depth than the 55 pages allowed. Basic principles, recording and reproduction theory, bias, and erasure are among the first subjects included. Sections on materials, tape and its properties, and details of head design present much information succinctly. Important aspects of reproduction, recording, editing, and transport design and performance all get attention. Recording-format figures are a bit large, but I'm glad they're included. The 73 pages of "Digital Magnetic-Tape Recording and Reproduction" is well used by the authors, W. J. van Gestel, H. G. de Hann, and T.G.J.A. Martens. The chapter starts with a comparison between analog and digital audio recording. The playback and recording processes are covered in detail, with discussion of heads, responses, losses, detection methods, and bit errors. There are also many applicable equations. Channel coding and error-control codes are presented in tutorial fashion, which adds to the value of this chapter. PCM (pulse-coce modulation) encoder/decoders, DASH (digital-audio stationary-head) recorders, 8-mm, S-DAT, and R-DAT are discussed, as are formats and codes.

The 56 pages of "Film Recording and Reproduction," by Ronald E. Uhlig, has good breadth and depth for audio engineers. Optical and magnetic sound recording, and postproduction with single- and double-system editing, are covered briefly. Much detail is provided on optical soundtracks; film, printer and reproducer characteristics, and optical-system quality factors. Magnetic soundtracks and theater systems get limited discussion.

The first half of "Studio Production Systems," by Ernst-Joachim Voelker, discusses the layout and fundamental properties of about 20 different studio configurations, from orchestral to announcing booths. Well-designed tables convey information on desired reverberation times, criteria for reflections, frequency responses, and noise and sound isolation requirements very quickly and clearly. The rest of the 59 pages give close attention to microphone recording in the studio, sound-level conditions in studio and home, and control room design and characteristics.

"Postproduction Systems and Editing," by Tomlinson Holman, covers postproduction for motion pictures and television. A lot of information new to many of us audio types is presented in these 44 pages. Audio standards, synchronization methods and processes, editors, and the editing process are clearly explained. The discussion on pre-mix and final mixing techniques will help many to understand the possibilities and limitations for sound with pictures.

Most of the 83 pages of "Noise Reduction Systems," by Ray Dolby, David P. Robinson, and Leslie B. Tyler, are used to cover the systems from Dolby Laboratories. Dolby A-, B-, and C-type and Spectral Recording are very well described in text and illustrations quite similar to the papers presented on these systems in the *Journal of the Audio Engineering Society*. Several pages are devoted to the dbx TV noise-reduction system used with the Zenith stereo-TV transmission system. Very brief attention is given to the professional ANT-Telefunken C4 and dbx Type I and 321 noise-reduction systems. The dbx Type II consumer noise-reduction system is hardly mentioned, and that's unfortunate. Quite a few serious amateur and semi-professional recordists use dbx II NR, and it wouldn't have taken much space to describe encoder, decoder, and basic performance characteristics.

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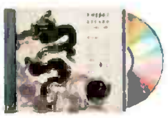

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Both of these books are important contributions to the literature of sound and audio, and will aid users for years to come.

"Audio Tests and Measurements," by Richard C. Cabot, is an excellent tutorial on the many facets of audio tests. The section on level measurement discusses types of meters; rms, average and peak detection, and the decibel. The text states that separation and crosstalk are both given in positive dB values. I wish it had emphasized the better logic and English usage to have crosstalk in negative dB values. Relatively brief coverage is given to noise, phase, frequency, and FFT measurements, but the comments are pertinent and succinct. Nonlinear distortion fortunately gets the space it deserves. Short but important sections are those on signal-source effects, time-domain tests, and input and output interfacing. The coverage on impedance and wow and flutter measurements was expected, but it was a pleasant surprise to see material on audiometric tests. TDS and automated measurements get just a few pages each.

The final chapter, "Standards and Recommended Practices" by Daniel Queen, is most welcome. The author gives an excellent overview of the generation of standards, organizations, types of standards, and their use. A categorized list includes standards from national and international coordinators, professional organizations, and industrial groups. The perceptive and pertinent one-sentence comments on each standard will be helpful.

The index uses a relatively small typeface, and there are many entries in its 21 pages, although there could have been even more listings considering the length of the book. A number of the chapters use italics for new terms, many times along with a helpful definition. Most of the chapters have extensive references, some as recent as 1986—very impressive. Helpful tables and figures throughout the book clarify complex relationships.

Both of these handbooks are in hard cover and bound in stitched signatures, which ensures long life under frequent use. They both have had very good production and are very legible; the *Handbook for Sound Engineers* has a slightly smaller and darker typeface. The prices are close, and both books have a great deal of good material. The *Handbook for Sound Engineers* is the better choice for those interested in sound reinforcement and certain aspects of studios, and it has more on components and equipment. The *Audio Engineering Handbook* digs more into the fundamentals of audio, including the mathematics. It is more up-to-date in the text, particularly in the digital area as well as the references. Both books are important contributions to the literature of sound and audio. Either one will aid the user for many years. Personally, I prefer the *Audio Engineering Handbook*, primarily because it has excellent chapters on areas of particular interest to me. I am, however, very glad to have the *Handbook for Sound Engineers* alongside on the shelf. *Howard A. Roberson*

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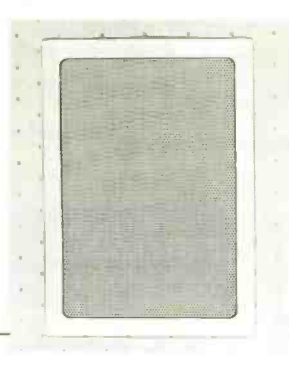
**AudioSource Surround Processor**

In addition to Dolby Pro-Logic, the SS Three decoder features matrix and hall surround modes, with switchable digital time delay. A 30-watt amplifier is provided for the rear speakers, as well as a line output for those who choose to use a higher powered amplifier. Line outputs are also provided for the center and subwoofer channels; the subwoofer channel has switch-selectable crossover frequencies of 80 or 150 Hz and an output level control. Other circuit features include automatic sequential test-tone generation, auto balance, and automatic calibration for left and right input signals. A wireless remote control is included. Price: $399.95.
For literature, circle No. 101

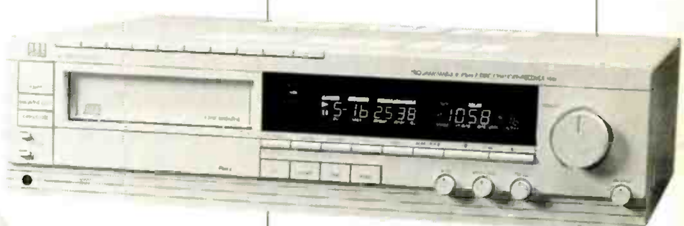
**PSB In-Wall Speaker**

A two-way system, the flush-mounting HW-1 uses a 6½-inch woofer and ¾-inch tweeter to achieve response rated at 56 Hz to 20 kHz, ±2 dB. Nominal impedance is 8 ohms, and sensitivity is 89 dB SPL at 1 meter for 1 watt input. The crossover is an 18-dB/octave acoustic Butterworth type, operating at a frequency of 2,400 Hz. Dimensions are 12 inches high and 8½ inches wide, with a mounting depth of 3¾ inches. A template for the wall opening is provided, and the speaker's overlapping frame will cover gaps from slightly oversize cuts; a rough-in kit for installation in new construction is available. Price: $300 per pair.
For literature, circle No. 102



**a/d/s/ In-wall Speaker**

Rather than risk cavity resonances and boundary diffraction by recessing the 750iL so that its grille would be flush with the wall, a/d/s/ set the plane of its baffle at the wall plane to minimize coloration. The three-way system uses a 7-inch, long-excursion woofer; a 1½-inch dome midrange, and a 1-inch dome tweeter. The crossover, a Linkwitz-Riley type, is mounted on two separate circuit boards to permit bi-wiring and to separate potentially interactive components. Spring-loaded, cast-aluminum tabs pivot from behind the baffle to clamp securely to sheet-rock walls. Price: $1,200 per pair.
For literature, circle No. 103



**ADC Receiver/CD Changer**

The ADC SoundStation 1440 combines an AM/FM receiver with a six-disc CD changer that includes a separate "plus one" drawer for convenient play of individual CDs. Tuner-preset and other control keys are built into the unit's upper edge, for convenient operation, and a 40-key remote control is supplied. The unit can memorize preferred programs from up to 10 CD magazines. The amplifier section delivers 60 watts per channel. Both black and white cabinets are available. Price: $699.95.
For literature, circle No. 104

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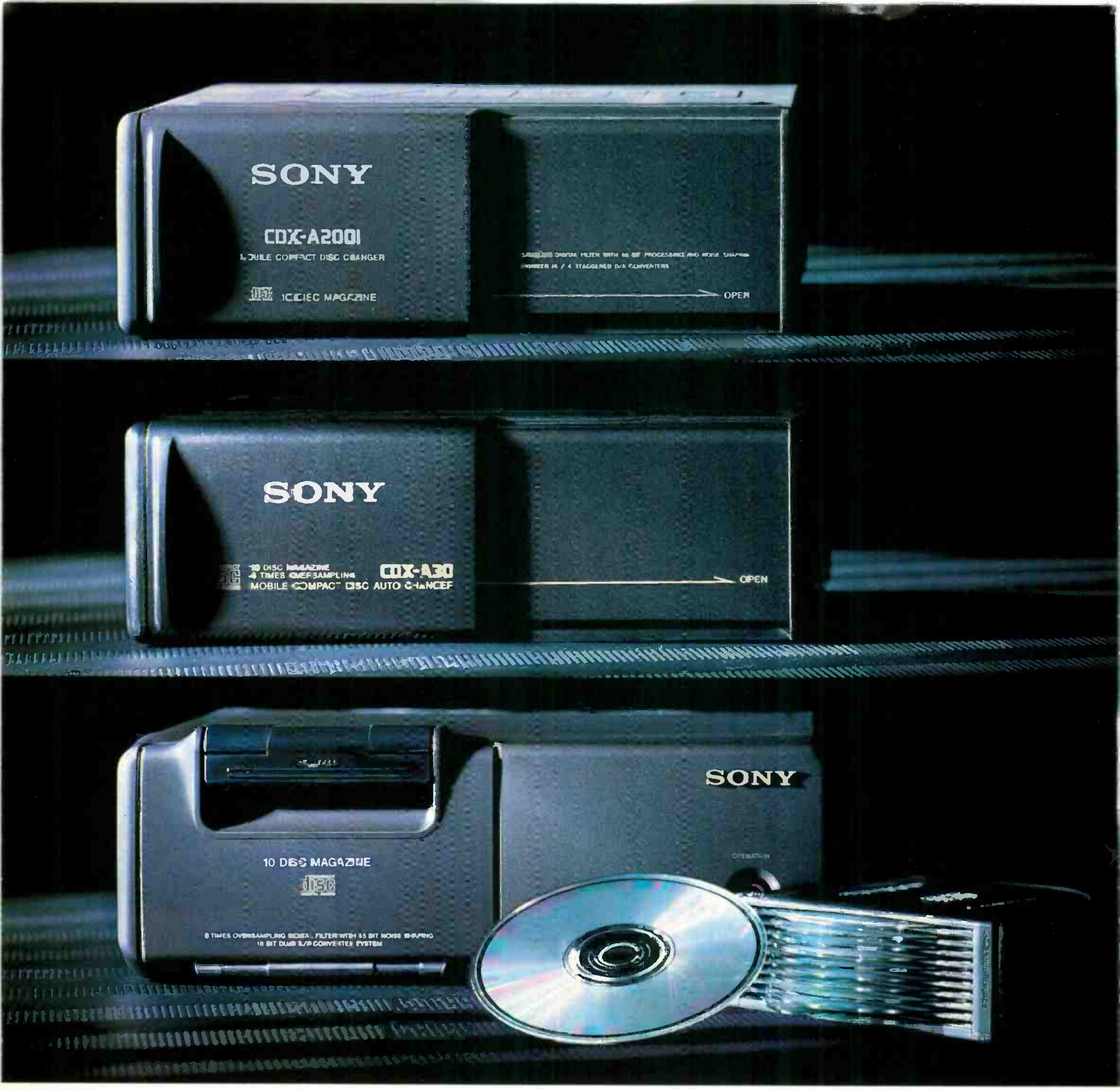


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DiscJockey grants you one other request. Its ten-disc magazine—used by more car stereo companies than any other design—is also compatible with Sony home DiscJockey ten-disc changers. Which means the same library of CD magazines that transport you in the car will be equally at home—at home.

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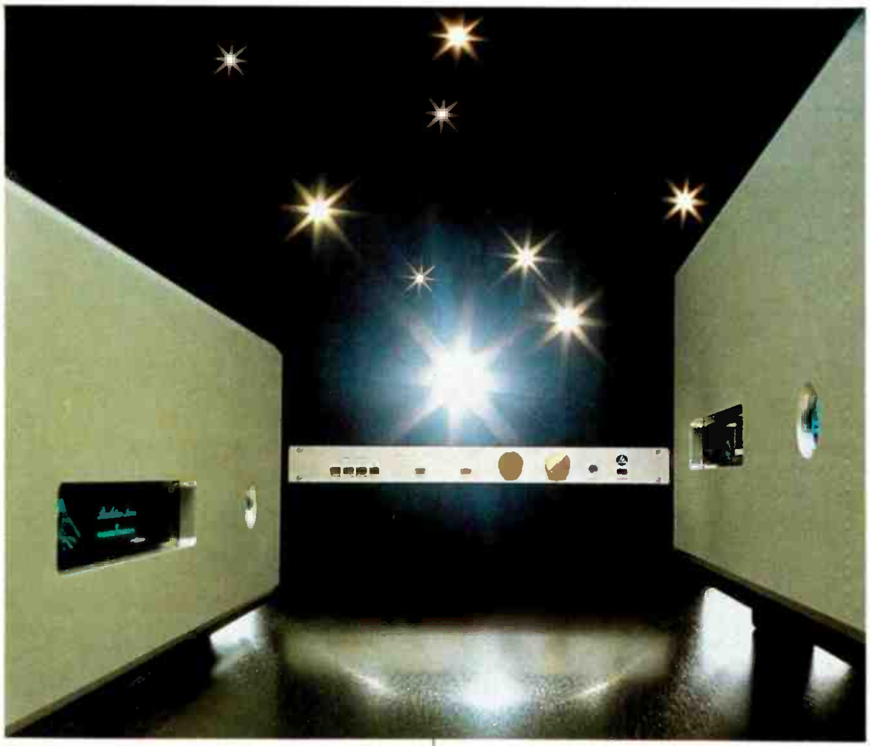
BERT WHYTE

# LIKE A SWISS WATCH



As I write this, the Iraqi crisis is worsening, the stock market is plunging, and the world seems to be going to hell in a handbag. So I feel a bit guilty writing about something as comparatively trivial as an extraordinary new preamplifier and power amp, even though they are surely the most glittering technological stars in the firmament of high-end audio.

The village of Wädenswil, near Zurich in Switzerland, is the home of the small plant of FM Acoustics Ltd. From this modest facility comes the most beautiful, precision-crafted, sophisticated and best-sounding preamplifier and power amplifier I have ever heard.

FM Acoustics is owned by Manuel Huber, a brilliant and innovative audio and design engineer whose technical expertise is augmented by his deep and abiding love of music. For 17 years, Huber has been making high-precision preamplifiers, power amplifiers, and electronic crossovers for the professional audio industry. Famous as much for their reliability as for their performance, FM Acoustics electronics are in use in recording and broadcast facilities throughout the world.

For the past seven years, Huber has been involved in research and development of a totally uncompromised, cost-no-object preamplifier and power amplifier for the high-end audiophile market, his personal "Holy Grail." Huber has now introduced his Resolution Series 611 and 811 amplifiers and 244 preamplifier. These products embody many of his innovative ideas in fabrication (including the use of custom-built, proprietary components) and include many unusual electronic features that contribute to performance, reliability, and protection of the equipment.

I briefly used the 611 amplifier but for some months now have been using the 811 power amplifier and the 244 preamplifier. Most of my comments on the 811 apply equally to the 611.

Huber's design philosophy is interesting. He quite rightly points out that amplifier design is a fairly mature technology. Huber feels there is much to be gained by the refinement and proper execution of many aspects of current amplifier designs. Many of these refinements are expensive, either in the basic costs of superior-quality components or in labor-intensive fabrication and testing procedures and techniques. In the pursuit of these refinements and the inclusion of his own ideas into his 244 preamplifier and 811 power amplifier, Huber has slain many sacred cows and stripped away some of the mythology that has encumbered amplifier design and fabrication for many years.

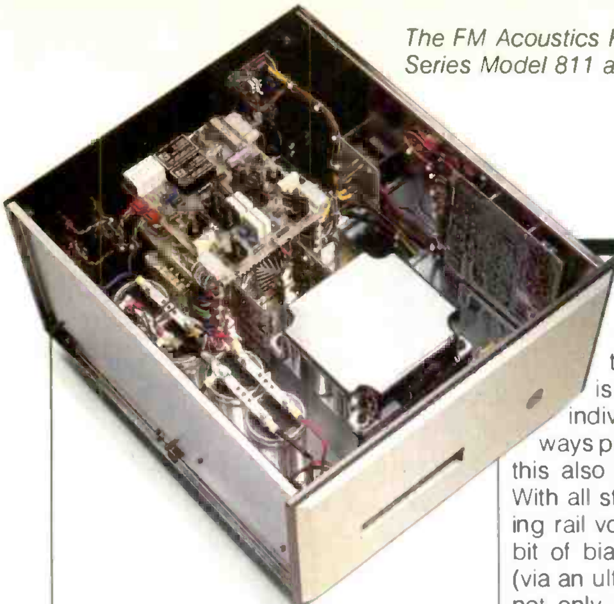
The FM Acoustics 244 preamplifier measures 17½ in. wide, 10½ in. deep, and 1¾ in. in height. Its 4-mm-thick aluminum enclosure is laser-cut and laser-polished to a unique satin finish. The front and back panel lettering is negatively anodized so it can never wear off.

The FM Acoustics 811 Resolution Series power amplifier measures 17½ in. wide, 21 in. deep, and 9 in. in height, and weighs 115 pounds. Its panels are also laser-polished to match the preamplifier. The front panel has an illuminated power switch and a central display that can indicate fault conditions.

Some expensive high-end amplifiers have separate left and right power supplies. Many even use monoblock construction, making the left and right channels separate amplifiers. The FMA 811, however, is configured as a stereo amplifier on a single chassis. Cost-cutting is not a consideration in the 811, and there are surprising and sound technical reasons, which I will detail next month, why FM Accoustics chose this kind of construction.

To fully describe and convey a true appreciation of the engineering masterpiece that is the FM Acoustics 811 power amplifier would require a great many pages in this journal; if ever a product epitomized the term "built like a Swiss watch," it is this fabulous amplifier. One would have to describe the meticulous and unrelenting attention to every detail of the unit. One would have to cite the use of the finest components and materials, and the ultra-precision fabrication. Above all, one would have to understand the importance of the exhaustive testing (much of it using proprietary procedures) of virtually every component in the FMA 811 amplifier.

A good example of the rigorous testing procedures is the special selection of all transistors used in both the 811 amplifier and 244 preamplifier. The 24 bipolar power transistors used in the 811 are proprietary designs made only for FM Acoustics. The 250-V,



*The FM Acoustics Resolution Series Model 811 amplifier.*

30-A chip is hermetically sealed in a ceramic case. Chip size defines the amount of current the transistor can supply. The average chip on a standard power transistor is around 10 square millimeters, while the FM Acoustics chip is 46 square millimeters. Thus the FM Acoustics chip is about five times larger than a normal transistor, and is also super high speed, about 10 times faster than standard transistors.

All FM Acoustics transistors are tested on a specially modified $40,000 curve tracer. A certain voltage is set, a certain bias resistance is set, and then the current is turned up and down very slowly, carefully observing the transfer curves for any anomalies. When a transistor is found that fulfills all the desired requirements, the tracer is switched over to the "B" test side. Other transistors are then tested to try and find one that absolutely matches the first transistor in all parameters, both statically and dynamically. This is all done by hand and is very tedious, time-consuming, and expensive. In the construction of a 244 preamplifier and an 811 power amplifier, as many as several hundred transistors must be tested to come up with the requisite number of matching transistors with identical transfer curves. These matched transistors are used in the positive and negative sides of the amplifier. This ensures that no distortion will be generated—it is actually cancelled within the stage, thus obviating the need for error correction or feedback.

In the 811, all stages are discrete Class A. There is a balanced input stage with a common-mode rejection of 90 db. Then come three voltage-gain stages, in finely tuned steps. Next is a precision predriver stage, the driver stage, and lastly the output stage. All these discrete Class-A stages are cascaded in the 811. Each stage affords optimal performance, and there is no excessive demand on an individual stage. Thus there is always plenty of reserve in each stage; this also improves long-term stability. With all stages running in Class A, using rail voltages of ±95 V and quite a bit of bias current, forced-air cooling (via an ultra-quiet fan) is required. This not only provides long-term reliability but also keeps the power transistors in the best temperature range for optimum performance. The fan has two speeds, but in my experience it only goes into its higher speed when very high-level, bass-heavy and long sustained passages of music occur. As a further aid in maintaining optimal temperature range on the power transistors, they are mounted directly on the cooling fins without insulating washers.

It should be noted that the use of matched transistors—all pure Class-A operation, no feedback—and all other features of the 811 amplifier apply equally to the 244 preamp.

In many ways, Huber takes a different approach to various aspects of amplifier design as compared to those of most high-end amplifiers. The typical high-end amplifier uses a toroidal transformer in its power supply. For the 811, Huber fabricates his own leaf-type transformer with a capacity of 2,900 VA continuous, and 9 kVA on peak repetitive impulses. Toroidal transformers certainly are preferred to the usual commercial leaf-type transformers which are notorious for their hum, stray fields, and mechanical noises from the stacked leaf plates. But the 811's transformer is another matter altogether. The leaf plates are made of a special high-performance steel (currently supplied only to the Swiss military and FM Acoustics) with a unique, proprietary version of grain-orientation, resulting in extremely low losses and hum, and stray fields that are an order of magnitude lower than those from toroidal transformers. Huber points out that a toroidal transformer of similar capacity to the 811 leaf-type would be inordinately large, very heavy, and difficult to mount safely. Because of manufacturing tolerances inevitable in torodial transformers where the metal core joins, there is very strong and directional magnetic radiation. Huber must pay dearly for his special transformers because they must be handmade. Each metal leaf plate is individually welded, so that the resultant stack has immense rigidity and produces no mechanical hum. Proprietary winding techniques are used to complete the transformer, and then a proprietary insulating material is used that can handle 4,000 volts! This careful hand-crafting is obviously quite expensive.

The FM Acoustics 811 power amplifier and 244 preamplifier are the most sophisticated audio amplification equipment that I have ever encountered, and the build quality is breathtaking in its fastidious and meticulous craftsmanship.

There is much cutting-edge technology in these units in respect to such things as special power-supply circuitry and capacitors, the enormous output-current capabilities, an on-board computer that monitors (at 20 times per second) such things as d.c. offsets, high-frequency oscillation, continuous and peak output currents, rail voltage, output voltage, temperature, and bias. There are also new ideas on amplifier/speaker interfaces and myriad other things, to say nothing of the incredible sonic performance of these units. All of these features and capabilities deserve full documentation, which I will provide in my next column.

*The Model 244 preamplifier.*

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The McIntosh C 34V Audio/Video Control Center is the latest in advanced performance, innovative versitility, user usefulness and engineered for human beings by human beings. Here is the preamplifier that merges video control with audio control. It is the most completely equipped Control Center stereo in existence. It consists of a *listen preamplifier*, a *record preamplifier*, a 20 *watt monitor amplifier*, a *five band signal processing equalizer* and a *compressor expander signal processor*. These signal processor circuits can be used in either the record or listen preamplifier, or switched completely out of the circuit.

Two independent, seven source input selector switches allow audio and video source selection (with the accessory McIntosh MVS-1 video control) for either listening, viewing or recording. The MVS-1 receives its control voltages by an interconnect with the C 34V. The flexibility in audio control you have come to expect from McIntosh has been extended to the control of video. Now, there is a true Home Entertainment Control Center. Unique separate listen and record facilities, introduced and perfected by McIntosh for both audio and video permit complete and independent operation. Separate input selectors, electrically isolated from each other, provide non-interference operation. Both listen and record input selectors control Field Effect Transistor analog switches. Because the FET analog switches are located at the input, noise, switch clicks and pops are eliminated and the potential for induced hum pickup is close to zero.

Loudness controls in ordinary equipment are usually simple, passive circuits connected to a portion of the rotation range of the volume control. As a consequence, loudness compensation accuracy is dependent on many variables such as speaker efficiency, amplifier gain and differences in input level.

The McIntosh compandor permits expansion or compression of the dynamic range of program material. Compressed recordings and broadcasts can be expanded on playback to restore dynamic range. Tapes can be recorded using compression and replayed using expansion to increase signal-to-noise ratio. The operating ranges of the compandor are so versatile that commercially encoded program material can be reproduced without the added investment in other outboard equipment.

Five separate tone shaping controls provide musical spectra tone shaping. Each control adjusts band segments to satisfy your personal preference or the demands of the program material. At the detent in the center of the rotation of each control the equalizer circuits are disconnected, completely removed from the operating circuits.

A wide band, very low distortion 20 watts per channel power amplifier feeds power to headphones. The power amplifier is a complete, fully designed amplifier. Music listening is protected by the POWER GUARD circuit (US Patent #4048573) and circuit components are protected by the Sentry Monitor circuit (US Patent #3526846).


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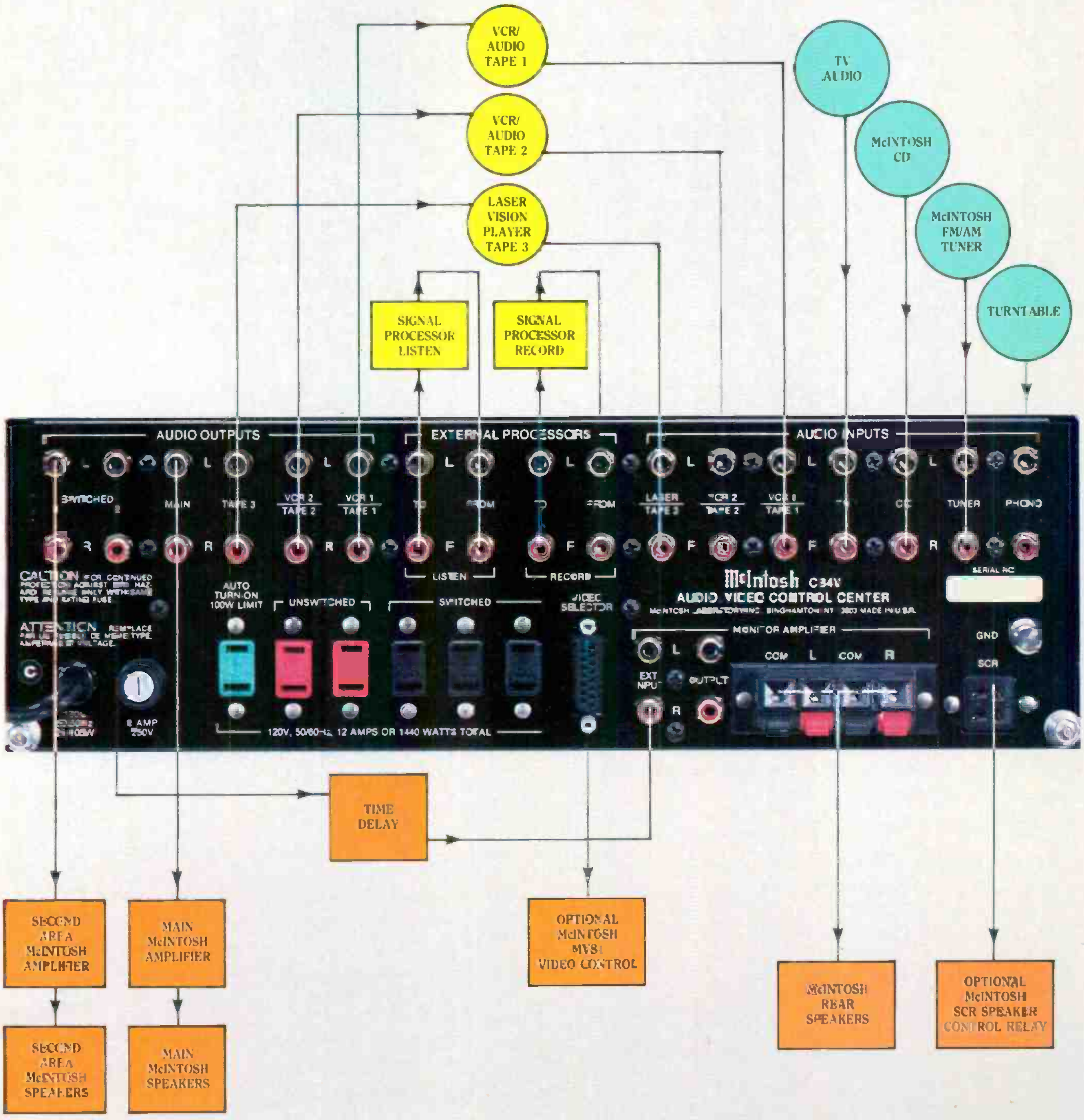


Here are only some of the ways and uses for which you can connect your C 34V.

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Protects your music to absolutely prevent the distortion generated from amplifier clipping (US Patent #4048573)
2. Sentry Monitor Circuit
Protects the amplifier from self destruction should there be component failure (US Patent #3526846).
3. True Power Reading Meters
Electronics that overcome the natural time error introduced by ballistics and mass of the meters (US Patent #3,783,399).

It is no accident that McIntosh amplifiers sound better.

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....the amplifier that in 40 years has outlived some 70 others who have simply faded away.

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EDWARD TATNALL CANBY

# HALL WITHOUT WALLS

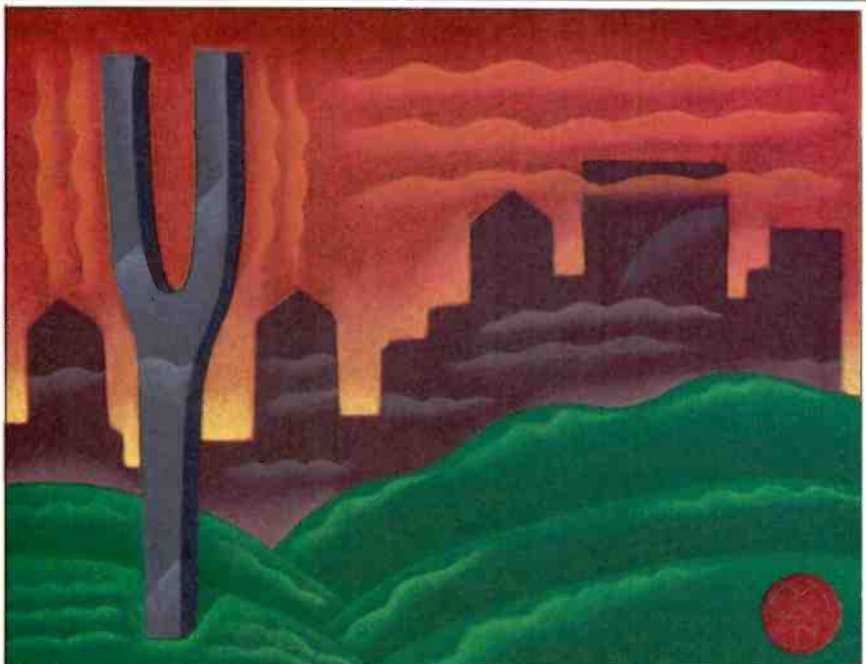

Illustration: Michael Donato

The great debate as to how we should actually reproduce the various forms of classical music into the ambient air, into space, or spaces, goes on and on—now more than ever, as the ads would say. Who remembers when it all started? Perhaps at the Trocadero in Paris, where, in the 1890s, an Edison phono with a huge horn attached appeared on stage before a large audience, or similarly, early in our century, at the Metropolitan in New York, "live versus recorded." Everybody declared the reproduction not only uncanny but perfection to the life. That took imagination, but we always have that when we need it, don't we?

Now that there is near-infinite audio horsepower and lots of audio quality to go with it, the emphasis is shifting. We know how to bring music into living rooms and small cars—the smaller the louder—but now we wonder how to create *simultaneous* audio reproduction of live music to reach large numbers of people, both indoors and, especially, outdoors, in sonically infinite space. Do we try for an invisible concert hall? Or would the battering sound of car stereo be more appropriate to the great outdoors? How about a living-room sound? Enlarged, of course, several million times. The very thought gets zanier and zanier. But we have to do *something* when faced with reality. Maybe something new under the sun?

WIDE OPEN SPACE OF NEW YORK CITY PARKS TO GET LIVING-ROOM SOUND, said the advance publicity for an astonishing new exploration of this area that burst upon the sonically polluted ambience of New York's Central Park one chilly morning last August. A rehearsal for a first outdoor concert via a brand-new outdoor system, for use by the New York Philharmonic and the Metropolitan Opera and jointly sponsored by the City, which has always liked to bring classical music to its masses since the days of Minnie Guggenheim and the famed stadium concerts. (I went to one of these, ages ago; thanks to the audio then being used, I was treated to the sound of several very loud French horns in a Brahms symphony and not much else, except for lots of planes overhead.) This system is, I quote, "portable" and will indeed be transported all over greater New York for outdoor concerts beginning in the summer of 1991. Quick—its formal name: The Carlos Moseley Music Pavilion. Even the name is innovative. If a pavilion looks vaguely like an enormous Chinese kite, or maybe the front end of an amplified Concorde seen from below with its nose removed, then this is surely a pavilion to end all such.

A full-sized concert stage is inside, surrounded by canvas-like plastic walls. Above the three slender steel supporting members, forming a pyramid outline, is a strange and beautiful round plastic shield—decoration, or is it a sound reflector? I do not know. Out in front, stretching away into the sonic outdoor distance, are ghostly white towers in a fan-like array, as far as the eye can see, a good many football fields away—the loudspeakers—each surrounded by a neat white fence. All of this is carried portably on six vast trucks, which—somewhat to my dismay—are described as "weighted with concrete ballast." More innovation, these monsters act as the solid foundation for the entire central rig and also include hydraulic lifters, like those we see in telephone and power-line work, to raise things into position. Most decidedly ingenious! My only thought in this connection was the memory of the end of New York's elevated highway, built in 1928 and mostly unmaintained until the day when a large truck, followed by several cars, dropped through the pavement to the street below. I have disturbing visions of the Carlos Moseley Music Pavilion suddenly dropping 50 feet down from, say, the corner of 59th Street and Columbus Avenue to the subway platform underneath, with disastrous results. But let that be as it may. Maybe the City should reinforce the streets that lead to its many parks.

All this and more I found out post-mortem, or post-vital, after the morning rehearsal. I was there, but the publicity wasn't, or didn't reach me. We somehow missed each other. So my experience was pristine, and all the better. I saw and heard the thing itself, which was, after all, what really mattered. Central Park is large, and the greenery has grown immensely since I used to inhabit it as a youngster. Nothing goes in a straight line in that park—it was the new semi-Gothic approach to nature in the 1870s and still is, now more than ever. In moments I was lost in dozens of spiral pathways, going 'round and 'round and hither and yon and up and down—phew! Where could that Great Lawn be?

Then I heard the distant sound of familiar music, a mile or so away, and zeroed in via my handy built-on binaural ears until—there it was, a vast white kite about to take off from a huge open, green space, laced with miles of red fencing and blue police barriers. A buzz of talk came out of the 24 speakers in their towers, emanating from the distant stage. Then suddenly a blast of Tchaikovsky/Sibelius—does it matter which?—in a "testing-testing," mode. Two or three minutes and then a stop, normal rehearsal style. Squeaks and trills from an oboe nearby, a half mile distant. A horn playing successive triad exercises, up and up by half steps. Muttered instructions, laughs, scraping chairs. Then a speaking voice, up front on the stage, crisp and right in front of me, trying out the "P.A." for speech. Even he was innovative. Instead of the usual "testing-testing," he said with firm energy, "Announcing, announcing, announcing, announcing, check-check-check, announcing." One could hear the click of his teeth. The level being okay, he retired and another sudden blast of music hit the ambient air, still a half mile distant, or so it seemed to me as I looked at the tiny blur that was the entire stage, with the N.Y. Philharmonic in all its majesty seated upon it.

What a remarkable scene! When the Philharmonic brass took off in a loud passage of Sibelius, dogs barked, pigeons flew up in clouds as before an earthquake, some nearby soccer players went on playing soccer, entirely oblivious, and a brace of galloping horses with blue-helmeted police officers on top swerved full speed into the vast sonic space to see what was going on, caracoling and prancing like Indians in a western, then galloped away. Passersby looked up and turned wearily back, just another noise in a noisy city. A passing dump cart mixed its rattling sounds with percussion by Sibelius, an effect that would have astounded that composer. Joggers jogged in and around the Great Lawn space and the white towers, and back and forth and in busy circles, paying no attention at all. Just more noise for them, like every day. One black-garbed jogger jogged into the sound field and, briefly interested, jogged backward and forward for 50 feet or so, never losing a beat, until she jogged away. White blobs of porta-toilets could be seen around the perimeter of the vast sound field, and the police barricades stretched in long lines in front of me. Press people and just plain park users wandered around; a cluster was around the up-front control installation, a mere 200-plus feet out from the stage. Then, the expected union break, and everyone filed back to the stage for the solo event.

I was off in space again, having tried just about every spot in the listening area, and I became aware of a tiny white spot on the crowded stage that was the soloist, none other than Isaac Stern, doyen of New York virtuoso fiddlers. I could not make the rest of him out nor see his violin, nor watch his bow arm move—I was that distant. Mr. Stern suddenly produced soaring fireworks of violin sound with trills attached, just to test the mikes. It could be heard miles away, yet was clean and clear, no scratch (a pop-screened mike well above his head), no heaviness, just good fiddle sound. I can tell you, after that 10 seconds of fiddle flourish, that Isaac Stern is still in excellent form! In tune. There was a pause, and then, casually, a few feet away from me (out of the nearest tower), Mr. Stern said "Hey, I'm waiting for some reaction." Mumble-mumble from off-mike voices, then, "Is there some reverberation?" More mumble, then, triumphantly, "I can tell, I can tell, I can tell!" Interesting.

Enough said. You may gather that I found this both a very potent and a surprisingly clean system. A solo fiddle, enormously amplified, is a clear test, at least of the upper range. Good old Sibelius told the rest of the story, right down to the super-duper subwoofer sound, more like real big drums than any I'd heard before. (Space, without any confinement, does indeed help, both the original low bass and the reproduction.)

But what WAS the system? It took me a long while that day, after the rehearsal, to get to the bottom of the system's philosophy, which is what interested me. (I'll forego the long list of brand names for numerous units.) I had, for instance, tried valiantly to figure out if there was any semblance of stereo, more than one channel, in the speaker array, and could not detect any meaningful spatial separation—just as well, I thought. After all, should the first fiddles be heard somewhere

Isaac Stern was no more than a dot on the stage. I was so distant that I could not see his violin or see his bow arm move.

up near the top of that apartment building at the left edge of the park, and the cellos come out of a grove of trees off to the right? Nonsense! This obviously was not a situation in which stereo is to be achieved.

Turns out that indeed there was a mono signal (out of a dozen or more mikes) that was treated to very sophisticated *digital delay*, adjustable at each tower. Only the innermost ring of speakers, in front of the stage, had a separate stereo (coincident) pickup for those listeners who were directly in front of the musicians and would need a correspondence between the sight they saw and the directional sound. Very sensible and perceptive.

What was really interesting was the special use of the delay to create a kind of reverse concert ambience among the 24 speaker towers in a manner that few of us would imagine. Each tower had two speaker systems—a multi-speaker array, but more of that later. The major system faces forward, away from the stage, with (as I observed) a rather sharp cutoff at either side. The second system, smaller, faces backward, *toward* the stage, and of course toward other speakers in the array; this second backward sound is given a sharply different delay time (the delay equipment is built into each tower), if I am right, that is considerably longer. This creates a very curious and, I would say, unprecedented repetitive "reverberation" field, between and around all the different speaker towers, multiplying itself at a distance and yet in no way suggesting the confinement and walls of a given indoor space. It would seem to me that this is a very remarkable approach, detaching us at last entirely from the "concert hall" sort of thinking and yet providing the sense of liveness that is *inherent* in every sort of classical performance.

Space is up, but you will want to know who is the prime mover in this extremely interesting concept: Christopher Jaffe, I found out afterward to my astonishment. Who else but the man who was responsible for the electronic acoustics in the remarkable concert hall at Eugene, Oregon, about which I wrote extensively back in the early '80s. Jaffe's company has finished an updated new hall of the same sort in Anchorage, Alaska, and I was in the midst of boning up on this, as well as updates in Eugene, when I was interrupted by the premiere of the Carlos Moseley Music Pavilion. Jaffe and more Jaffe!

There were many other innovators, of course, involved in the creation of the Moseley, and in due time I hope to give them honor, and to follow up on the very latest developments of electronic simultaneous reproduction of live music, both indoors and outdoors. It is, shall I say, a wide open field. Like the Great Lawn in Central Park. Infinite space! A new expansion for classical audio. ◮


MD-2
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# "In its price category, the Adcom GFA-535 is not only an excellent choice; it's the only choice."

Sam Tellig, The Audio Cheapskate

stereophile

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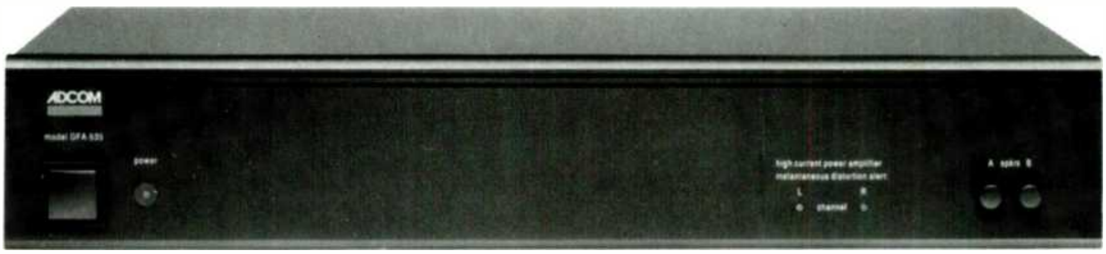


## The complete report:

## Adcom GFA-535 power amplifier.

Sometimes products are too cheap for their own good, and people don't take them seriously: the Superphon Revelation Basic Dual Mono preamp, Rega RB300 arm, AR ES-1 turntable, Shure V15-V MR cartridge, and the B&K ST-140 power amp. They can't be any good because they cost so little, right?

Wrong, of course.

Adcom appears to be having the same problem with their $299.95 GFA-535 amp. Credibility.

Now if this amplifier were imported from England and sold for $599.95, then maybe it would be taken seriously. And highly praised, no doubt.

For the baby Adcom is one of the finest solid-state amps I have heard. No, not the best; I'm not sure what *is* the best. But it's an amplifier that is so good for so little money as to be practically a gift.

Actually, when Rob Ain from Adcom called, I was about as enthusiastic about the GFA-535 as you were before you finish reading this piece. But Rob insisted, "You've gotta hear this amp."

He brought it over the next day, along with the GFP-555 preamp ($499.95), and we put both pieces into the rest of the system: a Shure Ultra 500 in a Rega RB300 arm on an AR ES-1 table, with Quad ESL-63 speakers on Arcici stands. Then we chatted for a half hour or so while the electronics warmed up.

And then, simultaneously, the two of us decided to shut up and listen.

"I've never heard the Quad ESL-63 sound better," Rob said. Of course, he was hardly an impartial observer, but the sound was extraordinarily clean, detailed, and musical. If it wasn't the best sound *I* have ever heard from Quads, it was pretty close.

This humble $300 amplifier was driving a pair of very revealing $3000 speakers and giving a very good account of itself. (We listened first to some Goran Sollscher classical guitar.)

"So how come this product isn't flying off the dealers' shelves?" I asked Rob.

"I don't know. Everyone wants the GFA-555 with 200 watts per channel. Including people who don't need it."

"Does the GFA-555 sound any better?" I asked.

"It's our aim to have all our amps sound pretty much the same. You pay more money, you get more power."

Rob pointed out that while the GFA-535 is rated at 60Wpc, it puts out more like 80. And while I did not do any measurements, my experience with other amps tells me Rob's right. I suppose Adcom doesn't want to steal sales from its GFA-545, rated at 100Wpc and selling for $200 more.

After a couple of hours, Rob left, grinning from ear to ear, and I later sat down to listen alone. True, when I tried certain Telarcs and pushed hard I could get the amplifier to clip—two LEDs quickly light up (very useful). But the Quads were running out of the ability to use the power anyway. My first impressions were confirmed: the GFA-535 is one of the best amplifiers around for driving Quads. Spendor SP-1s, too.

Suddenly, it hit me what this meant. Conventional wisdom had been dealt a severe blow. You know, the old saw that you should never power a good pair of speakers with a

## "The GFA-535 reminds me of...amplifiers that sell...for about three and five times the price."

cheap amplifier. Here was a cheap amp—one of the cheapest on the market—that sounded good with Quads, Spendors, later Vandersteens. Probably Thiels, too—at least the CS1. What it means is you can stretch your speaker budget a bit and get the speakers you really want, then economize by buying an Adcom GFA-535 for $299.95. True, you may be a little power shy, but probably not much. And to say the least, the GFA-535 would make a decent interim amp.

What does the GFA-535 sound like? (You thought I'd forget that part, right?) Well, this is one of the most neutral amps I've heard.

## "...the baby Adcom is one of the finest solid-state amps I have heard...so good for so little money as to be practically a gift."

While it doesn't sound particularly tubelike, it avoids the typical transistor nasties through the midrange and into the treble. I wouldn't call it sweet—there's no euphonic coloring—but it isn't cold or sterile. What it is, is smooth. And detailed. Far more detailed than I would ever imagine a $300 amplifier could be. The GFA-535 reminds me of the Eagle 2A and PS Audio 200C, amplifiers that sell, respectively, for about three and five times the price. Of course, they have more power. And they *are* more detailed. The point is, the Adcom comes close. Very close.

The bass, like everything else, is neutral, certainly not fat and overdone. But it's here where you notice that this amp is not a powerhouse. You just don't get the solidity and extension you get with a very powerful (and expensive) solid-state amp. Nor do you get the breadth and depth of soundstage that you often find with a very powerful amp. The Adcom GFA-535 sounds a wee bit small, which it is.

My only criticism, and it's more of a quibble, is that the speaker connectors are non-standard and unique (so far as I know). You insert bared speaker wire into a hole and twist the connector tight a quarter turn. Most speaker cables will fit, but some will not. Certainly MIT won't. Neither will the best Kimber, the kind with eight clumps of strands. The less costly four-clump Kimber will, and proved an excellent choice. My sample amp was quiet—

## "This amplifier is so good and so cheap that I think any CD owner who buys an integrated amp is nuts."

no hum—and ran cool. There are selectors for two sets of speakers. And the 535 looks nice.

And talk about economy: If you're not into LPs anymore, you could buy a Mod Squad, dbx, or Old Colony line-level switching box—or possibly a B&K Pro 5 preamp, with its switchable line amp section (only $350), or the Adcom SLC-505 passive preamp ($150)—and run it with a CD player. In fact, if you are into CD only (no tape, no tuner, no phono), you could buy a CD player with a variable volume output and run it directly into the Adcom. This amplifier is so good and so cheap that I think any CD owner who buys an integrated amp is nuts.

In its price category, the Adcom GFA-535 is not only an excellent choice; it's the only choice. The real question is whether you should buy one even if $299.95 is much *less* than you planned to spend for an amp—*ie*, whether you should put the money into a better CD player or pair of speakers instead.

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JOHN EARGLE

# CHICAGO SHOWDOWN

Illustration: Valerie Pizzo

Attendance at this summer's CES was down from last year, reflecting the soft economy in consumer electronics. As usual, video dominated the home entertainment side of the show, and audio was even more fragmented than in recent years. The reputation of the Summer Show as the exposition venue for high technology may be up for reassessment, since there was very little of note in this area. Only in camcorder design were there significant steps forward in signal processing, size and weight, and useful features.

Of all the Japanese giants, Sony is the one with the persona Americans find most credible. The other major players, at least in consumer electronics, often seem faceless and without flair. Sony has been right so many times that we can easily forget its fallibility. Those of us who have been around for a while, however, will remember the Elcaset, and more recently Sony's Beta VCR format has taken a fall. The entire Sony exhibit this year was devoted to the virtues of high-band 8-mm video recording. Their camcorders are remarkable, as is the array of consumer accessories intended for editing home movies. The implication here is that if Sony's Beta system is destined for obsolescence, then so is JVC's VHS system. Maybe so, inasmuch as 8 mm has the potential for better performance all around, but there is a universe of VHS recorders out there and a vast library of VHS movies that won't go away. It's a little like predicting the demise of the Philips Cassette merely because DAT is a better way of recording.

Which brings us to Sony's next big statement, actually made earlier this year, that Sony Classical (formerly CBS Masterworks) will bring out a release of 10 or so recorded DATs in an attempt to launch that medium as another format for the record industry. Since DAT machines (with a truce between hardware and software manufacturers on the copying issue) are now starting to come into the U.S., it is truly time to see if the medium can really fly on its own as a carrier of recorded sound into the home. Incidentally, DAT has already made it big in a variety of professional applications, and its position there seems secure.

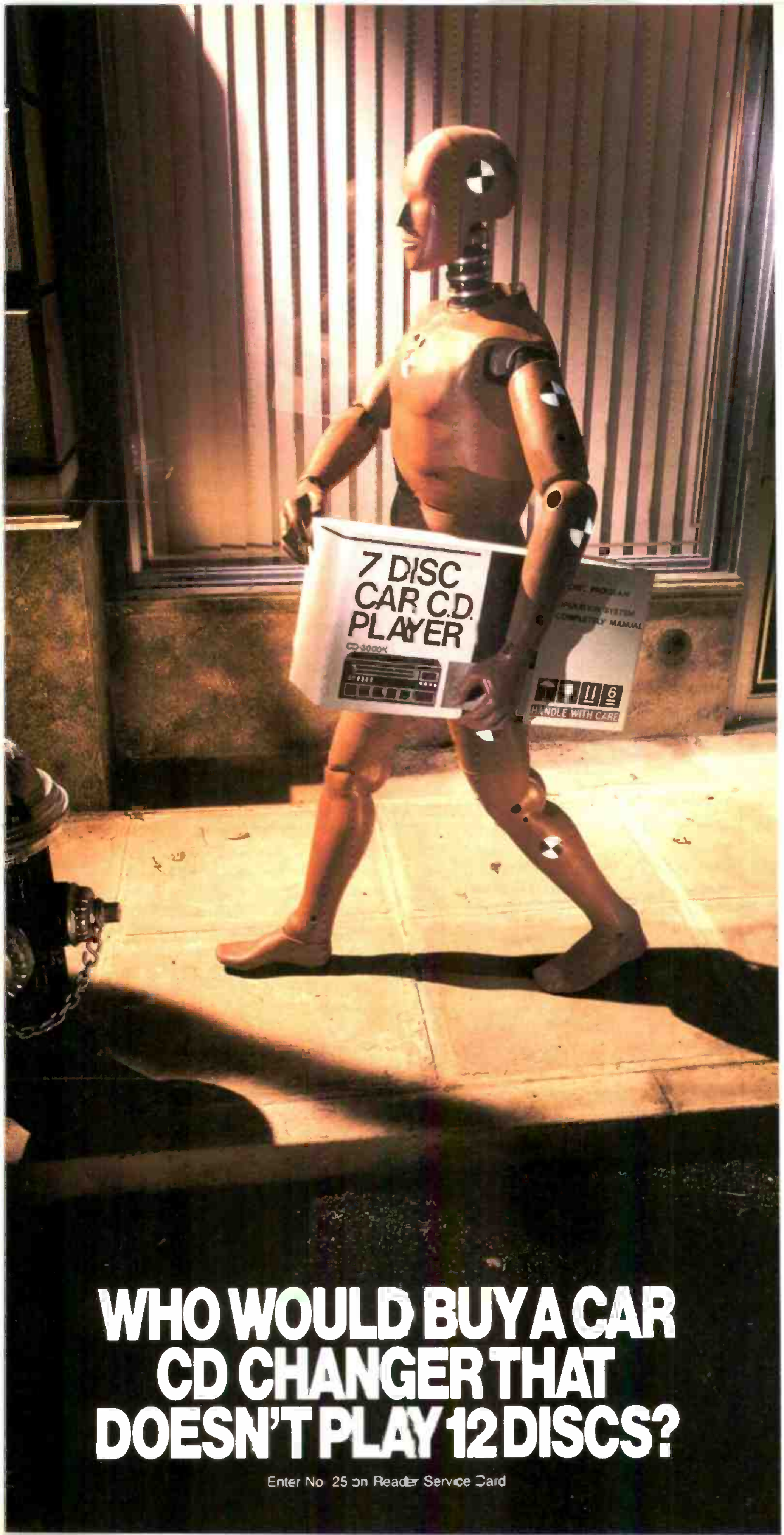
The biggest problem at the CES is high-end audio. It is a minority within a minority, and the special needs of its exhibitors have not been well met in recent years by the CES and its sponsoring organization, the Electronic Industries Association (EIA). Thus, a brief review of how things have fared over the last decade appears in order.

In the late '70s, most small high-end audio exhibitors were at the Bismarck Hotel downtown, making use of normal sleeping rooms with the beds removed, à la old-style audio fairs and hi-fi shows. A few of the larger audio manufacturers, such as JBL and AR, maintained static exhibits on the main floor at McCormick Place, and simultaneously had demo rooms and/or hospitality suites in what was known then as the McCormick Inn across the street. Some of the larger high-end companies rented suites in upscale hotels where they could demonstrate their wares without interference—and not under the aegis of the CES.

The Bismarck facilities were not good for demonstrating audio equipment and that activity later ended up at the Pick-Congress Hotel, below the Loop, on Michigan Avenue. The situation was a little better, but not much. The next stop in this trek was the Conrad Hilton Hotel. That lasted awhile, and then, just a few years back, the weary travelers ended up on floors three through eight at the McCormick Hotel (the old McCormick Inn). At last, the entire show was under one roof, or at least mostly in one location, and this is something that the CES had long desired. By this time, the larger, mainline audio exhibitors had found permanent homes in the various large exhibit rooms in and around the large halls and on the mezzanine of the McCormick Hotel.

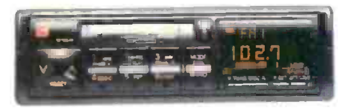
No one in high-end audio has ever been truly happy with the hotel room setup. The rooms are generally too small, and air handling is almost always insufficient—and noisy. Acoustically, the rooms are terrible. What high-end audio needs is a special venue of its own with acoustically isolated spaces of appropriate size that can be acoustically treated for the particular demonstration at hand. And the costs must not be out of line, since most of the high-end manufacturers have limited show budgets. Very likely, such a venue does not exist—nor can it be hastily thrown together by the Electronic Industries Association with prefabricated booths.

Back in 1980, an organization known as the Institute of High Fidelity (IHF) put on an audio-only show in Atlanta. It was a vain effort to cater to the special




**Panasonic presents a 12-disc CD changer for more selection and more miles of uninterrupted digital sound.**

Only a dummy would want to settle for anything less than up to 12 straight hours of music and the convenience of 12-disc random programmability.



The CX-DP15 CD changer offers you that and has incredibly high quality components, such as: a 2 DAC system with one DAC per channel, High Slew Rate Low Pass Filter, Oxygen Free Copper Audio Cables, Gold Plated Connectors, MASH* Circuitry and Quadruple Oversampling Digital Filter.

In other words, it sounds very good.

Also, this CD changer is so flexible it can connect to virtually any existing car stereo with the CY-RM15 or the CY-RM16 controllers.

However, if you also want a new car stereo, there's the CQ-L40 and the CQ-L30 cassette receivers. They both have 50 Watts maximum power, wireless remote, are removable and connect directly to the CD changer to give you full system control.

But don't listen to us, listen to the system.

We're confident that our customers are intelligent enough to make the right choice for themselves.

*Technics developed the MASH one bit DAC. NTT (LSI Labs) invented MASH technology. NTT has applied for trademark registration for MASH.


**Panasonic**®
just slightly ahead of our time

**At CES, high-end audio is usually a minority within a minority, but the special needs of audio exhibitors have not been well met.**

needs of audio demonstrators. The show was a failure, and the IHF ended up merging with the EIA, which puts on the CES twice a year. One of the reasons for the failure was that there were, even at that time, very few audio-only dealers. By 1980, most audio dealers were already getting into video, furniture, and related accessories; they had to go to the CES to see what was happening in those fields.

Meanwhile, at the McCormick Hotel in 1990, there were very few audio exhibits on the upper floors. Apparently, the Chicago fire marshal considered the heavy attendance in recent years a fire hazard, so space was limited this year to about four exhibits per floor. A few of the exhibitors I expected to find there were in prefab booths on the lower level of the North Hall (some weren't in Chicago at all), but many of them had bolted the show altogether and gone to the Chicago Historical Museum instead!

As I understand it, the exhibit at the museum had been organized in relatively short order by Dale Pitcher, president of Essence, a manufacturer of loudspeakers and amplifiers in Lincoln, Nebraska. It was apparently a great success, with 40 or so exhibitors showing 50 product lines. The location offered what many of the exhibitors were looking for: Good-sized rooms (not everybody wanted or had one), reasonable cost, and to-the-point floor traffic. Another friendly touch was the direct sale of CDs and LPs to attendees, something the CES banned about three years ago. Will there be a museum show next year? Nobody would say, but it seems apparent that if the EIA doesn't come up with a workable alternative, there certainly *could* be.

One of the best audio demonstrations during the entire Chicago trip was in the 800-seat auditorium at the museum. Wadia (of digital processor fame), FM Acoustics (Swiss amplifiers), Duntech (Australian loudspeakers), and Dorian Recordings had teamed up to put on demonstrations. Normally, this sort of thing is a ticket to disaster, since it imposes local acoustics on recorded acoustics, not to mention the inability of most loudspeaker/amplifier combinations to deliver enough clean sound into a fairly large space. The amps and loudspeakers were up to the task, and the acoustics of the space were not a problem at all.

The new Duntech model, The Black Knight, is of the same general format as the earlier Duntechs: A symmetrical vertical array with woofers top and bottom and with a dome tweeter at the midpoint flanked above and below by midranges. FM Acoustics is well known in Europe and is a favorite in many recording studios. Their Model 811 power amplifier, used in these demonstrations, has been designed with enough current capability to avoid output-current limiting under signal conditions that would confound many amplifiers of similar 8-ohm power rating. Astounding in every way.

Magnepan was exhibiting in a suite at the Palmer House. They were the only exhibit around, and when they turned off their air conditioning, they had absolute quiet for demonstrating. I must say how important it is for subtleties of imaging that demonstrations be made in an absolutely quiet environment. This cannot be done to satisfaction anywhere in the main show area Magnepan's new MG 2.6 producec some of the more memorable sound at the show.

One of the major trends in high-end audio loudspeaker design is the desire to cleanly create higher sound pressure levels in order to do justice to newer musical styles. This is not easy. inasmuch as the temptation is to adopt design principles that may be at odds with one's philosophical starting point. Take electrostatic loudspeakers, for example. Two of the most prominent manufacturers in the U.S. are Martin-Logan and Acoustat. Both have devoted considerable engineering efforts to make their products handle greater input power without arc-over problems, and both have successfully integrated their upper-range electrostatic transducers with dynamic low-frequency elements (cone loudspeakers) for added acoustical output capability. This is not easy to do, because the basic radiation pattern of a cone is that of a monopole (omnidirectional), while that of the electrostatic is a dipole (bidirectional). These are the physical descriptions, but think of the difference purely in terms of the electrostatic transducer having back radiation which is 180° out of phase with the front. The matching of the two patterns is no simple task, and making the transition seamless is a matter of carefully choosing crossover slopes and placing the crossover point in a frequency range where normal room modes will tend to mask the front and back pattern differences. Both of these companies have succeeded admirably.

A similar challenge faced both B & W and KEF some years ago. Ten years ago, these two British companies were noted for rather polite British sound: Smooth, laid back, and with great attention to imaging. In recent years, both companies have made inroads into the world of studio monitoring (mainly in Europe), where higher levels are necessary. Both have met the challenge by converting over to ported low-frequency sections for greater output, and in the case of KEF to multiple-tuned low-frequency systems. These changes are apparent in recent consumer designs, and B & W's recent Model 800 is an imposing statement in that regard. The 800 contains two 12-inch transducers in triangular enclosures, top and bottom, with a midrange/tweeter combination separating them. When I heard them, the sound was imposing, but a full assessment could only be made under better listening conditions. It seems that the original "laid back" quality, which many may have preferred, has given way to an "up front" quality for the American market—or is it that way for all markets?

On another front, a handful of American electronics manufacturers have made it well into the high-end international amplifier market. Such companies as Boulder, Mark Levinson (Madrigal), Krell, and Audio Research come to mind. Most of these companies have approached digital technology with reservations, mainly because it required a different set of talents. Krell has faced the problem head-on with two companies. Krell Digital had on display a magnificent stand-alone CD turntable, along with several models of digital processors for it. Across the room, Krell Industries was showing their newest Class-A amplifier, the KSA-150, capable of doubling its continuous power output into successively halved load impedances all the way down to 1 ohm.

# The Nakamichi
# The End of the Single-vs.

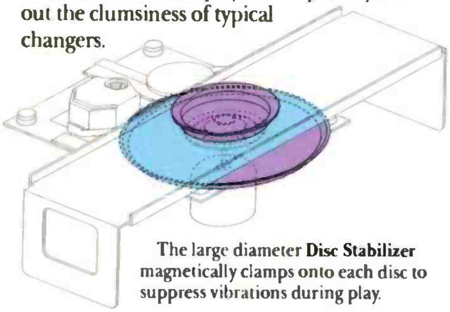

Choosing a CD player isn't as easy as it used to be. The best single-disc players are often very expensive and unnecessarily complicated. Changers offer multi-disc convenience. But because they're generally not designed for the serious listener, they cut corners off performance. They make it difficult to play just one CD. And their mechanisms are slow and clunky.

You could partially solve this dilemma by buying both a single-disc player *and* a changer. But now, thanks to Nakamichi, there's a much better solution.

The **MusicBank System™** lets you load up to six discs for multi-play yet always accommodates a seventh single-play disc. You can easily load or eject discs via a familiar single-disc tray.

Take a close look at Nakamichi's new CDPlayer2, for example. On the surface, it looks like a conventional single-disc player (only less cluttered and generally more pleasing to the eye of most beholders). Look inside, however, and you'll find something totally unique: the Nakamichi **MusicBank System™**.

The MusicBank System employs an ingenious "1 + 6" stocker mechanism that provides advanced multi-disc playback capability without the clumsiness of typical changers.

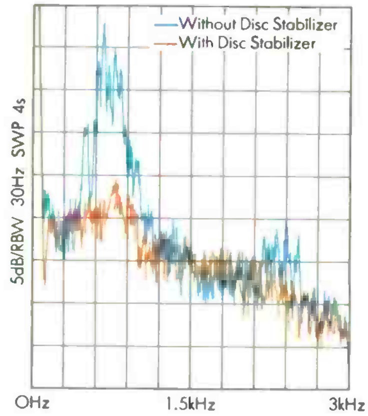


The large diameter **Disc Stabilizer** magnetically clamps onto each disc to suppress vibrations during play.

You can store up to six CDs in the MusicBank System, loading and unloading discs just as you would with a single-disc player. You can play a single CD at any time without juggling discs. And you don't even have to remove the single disc to play any of the stored discs.

You also get a full complement of easy-to-use single- and multi-disc programming capabilities, including delete play, 3-way random play, 3-way repeat play, and a 50-program memory. There's even Nakamichi's convenient **Synchro Recording** feature that automates CD dubbing with virtually any Nakamichi remote-controlled cassette or DAT deck. And whatever you ask of the MusicBank System, you'll find it responds quickly, smoothly, and quietly.

But forget about CDPlayer2's multi-disc capability for a moment. When it comes to sonic performance, CDPlayer2 must be compared to the most ambitious, high-end single-disc players—the ones that typically cost hundreds, and even thousands, of dollars more.




Measurements of focus servo error with and without the **Disc Stabilizer** reveal a dramatic improvement.

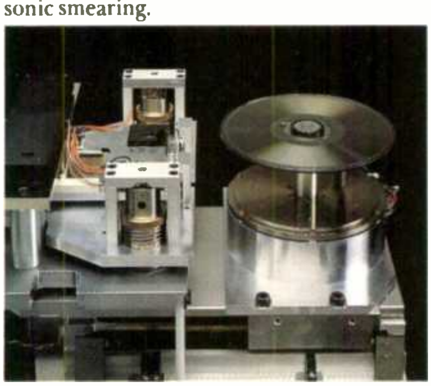
CDPlayer2 uses Nakamichi's newly developed **Enhanced Linearity 20-bit D/A Converters**. Unlike other so-called high-resolution systems, it is an innovative and real solution to the problem of converter precision. With this new technology—plus an 8-times oversampling digital filter, improved linear-phase 3rd-order

CDPlayer2 comes with a full-function wireless remote control.

# MusicBank System™: Multi-Disc Player Dilemma.

Bessel-type active analog filtering, and numerous other Nakamichi refinements—CDPlayer2 sets a new standard for musical accuracy. You'll hear musical detail, soundstage precision, and ambience you never knew existed on your CDs.

To further assure even the finest musical subtleties are preserved, CDPlayer2 has a large-diameter, magnetically chucked **Disc Stabilizer.** It suppresses the effects of external vibrations and dampens disc resonances that can lead to excessive focus servo activity and sonic smearing.



The OMS-2000's optical transport mechanism provides absolute positioning with unrivaled precision.

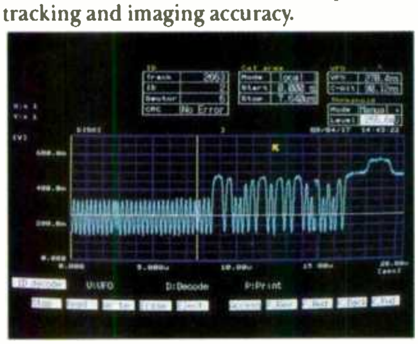
As impressive as CDPlayer2's internal features may be, the full story goes considerably beyond what lies behind its front panel. After all, advanced CD player technology of this kind is not developed overnight. CDPlayer2 and, for that matter, all other Nakamichi CD players and digital audio products, benefit from years of fundamental research that has put Nakamichi at the forefront of optical disk and digital signal processing technologies.

Just to put things into perspective, for a few hundred thousand dollars more than CDPlayer2 you can own a Nakamichi OMS-2000 optical disk analysis system. This remarkable read/write instrument can handle virtually every type of optical disk medium that has been or will be developed. The optical transport and disk drive mechanism are designed and manufactured by Nakamichi to unheard-of levels of precision—many orders of magnitude greater than that required for CD players. And through a sophisticated computer interface, the system permits a vast array of revealing measurements to be made. The list of companies using the OMS-2000 reads like a *Who's Who* of data industry giants.

The Nakamichi OMS-2000 optical disk analysis system has become the *de facto* standard in the data storage industry.

In fact, Nakamichi can rightfully claim a 95 per cent market share in optical disk analysis equipment of this type.

It was Nakamichi's experience in developing the OMS-2000 that revealed, for example, the importance of keeping the signal path between the laser and the signal processing circuitry as short as possible. Accordingly, the RF amplifier in CDPlayer2 is mounted right at the optical transport rather than remotely on the main circuit board as it is with conventional players. This, together with a new high-stability servo circuit developed with the aid of the OMS-2000, delivers much improved CD tracking and imaging accuracy.



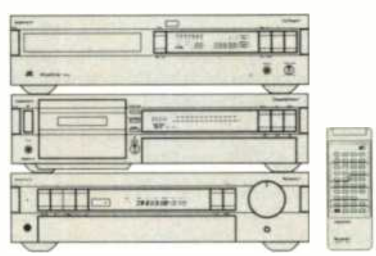
The OMS-2000's computer interface enables measurements that have yielded invaluable data and insights on optical disk technology.

But Nakamichi also knows that fine audio components cannot be developed in the laboratory alone. That's why the Nakamichi headquarters research and development facility includes a lavish concert hall and special listening room. They provide a "live vs. reproduced" reference standard against which Nakamichi engineers can continually judge the success of their designs.

*You* can be the judge when you visit your Nakamichi dealer. Audition CDPlayer2 or CDPlayer3, both featuring the MusicBank System. If you don't need multi-disc capability, ask about CDPlayer4. Compare them to other players for musical accuracy, ease of use, smoothness of operation, construction quality, versatility, and value. After that, the choice will be easy.

The ultimate reference standard: the Nakamichi Concert Hall and Listening Room are extravagant, yet essential, "test equipment" in the Nakamichi product development cycle.

Write or call for complete information on Nakamichi's new line of CD players, cassette decks, and receivers.



**MusicBank System™ is a trademark of Nakamichi.**

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**An Open Letter To Analog Cassette Hardware Manufacturers:**

The recording and consumer electronics industries have the opportunity to substantially improve the sound quality of prerecorded analog cassettes for the benefit of our mutual customer, the music consumer. As I will explain, the means for doing so is adjustable playback azimuth control.

The U.S. software market is divided roughly into three prerecorded media. Analog cassettes control roughly 70% of the market, CDs 25%, and vinyl LPs 5%. The analog cassette is clearly the dominant medium in the U.S.

It is important to note that the prerecorded cassette has outsold the blank in the U.S. for the last few years (in 1989 by more than 100 million units). Therefore, the fact is that prerecorded cassettes are likely to be used more often in cassette machines than cassettes recorded at home.

There has been serious effort by American music manufacturers to study and improve every part of the cassette duplicating process. As a result, during the last five years the recording industry has made great strides in improving the quality of prerecorded cassettes. Production improvements include the use of a digital source for running masters by virtually all manufacturers, improved mastering procedures, tapes, and recorders, and the constant testing of new duplicating formulations which are better able to meet the demands of digital masters. Additionally, quality control systems have been tightened and retightened, and all incoming cassette components are given close inspection.

In short, there has been a systematic program by the recording industry to study every part of the cassette duplicating process and improve it. Moreover, Dolby S-type signal processing is on the horizon, and we are on the verge of moving away from analog and toward digital reproducers.

It is my opinion that there is now very little left that can be done unilaterally to improve cassette quality.

The fact is that all of the improvements made to date still represent only half the equation; optimum sound quality can only be achieved by having the cassette and the player perfectly matched in terms of playback azimuth and frequency response.

While today's music manufacturers can and do control the quality of their software, cooperation with the hardware manufacturers to "match up" both software and hardware is essential for that last "quantum leap" in sound quality. I believe that, with proper hardware and software compatibility, the sound quality of the analog cassette would be very close to that of the Compact Disc.

While a tighter fixed azimuth standard might in the short term provide improved sound quality, extended time and use invariably will cause changes in alignment. As a result, I believe that adjustable azimuth is the only way to assure continued proper alignment for both prerecorded and home-recorded cassettes.

The CD and the CD player work as a *music system*, with the machine adjusting to the software. Why not the analog cassette? Why not make the music as good as it can be? Why not work together in improving the format favored by our customers, the analog cassette?

Edwin Outwater
Vice President, Quality Assurance
Warner Bros. Records
Burbank, Cal.

**An Open Reply To "An Open Letter . . ." From a Hardware Manufacturer**

I wish to acknowledge the five areas of improvement listed in the "Open Letter" and add two that went unmentioned: The use of the Dolby HX-Professional Headroom Extension System and Dolby B noise reduction. Unfortunately, both of these improvements are not available in every prerecorded tape, but the trend definitely seems to be in this direction. Further, by the time this is in print, the first cassette decks with Dolby S noise reduction will be in production. It will be interesting to see how the software manufacturers and retailers react to this new system. Will both Dolby B and Dolby S encoded software be offered? Will Dolby B software be phased out?

I also wish to voice my agreement that the best attainable sound quality can only be achieved when the software and hardware are matched in terms of azimuth and playback frequency response. However, my agreement ends where Mr. Outwater focuses on adjustable azimuth and goes no further on the subject of playback frequency response. I place the opposite priority on these two items.

To my knowledge, there is no technological excuse for poor azimuth alignment, only one of cost. It is our experience that quality components (specifically, the transport mechanism and the head assembly), a finely threaded azimuth setscrew, and a well-placed drop of adhesive will hold an accurate azimuth alignment for the life of the tape head. I know of no professionally obtained evidence to the contrary. I can confidently state that most of the worn heads replaced by our repair technicians are found to have accurate azimuth alignment. For this reason, I believe that a tight fixed-azimuth standard will significantly improve sound quality and that consumer-adjustable azimuth is unnecessary.

In addition to being unnecessary, consumer-adjustable azimuth has serious drawbacks. Consider the following. The tape heads in all cassette decks unfortunately twist or jitter somewhat while in use. The effect of this twisting or jittering is that the azimuth is constantly shifting back and forth, developing a positive and negative error. Even though the nominal, or average, azimuth can be adjusted precisely, the instantaneous error cannot. As can be expected, the best-sounding decks have fewer instantaneous errors. One way to minimize these errors is to positively secure the tape head. Any added mechanism or linkage to facilitate easy azimuth adjustment would inherently make the tape head less secure and increase these errors.

Also, hardware can most likely be designed so that, in the playback mode, the user can adjust the azimuth either by ear or with the aid of a test tape and some form of instrumentation. But how does one adjust it when recording on a blank tape? Should the customer be expected to adjust his deck to an alignment tape prior to recording? How many customers will appreciate the added complication, and how many customers will adjust their decks correctly? And what if they adjust it incorrectly? The resulting tape

There are no industry regulations that force compliance to azimuth and playback frequency response standards.

will not sound good when played on other decks.

For these reasons, I believe that consumer-adjustable azimuth is counterproductive to the effort to obtain better sound quality.

The playback frequency response of many cassette decks in not as uniform as one might think. This is because the hardware industry highlights record/playback frequency response rather than playback frequency response.

In short, playback frequency reponse is that which is obtained when playing back a standardized test tape. Record/playback frequency response, on the other hand, is obtained by recording test signals on a blank tape and playing the tape back on the same deck on which it was recorded. A deck with wide, flat record/playback frequency response can have compensating errors in its record and playback sections and poor playback frequency response. Such a deck will produce poor sound quality when playing back prerecorded tapes and would record tapes that would have poor sound quality when played on other decks.

What caused the situation we are in today? I believe that both the hardware and software industries are to blame. Since there is always a large market for cheaper hardware and since the hardware industry doesn't highlight playback frequency response, poor-performing decks will command a share of the market. And while it is good to know that cassette software has improved dramatically in the last five years, what about the formative 10 years before then, when hardware manufacturers and consumers developed their sense of how good prerecorded cassettes tend to be?

Accepting that software is less of a problem today, what will spur hardware manufacturers to tighten their standards? There are no government or industry regulations that force compliance to standards for azimuth and playback frequency response. Today, both government and industry are so fixated on digital recorders that analog issues are very likely to remain a low priority.

A possible solution may be indirectly offered by Dolby Labs. They are well aware of how azimuth and playback frequency response affect sound quality, and have specified tight tolerances in the Dolby S licensing agreement. While this will apply only to higher-priced decks at first, Dolby S will eventually become more affordable and, hopefully, will become a common feature. If that happens, the problems of azimuth and playback frequency response may both be solved, and the analog cassette will provide its full potential sound quality.

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# Archival

Illustration: Ajin

# Revival

## Problems and Solutions In Long-Term Tape Performance

Several years ago, a friend told me that many of his prized tape recordings had suddenly started to deteriorate. As a collector of rare and historic recordings who was aware of their fragility, he had committed many to tape. A good number had been recorded only a few years previously. They were all made with great care, and often required hours of editing and equalizing to assemble on tape. Now, he found, the passage of the tapes over the tape heads and guides produced a squeal that was heard not only from the tape machine, but also through the loudspeaker. Some of the tapes would continuously leave head-clogging deposits and require him to stop the machine every few minutes for cleaning; others might even bind in the guides. He could offer no reason for this, but he indicated that it seemed to occur rather suddenly and he thought it was largely attributable to one brand of tape that he had been using.

Initially, I didn't register the story as really serious, and I assumed that he had probably purchased some cheap, used tape. Interestingly enough, a few other collectors began telling me similar tales of woe, about whole collections of recordings that were now largely useless. The tapes used included 3M, Ampex, low-cost Shamrock, and other brands. As these collectors were largely old-time radio collectors who are notorious for their use of extremely cheap tape and their disregard for high-quality audio, the problem still didn't register.

The problem finally reached me when I began to notice a short squeak, which would quickly go away, when playing some tapes in my own collection. If the squeak was any more serious, a quick cleaning of the heads and/or guides would usually eliminate the unpleasantness for the entire playing of the reel. Not many months later, though, these and other tapes would squeal almost continuously, leave deposits on heads and guides, and, in extreme cases, jam in the guides!

I brought up the subject with a tape supplier and user who categorically stated that he thought such problems only occur with cheaper, non-top-quality tapes. He suggested that I use a particular top-line tape, which, it turned out, had been among the very tapes whose squealing had sparked my investigation. In that instance, the tapes were from the transcription service of one of the richest radio stations in the U.S. They had been donated to the local broadcast museum, and I was transcribing them for the use of the museum's patrons.

Thinking the tape players might be at fault, I tried three different machines. These tapes squealed and jammed in each one. Tape transfer could only be obtained by repetitively stopping and cleaning the heads and making countless flying starts.

Michael N. Stosich

Over time, the lubricants in some tapes break down, leaving a white, mold-like, powdery residue on the tape's edges.

I began my inquiry into this problem by contacting dealers, professional recording engineers, record producers, tape-head manufacturers, and acquaintances and friends who engage in serious audio. Later, I contacted tape manufacturers, people I knew at various sound archives and government agencies involved with recordings, and even a developer of early tape recorders. Information on the subject of handling and storing tape is not too easy to come by, and a lot of it seems redundant. Much of the following is culled from technical papers and articles obtained from 3M and Ampex.

### Tape Problems

Recording tape consists of a flexible backing material coated with a mixture of magnetic oxides in a flexible binder material that holds the oxides on the tape. Formerly, the backing material was acetate; now it is almost always a polyester film. Most high-quality tapes also have a textured, conductive back coating. The binder is usually implicated in tape squeal. Because of the proprietary nature of the processes and formulas involved in the manufacture of recording tape, it is not possible to determine the exact cause of any degradation that may be taking place.

My experience and that of others is that this problem is associated with top-quality, brand-name tape formulations which appeared in the later '60s and the '70s [1]. I know no cases of old-fashioned acetate tapes squealing or jamming, although I am told it can happen. Acetate tapes do tend to dry out and become wrinkled and crumbly. They are prone to constant breakage, but at least they play. Interestingly enough, some of the humbler quality, less polished, and less expensive tape formulations, such as Ampex 631/641 and the discontinued Scotch 150, never seem to have the problem.

To have a low-noise product, and to minimize head and tape guide wear, it is desirable to have a smooth, highly polished tape surface. This is especially important to maintain low noise in low-speed operation, such as cassette recording. However, tape can be *too* smooth, and tape manufacturers are now approaching the limit in this area. Tape's abrasiveness helps keep the path of tape travel clean. A tape with too smooth a surface will not be efficient at removing minor debris from the path. In addition, a minute air gap is required between the surfaces of heads and tape to maintain accurate tape motion. With too smooth a tape surface, the tape will tend to stick to the surface of tape heads and guides, alternately sticking to the head and breaking loose in a continuous cycle [2]. When this occurs at a very high rate, we identify it as squeal. The high polish of some quality tapes may exacerbate the potential for squeal.

Many of us are aware of cheaper "white box" tapes that were once commonly sold. They usually were regarded by purchasers as rejects, substandard or defective. The defects were often quite apparent ones, such as width problems, splices, and squealing. Some tape salespeople have suggested that bad batches of tape have sometimes been unintentionally delivered to stores as first-line, because they either did not get caught by quality control or were only later found to have problems. Substandard tapes have been known to show up in the marketplace, but this appears to be an insignificant problem. The problems that people experience are due both to the combination of basic materials from which most tapes are made and to inadequate storage.

I know of three explanations why tape squeal is now emerging so frequently. One reason is that over time, the lubricants in the tape have broken down. Tape with this problem exhibits a white, mold-like, powdery residue on the edges of a reel [3].

Another conjecture is that the binders of some back-coated tapes break down with time due to their particular chemical makeup, and that higher temperatures hasten this process [1]. Chemicals released from this degradation cause the friction that produces the familiar squeal.

The prevalent explanation of tape squeal is that the polyurethane binders used in most modern formulations of recording tape are hygroscopic—that is, they absorb moisture from the air to a degree that depends on the humidity [4]. These binders, depending on the length of their urethane molecules, have been shown to undergo a chemical change at high humidity and high temperature. Ampex has recently acknowledged that this problem can occur with the binders used in their Type 406 and 456 tapes manufactured between 1975 and 1984 [3]. This degradation, known as hydrolysis, can occur very rapidly—under laboratory conditions, in as little as four weeks at a relative humidity (RH) near 100% [5]. In fact, one suggestion for testing tape is subjecting it to 80% to 95% RH at 120° to 130° F for three days and examining it for problems [6]. Under less extreme conditions, degradation may take much longer to occur and may not affect all the molecules constituting the binder.

High temperature and humidity are looked on as the main causes of hydrolysis. Humidity is considered the basic culprit, with temperature merely hastening the process. Hydrolysis induces the molecular chains of the binder to break down, which causes the resultant chemicals and/or the tape's lubricants to arrive eventually at the surface of the tape. Tape that has undergone hydrolysis becomes sticky, thus adhering to and squealing against tape heads, and can even cause many layers of tape to stick together in a block on the reel. When the binder's breakdown is complete, the oxide layer may crack off the backing. A 3M publication cites cases of tape stored for extended periods of time at 80° F and 80% RH actually having the layers stick together after 15 years [4]. The effects of humidity (squealing, stickiness), once exhibited, often indicate permanent damage to the tape. Fortunately, the literature also indicates that hydrolysis is somewhat reversible. In mild cases it can be reversed by subjecting the tape to a very low humidity (11%) for a period of time [5].

## Storage Environment

Table I summarizes the temperature and humidity ranges that have been recommended by a number of published sources on the subject for normal and archival storage environments and those cited as detrimental. Sometimes this had to be extrapolated from the articles. Papers on the subject usually do not state exactly what constitutes a detrimental environment for tape, but 3M [4] does refer to deterioration after storage at 80% RH and 80° F, and a recent article in the *Journal of the Audio Engineering Society* by an Ampex authority [7] suggests deterioration at conditions above 40% RH and 68° F. This latter assertion agrees with temperature-versus-humidity curves, published by Agfa (Fig. 1), for two levels of tape degradation caused by binder hydrolysis [8]. The curves indicate 40% RH at 68° F, for example, to be a marginal storage condition, and 70% RH at 80° F to be a detrimental storage condition.

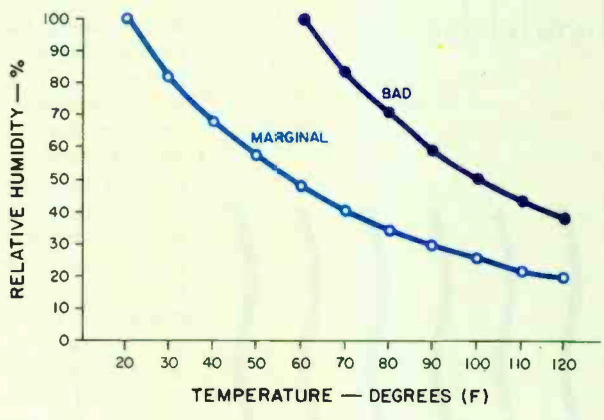
Authorities on the subject are in general agreement that low temperatures and humidities are necessary for long-term storage of recording tapes. Typically, the recommended temperature range is from 60° to 75° F and the humidity from 30% to 50%. It should be noted from Table I that exceptionally low humidities, i.e., 25% to 38%, are recommended for archival storage by most recent sources. Many common laboratory and household hygrometers (instruments for measuring relative humidity) indicate the ideal humidity range for humans as being 45% to 65%. Someone who lives in Colorado, where the humidity seldom exceeds 30%, recently told me that he has never experienced any of the squeal problems using the same brands and types of tape.

Nowhere in the literature is there a definition of just what period of time constitutes archival. In fact, the longest times referred to in any of the papers is 35 years—that concerned acetate tape, and I have never heard a report of acetate tape squealing. Articles and papers usually use 10 or 20 years when referring to storage times of modern polyester formulations (which, after all, are not much older than that). One who is familiar with old recordings, however, would hardly refer to such comparatively short periods as archival. I would suggest that normal storage periods for other types of items might be 25 years and that archival

**Table I**—Tape storage conditions as defined by temperature and humidity. The figures represent the range of values given in various publications of Ampex, BKM Associates, European Broadcasting Union, and 3M, and in papers and books by Marvin Camras, Howard M. Tremaine, and Jim Wheeler.

| | Temperature, Degrees F | | | Relative Humidity, % | | |
|---|---|---|---|---|---|---|
| | Archival | Normal | Detrimental | Archival | Normal | Detrimental |
| Minimum | 32 | 60 | 68 | 25 | 20 | 40 |
| Mean | 68 | 67.5 | 114.5 | 38.1 | 41.8 | 73.3 |
| Maximum | 81 | 80 | 167 | 60 | 60 | 100 |

Fig. 1—Temperature and humidity conditions which cause marginal or bad tape degradation due to hydrolysis of the binder, as determined by Agfa.



Authorities agree that both humidity and temperature should be kept low for tape storage. They don't agree on how low they should be.

should refer to at least 50 years. Table I indicates that archival storage conditions are quite dry and cool by the standards of summers in central U.S.A. As the ranges given in the Table imply, the storage conditions considered normal by some authorities overlap the conditions that other authorities suggest as archival, and conditions recommended for archival storage by one source exceed those listed as detrimental by another! One could interpret the information to suggest that under normal storage conditions, the life of tape might be very short. In fact, Ampex now states only that their product should last at least 10 years under proper storage conditions [3].

What is disturbing about this is that many of these tapes may be recordings of important family events, master tapes of celebrated musical and dramatic performances, or recordings of important historical events. Recordings assumed to be permanent may be deterioriating on the shelves. I have carefully made many safety copies of crumbly, old acetate tapes only to find those safety copies squealing after only two years. It is frightening to think that the only way we can make a safety copy of a recording on an unstable medium is on another unstable medium. Much of what is written on the subject basically tells us how we might obtain a safety copy of a deteriorated tape. We must consider the fact that every time we introduce a generation of recording, as in safety dubbing, we audibly degrade the recording with distortion, noise, and speed irregularity.

### Storage Problems

Special precautions should be taken when storing tapes in building basements. Being porous, concrete absorbs ground moisture and acts like a wick. Concrete floors and walls, therefore, are very effective humidifiers. A dehumidifier may not be sufficient to remove this moisture. My advice is to make sure no ground water is in contact with the floor. Most newer houses have sump pumps, but older ones often do not. I highly recommend the installation of one if your house is not so equipped. In my case, the house was 60 years old and a hole had to be dug into the floor. Crushed stone was put into the hole and then a sump pump was added, for a total cost of about $500. While it would be nice to have drain tile around the basement to connect to the pump pit, it is not absolutely necessary. Water will tend to collect at that spot, and the ejector pump will remove it. In many basements that are not too deep, a dehumidifier may suffice, but I recommend one in every case. If silica gel or other non-liquefying desiccants are available, place a small amount in the tape boxes and/or store reels in plastic bags [9].

People who store their collections of tapes above ground, but who don't mind the heat in summer, may also have problems. I am amazed at the number of people who don't have air conditioning even in the relatively hot, humid climate I live in. Some collectors may think that they don't need air conditioning for themselves, but according to the data, their tapes may not survive in the high humidity and temperature that summer often brings. The best way to reduce house or apartment humidity is to use air conditioning. In fact, much of the feeling of coolness associated with air conditioning is due to its lowering of ambient humidity.

### Remedies

What can you do to tapes that won't play? One solution, suggested by a longtime record producer, is to dub the tapes at a minimum of twice the recording speed. The idea is to shift the tape's mechanical vibrations way up in frequency, possibly even to a frequency so high that the tape's mass will limit its vibration. Theoretically, the tape won't have the time to stick.

As mentioned before, some of the humidity damage can be reversed or reduced. Before throwing the reels out, here are a few hints: First, dehumidify the tapes. If a vacuum chamber is available, try leaving the affected tapes in it for an afternoon or a day. If the season is warm and the weather dry, try sticking them in an attic for an afternoon, with the boxes open (assuming the attic's temperature doesn't exceed 140° F). In winter, when the heat is on and the humidity (if you don't have a super humidifier) is low, open the tape boxes and let them dry out for a few weeks.

I have heard of several methods of rejuvenating tapes by baking them in ovens. However, the benefits may not last. One method is to bake them under precise conditions in a convection oven. This process requires regulation of the temperature within 3° F over a time and temperature cycle [1]. It is claimed that this allows the binder's broken chemical bonds to be remade. An alternate baking method has been described for drying out tapes which have been subjected either to excess moisture or to flooding [7]. For excess moisture, the process is to bake the tape in an oven at 120° F for 24 hours, cool, then rewind and fast forward the tape a couple times. For flooding, the process is repeated.

A laboratory oven is recommended for this process, as kitchen ovens can easily overheat and ruin a tape. Nevertheless, I have adapted the described processes to the home oven so that I can salvage otherwise unplayable tapes to make safety copies of them. The following method for rejuvenating tapes is similar and has been effective but must be followed with extreme care to avoid catastrophic mistakes: Heat a stove oven to approximately 125° F (probably the lowest setting on the dial). You must use an oven thermometer, as it is imperative that the tape not be heated above 150° F. After the oven's temperature has stabilized for 10 to 15 minutes, turn it off. If the oven will not stabilize at a temperature below 140° F, simply turn it off and wait until the temperature, as measured on the oven thermometer, drops below 140°. Quickly place the bad reel into the oven, and leave it there for at least 30 minutes—don't turn the oven back on! (When on, an oven produces pulses of high temperature, then cools. Thus the average temperature may be low, but the peaks can damage the plastic reels and tape itself.) After the reel has been lightly baked for 30 minutes, it should be removed and allowed to cool and stabilize for several hours or overnight. Do not rush the process. If necessary, repeat the process again. I have found the results to be cumulative. Tapes thus treated often play with little or no squeal.

As mentioned before, the benefits of baking may not be permanent with severely deteriorated tapes. Practice this with totally unimportant reels before subjecting a valuable reel to this potentially destructive treatment. In fact, this method may only allow you the ability to make a safety dub of the deteriorated tape. Paradoxically, it may be advisable to use one of the older formulations, with a rougher polish (such as Ampex 631 or 641), to ensure against the recurrence of squealing in the safety copy.

Very recently Agfa showed, by setting up a unit to recondition and copy such tapes, that they not only were aware of the problem but that they acknowledged some responsibilities to users of their products [10]. By its proprietary XT process, Agfa hopes to provide customers with a means of retrieving information "lost" on deteriorated tapes. Prices range between $280 and $350 for processing a 2,500-foot reel. Whether they will process other manufacturers' tape is not known at this time.

## Machine Problems

You can minimize friction by removing oxides that deteriorated tapes have shed onto heads and guides. So keep these surfaces clean with either commercial tape-deck cleaning products or, as I do, with cotton swabs and isopropyl alcohol. Be careful when buying products labelled "rubbing alcohol." Avoid the many such products that include oils.

When dubbing a bad reel onto a good one, you may have to stop and clean machine surfaces several times before completing a dub. More often than not, even when I cannot see a buildup, cleaning these surfaces mysteriously stops the squeal—for a while. Make sure that all heads and guides are demagnetized, as magnetized surfaces tend to attract loose magnetic oxides.

If the squeal is very mild, it may be possible to alleviate it somewhat on machines equipped with manual holdback-tension switches (often labelled "reel size" or something similar), by reducing tape tension. If playing a 10-inch reel, set the switch to the tension recommended for a 7-inch reel. If you need to play a 7-inch reel, wind the tape onto a 10-inch reel. If you don't have a switch, and the machine is a 7-inch machine, it may be possible to wind the tape onto a 7-inch reel with a large hub, such as those once popular for prerecorded tapes. Bear in mind that altering the holdback tension can induce other tape motion problems, such as improper reel braking, flutter, or running off speed; so proceed with caution.

One collector, James L. Snyder, has suggested that using a bidirectional tape recorder may help [11]. These machines often have asymmetrical head and guide arrangements, so that the tape passes over the drive components in a different order for each direction of play. Using three different brands of machine, Snyder found that, 85% of the time, tapes would squeal in one direction but not in the other. This may also be due to a difference in holdback and take-up tensions in the two directions. While I haven't personally done this, I have used different machines with different head/guide arrangements and have obtained similar results.

Tape heads and guides with "flats" worn into them can aggravate the situation by enlarging the surface the tape passes over and can stick to, thus producing or increasing squeal. If the guides cannot be rotated to expose new surfaces, they should be replaced. Even relapped heads may lose their previous sharp profile and develop a larger contact area that aggravates sticking and squealing.

The design of some tape guides and tensioners can add to the problem. Some machines, such as old Revoxes and Vikings, have spring-metal tensioners which serve as "shock absorbers" over which the tape rides [12]. These have been known to whine as the tape passes in contact with them and impart squeal to the recording or playback. I found that the spring-loaded, adjustable-height tape guides on both of my Technics RS-1500s acted the same way. I replaced these two guides with a pair of ridged, nonadjustable ones identical to others employed elsewhere on the deck. This resulted in only a slight reduction in some tapes' tendency to squeal, but even such small effects may combine with the effects of other remedies to significantly reduce the problem.

If the need is to make a safety copy of a deteriorated tape, it may be advantageous to remove any and all unnecessary surfaces over which the tape passes and to which it might adhere. Such surfaces include unused erase and record heads, and even some guides. If the machine in question has a removable head-block system, a special head block can be contrived having only a play head and minimum number of guides. I have used this method with great success over the last several years.

### Lubricants

In lieu of drying out tapes and cleaning and demagnetizing playing surfaces, few other things can be done. Applying some sort of lubricant either to the head or tape has been tried by many, but usually with limited results. I know of people who have tried spraying silicone lubricant on tape heads and reels, but to little avail. As an experiment, I tried applying a little of this lubricant to tape heads, and it worked for only the time it took the tape to wipe the head dry—about a minute. The collector mentioned earlier in this article went to the extreme of applying French horn valve oil to particularly unplayable tapes to make safety copies. Just recently, he contacted me to describe a method where he repeatedly fast-spooled the tape over the surface of a silicone-impregnated record/tape cleaning cloth like those made by Radio Shack and countless other manufacturers. He noted that by the time oxide ceased being deposited on the cloth, the tape was ready to play properly. One producer of historical and old radio broadcast records offered the following suggestion: Lubricate the oxide surface of troublesome tapes by rewinding each tape so it passes over the lead of a pencil, whose graphite will act as a dry lubricant. Another record producer suggested the application of motion-picture film lubricants such as Filmagic Pylon Blue Lubricant, Xekote, or Vitafilm Lubricant and Preservative. These motion-picture products are applied both to the projector mechanics and to the film directly. Their safety when used with recording tape has yet to be demonstrated, so I recommend using them only as a last resort.

Ampex Corporation was kind enough to provide me with a sample of "Topical Lubricant Solution—0.5% Fluorosilicone," a tape lubricant consisting basically of a small percentage of silicone of some kind, dissolved in Freon TF. To use it, one has to hold a lubricant-soaked applicator against the oxide side of the tape as it passes into the head/guide of concern. While it was somewhat effective, it proved extremely difficult to use, as it was necessary to repeatedly soak the applicator to get through a complete reel of tape. Tape squeal would often begin before this could be done. It was also very awkward to hold a cotton swab in precise alignment against the tape for extended periods. I also looked into Krytox, a fluorinated oil made by Du Pont, which is used by some manufacturers of magnetic memory discs as a surface lubricant [13]. Krytox has been indicated as useful in lubricating old tapes whose lubricants have actually migrated away. For this use, a 1% solution of Krytox 143AC in 99% Freon TF was suggested. It is applied directly to the tape with a soaked applicator while fast-spooling [7]. On the theory that this might also apply to tape affected by hydrolysis, I applied a 2% Krytox 143AC solution to a tape severely deteriorated by hydrolysis but observed little benefit. Furthermore, Krytox costs $176 per pound, and Freon TF cannot normally be purchased except as small bottles of tape head cleaner or in spray cans. (Freon TF is commonly available in Radio Shack stores as their professional tape head cleaner.) These products and chemicals are either not commercially available, difficult to locate, or very expensive. They are only mentioned here for the sake of completeness.

I was able, however, to find similar products expressly aimed at recording tape. I know of only a few commercial products presently available that address squeal. GC Electronics of Rockford, Illinois produces a "Tape Head Lubricant," Cat. No. 30-124-2. Amongst its listed benefits are a reduction of wow, flutter, and squeals. Radio Shack sells a tape care kit, Cat. No. 44-217, which includes cotton swabs, a head cleaner, and a head lubricant. Both of these lubricants appear to be a silicone in an alcohol base. As described previously, these products proved to have very limited benefits, as the tape quickly carried off the lubricant. Some people have had successful results at lubricating tape when they applied Radio Shack's head lubricant directly to the oxide surface of the tape

You can sometimes reduce squeal by resetting your deck's holdback tension or putting the tape on reels with bigger hubs.

with a cotton swab while fast-spooling [11]. I suggest the following for more uniform application: Start from one end of the reel, applying half of the intended volume of lubricant, and then follow up by applying the remainder from the other end of the reel. Be careful not to get lubricant all over tape drive surfaces like the rubber pinch roller and capstan, which would severely limit their ability to regulate tape speed.

Another product is Last Factory System Formula #9 Interlast Tape Head Treatment. The manufacturer claims that it is not a lubricant in the traditional sense, and that it does not introduce a film between head and tape. (Such a lubricant film might reduce high-frequency performance by introducing too large a gap, and also might contaminate the tape with potentially detrimental products.) The manufacturer's explanation of how the product reduces the "surface energy" of the head face is not fully comprehensible to me. My experience with the product is that it can reduce the squeal considerably. Often, it will work for the playing of an entire reel. With more seriously deteriorated tapes, it may provide only short-term squeal-free operation—usually, but not always, enough to get a safety copy.

Another curious product I found is not advertised as a tape lubricant, but its application is similar to other products I have described. Last Factory Formula #10 Tape Preservative comes with its own applicator and marker labels to indicate treated tapes. The applicator is a large plastic foam swab. Application is made by pouring a quantity of preservative into the applicator and fast-spooling the tape with the applicator in contact. I do doubt the uniformity of application via this method, but there are few alternatives. Last claims that this product can slow the process of hydrolysis and thus multiply the life of tape three to seven times [14]. However, I have not noticed from one application any reduction in squeal with tapes that have already degraded. If you've dried out some tapes, it has been suggested that with time they'll be more likely to exhibit the problem than new, or properly stored, tapes. It might be a very good idea to initially dry out a tape by one of the methods I have suggested, then apply Formula #10. A dried-out tape may better absorb the beneficial compounds, resulting in a more permanent restoration. The effectiveness of this process awaits long-term conclusive evidence. As the product is most likely to apply to recording tape as described, this process may alternately serve as a simple home method of cleaning tape of some of the gummy material and loose oxide produced by hydrolysis.

Going on the assumption that the sticky products of deterioration collect on the playing surface of the tape, I attempted to clean tapes that had recently shown a tendency to squeal. I cleaned samples of the tape with several fast-spooling passes, using a cleaning/lubricating cloth and also by pinching the tape lightly with a cloth dampened with Last Formula #10 and with straight Freon TF. In all cases, the tendency to squeal was reduced. However, I do not know the long-term effects of cleaning with such Freon-based solutions as Last or Radio Shack head cleaner, since such cleaning (as opposed to other methods such as baking) definitely removes some constituent of the binder.

## Conclusions

I offer these specific recommendations that may help prevent premature deterioration of your tape collection. In temperate climates, store tapes in basements only as a last resort. If tape must be stored in a basement, use a dehumidifier, and ensure against ground water being in contact with the floor. Also, never store tape in non-temperature-controlled garages. In summer, use air conditioning, at least where the tape is stored. Never use a tape that exhibits even a slight, one-time squeak. And finally, consider using older, higher noise tape formulations, which are more abrasive.

The following techniques may prove helpful in improving playback of degraded tapes for dubbing: Demagnetize and clean heads frequently, clean the tape, reduce tape tension, use tape head/guide lubricants, dehumidify/bake tapes, remove unused heads and guides, and make sure guides do not resonate at a squeal frequency.

The techniques described in this article were largely developed while under pressure to maintain recording production. These methods are doubtlessly not the only ones available for dealing with deteriorated tape. Since tape recording as we know it is only about 40 years old, and the specific problems described here are far more recent, we are still in the preliminary stages of identifying the problems and the anecdotal and experimental stages of dealing with them. These techniques, however, have been used by knowledgeable people who required definite results. **A**

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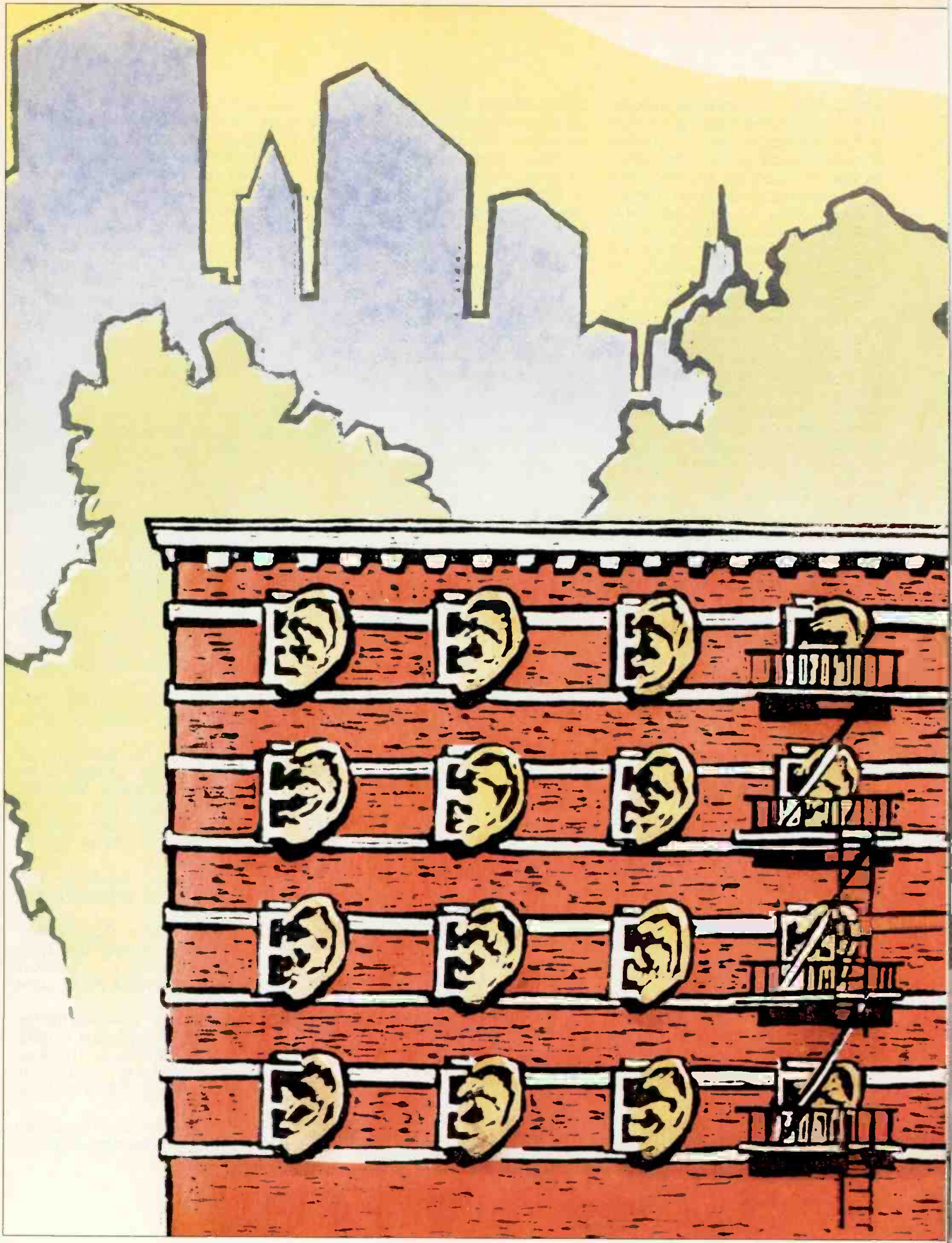

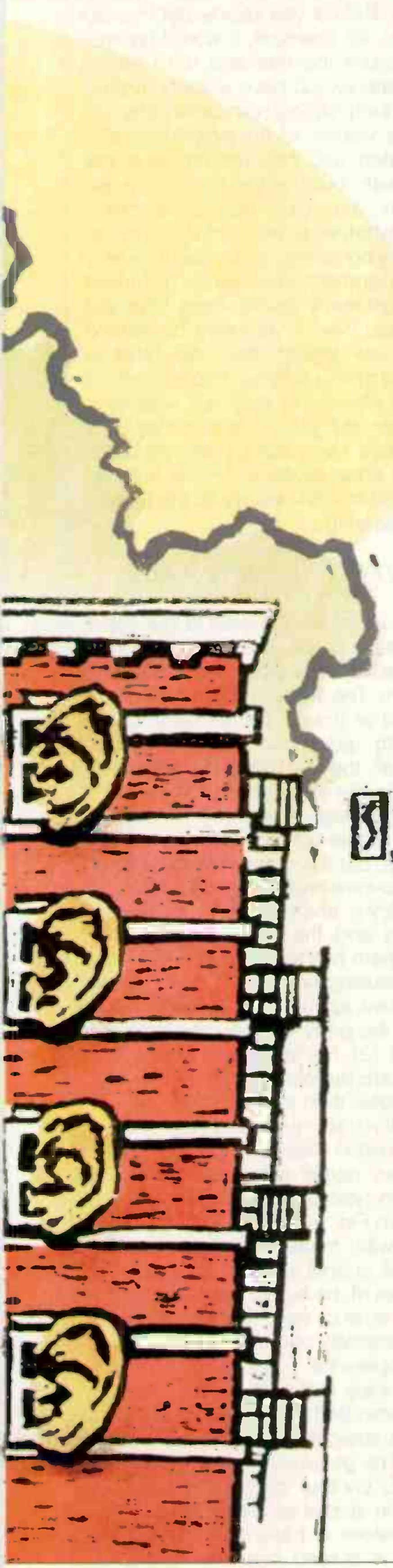

# MUFFLING THE NEIGHBORS

## TEN TIPS TO REDUCE NOISE

F. ALTON EVEREST

Living in an apartment or condominium means living close to neighbors. Though we may not even know their names, those living next door often inject themselves into our lives. Their daily noises aggravate us like the smell of their stir-fry seeping into the hallways. Exasperating as such things are, when my low Brahms passages are profaned by a cacophony of drum sounds from the loudspeaker in the next apartment, I become a raging hawk in the party-wall battle.

Consternation leads to disgust as one realizes how this whole problem could so easily have been solved as the apartment building was erected. It is all too easy to point a finger at the architect. He or she may merely have conformed to inadequate local building codes. Another possibility is that poor workmanship ruined a good design. But the increased cost of an effective wall is extremely small, so the cost argument evaporates.

What is initially important is a good design followed by adequate supervision to assure that the design is implemented to the most minute detail. Ignorance and distorted ideas of economy are the basic reasons for the poor sound insulation prevalent in so many apartments and condominiums today. As we dig into the problem, we shall see that corrective procedures are both messy and costly.

What follows will provide an orderly introduction to the subject of sound leakage from one apartment to the next. This is not a "do these ten things and the problem is solved" approach. Rather, it is a logical consideration of the factors involved. Once these factors are understood, the solutions to specific sound intrusion problems become evident.

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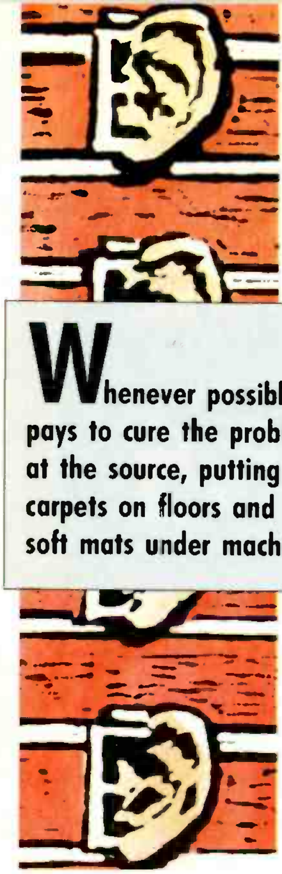


**Whenever possible, it pays to cure the problem at the source, putting carpets on floors and soft mats under machinery.**

### GO TO THE SOURCE

In any noise-reduction problem, the acoustics consultant always asks what can be done at the source. The bothersome heel taps upstairs may be cured by a carpet. The noise of a business machine may be reduced to acceptable levels simply by putting an inch-thick felt pad under it. Why tear up the place if such a simple approach will solve the problem?

If the neighbor's stereo is too loud in your apartment, it is possible that the neighbor would be cooperative enough to lower the volume to an acceptable level. But this is not acoustics, it's "psycho"-acoustics. It presupposes a kid-gloves approach and a cooperative neighbor, but it is worth considering because it is the fastest and the cheapest solution. It is also a two-way street: You may be asked to lower the volume of your own stereo.

Establishing a friendly relationship with your neighbor is not only the human thing to do, but it may also increase the neighbor's tolerance of you if you must do a lot of hammering as an alternate solution.

### IT'S A THREE-PART PROBLEM

The annoyance a neighbor's noise creates in your apartment depends on three things—the level of the neighbor's sound in his apartment, the transmission loss of the party wall, and the background noise in your own apartment. The overall annoyance, of course, is a combination of all three effects. Before you tackle beefing up the wall, for example, it would be well to consider the first and third items. Undoubtedly you have already formed some pretty strong opinions on the excessive volume of the neighbor's stereo system and the deficiencies of the party wall, but the background noise level in your own apartment determines whether a given intruding noise is annoying or not. If you live in a very quiet apartment, you may be disturbed by almost every sound, even if the wall is a good one. If your own household noises are louder, they will tend to mask intruding noises. If your stereo is played often, you may not hear your neighbor, but your neighbor may hear you. Table I lists some common background-noise levels in "noise criteria" (NC) and in dBA relative to the threshold of hearing.

### ESTIMATING PARTY-WALL EFFECTIVENESS

Only when we are able to put some numbers to it are we in any position to move on to a solution of the party-wall problem. The industry has adopted the concept of Sound Transmission Class (STC) to reduce to a single-number rating all the complicated factors involved in the attenuation of sound as it passes through a wall [1]. Of course, such a single number rating is a compromise, but it is convenient, practical, and accurate enough for our purposes.

Bradley's study of 100 apartment dwellers and the 50 party walls between them has shown that the annoyance resulting from music and speech in the next apartment is related to the STC of the party wall, as can be seen in Fig. 1 [2]. His study also shows that people are far more sensitive to neighbors' music than to their speech.

To illustrate just how the Sound Transmission Class of a partition is determined, actual measurements on a common type of wall construction are shown in Fig. 2. The transmission loss of the wall, measured at third-octave intervals, is poor at low frequencies but improves at the higher frequencies in a rather erratic way. Fortunatley, the poor sensitivity of the human ear tends to compensate for low transmission loss of walls at the low frequencies.

The standard STC contour, made up of three straight lines, is also shown in Fig. 2. The general procedure is to plot the STC contour on tracing paper to the same scales as the graph of measured values of transmission loss. The tracing is placed over the measured

*TABLE I*—Common background-noise levels for typical spaces, measured with all heating, ventilating, and air-conditioning equipment running [2].

| Space | Noise Criterion Contour Range, NC | A-Weighted Sound Level, dB |
|---|---|---|
| Private urban residence | 25 to 35 | 36 to 45 |
| Private rural residence | 20 to 30 | 32 to 40 |
| Hotel room | 30 to 40 | 40 to 49 |
| Hospital, private room | 25 to 35 | 36 to 45 |
| Hospital, lobby and corridors | 35 to 45 | 45 to 53 |
| Office, executive | 30 to 40 | 40 to 49 |
| Offices, open | 35 to 45 | 45 to 53 |
| Restaurant | 35 to 45 | 45 to 53 |
| Church sanctuary | 20 to 30 | 32 to 40 |
| Concert hall, opera house | 15 to 25 | 27 to 36 |
| Recording studio | 15 to 25 | 27 to 36 |

*TABLE II*—Criteria for roughly estimating sound transmission class of a party wall [4].

| Privacy Afforded | STC Rating |
|---|---|
| Normal speech easily understood | 25 |
| Normal speech audible but not intelligible | 30 |
| Loud speech audible and fairly understandable | 35 |
| Loud speech audible but not intelligible | 40 |
| Loud speech barely audible | 45 |
| Shouting barely audible | 50 |
| Shouting not audible | 55 |

graph with the frequency scales coinciding. Neglecting all measured points above it, the STC contour is moved up and down until the measured points below the STC curve reach a certain standard limit. (This is defined in [1]. If you are interested in the process, see [3] for a step-by-step determination of STC.) The single-number STC rating for this particular measured transmission loss graph is read off at 500 Hz. The partition of Fig. 2 is then said to be in the Sound Transmission Class of STC-44. This shorthand method of classifying complicated transmission loss curves is now used throughout the building trades. As a very rough indicaton, you may think of a partition rated at STC-44 as giving approximately 44 dB of transmission loss at 500 Hz. In this particular case, the measured transmission loss at 500 Hz is actually 46 dB. The transmission loss of partitions will generally be less than the STC single-figure rating below 500 Hz and greater above 500 Hz.

Right now we are interested in one partition only, and that is the party wall between you and your neighbor. What STC rating does it have? We could drag in a pink-noise generator, powerful amplifier, loudspeaker, and sound-level meter and measure it at ⅓-octave points and make correction for the absorption in the receiving room, but that is a bit beyond our present purpose. To get a *very rough* indication of that wall's performance, send someone into the room the noise is coming from and have them speak at various levels. Then compare what you hear with the ratings in Table II. If your neighbor cooperates, you should be able to estimate the STC of your party wall. Remember that number while we consider other factors involved in sound transmission through walls.

## RELATING STC TO NOISE LEVELS

Let us assume that, on the neighbor's side of the party wall, the "noise" is a musical selection with the spectrum shown in Fig. 3. The sound level computed from this spectrum is 78 dBA, which is a rather low level. The energy falls off at low and high frequencies in a way that is characteristic of normal sounds.

To describe the background noise in your own apartment, we can use the NC concept. Like STC, noise criterion is a method of expressing a noise spectrum in a single NC number. Note that both the STC and the NC single numbers are approximate representations of spectra, taking advantage of the fact that background noise spectra tend to have similar shapes, as do transmission loss curves.

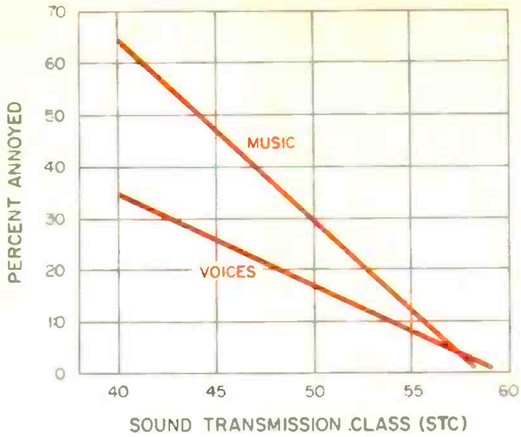



*Fig. 1—Relative annoyance values of music and speech for various party-wall sound transmission classes, based on a survey of 100 apartments by Bradley [2].*

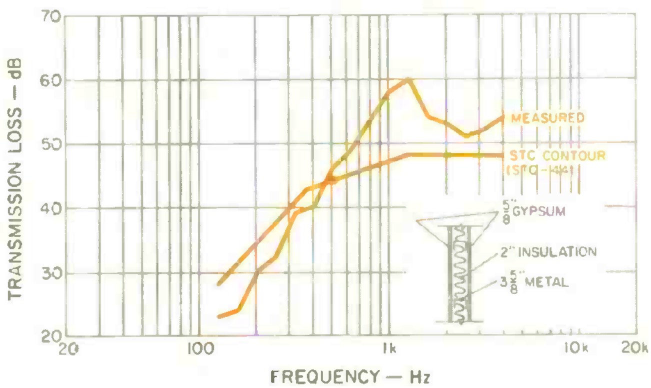



*Fig. 2—Spectrum of noise transmission loss and sound transmission class (STC 44) of a common type of wall construction (Kodaris Acoustical Laboratories).*

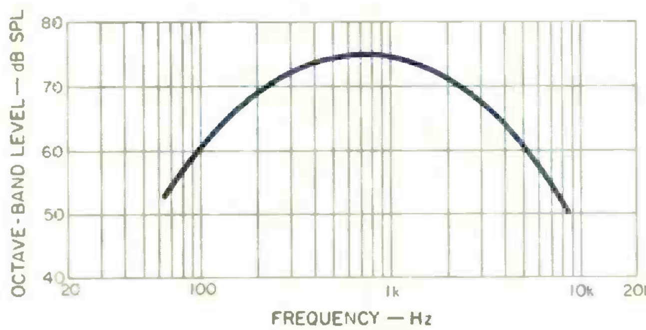



*Fig. 3—Assumed spectrum of annoying music in adjacent apartment. The level calculated from this spectrum is 78 dBA.*

*TABLE III*—Party-wall attenuation requirements to meet various noise goals for the example given in Fig. 5.

| Noise Goal In Listener's Apartment | Party Wall Required |
|---|---|
| NC-15 | STC-53 |
| NC-20 | STC-48 |
| NC-25 | STC-44 |
| NC-30 | STC-40 |

A family of NC curves is shown in Fig. 4. The general shape of these curves takes into consideration not only the general spectrum shape, but also the human ear's lesser sensitivity to low-frequency sounds. Table I lists ranges of NC numbers applied to background noise in numerous real-life situations. The NC-15 curve would be a quite stringent background-noise goal for a professional recording studio. The NC-25 curve would represent about the highest background noise allowable in a public auditorium; the air-conditioning contractor might have to go to some pains to meet such a specification. As for your apartment, considering both household noises and the intrusion of environmental noise from the outside, NC-30 might be a reasonable point of departure.

The neighbor's spectrum from Fig. 3 has been added to Fig. 4 at its actual level. The neighbor's "noise" spectrum, as measured in the apartment next door, is 44 dB above the NC-30 contour at 1 kHz. Therefore, the party wall must attenuate the noise by 44 dB to reduce the 75-dB octave-band level at 1 kHz on the neighbor's side to the desired NC-30 contour in your apartment. Measuring the difference between the spectrum of the neighbor's "noise" and the NC-30 contour of Fig. 4 at other frequencies defines the minimum transmission loss required of the party wall. This has been done in Fig. 5, not only for the NC-30 contour but for three lower NC contours as well. The curve labelled NC-30 in Fig. 5 defines the attenuation required of the party wall between the two apartments.

The dashed STC contour, which is fitted to the NC-30 attenuation-required curve according to standard rules, reads 40 dB at 500 Hz, or STC-40. An STC-40 wall, which is easily achieved, is all that would be required to attenuate the 78 dBA music in the neighbor's apartment to the NC-30 contour in your own apartment. Louder music would require a heavier wall.

A lower NC in your apartment would also require a heavier wall, even for this relatively quiet music. Party-wall attenuation requirements for NC-25, NC-20, and NC-15 are also shown in Fig. 5. Fitting the STC line to each of these yields the STC wall ratings shown in Table III. And this is for a relatively quiet "noise" on the neighbor's side (78 dBA for music) We must avoid the temptation to add ten STC points if a neighbor's music level is 10 dB higher. It is necessary to go through all these steps to take into proper consideration the spectral distribution of energy in the neighbor's music and the background noise in our apartment, as well as the variation of wall transmission loss with frequency.

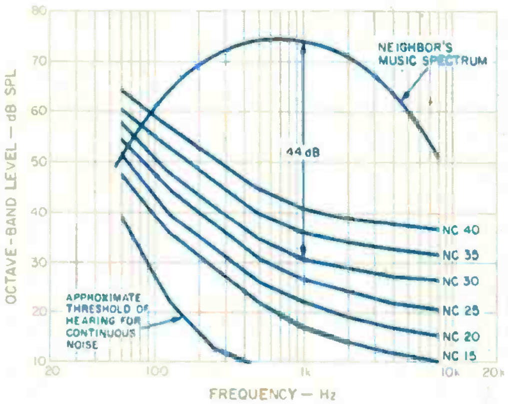



*Fig. 4—Family of noise criteria (NC) contours commonly used to specify background noise level in sound-sensitive spaces, plotted against music spectrum of Fig. 3. To achieve an NC-30 contour in the listener's apartment under these conditions, the party wall must provide 44 dB of transmission loss at 1 kHz. The difference between the NC-30 contour and the noise spectrum at each frequency determines the minimum performance of the party wall required to reach NC-30.*

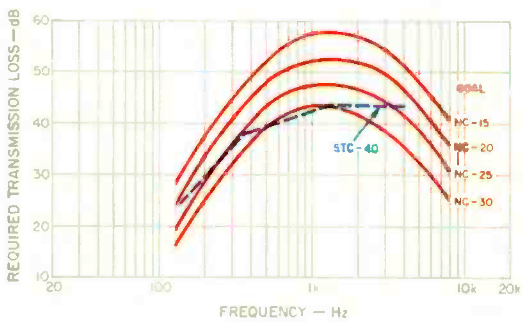



*Fig. 5—Minimum transmission loss required of a party wall to reach various noise criteria with the noise source of Fig. 3. In this case, a wall with a sound transmission class of 40 is required to achieve NC-30.*

## SOUND PATHS

By this time, as a result of our yelling, we have formed some idea of the STC of the existing party wall (Table II). In addition to that we now have a better feel for the relationship between wall STC and noise levels on both sides of the wall (Figs. 1 to 5). Now we will consider the myriad ways sound travels from one apartment to the other.

Sound travelling through air seems quite natural, but sound travels through solid structures as well. Solid paths between our apartment and neighboring spaces are illustrated in Fig. 6. The solid arrows labelled D represent sound that travels directly through a wall that is subject to a transmission loss already considered. Walls are commonly made up of wood or metal studs with sheets of drywall (also called plasterboard, gypsum board, or sheetrock) or other materials on each side. The sound in a room causes the drywall panels to vibrate as diaphragms. Some of the energy in the vibrating panel on one side is transmitted to the diaphragm on the other side directly through the studs. Vibrating diaphragm energy also sets the air in the cavity between the two wall faces to vibrating, which, in turn, excites the opposite diaphragm. Both airborne and structure-borne sound are thus involved in this process.

The broken arrows and lines of Fig. 6 represent sound that travels through the structure itself. Such solid-borne sound travelling to adjacent rooms is usually not a direct threat. The problem arises when the solid-borne sound sets large wall diaphragms to vibrating and radiating sound in adjacent rooms with relatively high efficiency.

I will never forget a visit to a newly constructed, multi-million-dollar radio studio. Inside one of the studios a distinct hammering sound was clearly audible. The embarrassed host engineer explained that the hammering was quite far from the studio. They had been sure to insulate the studios from the noise of aircraft on a nearby approach path, but they had not provided for suitable isolation from structure-borne noise within the building. Structure-borne sound is a reality, coupling our listening space to distant events such as heel taps, plumbing pipe noises, and elevator sounds, as well as the neighbor's stereo. The level of such sounds is often lower than the sound that comes through the party wall.

Figure 6 is a plan view. The elevation view of Fig. 7 suggests other flanking paths that may involve both airborne and structure-borne paths. Sound can readily travel from one apartment to another through an "attic" space above the ceiling or crawlspace beneath the floor. Solid barriers at positions A and B of Fig. 7 are required to minimize the effect of such unwanted paths.

Sound can travel from one apartment to another through heating ducts acting like speaking tubes. This can be reduced by increasing the length of ducting between apartments, using ducts with absorbent linings, increasing the number of bends, or installing noise-reducing plenums.

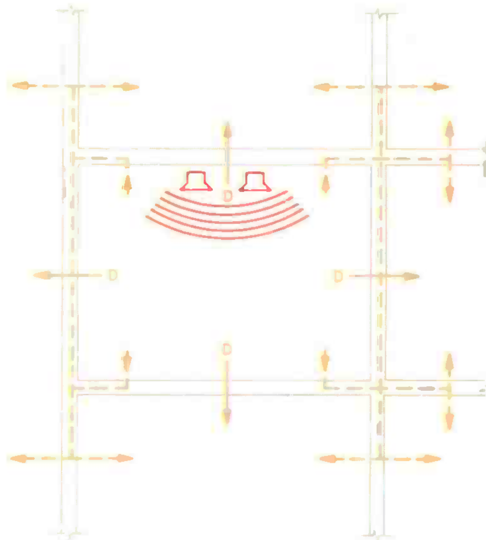


*Fig. 6—Plan view showing direct sound-transmission paths (solid arrows) and flanking paths (dashed arrows).*

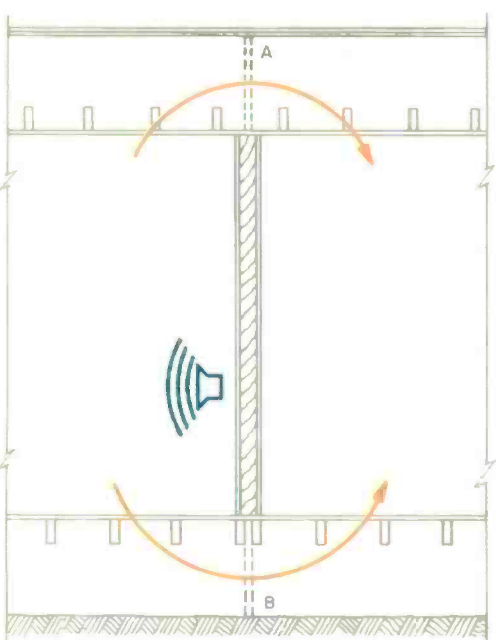
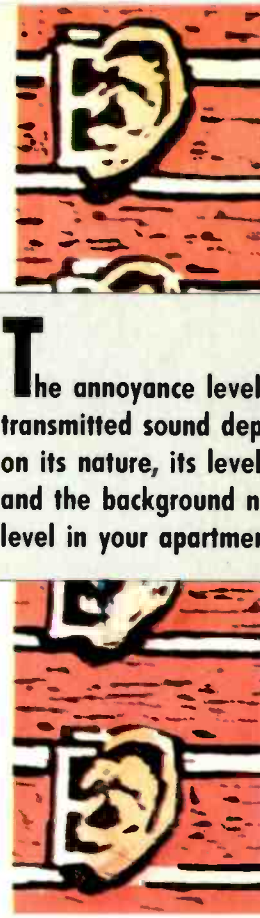



*Fig. 7—Sound transmission between rooms or apartments by flanking paths above the ceiling or beneath the floor. Solid barriers at points A and B are required to block such paths.*



**The annoyance level of transmitted sound depends on its nature, its level, and the background noise level in your apartment.**

## *SOUND LEAKAGE*

The tiniest hole or crack can ruin the insulating effect of an otherwise good party wall. Cracks at the floorline are notorious in this regard. The 2 x 4-inch plate or steel runner that rests on the structural floor invariably makes poor contact due to the floor's rough texture.

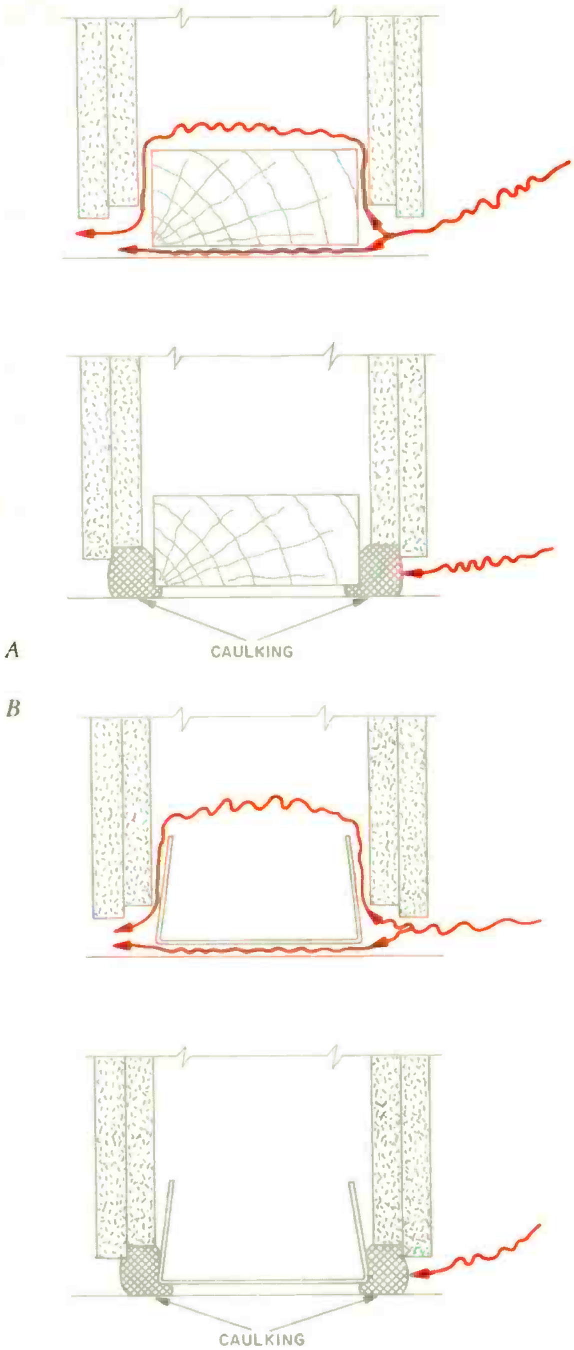



*Fig. 8—Plan view showing common leakage paths through party walls using wood studs (A) and steel studs (B). Caulking with non-hardening sealant stops such leaks.*

In new construction, an excellent acoustical precaution would be to set this plate or runner in non-hardening acoustical sealant. Using ordinary mastic is not an answer because, when it hardens, it tends to pull away from the surfaces it should seal.

Figure 8A illustrates the problem with walls resting on 2 x 4-inch wood plates. Sound may leak between the drywall and the plate as well as under the plate. A generous, running bead of acoustical sealant on both sides of the wall, as shown, will eliminate this source of leakage sound. A similar situation exists for steel runner track for steel-stud construction, as shown in Fig. 8B. Rolling the carpet back and introducing beads of sealant on each side of a party wall will take care of sound leaking under it. Similar possibilities of leakage exist around the rest of the periphery of the walls. Beads of acoustical sealant along the vertical joints as well as at the ceiling will help to assure tightness.

Electrical service boxes in the party wall should receive a critical inspection. An especially weak condition would result if such boxes were back to back. Look for crevices and holes in the boxes, which should be daubed with sealant. Conduits running between the two wall faces can be neutralized by ramming glass fiber tightly into each conduit between the wires. In eliminating sound leakage, the wall must be treated as though you were making the room airtight.

## *USE THOSE GOLDEN EARS*

Audiophiles reading this are uniquely equipped to perform the next test. After all, anyone who can detect the difference between 0.01% and 0.02% distortion and between $2 and $100 loudspeaker cables should be ideally suited to finding leaks in a party wall.

Seriously, an acute and trained human ear can tell a lot about how sound travels from the neighbor's apartment to your own. By careful listening, you may be able to tell whether the sound comes through the walls (the normal first assumption) or whether some flanking paths are involved. Check for sound leaks around the periphery of the wall and around electrical, television, and telephone service outlets. If flanking paths seem to be major contributors to the intruding sound from the next apartment, it may be an exercise in futility to strengthen the party wall. It may be wiser to go after the flanking paths.

## *IMPROVING THE PARTY WALL*

You must consider wall constructions and their relationship to sound insulation. This is not only good information for solving existing noise intrusion problems but is also basic for new construction. Remember that the STC values to be considered are based on laboratory measurements. Great effort has been expended toward conforming measurements made at different laboratories or measurements made in the same laboratory at different times. There may be internal inconsistencies of an STC point or two that should not be allowed to overshadow the fundamental principles being considered.

Figure 9 shows eight different wall constructions based on 2 x 4-inch wood studs spaced 16 inches on centers, each with its STC rating. Note that 2½-inch glass fiberfill is specified for each of the eight. Construction A is all too commonly encountered in party walls—2 x 4-inch studs with a single layer of drywall, usually ½ inch, on each side. The rating is only STC-36, weak enough to result in real tenant annoyance if used between apartments. Adding other layers of drywall to this ubiquitous but deficient party wall will yield only minor increases in STC rating.

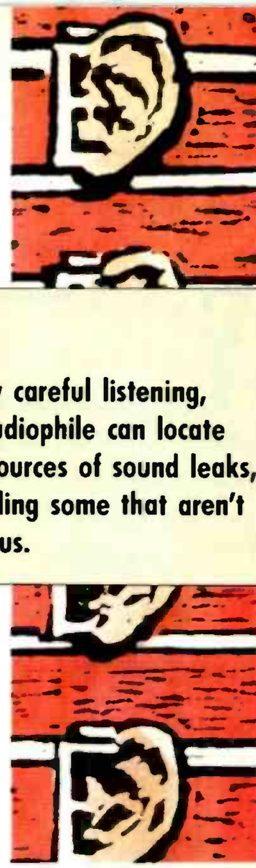
An entirely new principle is used in the construction shown in Fig. 9B. This is the staggered-stud method of avoiding direct connection between the facing on one side and that on the other side. With only a single layer of drywall on each side, we see a significant jump from STC-36 to STC-49, an increase of 13 points attributable solely to isolating one face of the wall from the other. In Fig. 9C we note that adding a second layer of drywall on one side of the staggered-stud construction adds only four points, to bring it to STC-53. More mass has been added, but there has been no change of design principle such as occurred between Figs. 9A and 9B. The construction of Fig. 9D, with double drywall on both sides of the staggered-stud wall, increases the rating only another three points, to STC-56. We conclude that doubling the mass on one side adds only three or four points.

While the construction of Fig. 9E goes back to the straight 2 x 4-inch stud wall, it still isolates one wall facing from the other. But rather than using staggered studs, it uses Z-shaped resilient channels to mount the double drywall facing on one side. This results in the same STC-56 rating as the staggered-stud construction of Fig. 9D.

Figure 9F shows a double-wall construction, with two separate rows of studs on separate plates, spaced an inch or two apart. This complete separation of the two wall surfaces achieves an STC rating of 56 with only a single drywall surface on each side. In Figs. 9G and 9H, we find, once again, an increase of four points by doubling the drywall on one side and three more points by adding double drywall on the other side. Figs. 9B, 9C, and 9D constitute a staggered-stud family, Figs. 9F, 9G, and 9H a double-wall family. In either case, doubling the drywall layers on one side adds four STC points, and doubling the drywall layers on the other side adds only another three points.

The wall constructions of Fig. 9 run the gamut from STC-36 to STC-63—from deficient to excellent when used as party walls in apartments and evaluated on the basis of annoyance as in Fig. 1.

Figure 10 shows six wall constructions based on 3⅝-inch steel studs spaced 24 inches on centers. It is fortunate that steel studs are widely used



**By careful listening, an audiophile can locate the sources of sound leaks, including some that aren't obvious.**

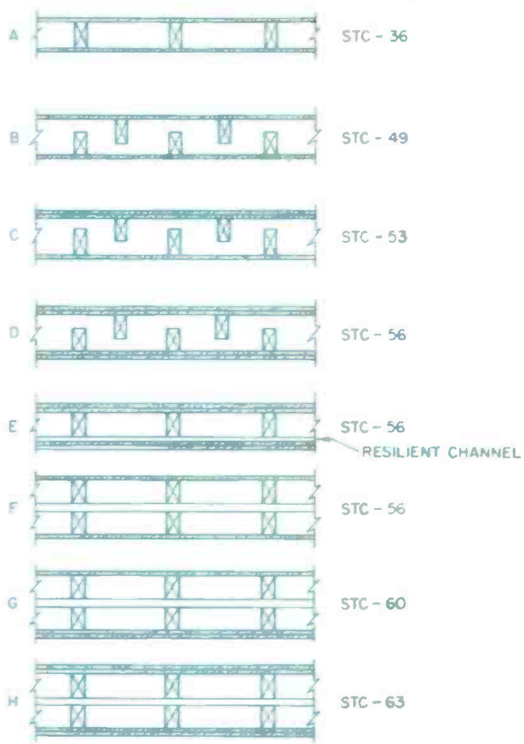
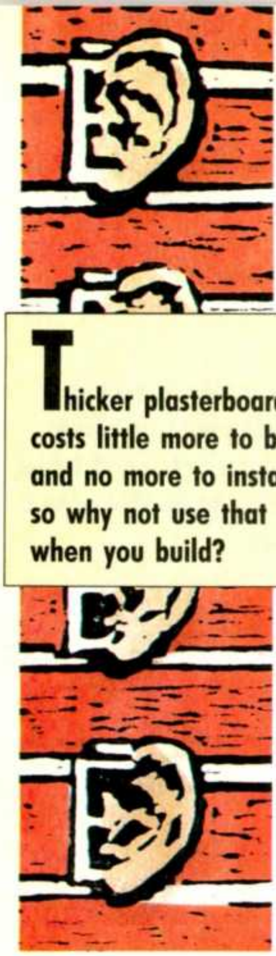



*Fig. 9—Typical walls using 2 x 4-inch wood studs spaced on 16-inch centers, and the STC ratings for each. Note the great improvement in STC when the two faces of the wall are decoupled from each other by the staggering of studs (B, C, and D), the insertion of resilient channels (E), or double-wall construction (F, G, and H); [6]. All cases include 2½-inch insulation (not shown) between studs.*



**Thicker plasterboard costs little more to buy and no more to install, so why not use that when you build?**

in new construction today because the stud itself introduces a modest degree of resiliency lacking in the wood 2 x 4.

In Fig. 10A, the STC rating is increased eight points by the addition of 2½ inches of thermal insulation as fill. This is greater than the three- to five-point improvement normally found when such insulation is added to wood-stud construction. This glass fiber serves to reduce the coupling between wall faces by discouraging the resonance of the air in the cavity.

Figure 10B tells us something about how much insulation fill should be used. The STC-47 is reduced to STC-45 by jamming 4 inches of glass fiber into the 3⅝-inch space. It is not wise to place too much value on the two-point difference, but it suggests that nothing is to be gained by adding more than the usual 2½ inches of insulation into the cavity. It is possible that compressing the 4 inches of insulation introduces a slight direct coupling between the two faces of the wall, which accounts for the reduction of two STC points.

With various numbers of layers of drywall in the constructions of Figs. 10C through 10F, the ratings vary only between STC-49 and STC-51. This may or may not be sufficient for a party wall. If not, staggered-stud or double-wall techniques, or resilient Z-channels, may be called into play.

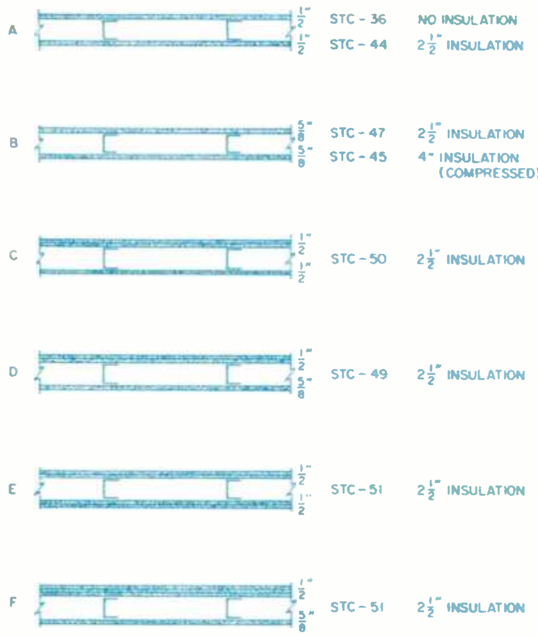



*Fig. 10—Typical walls using steel studs on 24-inch centers, and STC ratings for each. The resilience of steel studs tends to decouple the two faces of the wall; [6].*

If investigation suggests the need to strengthen the party wall between you and the offending stereo noise in the next apartment, how does one go about it? In Fig. 11, three approaches are shown. If only a modest increase in party-wall transmission loss is needed, the wall supplement shown in Fig. 11A may be sufficient. In this case, two layers of drywall are added, but they are added resiliently by the use of Z-channels. It would hardly be worthwhile adding the drywall directly to the existing wall, as this would add only three or four points to the existing STC. The air space provided by the Z-channels, while small, improves the low-frequency absorption and should be filled with some thermal-type glass-fiber insulation.

A higher STC rating can be achieved with essentially the same labor and little additional materials by using the plan of Fig. 11B. Mounting the Z-channels on 2 x 2-inch wood furring strips increases the air space and thus the wall's transmission loss. The party-wall supplement of Fig. 11A is not recommended (it has been included only as an instructional first step); that of Fig. 11B has superior performance at essentially the same cost.

If the loss of space can be justified, the party-wall supplement shown in Fig. 11C should solve any problem attributable to sound transmission directly through the party wall. This construction makes the party wall a double wall and should yield an STC of 60 or thereabouts. Table I would tell us that shouting in the other room should not be audible in a room with such an improved party wall. Flanking paths, however, could very well become significant with such a wall supplement.

## *IMPROVING THE FLOOR/CEILING BOUNDARY*

The tacit assumption, to this time, has been that only the walls are suspect if the neighbor's stereo bothers you. This assumption may not be valid. You may annoy the tenants below or above you, or they may annoy you. The same principles we have considered for walls apply to floors and ceilings except that structure-borne sound may be more dominant.

The three constructions of Fig. 12 are arranged in order of progressively greater transmission loss. In Fig. 12A, it is assumed that there is no control over what happens above, that all changes must be made from below. A double layer of gypsum board is fitted between the joists and cemented to the subflooring. This increases the mass of the floor diaphragm. A 6-inch layer of thermal glass fiber is then introduced in the space between the joists. A second gypsum-board ceiling layer should then be supported by resilient Z-channels.

Figure 12B is the same as 12A on the lower portion, but changes have been made in the flooring. A 1½-inch layer of lightweight concrete is poured on a subfloor of two layers of plywood. The mass of the concrete makes a significant contribution to the the transmission loss.

There is much interest in "floating floors." The concrete of Fig. 12B could have been poured on top of a proprietary glass-fiber layer, but the cost would have been much higher. Another possibility is to pour the concrete on a soft-fiber soundboard over which a plastic sheet has been laid.

In Fig. 12C, a less expensive (and somewhat less effective) floating floor is illustrated. A framework of wooden strapping rests resiliently on a layer of glass fiber. A double layer of gypsum board rests on the strapping and is topped by the finish flooring. It is imperative that no solid part of the floating structure makes contact with the existing floor or walls. An edging of denser glass fiber is one way of assuring this. Non-hardening sealant traps the air beneath the flooring so this air's springiness will be retained.

The density of the glass fiber on which the strapping of Fig. 12C rests is important. If it is too flimsy, the strapping will make solid contact with the existing floor. On the other hand, if too dense and hard, there will be little resilience and, again, a virtual solid contact will result. It is easy to build a floating floor but not so easy to design one that will perform properly. Floating floors require proper design to assure proper performance.

STC ratings are not normally applied to floor/ceiling structures. Instead, Impact Insulation Class IIC applies. This involves a standardized floor tapper as a sound source. However, the IIC ratings are not available.

### *PRACTICAL HINTS*

Make sure you understand the importance of mass in building a barrier with high transmission loss. For example, if anyone suggests cementing a layer of carpet, acoustical tile, or other lightweight material on your party wall as a sound barrier, forget it. These techniques may be good for absorbing sound reflections, but, because of their low mass, they have little effect on stopping sound transmission.

The insulation in the wall cavity is not put there to stop sound. It is there to

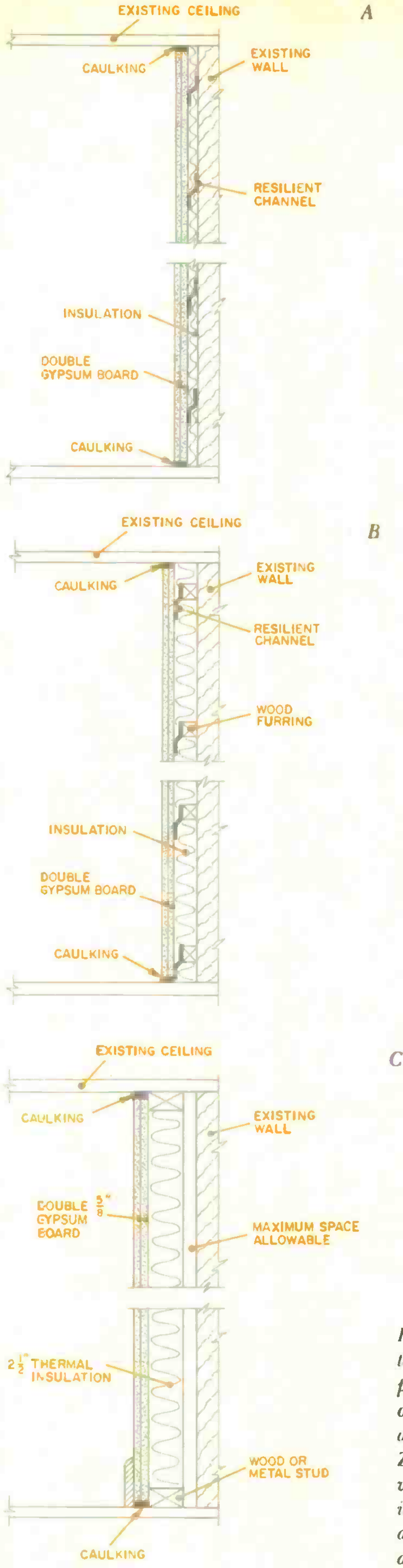
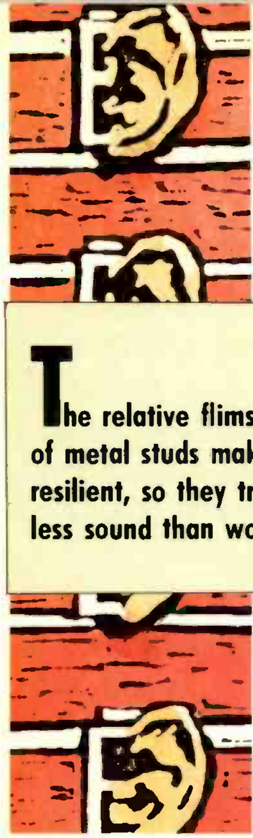



*Fig. 11—Three approaches to strengthening an existing party wall, in ascending order of effectiveness: Double drywall mounted on resilient Z-channels (A); the same, with wood furring to increase the air gap (B); and double wall for even greater air space and decoupling (C).*



**The relative flimsiness of metal studs makes them resilient, so they transmit less sound than wood studs.**

reduce the cavity resonance, which tends to couple the two faces and thus lower the transmission loss.

Drywall is a relatively inexpensive material with significant mass, and its use helps achieve high transmission loss and high STC ratings. Half-inch-thick drywall is widely used in construction. When mass is needed, why not use ⅝-inch or even thicker drywall? The cost increase is modest, and the labor costs will be essentially the same.

As important as mass is in stopping sound, staggered-stud or double-stud walls far outperform mass alone.

The greater the air space between two wall surfaces, the greater the transmission loss of the wall, especially at low frequencies—and all walls need help in the low-frequency region.

Metal studs are better than wood studs in walls in which transmission loss is important. Metal studs are made of relatively flimsy steel, so they act as a sort of resilient channels. Therefore, less sound is transmitted from one wall face to the other.

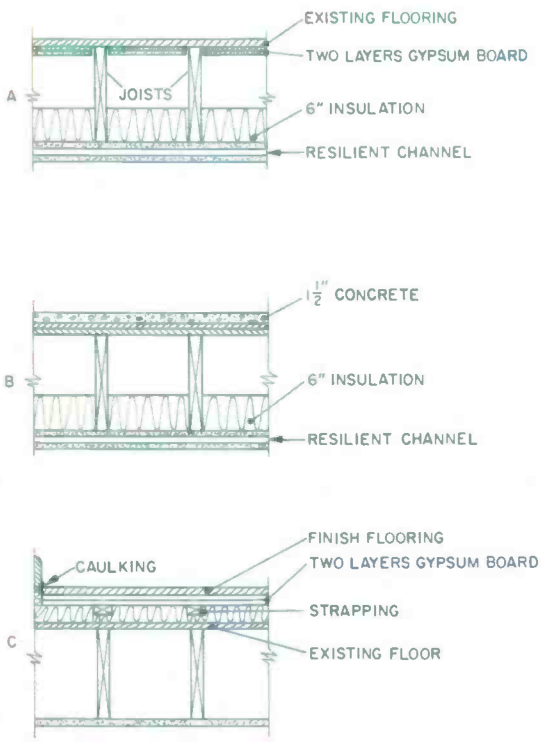



*Fig. 12—Three approaches to strengthening the floor/ceiling or ceiling/floor boundaries of a room, requiring access to the ceiling alone (A), both floor and ceiling (B), and floor alone (C).*

Be sure to investigate potential flanking paths around a party wall. If they tend to dominate, there is little to be gained by strengthening the wall itself.

Be alert to the possibility of flanking paths through the windows of your and your neighbor's apartments, or by way of doors (or the cracks around their edges) and hallways.

If a neighbor's loudspeaker is resting on the bare floor or is otherwise in direct contact with the structure, flanking sound via the structure will be increased. Placing loudspeakers on a carpet, rug, or other resilient material will help.

While lightweight sound-absorptive materials will not block sound transmission (due to their low mass), they can still reduce unwanted sound levels slightly. By doubling the sound absorbents in your apartment, the level of all sound in your room will be reduced by 3 dB (which isn't much). If you then raise your stereo system's gain by 3 dB, a net signal-to-noise improvement of 3 dB (which again isn't much) will result. Of course, your room would probably then be too dead for your musical tastes, unless it was far too live to start with. Increasing room absorption is a very questionable way of reducing the effects of your neighbor's noise. **A**

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- *Stereophile Magazine*

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- *Sound & Vision Magazine*

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# The Mosaic Reissues

# Standards of Excellence

Throughout its eight years, Mosaic Records has been a two-man (Michael Cuscuna and Charlie Lourie) operation based in Stamford, Conn. This label has continually brought to market the most exciting and consummately produced jazz reissues with a widely catholic taste. This is in marked contrast to the hit-or-miss efforts by the major labels like CBS (Sony), RCA (BMG), and MCA (Universal). Some of the early history of the reissue effort is worth noting.

Jazz reissues began during the depression when RCA, which had taken over the Victor Company in the late-'20s, began releasing cut-out masters by Bennie Moten, Jelly Roll Morton, and countless other jazz, blues, and country artists on their new Bluebird label at less than half the price they had sold for originally.

Another group of bankrupt labels including Okeh, Columbia, and Vocalion had been pulled together under the umbrella called the American Record Corporation (ARC), a by-product of Republic Pictures and Consolidated Film Corporation. They used Vocalion to re-re-release the famous Louis Armstrong Okehs.

In 1938, CBS—the radio network—bought out ARC and reintroduced the Columbia label where both John Hammond and George Avakian were soon to produce three- and four-record 78-rpm albums of Armstrong, Ellington, Fletcher Henderson, Bessie Smith, and others. Soon after, Eugene Williams headed a similar project at Decca, which owned much of the old Brunswick and Vocalion labels.

An important figure during those years was Milt Gabler, whose Commodore Record Shop had been a gathering place for jazz fans of that time. He formed the United Hot Clubs of America, which, in 1936, began leasing rare classic jazz masters from the big three and other bankrupt companies. Two years later he formed Commodore Records, the first of the great jazz independent labels.

The introduction of the LP in 1948 opened up new possibilities and Columbia's George Avakian produced some landmark LP reissues including those of Armstrong, Bix Beiderbecke, and Bessie Smith. Later, Decca would pursue similar LP reissues under Milt Gabler, who had moved to the company in 1944.

As a young record collector and jazz critic, it soon became obvious to me that many of the finest and hardest to find recorded performances might never be reissued by the big three. To counter this, bootlegging began in earnest—but that is a story for another day.


Frank Driggs

John Hammond returned to Columbia, after stints at Mercury and Vanguard where he produced some stunning recordings, to head up a newly formed reissue program. He immediately became involved with newer artists including Aretha Franklin and Bob Dylan and really did little to move the reissue program into high gear. Hammond was aware of me through my jazz writings. In the summer of '60, I was the lucky one he sought out to take the reissue project in hand. I did so, and for the next six years Columbia pretty much had the field to itself. We pioneered the concept of three- and four-LP sets complete with lavishly illustrated booklets. These sets featured the major works of Billie Holiday, Duke Ellington, Fletcher Henderson, Robert Johnson (single LPs), and others.

In 1964, RCA began its Vintage series, which were single LP releases, under Brad McCuen and later Mike Lipskin. Around 1967, Decca (later as MCA) once again brought in Milt Gabler for its reissue program.

The only major commitment maintained from the early-'50s through the early-'60s was by Riverside. Orrin Keepnews and Bill Grauer had done some exemplary reissues at Victor's X label in the early '50s before they formed Riverside Records to reissue the '20s Gennett and Paramount recordings they owned.

The reissues business seemed healthy for a time, but the huge success of the Beatles on Capitol Records in the '60s soon brought in new management and new attitudes toward profits, and reissue programs were rarely, if ever, to be the same again.

Columbia (now CBS) soon stopped the boxes. I was out. Chris Albertson did the wonderful two-fers including Bessie Smith, and soon left. Michael Brooks, John Hammond's last protégé, has been handling CBS's efforts in the past years with some degree of success. Blues and country material, including the long-awaited three-LP set by Robert Johnson, will be brought out under Larry Cohn's diligent hands.

MCA's program disappeared and Milt Gabler retired not long after that. RCA's Vintage series folded, was revived for a moment, and RCA did nothing until a new benevolent management came in the mid-'70s enabling me to once again work that company's superb vaults using the long-dormant Bluebird label as a broad-based effort with jazz, blues, country, pop, and R&B issues, all of which came crashingly to a halt a month before Elvis Presley died in 1977. Several management changes later, Orrin Keepnews is now at Bluebird's helm. He also handles MCA's reissue program—probably the first time in history that one person has simultaneously run two competing record companies' reissue programs.

The most satisfying efforts have been done by DRG and Polygram. Hugh Fordin's DRG company has brought out some wonderful packages using the old Swing label of France. Polygram has made intelligent use of the Mercury and Verve vaults and has brought out boxed sets by such artists as Sarah Vaughan and Dinah Washington. Polygram's most impressive effort to date is the massive 21-LP boxed set of the complete works of Harry Lim's Keynote label of the '40s. This was produced in Japan and wisely brought out in the U.S. by them.

There is also the Smithsonian program headed by critic Martin Williams, which has done some good work—as well as some which seems not so good. It has produced a good deal less than one might have expected.

Most of these programs, with the few exceptions already noted, always seemed to have something wrong with them: Incompleteness, lack of information, wrong data, inept editing and programming, occasionally awful mastering and pressings, a lot of terrible artwork, liner notes that ranged from superb to unbelievable, and sometimes headshaking howlers from which even I have not been immune.

Many people, myself included, were probably skeptical when Mosaic announced, as so many had before them, great and wondrous plans to bring forth significant treasures, many long unavailable, to the market in the coming months and years. They have kept their word, delivered the goods, and the goods are the best they could be.

Ranging from single LP compilations like the Port Of Harlem Jazzmen (MR1-108), Benny Morton-Jimmy Hamilton Swingtets (MR1-115), and Pete Johnson/Earl Hines/Teddy Bunn (MR1-119) to the awesome 23-LP Commodore Collections (two of these 23-LP boxes are now on the market with a third to come) simply boggle the mind. Most of their catalog are three- and four-LP boxes (with superbly illustrated booklets with William Claxton and Francis Wolfe's outstanding photography) of everything from boogie-woogie pianists Albert Ammons and Meade Lux Lewis and New Orleans clarinetist George Lewis, through swing artists like Johnny Hodges, Ike Quebec, and John Hardee. Also included are modernists like Art Pepper, Freddie Redd, Budd Powell, Thelonious Monk, (two different boxes, one already sold out), Chet Baker (three different boxes), Herbie Nichols, Shorty Rogers, Art Hodes, Tina Brooks, Paul Desmond with Jim Hall, Buddy DeFranco, and Clifford Brown. Cecil Taylor and Charlie Mingus are here as well. Mosaic's first blues release is a nine-LP and six-CD set by the one and only T-Bone Walker.

We have much more to look forward to. Mosaic will be putting together some prime Count Basie sets from the Roulette catalog, a Nat King Cole Trio package is down the road, and in the near future we can expect Mosaic's first non-limited edition, the release of the Dean Benedetti legendary disc recordings of Charlie Parker.

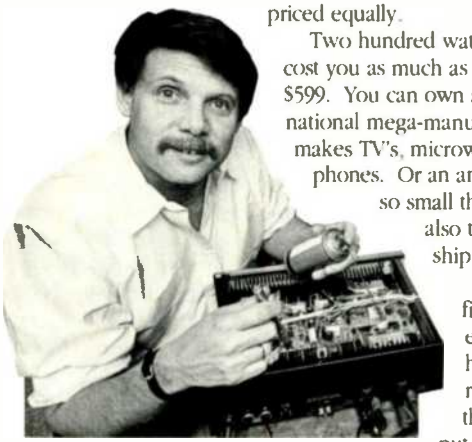
This is all top-grade stuff, the very best that jazz has to offer in every way, presented for the maximum listening (and learning) pleasure. Mosaic's product stands in sharp contrast to almost everything else in the field. Here is a commitment made and a commitment kept, and bodes well for the foreseeable future.

Mosaic Records are only available in limited editions, by mail or phone. Call (203) 327-7111, or write Mosaic Records, 35 Melrose Place, Stamford, Conn. 06902.

# HOW MUCH SHOULD A GOOD AMPLIFIER COST?

*Reflections on the esoteric myths and economic realities of power amplifier design, by Bob Carver.*

Thumb through *Audio's* Annual Equipment Directory and you'll see vivid proof that all power amplifiers are neither created equal nor priced equally.



Two hundred watts per channel can cost you as much as $8,400 or as little as $599. You can own an amp from a multi-national mega-manufacturer who also makes TV's, microwaves and cellular phones. Or an amp from a company so small that the designer is also the assembler and shipping clerk.

Can it be that amplifiers are sonically equal? Some seem to have muscular power reserves far beyond their FTC-rated output. Others sound great until they're challenged by a dynamic passage and then sound like a Buick hitting a row of garbage cans. Some are (to indulge in audiophile jargon) so "fluid" that you practically need a drop cloth under them. Others seem to sound harsh, "metallic" and brittle at any output level.

A casual comparison of perceived sound quality versus price tags may lead to an erroneous conclusion: that an amplifier must be *expensive* to sound good.

The truth is a bit more complicated: Cosmetic glitz aside, an amplifier's cost is primarily determined by its power supply.[1] In other words, within reason, you generally do get what you pay for when you buy a conventional amp design. But the key word here is "conventional."

My decidedly *un*-conventional Magnetic Field Power Supply is capable of outperforming conventional power supplies of the same size. Result: A significantly better power amplifier value for you.

Let me explain.

## NO MAGIC. JUST FOUR CRITICAL QUANTITATIVE FACTORS.

When I fervently state that "*the sound of an amplifier need not be related to its price*," you might think we're veering off into the land of Snake Oil and Gimmicks. Quite the contrary.

I and other members of the scientific audio community know that just four factors determine the sonic characteristics of an amplifier:

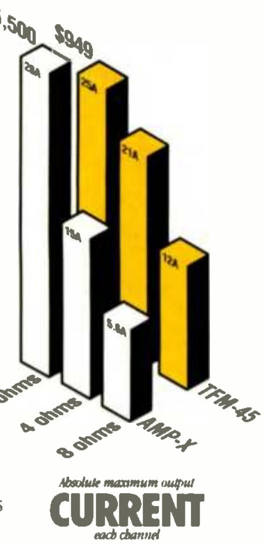
*1. Current output*
*2. Voltage output*
*3. Power output*
*4. Transfer function* ***as evidenced by the interrelationship of frequency response and output impedance.***

These factors transcend the usual trivial debates over tubes vs. solid state, MOS-FETs vs. bi-polar, Class A vs. AB, silver Leitz wiring vs. copper, gold-plated front panels, WonderCaps and my favorite: hand-ground-open transistors filled with a proprietary crystalline substance that stops ringing (honest, I'm not kidding!). An amp can have any combination of these entertaining variables (plus special bricks stacked on top) and yes, sound wonderful...provided it ALSO has high current, voltage and power output and the correct output impedance.

Thus the Four Factors explain why expensive amplifiers generally sound better than cheap amplifiers. But also why that doesn't necessarily have to be the case.

## FACTORS 1-3: THE POWER SUPPLY BEHIND THE SOUND

An amplifier's power supply produces current and voltage. A preponderance of one without the other is meaningless.[2] To maximize SIMULTANEOUS current and voltage output using traditional design approaches costs serious money. For example, we recently tested a competitor's $2,000 amplifier that was rated at 20 watts/channel. Believe me, from a parts and materials standpoint, it was worth $2,000, with most of that money being spent on an amazingly rugged power supply. Another more extreme example is my own ultra-conventional Silver Seven Tube amplifier design. Its "money-is-no-object" power supply helps set the price of a pair of S-7's at around $20,000.00.




Now, since it is universally agreed among amplifier designers that current/voltage/power output directly affects the sound of an amplifier,

# SONY DTC-75ES DAT RECORDER

**Manufacturer's Specifications**

**Sampling Frequencies:** 48, 44.1, and 32 kHz; see text.

**Frequency Response:** Standard, 2 Hz to 22 kHz, ±0.5 dB; long play, 2 Hz to 14.5 kHz, ±0.5 dB.

**S/N:** Standard, more than 93 dB; long play, more than 92 dB.

**Dynamic Range:** Standard, more than 93 dB; long play, more than 92 dB.

**THD At 1 kHz:** Standard, less than 0.004%; long play, less than 0.08%.

**Rated Input Level:** Line in, −4 dBm; coaxial digital input, 0.5 V peak to peak ±20%.

**Rated Output Level:** Line output, −4 dBm; coaxial digital output, 0.5 V peak to peak, ±20%; phone, 0.6 mW into 32 ohms; optical digital output wavelength, 600 nm.

**Maximum Recording Time:** Standard, 120 minutes; long-play mode, 240 minutes.

**Power Requirements:** 120 V a.c., 60 Hz, 32 W.

**Dimensions:** 18½ in. W × 4½ in. H × 13 in. D (47.0 cm × 11.5 cm × 33 cm).


**Weight:** 18 lbs. 5 oz. (8.3 kg).

**Price:** $950.

**Company Address:** Sony Dr., Park Ridge, N.J. 07656.

For literature, circle No. 90

It's been a long time coming, but DAT recorders are finally available in the United States. The first company to introduce DAT through authorized distribution channels in the U.S. was Sony Corporation of America, who, in late June of this year, provided DAT units to dealers handling their high-end "ES" line. A few weeks later, the company introduced a somewhat lower-priced unit to other, mainstream dealers. Having owned home and portable DAT units for nearly two years (obtained during trips to Japan although these models were also available through so-called gray-market dealers in the U.S.), I was particularly interested in how these late-generation recorders from Sony differed from earlier models. The most outstanding difference, of course, was the price. First-generation players, even in Japan, sold for $2,000 or more in early 1987, when they were first introduced. By introducing the DTC-75ES at under $1,000, Sony has taken a major step toward ensuring the success of this new technology.

Another major difference between the earlier and later models is the inclusion of SCMS on the DTC-75ES. This is the so-called compromise that permits direct taping from sources such as CD via the digital channels but limits digital copying from the resulting tapes. It does this by adding a code to any recording made via the deck's digital inputs so that other decks with SCMS will refuse to record the digital bit-stream from those recordings. The exception is if the original source material contained a code that turned the SCMS encoding off. Taping via the analog channels is unrestricted.

A final difference between this and earlier Sony DAT recorders is its ability to record in the long-play mode. By moving the tape at half speed (4.075 mm/S as against the standard 8.15 mm/S), using a lower sampling rate (32 kHz instead of 48 or 44.1 kHz) and using nonlinear 12-bit instead of linear 16-bit encoding, maximum recording time is doubled, to yield up to four hours per tape. The trade-offs for the lower sampling rate and word length are, respectively, poorer frequency response (flat to just under 15 kHz) and slightly poorer signal-to-noise ratio and dynamic range. This slow speed, it seems to me, would be ideal for recording FM programs, where frequency response is also limited to 15 kHz and dynamic range falls far short of that attainable on DAT even in the long-play mode.

Both the D/A and A/D converters use Sony's High Density Linear Converter system, a variation of the much-publicized one-bit conversion method. The HDLC system also uses a 45-bit, noise-shaping digital filter and has a direct digital sync stage to reduce time-base errors known as jitter. Other new technology includes a four-stage feedforward circuit that improves error-correction capability and a new digital servo IC that reduces servo control variations caused by component aging and temperature drift. A four-motor transport results in both quick loading and fast track-to-track access time.

As for user convenience features, the Sony DTC-75ES offers high-speed music search (200 times normal playing speed), music scan, three-way repeat, 10-key direct-access track selection, and 60-track programmability. In addition, various subcode interactive features built into the DAT standard can be utilized, including "Start ID," "Skip ID," and "End ID" functions. A digital fader lets you make professional fade-outs and fade-ins.

Start ID codes, which mark the beginning of each selection, can be entered automatically or manually. Skip and end IDs are entered manually. When the deck encounters a skip ID, it stops playing and then fast-forwards to the next start-ID code; end IDs, at which the deck stops automatically, can be used to mark the next recording point on a partially used tape, or to mark material at the end of the tape that you don't want to play. Program numbers can be "written" onto a tape during recording or later, in a renumbering process. Since all these subcodes are written onto the tape separately from the recorded digital audio data, they do not affect audio quality.

**Control Layout**

The switches for power, external timer operation, and recording mode ("Long" or "Standard") are located at the far left of the all-black front panel. The DAT cassette loading compartment is nearby; unlike the tape trays of other DAT recorders I have seen, it has a small window through which the user can see the tape when it is loaded into position. The counter reset and counter mode buttons are immediately to the right of the tape compartment. Absolute time, elapsed time of the current selection, and total remaining time on a tape can be selectively displayed. Clustered beneath the display are the buttons that control the tape transport, including the functions already familiar from analog cassette decks, an "Open/Close" button for the tape compartment, and forward and reverse "AMS" (Automatic Music Search) buttons used to locate the beginnings of selections during playback. The buttons that initiate fast forward and rewind when the tape is stopped can be used in playback mode for audible searching. Number buttons, at the right of the display, are used to call up a selection on the tape by number. Also here are the "Clear" button, used for cancelling selections, and a "Music Scan" button that plays the first few seconds of each selection on a tape. The "Fader," "Repeat" mode, "Skip Play," and "Margin Reset" buttons are found just below the number buttons.

The "Margin" indicator on the display is extremely useful when recording via the analog inputs. It constantly monitors and displays the loudest level being fed to the recorder, expressing it in dB below maximum recommended recording level. (When recording via digital inputs, levels automatically match those of the incoming signal.) In digital recording, exceeding maximum record level causes horrendously high distortion, so it's vital to be able to monitor levels this way even if instantaneous peak reading level meters are also provided. The "Margin" display always shows the highest level seen at the analog inputs, and updates that reading when a higher signal level is encountered.

The DTC-75ES is the first consumer DAT officially imported, but it benefits from nearly four years of development in Japan.

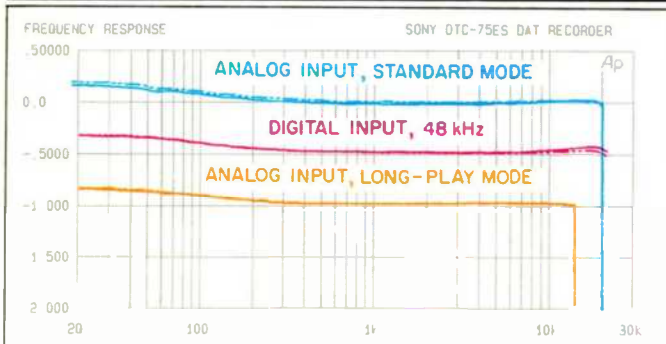



**Fig. 1A—Frequency response for recording in standard mode with 48-kHz sampling via analog inputs (top) and digital inputs (middle), and via analog inputs with 32-kHz sampling in long-play mode (bottom).**

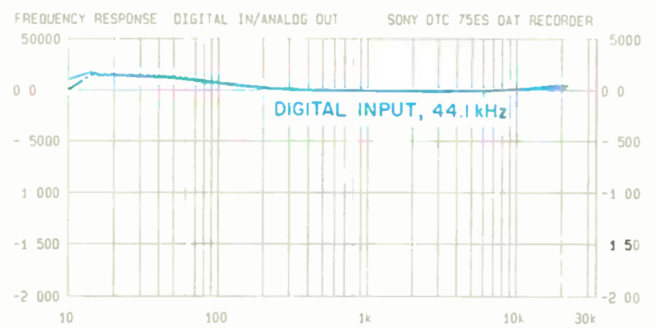



**Fig. 1B—Frequency response, via digital inputs, for recording in standard mode at 44.1 kHz.**

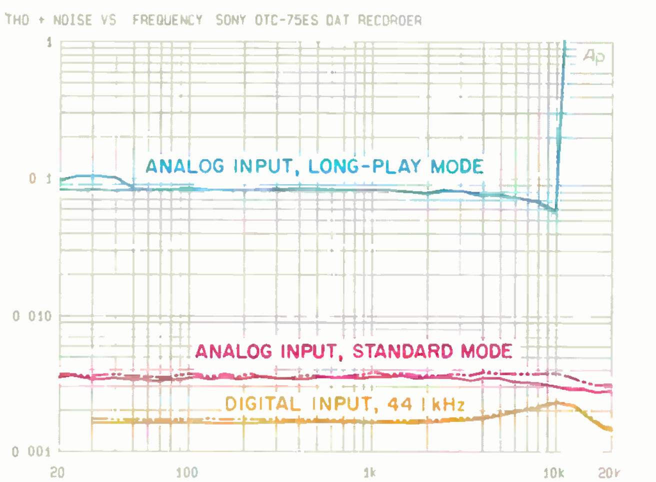



**Fig. 2—THD + N vs. frequency for (top to bottom) analog input in long-play mode, analog input in standard mode (48 kHz), and digital input (44.1 kHz).**

Buttons for writing or erasing start, skip, and end IDs, and for renumbering start IDs are all to the right of the tape transport buttons. Further to the right are dual concentric record level controls (used only when recording via the analog inputs), an input selector for the analog or the optical or coaxial digital inputs, and a stereo headphone jack and level control.

The large display, which shows every conceivable aspect of DAT operation, also provides level indications during recording and playback. Among the more unusual displays is the "Rehearsal" indicator, which is used when manually writing a start ID during playback of a tape. This rehearsal mode facilitates more precise entry of the start ID than the record mode because the precise point at which the ID is written can be shifted backward or forward in increments of 0.3 seconds while the current start point is played over and over allowing you to judge the direction in which it should be shifted for the final written start ID. Other visual displays include sampling rate, the three time indications mentioned earlier, the type of input employed (optical, coaxial, or analog), program numbers, recording mode (standard or long play), and the previously described "Margin" indication in dB.

The supplied remote control has a button to turn off this display, though Sony doesn't say whether that's to eliminate any possible noise from its digital circuitry or to make it less distracting. Other functions found only on the remote include an "A-B" repeat button, buttons for entering and checking sequence of programmed selections, "CD Synchro" buttons to synchronize tape motion with a Sony CD player when copying, and buttons to control Sony CD players. The remote also duplicates many of the controls on the front panel including transport controls, the numeric keypad, and the various ID write and erase buttons.

The rear panel is equipped with two types of digital inputs and outputs (coaxial and optical) as well as with analog pairs of input and output RCA-type jacks.

**Lab Measurements**

A true evaluation and test of any DAT recorder must include lab measurements via the digital as well as the analog inputs. Furthermore, since the digital inputs will accept digital signals at sampling rates of either 44.1 kHz (as from a CD) or 48 kHz (as from another DAT), I felt it necessary to make at least some tests at both sampling frequencies. Finally, some measurements had to be made in the long-play mode via the analog inputs only.

Figure 1A shows the frequency response obtained at the analog outputs for signals recorded in the standard mode (linear 16-bit with 48-kHz sampling) from the analog and digital inputs and in long-play mode (nonlinear 12-bit with 32-kHz sampling). Since recordings made via the analog inputs are automatically digitized at a 48-kHz sampling rate, you can see that flat frequency response extended slightly beyond 20 kHz, to around 22 kHz, before dropping off quickly due to the low-pass filter action required in any digital system. The slight rise in amplitude noted at the low end was probably the result of something in the analog stages and appears in all four response measurements. It amounted to no more than +0.15 dB at any point.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Not only does the display show every relevant aspect of operation, but the tape door has a window showing when tape is loaded.

Similar results were obtained when I recorded a digital frequency sweep, with a 48-kHz sampling frequency, using my Audio Precision System One. I did not program this sweep to go beyond 22 kHz, avoiding the sharp drop-off visible in the previous curve.

Next, I recorded a frequency sweep signal via the analog inputs, this time in long-play recording mode. This mode's 32-kHz sampling rate limits the possible frequency response to a top end of around 15 kHz, as shown.

Figure 1B shows the response obtained via the digital input, with 44.1-kHz sampling, using my CBS CD-1 test disc as a source. The disc was played on a CD player equipped with an optical digital output connected to the DTC-75ES' optical input via a fiber-optic cable. Results were similar to those of Fig. 1A except that response was now limited to very slightly more than 20 kHz.

Figure 2 shows distortion versus frequency for signals at maximum level. When signals were applied via the analog inputs (middle curve), THD + N at all audio frequencies was less than the 0.004% that Sony quotes for 1 kHz. When the test was repeated via the optical digital inputs (bottom curve), THD + N was considerably lower, measuring less than 0.002% over most of the audio range. The top curve in Fig. 2 was produced in the long-play mode, with its lower sampling rate and lower bit count.

Incidentally, the block diagram for the DTC-75ES implies that one would get the same readings going through the A/D encoder and D/A decoder as when actually recording signals and playing them back, and this is true for the standard recording modes. In long-play mode, however, just going through the A/D and D/A circuits gave me distortion readings virtually as low as they had been for standard modes. I knew something was wrong, as Sony would not have listed a THD rating of 0.08% for this mode if it was in fact only half that much. Sure enough, when I actually recorded and played back my test signals in the long-play mode, my results were very close to Sony's. This may be because the long-play mode uses nonlinear 12-bit coding rather than the linear 16-bit coding of the standard modes, but it's also possible that long-play recording involves some element not shown on the block diagram.

Figure 3A shows how THD + N of a 1 kHz signal varied with amplitude, using the analog inputs. Interestingly, "0 dB" as indicated on the level meters (and as read by the numeric "Margin" display) really does not correspond to maximum digital level. The steep rise in THD that occurs when applying too great an input signal to a digital recording system did not occur until my input level was 5 dB greater than indicated on the meters. Obviously, Sony calibrated their metering system this way because they were aware of the fact that most recording enthusiasts accustomed to analog cassette or open-reel recorders tend to allow signals to push meters "into the red." In analog recorders, slight overload results in a gentle increase in distortion. In digital recording, when you "run out of binary ones," distortion rises to unacceptably high levels immediately. If you should purchase this superb DAT recorder, my advice would still be to keep levels low enough that you never go above the arbitrary "zero" dB level established by Sony.

I used my CD-1 test disc once more to couple a digital optical signal to the digital input and to show how THD + N varied with amplitude for a 44.1-kHz digitally sampled input. Results are shown in Fig. 3B. Since the CD-1 test disc has no signals above "maximum recording level," the distortion shown in Fig. 3B never rises above normal levels. Note, however, that when using the digital input this way, overall distortion level remained about 95 dB below maximum recording level—an improvement of about 5 dB over results obtained in Fig. 3A.

Using the analog inputs once again, I measured the actual harmonics generated when recording and playing back a 1-kHz test tone. Figure 4A shows results using the analog input. With an indicated recording level of 0 dB, no harmonic component exceeded 0.002% in amplitude. When this measurement was repeated at a −60 dB level, the distortion components increased and the noise floor rose, as expected in a digital system; for example, a major harmonic component at 16 kHz measured 0.3% of the (now reduced) signal amplitude. Figure 4B is similar to Fig. 4A, except that this time a digital signal, at the 44.1-kHz sampling rate and maximum recording amplitude, was applied to the optical digital input. While harmonics were still negligi-

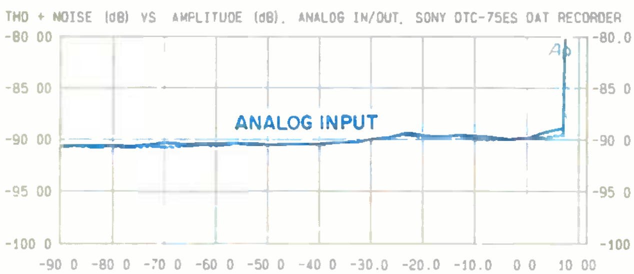



**Fig. 3A—THD + N vs. signal amplitude, referred to 0-dB meter level, for recording via analog input.**

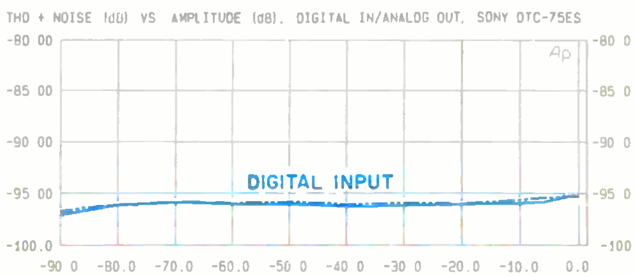



**Fig. 3B—THD + N vs. signal amplitude, referred to absolute 0-dB level, for recording via digital input.**

Linearity was excellent, from input to playback output, for both analog and digital inputs.

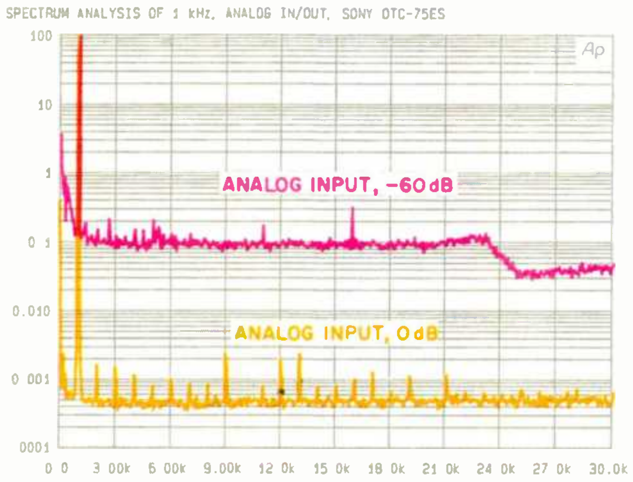



**Fig. 4A—Spectrum analysis of 1-kHz signal, recorded via analog inputs at 0 dB and −60 dB indicated level.**

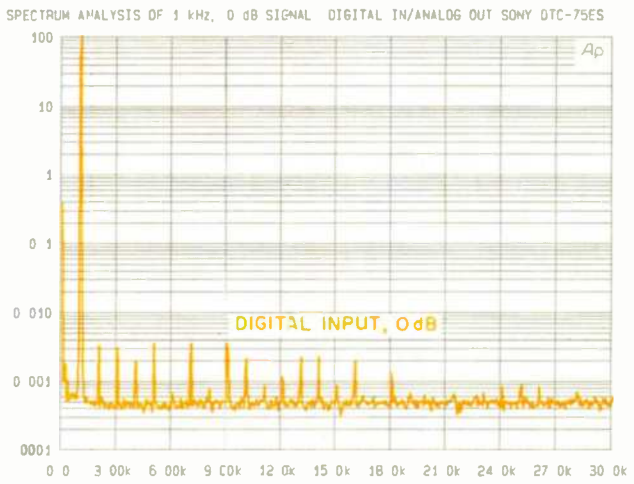



**Fig. 4B—Spectrum analysis of 1-kHz signal recorded via digital input at 0 dB actual level.**

bly low (not much more than 0.003% for any one of them), the only reason I can think of as to why these components were higher than those obtained in Fig. 4A is, as already stated, because "0 dB" as shown by the metering system when using the analog inputs is really lower than maximum permissible recording level. On the other hand, "0 dB" digital signals as derived from playback of my CD-1 test disc are truly maximum-level signals.

The benefits of digital-to-digital recording, already obvious from some of my earlier measurements, became even clearer when I began to measure signal-to-noise ratios under various conditions. Using the analog inputs (with no signal applied and the input jacks shorted), A-weighted S/N at the analog outputs was 92.7 dB for the left channel and 92.8 for the right channel. These results were referred to 0 dB as indicated by the level meters and the "Margin" display. Recall, however, that actual maximum recording level is as much as 5 dB higher, so one could maintain that, relative to actual maximum recorded level—via the analog inputs—S/N was closer to 98 dB.

In fact, when I played the "no signal" track of my CD-1 test disc, again using the optical digital connection from the CD player to the DTC-75ES, S/N measured 103.5 dB for one channel and 103.6 dB for the other channel. Using a 48-kHz sampling rate generated by my Audio Precision system, but with no audio modulation, S/N measured 99.5 dB on one channel and 98.0 dB on the other. In the long-play mode, S/N decreased, but only to just over 92 dB. Those familiar with digital audio theory may, at first, be surprised at that figure. S/N ratio is supposed to be about 6 dB/bit and, this being a 12-bit system, theoretical S/N should be about 72 dB. The figure is higher because this is a nonlinear 12-bit system that involves some companding.

Figure 5 shows third-octave spectrum analysis of residual noise, measured at the analog outputs, for both the analog and digital inputs. With the digital inputs, residual noise was about 10 dB lower at any given frequency, and noise peaks attributable to the power-supply frequency and its harmonics were far less prominent.

Figure 6 shows the excellent linearity from input to playback output of the DTC-75ES. Using the analog inputs and a sampling rate of 48 kHz, deviation from perfect linearity at an indicated −90 dB was only 0.45 dB for the channel shown, and about +0.48 dB for the other channel. (Since the meter's 0-dB point is actually about -5 dB, these readings actually show performance at about −95 dB.) Using the digital inputs and 44.1-kHz sampling, deviation from perfect linearity at an actual −90 dB was only 0.32 dB for the left channel and 0.79 dB for the right channel.

Stereo separation, as measured via the analog inputs and outputs, is shown in Fig. 7. At low and middle frequencies, separation exceeded 80 dB, decreasing to between 71 and 75 dB at 20 kHz. The decrease in separation at higher frequencies was no doubt caused by capacitive coupling, either internally or between the external cables connected to the analog outputs of the recorder.

## Use and Listening Tests

I have owned a DAT recorder for some time so perhaps my familiarity with such products may color my evaluation of how easy these products are to use. Still, I think even a newcomer to the world of digital audio tape recording will be delighted with the features that have been built into the R-DAT format—just about all of which have been implemented in the Sony DTC-75ES. Even before I began measuring the performance of this unit in my lab, I couldn't resist the temptation to record a couple of my most recent CD acquisitions onto DAT. As with most DAT recorders, start IDs and program numbers are automatically written at the start of each track, triggered either by a CD's own start

Sony's latest DAT recorder not only outperforms their earlier models in every way but costs less than half what the first model did.

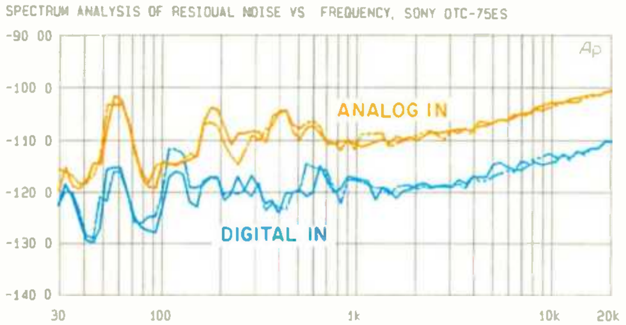



Fig. 5—Spectrum analysis of residual noise with no audio signal applied, for analog and digital inputs.

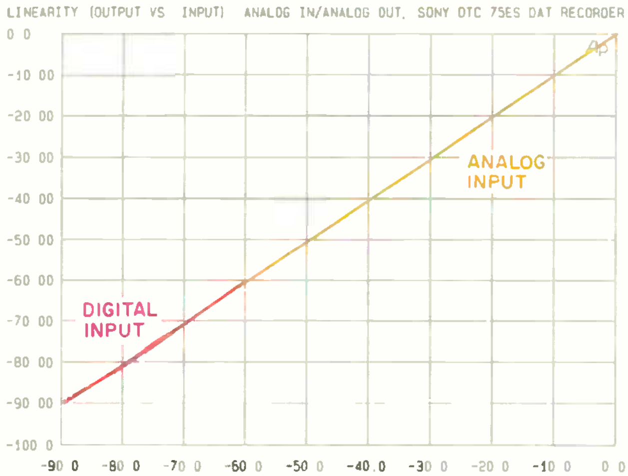



Fig. 6—Linearity (output vs. input) for analog and digital inputs; see text.

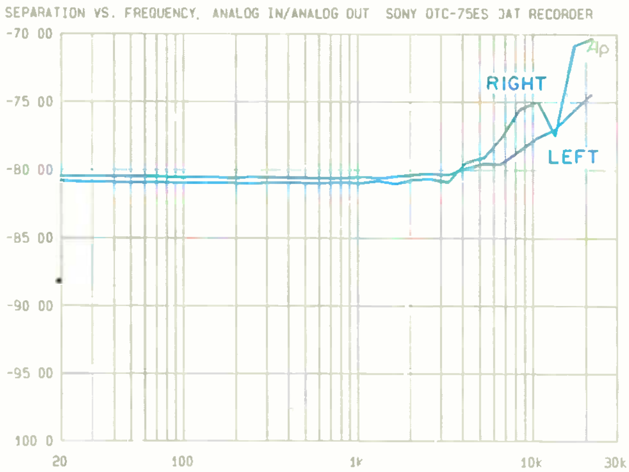



Fig. 7—Stereo separation vs. frequency, analog inputs.

codes when copying via the digital inputs or, when recording via the analog inputs, by the pauses that normally occur between tracks; on some earlier machines, one had to use the "Renumber" function (which is automatic but takes several minutes) to apply program numbers at each start ID point. I also appreciated the fact that the DTC-75ES can display absolute time indications based on time codes recorded on the tape; some machines I have dealt with in the past have simply approximated elapsed and remaining time based on motion of the spindles that drive the DAT cassette hubs.

The fade-in/fade-out feature, on the other hand, is not yet common. It lets you fade recordings in and out even when recording through the digital inputs, which are not affected by the Sony's record level control. If you press the "Fader" button while the deck is in record-pause mode, recording starts and the signal fades in; if you press the button during a recording, the signal level is gradually reduced to zero, after which the deck goes into record-pause mode. For playback, pressing the button when in pause mode starts the tape and fades the sound in, while pressing it during play fades the sound out and puts the deck in pause. (In either recording or playback, the fader does not affect the signals at the digital outputs.) An especially pleasant surprise was the variable fade duration from as short as 0.2 S to as long as 15 S.

I tried recording a couple of CDs two ways: First using analog outputs from my reference CD player into the analog inputs of the DTC-75ES, and then using a digital-to-digital interface to record the same program material. While both recordings sounded great, I could distinguish some very slight differences between the original CD and the played back analog-to-analog recording. This was especially true of some of the organ music contained in a new Delos CD (*Organ Music of Vierne and Reger*, Delos DE3096); less so in comparing my analog-to-analog recording of a Denon CD featuring a Mozart serenade for violin and orchestra (Denon CO-73676). There was no distinguishable difference between the original CDs and the *digital* DAT equivalents. In making these comparisons, I was particularly careful to ensure that levels were set identically as I switched back and forth between the original CD and its DAT "copy."

I also recorded some FM programs, using the long-play mode and the lower, 32-kHz, sampling rate. Of course, here I had to trust memory, since I could not compare the FM program with the recording of it, but it seemed to me that the quality of sound was in no way compromised through the use of this long-play mode. I would not, however, recommend using the long-play mode for transcribing CDs to tape or for any application where widest frequency response and lowest distortion are of paramount importance.

Obviously, the nearly four years during which political considerations have delayed the introduction of DAT recorders to the U.S. have been well spent by Sony. The DTC-75ES, Sony's latest DAT recorder, not only outperforms its earlier models in every way, but can be bought for less than half the cost of that first-generation unit. That being the case, I can't imagine how any serious amateur tape recordist will be able to resist owning a DTC-75ES. Rejoice! The long wait for DAT is over. *Leonard Feldman*

2

# B & W 801 MATRIX SERIES 2 SPEAKER

**Manufacturer's Specifications**

**System Type:** Three-way, vented-box enclosure with external electronic high-pass alignment filter and equalizer.

**Drivers:** One 12-in. (300-mm) polymer cone woofer, one 5-in. (126-mm) Kevlar cone midrange, one 1-in. (26-mm) metal dome tweeter.

**Free-Field Frequency Response (With Filter/Equalizer):** 20 Hz to 20 kHz, ±2.5 dB; −6 dB at 17.5 Hz and 25 kHz.

**Dispersion (20 Hz to 15 kHz):** Horizontal, +0, −3 dB within ±30° of axis; vertical, ±1 dB within ±5° of axis.

**Sensitivity:** 87 dB SPL at 1 meter for 2.83 V rms.

**Crossover Frequencies:** 380 Hz and 3 kHz.

**Impedance:** 8 ohms nominal, 4 ohms minimum.

**Recommended Amplifier Power:** 50 to 600 watts per channel.

**Dimensions:** 39 11/16 in. H × 17 in. W × 22 in. D (100.8 cm × 43.2 cm × 55.9 cm).

**Weight:** 110 lbs. (50 kg) each.

**Price:** $5,900 per pair.

**Company Address:** B & W Loudspeakers, P.O. Box 653, Buffalo, N.Y. 14240.

For literature, circle No. 91

Very few speaker systems are held in high regard by both recording engineers and high-end audio people, but the B & W 801 Matrix Series 2 is just such a system. Even though promoted primarily as a professional monitor loudspeaker, it enjoys high popularity in the audiophile home market. The recording engineer places high emphasis on such characteristics as reliability and high acoustic output capabilities (among other qualities), whereas the audiophile stresses such qualities as accuracy, imaging, and frequency response that is wide, flat, and smooth. The 801, because it embodies all these attributes, appeals to both sides of the user community.

B & W Loudspeakers, one of Britain's premier loudspeaker companies, was founded by John Bowers in 1966 as Bowers and Wilkins Loudspeakers Ltd. The company had its humble beginnings in a workshop behind the Bowers and Wilkins "Hi-Fi Shop" in Worthing, England, where Bowers would tinker and improve loudspeakers for the shop's clientele. B & W now employs over 250 people in the U.K. and supports a dedicated research and development facility that employs over 20 full-time staff personnel.

B & W has been a world leader in applying high technology to the field of loudspeaker development and manufacturing, and it pioneered the use of laser interferometry in the

RX-1130 RECEIVER

125 watts per channel into 8 ohms from 20-20,000 Hz at no more than 0.015% THD

Low impedance drive capability provides 360 watts per channel into 2 ohms dynamic power

Additional amplifier section for two rear channels with rear channel level control

Five digital Surround Sound modes (Dolby,® Natural, Hall, Simulated Stereo, Live)

Computer Servo Lock tuning

MM/MC Phono Selector

Banana plug compatible speaker connection terminals

24-segment signal quality meter

Continuously variable loudness control

Learning-capable multi-function remote control

Eight audio inputs, three video inputs

Four audio outputs, three video outputs

S-VHS compatible

Separate front and rear pre-main coupling terminals

Eight-mode REC OUT selector

Continuously variable delay time control

CD Direct switch

Motor-driven volume control with LED indicator

Sleep timer

Center defeat bass/mid-range/treble tone controls

16-station random access preset tuning with multi-status memory

Absolute Linear Amplification (ALA) circuitry

Preset indicators with preset number and station frequency

Front panel headphone jack

Tone bypass switch

High-gain AM loop antenna

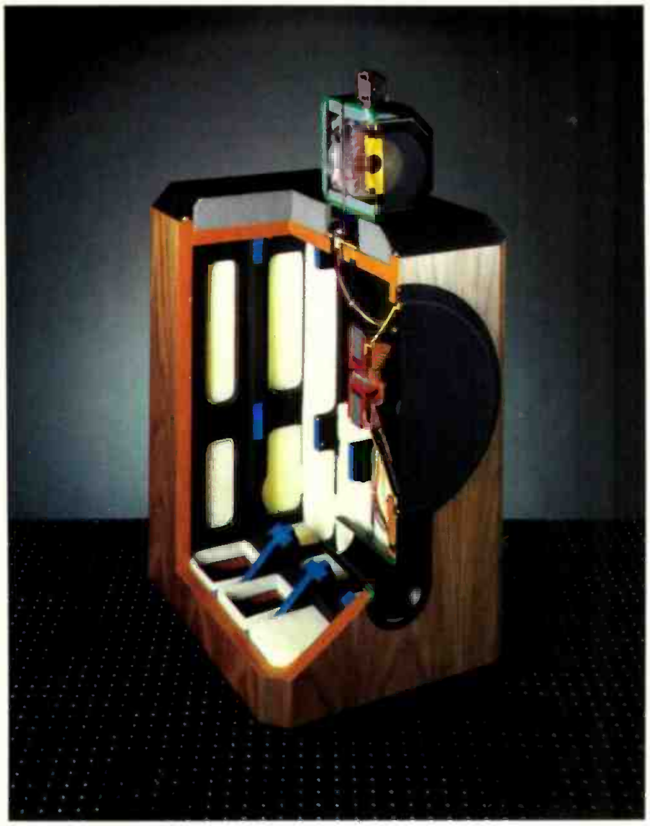
Manual or auto IF Mode selector (wide or narrow)

Auto search tuning

Manual up/down tuning

If any of these features compromised its sound, this is the first thing we'd remove: **YAMAHA®**

**The 801's striking physical appearance makes quite a design statement; either you hate it or you love it.**



study of loudspeaker vibration. It is the only company licensed to use DuPont's high-strength material Kevlar, which is used in the midrange cone of the 801. The 801 is used quite extensively in Europe and elsewhere for monitoring classical music recordings by such companies as EMI, Deutsche Grammophon, Decca, and Sony Classical.

The 801's most striking feature is its physical appearance. With its massive front-vented bass enclosure and external top-mounted mid/high-frequency head assembly, and individual grilles, it makes quite a design statement; you either love it or you hate it. (My wife is in the latter category—she calls them the robots. When I first set them up in the listening room, our dog came in and barked at them!) The industrial design of the 801 was by the celebrated designer Kenneth Grange, who has done work for Kenwood, Kodak, Wilkinson razors, and the British government, among others. The enclosure is available in several real wood veneers including black ash (the review sample finish), walnut, rosewood, and teak, and in satin white.

B & W has gone to great lengths to reduce cabinet resonances and cabinet wall radiation by the use of sophisticated construction methods. These include techniques such as structural foam bonded with Fibrecrete, used in the head assembly, and honeycomb bracing used in the bass enclosure (this is where the "Matrix" term comes from).

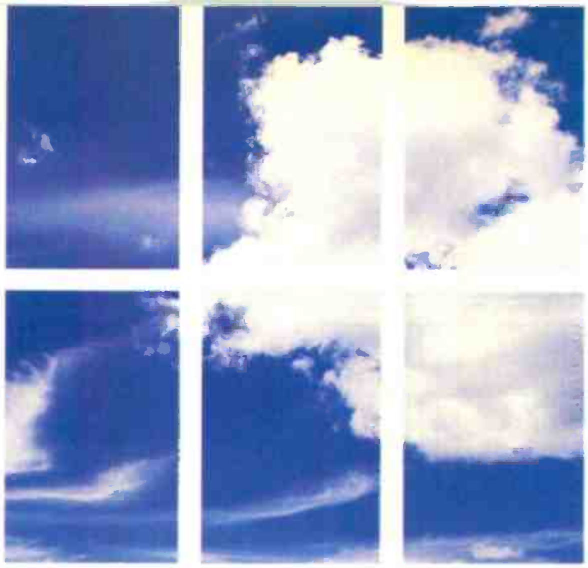
The drive units of the 801 represent B & W's best efforts in design and development. The high-excursion bass driver has a cone made of a specially formulated polymer plastic compound that is heavily damped to reduce unwanted colorations. The driver has a large, 13-lb. (6-kg), dual ceramic magnet assembly that provides the high magnetic field required for proper control of the cone's motion. The cone of the 5-in. midrange driver is made from woven Kevlar, which provides high strength, damping, and low mass for accurate midrange operation. The tweeter incorporates a metal-dome diaphragm designed and analyzed using B & W's laser interferometry and finite-element analysis techniques. Because of the metal dome's high stiffness and low-mass structure, the first resonant breakup mode is far above the audible frequency range (my measurements show the first breakup to occur at about 27 kHz).

The low-frequency enclosure of the 801 is a vented-box design with the box (Helmholtz) resonance frequency placed rather low, at 19 Hz. The box is tuned with a flared-end 7-in.-long (178-mm) tube of about 2¼-in. (57-mm) diameter. An active high-pass alignment filter is supplied, which connects to a system tape loop or between the preamp and amp. With this filter, the system is a pure sixth-order Butterworth, high-pass design conforming to Thiele's alignment No. 15 (for you Thiele-Small buffs). The driving filter is a second-order high-pass filter with a Q of 2, which provides 6 dB of boost at 20 Hz while rolling off by 12 dB/octave at lower frequencies. This filter equalizes the system's response flat (−3 dB) to 20 Hz and provides a steep roll-off below to decrease the system's sensitivity to high-level below-band subsonic energy. This popular vented-box alignment is used in several other consumer and professional systems, including many subwoofers. The system, of course, does not have to be used with the filter. Without the filter, the system's low-frequency response has a fourth-order Bessel response with a gradual roll-off, about 3 dB down at 30 Hz and 9 dB down at 20 Hz. This is not a bad response target for any system.

The mid/high-frequency head assembly is mounted to the top of the low-frequency cabinet with a long threaded bolt that passes through the head and screws into the woofer cabinet. Connections between the head and woofer cabinet are made with a mating pair of Switchcraft three-pin XLR connectors (standard low-impedance pro microphone connectors). The head assembly is shipped attached to the bass cabinet but must be removed and then replaced by the user after fitting a separately packed foam and fabric top cover on the cabinet.

The crossover (together with the protection circuitry) is wired on a large printed-circuit board that is mounted underneath the low-frequency enclosure and covered with a ¼-in.-thick piece of hardboard. Not counting the protection-circuitry components, the rather elaborate crossover consists of 25 components: 11 capacitors, eight inductors, and six resistors. Liberal use was made of impedance-correcting networks across the woofer and tweeter terminals.

Input connections to the 801 are through a dual set of gold-plated, finger-tightened binding posts with standard ¾-in. (19-mm) spacing. Internal connections from the input terminal panel to the p.c. board are made with 50-strand van den Hul wire. Dual sets of input connectors are provided for optional bi-wiring (separate cable connections from the amplifier to the low-frequency and high-frequency sec-



# Nº 27

The music begins and a window opens. The boundaries of time and place fade as a unique musical experience is recreated in your home.

Our quest for this ideal has produced the new Mark Levinson No. 27 Dual Monaural Power Amplifier. We believe it is destined to bring more music lovers closer to their ideal than ever before.

To learn why, you are invited to share the experience at your nearest Mark Levinson dealer.

Exotic materials used in the 801 include Fibrecrete and honeycomb bracing in the cabinet and Kevlar in the midrange driver.

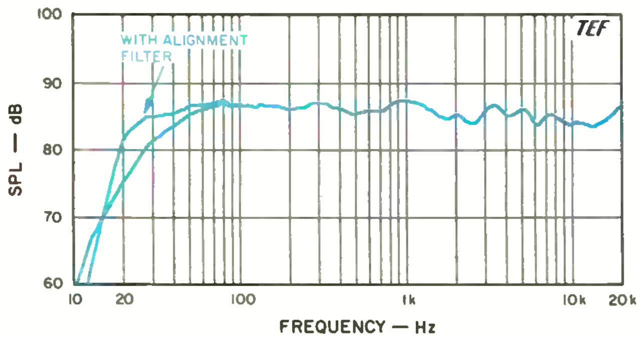



**Fig. 1—On-axis frequency response. Also shown is the effect of the alignment filter and equalizer on the low-frequency response.**

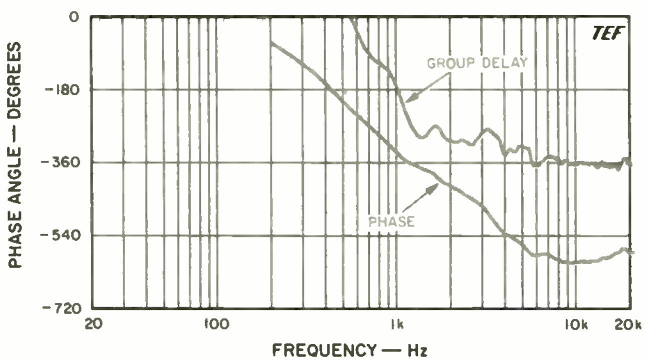



**Fig. 2—On-axis phase response (lower curve) and group delay (upper curve), corrected for tweeter arrival time.**

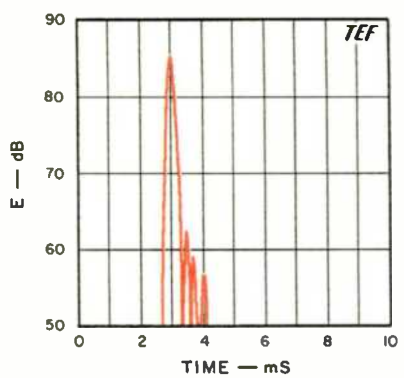



**Fig. 3—One-meter on-axis energy/time curve, measured with all grilles on.**

tions of the system, which potentially may reduce any intermodulation of the high frequencies by high-current low-frequency signals flowing in a common connection cable). Conversion to the bi-wiring configuration is accomplished by removing the bottom crossover cover, taking out two wire links in a screw-type terminal strip, and using the dual input connectors for the separate low- and mid/high-frequency drives.

The protection circuitry, which B & W calls an "Audio-Powered Overload Circuit" (APOC), consists of two separate two-transistor circuits controlling relays with sense connections to each of the driver terminals. When energized, the relays disconnect the drive respectively to the woofer and the midrange/tweeter combination and illuminate a warning LED on the front of the cabinet. When the overload passes, the drivers are reconnected and the LED is extinguished. An overload sensed in either the midrange or the tweeter would disconnect both units at the same time. This dual protection circuitry ensures proper protection for the drivers even when the system is bi-wired. The detection circuitry consists of a simple, voltage-sensing half-wave diode rectifier feeding a large capacitor. Voltage dividers are used across each driver to set the trip point and attack time of each circuit. Power for the protection circuits is derived from the audio input with rectification and zener

Both protection circuits are identical, except for different charge-time constants (roughly 0.4 second for woofer and 0.1 second for midrange/tweeter) that govern the length of time it takes to cut off the offending signal. The discharge time constants (hence release time) of the sense circuits appeared to be on the order of about 0.5 second. This type of circuit will essentially protect the drivers from long-term continuous overloads but allow short-term transients to pass through unimpeded to each driver. (In the high-power tone-burst power tests described later, the protection relays did not energize at any time.) According to B & W, the protection relays are set to energize at the following continuous sine-wave rms input voltages: 100 Hz at 40 V (200 watts into 8 ohms); 1 kHz at 43.5 V (236 watts), and 10 kHz at a level of 13 V (21 watts). All had a ±1.5 V tolerance.

The systems have pre-attached furniture castors for easy movement and floor spikes that can be attached for greater stability on a carpeted floor. B & W also has optional stands that raise the system off the floor for situations where greater height is needed The 801 has generated a thriving after-market for various items aimed at improving it. These include such items as internal cable harnesses, replacement input terminals, and stands. With the suggestion of B & W's North American public relations person, I was supplied with a pair of special stands for the 801 from Sound Anchors, Inc. (Palm Bay, Fla.). These stands are composed of an extremely rigid, damped, metal structure, which is bolted to the base of the 801; it provides a three-point spiked contact with the floor and simultaneously raises the speaker by about 11 in. Provided are means for easy adjustment of the system's vertical aiming angle. Due to logistic reasons and time constraints, I did not properly evaluate these stands but would recommend them for installations where the 801s are going to be permanently mounted and can benefit from the features that the stands provide.

The external equalizer and alignment filter make the bass response flat down to 20 Hz; then they roll off any subsonic energy.

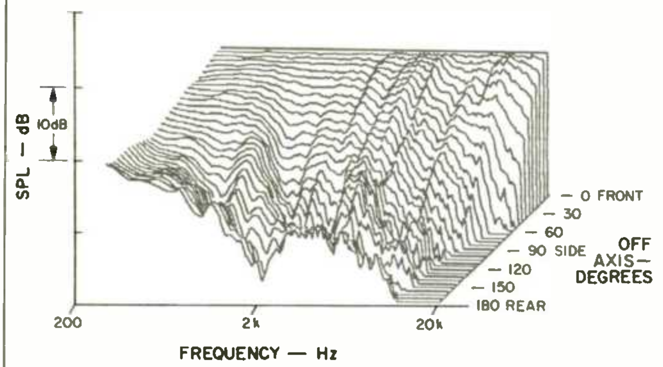



**Fig. 4—Horizontal off-axis frequency responses, taken from the front, around the side, and to the rear of the speaker and normalized to the on-axis response; see text.**

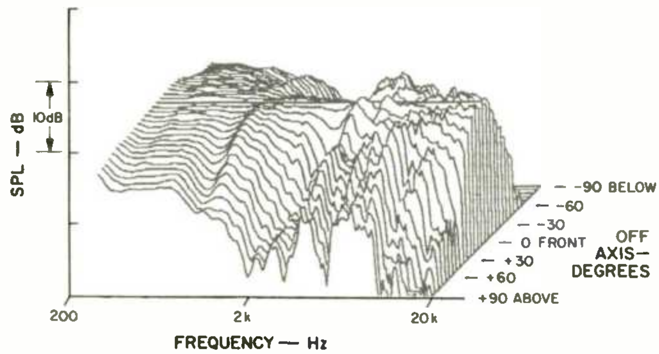



**Fig. 5—Vertical off-axis responses taken from below, up the front, and to the top of the speaker and normalized to the on-axis response.**

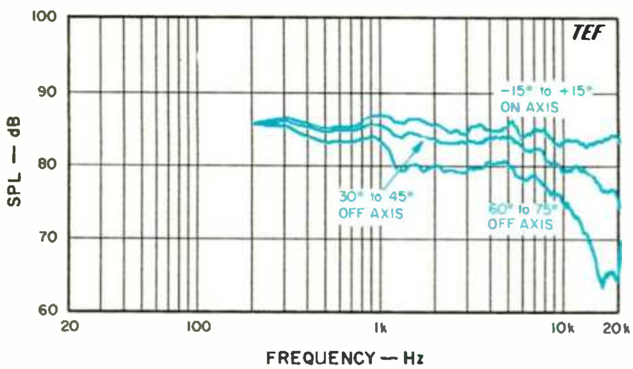



**Fig. 6—Mean horizontal response, derived from data of Fig. 4; see text.**

**Measurements**

A number of measurements were performed on the 801 to assess its performance. These included on- and off-axis frequency response, energy-time curves, impedance versus frequency, harmonic and IM distortion, and maximum peak input and output capabilities. The measurements were performed at a number of locations, including my own listening room and lab and outdoors on my driveway. Measurement equipment consisted of a Techron TEF System 12 Plus Time-Delay Spectrometry (TDS) analyzer, B & K 4007 condenser microphone, Crown Macro-Tech MA-2400 power amplifier, and Leader signal generators, attenuators, voltmeter, and oscilloscope. The system was evaluated using elevated free-field, near-field, and ground-plane measurement methods.

The on-axis system frequency-response measurement was done at a distance of 2 meters, normal to the front baffle, on an axis halfway between the tweeter and the midrange driver. The input level was 2.83 V rms, which is equal to a level of 1 watt into the system's nominal 8-ohm impedance. The on-axis response was corrected to the standard distance of 1 meter for display of the data, and a tenth-octave smoothing filter was used to smooth the response for easier interpretation.

The 1-watt, 1-meter, on-axis frequency response of the 801 is shown in Fig. 1. The curve was taken with all grilles on. Note that this graph covers the wider range of 10 Hz to 20 kHz rather than the usual 20 Hz to 20 kHz. Also shown is the low-frequency effect of the high-pass alignment filter. The response is quite good without the filter, extending from 42 Hz to 20 kHz (±2 dB); with the filter, the response is extended down to 25 Hz within the same envelope, being only about 3.5 dB down at 20 kHz. The response above 20 kHz (not shown) reveals a dip at 23 kHz and a peak at 27 kHz, which is presumably due to a resonance of the tweeter's metal dome.

The filter, in addition to significantly boosting the response between 18 and 50 Hz, rolls off the response below 15 Hz, thus minimizing the effect of possible high-level subsonic energy in the program material. This is fortunate, because later measurements in this review revealed that the system could handle only about 10 to 15 watts of input below 12 Hz without exceeding the linear excursion range of its vented-box-loaded woofer. A vented-box enclosure essentially unloads its woofer about a half octave below its box-resonance tuning frequency (box tuning for the 801 is about 20 Hz).

Averaging the axial response over the range of 250 Hz to 4 kHz yielded a sensitivity of 86 dB SPL, within 1 dB of the manufacturer's rating of 87 dB at 1 kHz. A separate test, comparing the axial response of both right and left speakers in the range from 200 Hz to 20 kHz (not shown), yielded a moderately good match of about ±1 dB. The level differences were more or less randomly distributed over this frequency range.

Figure 2 shows the on-axis phase and group-delay responses of the system, corrected for the time arrival of the tweeter. The phase response (lower curve) exhibits moderate phase rotation of 270° between 1 kHz and 20 kHz. The group delay (upper curve) indicates that the midrange trails

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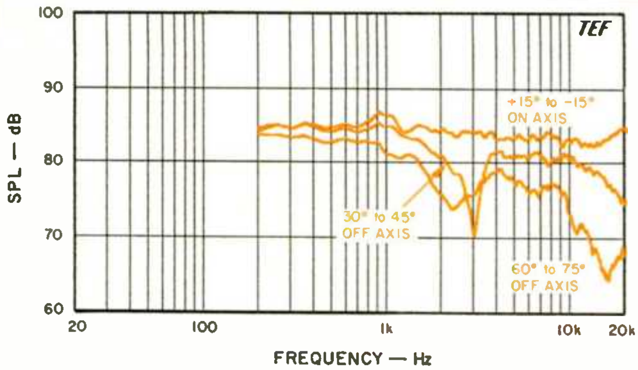


**Fig. 7—Mean vertical response, derived from data of Fig. 5.**

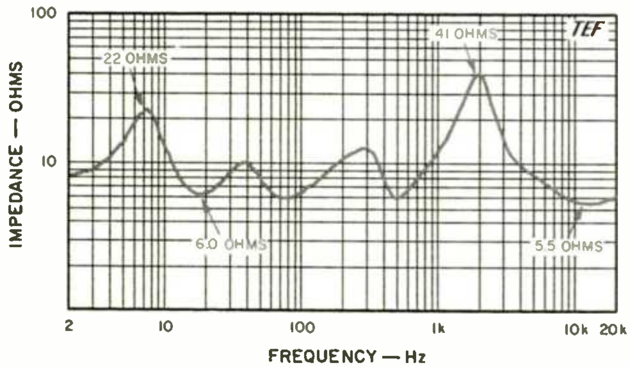


**Fig. 8—Magnitude of impedance; note the logarithmic impedance scale.**

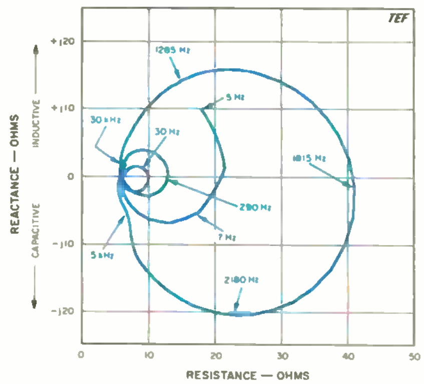


**Fig. 9—Complex impedance, showing reactance and resistance vs. frequency.**

the tweeter by about 0.20 mS (200 µS), which corresponds to a distance of 2.7 in. (69 mm). This time offset represents approximately 0.6 wavelength, or 216°, at the crossover frequency of 3 kHz.

The woofer's excursion capability was determined by sweeping with a high-level sine wave covering the low-frequency range. The maximum linear excursion capability of the woofer was a healthy ±0.25 to ±0.3 in. (0.5 to 0.6 in., peak to peak). In the upper bass range of 50 to 100 Hz, this large excursion capability was mostly nullified by rather high amounts of "dynamic offset" or "oil canning" problems. (See *Audio*, September 1989 for more information on the oil-can effect.) At 50 Hz, the cone would displace outward at voltage levels of 14 V and above (roughly 25 watts into 8 ohms), with an increase of second-harmonic distortion. The test of harmonic distortion versus power shown later in this review unfortunately does not show these problems because the standard test frequencies of 41.2 ($E_1$) and 110 Hz ($A_2$) straddle the problem frequency area.

The woofer had an effective radiating diameter of about 10½ in. The box was well sealed and had no leaks even with high levels at low frequencies. The vented-box port did exhibit significant air-rush chuffing sounds, due to vent air turbulence, when the system was driven above 10 V rms with a sine wave at frequencies near box tuning (15 to 25 Hz). The chuffing sounds appeared to originate inside the cabinet, at the inlet to the vent tube. The enclosure sidewalls were very rigid (inert would be a better word!) and displayed absolutely no detectable sidewall vibrations. However, the ¼-in.-thick hardboard panel covering the crossover network on the bottom of the cabinet (supported only by its edges) did resonate quite strongly, in the range from 105 to 112 Hz, with high-level signals. I suggest leaving this panel off for serious listening. The panel also flunked the finger-tap-and-listen test.

The 1-meter, 1-watt, on-axis energy/time response (ETC) is shown in Fig. 3, for a test signal swept over the range of 200 Hz to 10 kHz. This ETC represents mostly the tweeter's response and emphasizes energy in the range of 2 to 9 kHz. The response is quite compact and only followed by three lower level arrivals, which are more than 23 dB down from the main arrival.

The off-axis response of the system was measured in two different ways. The first method displays the data in a three-dimensional "waterfall" format, and the second method closely follows the way the on- and off-axis response curves are measured and derived at the Canadian NRC's test facilities (see *Audio*, September 1989 for more information).

Figures 4 and 5, respectively, show the horizontal and vertical off-axis frequency response curves of the 801 in the "3-D" format. These curves were derived from frequency response measurements made approximately at 5° increments along the major horizontal and vertical planes of the system. No additional smoothing was done on these curves except for the constant bandwidth smoothing that results from the TDS measurement process.

These graphs have a logarithmic frequency scale and are normalized to the on-axis frequency response. The normalization makes the on-axis curve a straight line and clearly shows the differences between on- and off-axis curves.

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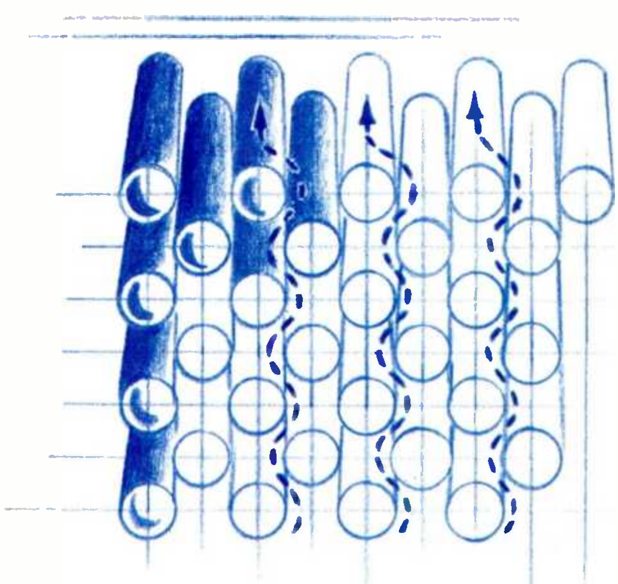

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**Even without the alignment filter, frequency response is quite good, extending from 42 Hz to 20 kHz, ±2 dB, and the filter extends it.**

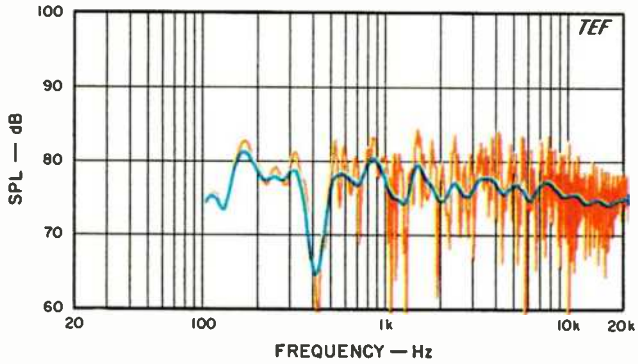


**Fig. 10—Three-meter room response, showing both raw and smoothed data; see text.**

The horizontal "3-D" off-axis curves in Fig. 4 indicate well-behaved off-axis behavior, with high-frequency coverage up to 15 kHz out to about 30° off axis. The vertical off-axis curves in Fig. 5 indicate quite symmetrical up-down behavior through the upper crossover region from 1.5 to 6 kHz. This symmetrical behavior implies no "lobing error" and indicates that the relative phase angles of the midrange and tweeter acoustic outputs are very close together in the crossover region. This low relative phasing has the beneficial effect of directing the main lobe of the system's crossover acoustic output straight ahead, toward the listener, and thus minimizes response changes with vertical listener location.

Electrical measurements (not shown) of each driver's crossover voltage drive indicated that the tweeter was rolled off below 4 kHz at 18 dB/octave. The midrange was rolled off below 400 Hz at 12 dB/octave (with additional response shaping just below cutoff) and above 3 kHz at 18 dB/octave. The woofer had a 24-dB/octave roll-off above 300 Hz. These steep crossover roll-off rates minimize the effect of the crossover on the system's directional response. Note that the total crossover response is the combination of both the crossover electrical drive *and* the driver's acoustical response in the region.

The NRC-style mean horizontal and vertical on- and off-axis response curves of the system are shown in Figs. 6 and 7. These responses were derived from the previous "3-D" data by calculating response averages of several adjacent curves in specific on- and off-axis angular regions.

The mean axial horizontal response curve (Fig. 6) is fairly flat and smooth, although exhibiting a slight droop as frequency increases, and falls within a ±2 dB envelope out to 20 kHz. This curve represents the average frequency balance within ±15° of the axis horizontally but on-axis vertically. The 30° to 45° response is also quite smooth but rolls off at about 4 dB/octave above 5 kHz. The 60° to 75° response, although somewhat rougher, fits in an envelope of ±4 dB out to 8 kHz, where the level drops quickly at higher frequencies. The smooth wide-angle horizontal response indicates that the 801s should maintain good stereo images over a fairly broad horizontal listening area but with some high-frequency loss at extreme angles.

Except for a slight peak at 1 kHz, the mean vertical axial response (Fig. 7) is very close to the horizontal mean axial response and actually slightly smoother. Because ±15° includes both sitting and standing listeners, this curve indicates that the tonal balance of the system should change very little with changes in listener height.

The 30° to 45° mean response has a hole ⅔-octave wide, centered at 3 kHz. This is due to the unavoidable interference effects of the spatially separated midrange and tweeter (the 4.5-in. center-to-center spacing corresponds to about one wavelength at 3 kHz). The in-phase crossover condition of the midrange and tweeter actually places the interference nulls symmetrically in both the up and down 30° to 45° regions. Indeed, analysis reveals that two in-phase acoustic sources separated by one wavelength will have symmetrical off-axis nulls in the polar response at up and down angles of about 35°. Fortunately, the rather steep acoustic roll-offs of the crossover confine the aberrations to a relatively narrow frequency range, ⅔-octave wide. The 60°-to-70° mean response has a depression in the range from 2 to 3 kHz, and drops quickly above 9 kHz.

Figure 8 shows the input impedance of the 801 plotted over the four-decade-wide range of 2 Hz to 20 kHz with a logarithmic vertical scale. A minimum impedance of 5.5 ohms at 12 kHz and a maximum of 41 ohms at 1.9 kHz was measured. This range of nearly 8 to 1 in impedance magnitude will make the 801s somewhat cable-sensitive, especially for long runs of smaller diameter wire. Series cable resistance should be less than about 70 milliohms, to limit peak-dip response variations in voltage drive to less than 0.1 dB.

Figure 9 shows the complex magnitude-phase (Nyquist) polar plot of the impedance over the range of 5 Hz to 30 kHz. The curve is very well behaved, with no minor loops exhibited. This indicates no spurious higher order resonances in the cabinet or the driver moving systems. The system attained a maximum positive (inductive) phase angle of 47° at 1.1 kHz and maximum negative (capacitive) phase angle of −55° at 2.8 kHz. These maximum phase angles should present no problems to any reasonably well-designed amplifier.

Figure 10 shows the 3-meter room curve of the system (both raw and sixth-octave smoothed data shown), located in the right stereo position, with the test microphone placed at ear height on the sofa where the listener normally sits. The system was swept from 100 Hz to 20 kHz with a 2.83 V rms sine-wave signal (equivalent to 1 watt into the nominal 8-ohm impedance). The resultant sound levels can be read directly off the graph.

The parameters of the TDS sweep were chosen to include the direct sound plus 13 mS of the room's reverberation. This amount of room sound represents approximately the effective averaging of the human ear, with its emphasis on the direct sound plus early energy arrivals.

The curve is quite well behaved and flat except for a large hole in the response at 400 Hz. Even though this first appears to be a floor bounce problem, it was found not to

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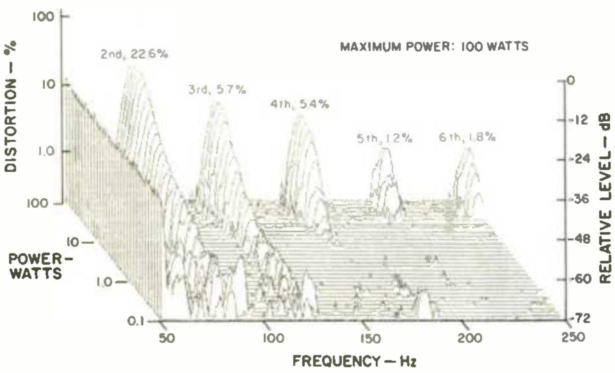


**Fig. 11—Harmonic distortion products for the musical tone $E_1$ (41.2 Hz).**

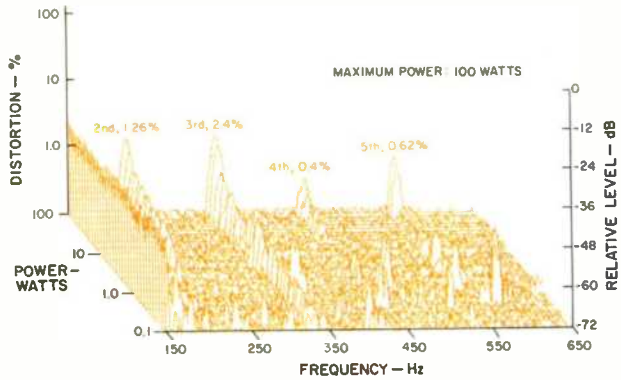


**Fig. 12—Harmonic distortion products for the musical tone $A_2$ (110 Hz).**

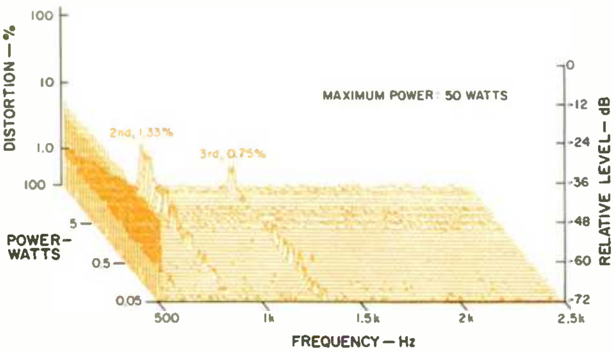


**Fig. 13—Harmonic distortion products for the musical tone $A_4$ (440 Hz). The power was limited to 50 watts because of resistors overheating in the crossover network.**

be. Stacking pillows on the couch just below the test microphone mostly corrected the problem and indicated that a reflection or interference from the couch was the culprit. I should have made a measurement with a person actually sitting on the couch to see what the effect was. The problem frequency range is very close to the 801's lower crossover frequency, where the acoustic source is spread between the woofer and midrange. A spread source tends to decrease the floor bounce effect.

Harmonic and intermodulation (IM) distortion is displayed in four graphs. Figures 11, 12, and 13, respectively, show the spectra for single-frequency harmonic distortion versus power level at the musical notes of $E_1$ (41.2 Hz), $A_2$ (110 Hz), and $A_4$ (440 Hz). These curves indicate the level of harmonic distortion that is generated by the system with the application of a single-frequency sine wave at power levels covering the range of 0.1 to 100 watts (–10 to 20 dBW, a 30-dB dynamic range). The power levels were computed using the rated system impedance of 8 ohms. At no time did the protection circuitry engage during these tests or the later tests of peak power.

The curves were run by successively increasing the sine-wave input level in 1-dB increments (each step about 26% higher in power than the previous level.) At each power level, a swept spectrum analysis was done over a frequency range covering up to the fifth or sixth harmonic. Two precision 1-dB/step attenuators were used in the setup, one in the send path and one in the receive path, to ensure that the power level steps were accurate. The receive attenuator provides a constant fundamental level to the spectrum analyzer so that distortion percentages can be directly read off the plotted data scales.

Figure 11 shows the $E_1$ (41.2-Hz) harmonic distortion data. The nonharmonically related spikes, at lower power levels, are due to measurement setup background noise and are not generated by the loudspeaker. At lower power levels, the second and third harmonics are evident. At higher power levels, the fourth, fifth, and sixth harmonics join the lower ones. The second harmonic is seen to predominate over the whole power range, which indicates a one-sided nonlinearity. Note that 100 watts at 41 Hz generates roughly 104 dB (loud!) at 1 meter with this system. These distortion percentages, though not the lowest, are reasonable considering the size of the woofer.

The $A_2$ (110-Hz) harmonic data is shown in Fig. 12. The graph shows that only the second and third harmonics were significant over most of the power range. The second harmonic increases gradually with power, reaching a level of only 1.26% at 100 watts. The third harmonic, though somewhat higher, reached only 2.4%. As in the previous graph, all the nonharmonic random-like information shown is *not* produced by the speaker but is the result of background noise and other effects in the test setup.

The $A_4$ (440-Hz) harmonic measurements are shown in Fig. 13. As in the 110-Hz measurements, the predominant distortion is a low amount of second and third, with negligible amounts of higher order distortion. For this test, the maximum power was limited to 50 watts because of resistors overheating in the crossover network. Some preliminary testing was done at 100 watts, which caused a pair of power

A subwoofer is definitely not required with the 801. With room gain, it can generate healthy bass peaks in excess of 110 dB SPL.

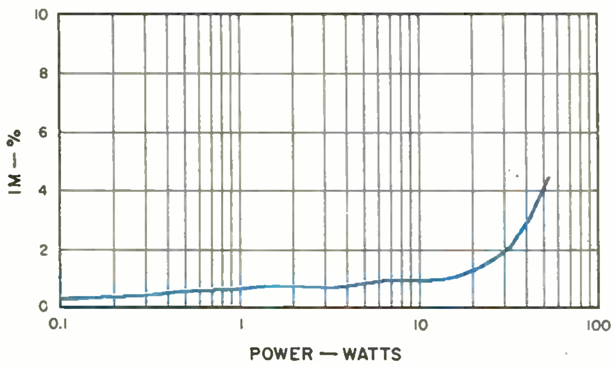


**Fig. 14—IM distortion on 440 Hz ($A_4$) produced by 41.2 Hz ($E_1$) when mixed in one-to-one proportion.**

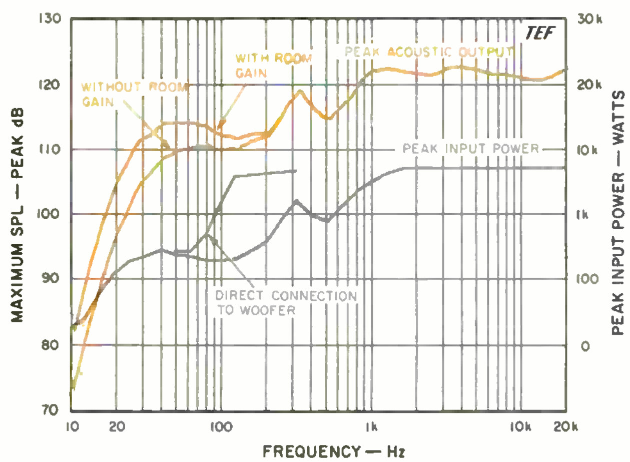


**Fig. 15—Maximum peak input power vs. frequency, and maximum peak sound output (measured at 1 meter on axis), for the input levels shown; see text.**

resistors in series with the midrange portion of the network to heat up enough to smell quite badly.

The 41.2-Hz distortion test also caused overheating of a 10-watt power resistor in the woofer part of the crossover (in a Zobel impedance-correcting network in parallel with the woofer, coincidentally tuned to about 40 Hz). I burned my finger on this one while trying to find which resistor was overheating! Note that under normal operating conditions, with program material, resistor overheating should not be a problem. It takes some crazy reviewer like me, doing continuous high-power, narrow-band sine-wave testing, to cause overheating!

The IM on a 440-Hz ($A_4$) tone created by an equal-level (input power, not acoustic output level) 41.2-Hz ($E_1$) tone, is shown in Fig. 14. The IM distortion gradually rises with power, reaching a level of only about 5% at 50 watts. The first-order ($f_2 \pm f_1$) and second-order ($f_2 \pm 2f_1$) side frequencies predominated in this power range. These IM levels are quite low, primarily due to the fact that the woofer handles the lower frequency signal and the midrange essentially handles the upper. The maximum power was again limited to 50 watts due to crossover limitations.

Figure 15 shows the short-term peak-power input and output capabilities of the system, as a function of frequency. The tests were run by exercising the system with a high-level, shaped, 6½-cycle, sine-wave tone-burst signal. This test signal covers a third-octave bandwidth, with a time duration that increases as the frequency goes down. The duty cycle of the test signal is low enough so that the long-term thermal characteristics of the speaker under test are not exercised.

The test consisted of determining the maximum peak input power-handling capacity and maximum output peak sound pressure levels, in the range of 10 Hz to 20 kHz, at all third-octave center frequencies. The Crown MA-2400 power amplifier, configured in the bridged mode, was used to drive the system. In this configuration, the amplifier can generate short-term peaks of about 5.0 to 5.5 kW (+37 dBW, or ±210 V into an 8-ohm load) depending on the load. The peak input power was calculated by assuming that the measured voltage was applied across the rated 8-ohm impedance.

The test sequence consisted of determining how much of the burst test signal could be handled by the speaker, at each frequency, before either the output sounded audibly distorted or the acoustic output waveform appeared distorted, whichever occurred first. At each frequency, the maximum peak input voltage and the corresponding generated peak output sound pressure level at 1 meter were recorded (Fig. 15).

The maximum peak electrical input power-handling capacity is seen to rise with frequency until about 40 Hz, where it stays roughly constant at about 250 watts and then rises to a peak of 1,650 watts at 315 Hz. Above 315 Hz, the level drops slightly at 500 Hz, then rises smoothly up to about 5.1 kW at 1 6 kHz and stays at this level for all higher frequencies. Above 1.6 kHz, the amplifier's clipping power limit was reached before the speaker's was! The depression at 500 Hz is due to midrange excursion limitations. The system can actually handle more power than the curves show but at the expense of much greater distortion and possible damage risk at higher frequencies.

Initially, I was at a loss to explain why the power handling in the range from 80 to 250 Hz was so low. In this range, the acoustic output waveshape turned into a triangle wave with accompanying high values of harmonic distortion, at levels above 45 V peak (250 peak watts). By comparison, the Dahlquist M907i reviewed in the August issue had about six to eight times higher power-handling on bursts in this frequency range.

Before you say, "So what, 250 watts is sufficiently high for practical purposes," realize that with transient burst signals the subjective loudness of the output is significantly lower than an equivalent continuous signal of the same peak power. In a side-by-side comparison, the highest clean

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**The 801s sounded very clean on high-level organ bass, sending chills down my back. These systems can really rattle the windows!**

burst output of the 801 at 125 Hz sounded rather anemic compared to the M907i's output.

To track down the cause of the power reduction, I first ran a peak input power test with direct connection to the woofer, which is shown in Fig. 15. This indicated that it was the crossover that was responsible for the power limitation. My early hunch about the low power handling was to attribute it to the protection circuitry in the crossover. Further investigation revealed that it was not due to the protection circuitry but rather was due to current limitations in one of the two high-value inductors in the low-frequency portion of the crossover network.

This was determined by simply bypassing (shorting across) each of the inductors in the woofer section of the crossover, one by one. The inductor in question is a ferrite-cored, 6.5-mH inductor that apparently was undergoing core saturation, B & W provided me with a very comprehensive replacement-parts manual and schematic set for the 801 that provided considerable help in the investigation (the inductor under discussion is labelled L6). Note that for typical program material with realistic crest factors played through power amplifiers of 150 watts or less, inductor saturation and resistor overheating should be no problem.

The other major peak-power limitation in the low-frequency range of the 801 was due to dynamic offset of the woofer. This primarily reduced the power handling in the range from 50 to 100 Hz. With high-level bursts, the outward cone displacement was quite prominent. Reversing the system input connections (polarity), of course, had no effect on the direction of displacement.

The upper curves of Fig. 15 illustrate the maximum peak sound pressure levels the system can generate at a distance of 1 meter on axis for the input levels shown in the lower curves. Also shown on the graph is the room gain of a typical listening room at low frequencies. This adds about 3 dB to the response at 80 Hz and 9 dB at 20 Hz. (See the Dahlquist speaker review in the August issue for more information on room gain.) Note that the external alignment filter has no effect on the measured peak input and output capabilities of the system. Only the characteristics of the system itself affect the measured maximum powers.

With room gain, a single system can generate healthy peak levels in excess of 110 dB in the critical low-frequency range from 25 to 100 Hz. A pair of these systems, operating with mono bass, will be able to generate higher levels by some 3 to 6 dB in this same range. The good low-frequency peak-power output capabilities of the 801 mean that a subwoofer is definitely not required.

Measurements of the external active high-pass alignment filter confirmed that it is a second-order high-pass filter with a Q of about 2. The filter exhibited a maximum gain of 5.7 dB at 207 Hz and rolled off at 12 dB/octave at lower frequencies. Its output impedance was resistive at about 100 ohms and clipped at about ±15 V into an open circuit. The filter had a unity mid-band gain, with a slight high-frequency droop of 0.6 dB at 20 kHz.

### Use and Listening Tests

I have had the 801s for seven months, and they have been the primary reference standard that I compared other reviewed systems against. The main difficulty with doing the listening test on the 801s is that I can't now write, "As compared to my reference systems . . . thus and so," as I often do. As a result of this relatively long association, several descriptive terms come to mind in describing the sound of the 801s: Revealing, neutral, wide-range, great low end, smooth, effortless, loud, and clean.

Before I got to the listening part of this review, several use-related items need to be gotten out of the way. B & W provides a fairly well-done five-page instruction manual for setup and use of the 801s, divided into nine sections. Contrary to the title for Section 4, "The listening room and positioning your loudspeakers," hardly any information on actually positioning the loudspeakers is provided. Only general comments on listening-room acoustics, dimensions, construction methods, and the effect of furnishings are provided. The rest of the manual is devoted to such topics as unpacking, installation, amplification and control equipment, protection circuitry, accessories, and cables.

In the fit and finish department (yes, I do read automotive reviews), the first time I used a double-banana plug to make and break a connection to one of the systems, the rear terminal panel came off in my hands and was dangling only by its wires. This fortunately does not break the seal to the bass enclosure, because the mounting hole only connects to dead space under the cabinet. This terminal board is not held on by screws or other fasteners; instead, it is held on by hot-melt adhesive that apparently was not applied very liberally.

I also had a lot of difficulty in attaching (and keeping attached) my large spade-lugged Straight Wire cables to the input terminals of the 801. The terminals are not the usual five-way binding posts but are designed only to accept bare wire ends and can only be finger-tightened (if you can get your fingers into the cramped space!). Because I connect and reconnect the cables so often, I finally resorted to an external adaptor, composed of a large industrial-grade barrier-terminal strip connected to a double-banana plug by a 2-in. length of 12-gauge wire.

The woofer grille assembly is a circular framework constructed of 0.15-in.-diameter metal wire stock with grille cloth stretched tightly over it. Projections on the grille frame mate with rubber grommets in holes drilled in the woofer frame to attach the grille to the cabinet. When I removed and replaced the woofer grille for the first time, I inadvertently pushed a couple of the grommets into the woofer frame, thus preventing the grille from seating properly. This was due to misalignment of the grille frame, which prevented the projections from aligning properly with the centers of the grommets. I had to take time to fish the grommets out of the woofer frame with a small screwdriver. Needless to say, I now make sure the projections align with the grommets before seating the grille frame.

All listening was performed in my newly constructed listening room, which has dimensions of approximately 15½ × 27 × 8 feet. The room has normal living-room furnishings and a carpeted floor. Equipment used for listening included an Onkyo Grand Integra DX-G10 CD player, a Krell KSP-7B preamp, a Krell KSA-200B solid-state power amplifier, and Straight Wire Maestro interconnects and speaker cables.

**The B & W 801's reliability and high output appeal to pros, while its accuracy, imaging, and wide, flat response lure audiophiles.**

More recently, two other CD players were also used: Rotel's Model RCD855 and a Meridian Model 206. The systems were hooked up conventionally; I did not bi-wire them. The majority of my listening was done before the measurements were made.

Most of the listening was done with the 801s placed well out in the room, about 6 feet (1.8 m) away from the short rear wall and separated by 8 feet (2.4 m). This left a spacing of about 4 feet (1.2 m) from the side walls. The systems were aimed horizontally at my normal listening position so that I was on the midrange/tweeter axis of the system. I did not simply rotate the head assembly to achieve this aiming; I rotated the whole cabinet. Listening took place on the sofa, about 10 feet (3 m) away.

The majority of the listening was done with the castors installed on the bottom of the cabinet. This was purely a logistical convenience because I frequently have to move the systems in and out of my listening room. As stated earlier, I did not take the time to install the supplied Sound Anchor stands but did listen to the systems with the spikes installed. Listening with the spikes attached provided a subtle improvement in bass transient capability and level, but don't expect any large, night-and-day change in the sound of the system with this addition. In some situations, the spikes may actually increase the transmission of sounds through the floor and cause a form of bass pre-echo that could be quite objectionable. Make sure the surface that the systems are spiked to is quite stable and immovable.

Most listening was done with all the grilles on because the tweeter grille is not easily removed. Sometimes I would take the woofer grille off to check cone excursion on high-level bass passages.

The 801s sounded very clean at all playback levels, even with selections whose low-frequency content was at very high levels, such as the organ version of *Pictures at an Exhibition* (Dorian DOR-90117, recommended highly if you are into pipe organ music). The systems do such an excellent job on this CD that it sent chills down my back when listening to the second track. These systems can rattle the windows when called on to do so!

I did listen to the *Pictures* CD again, after I had done the measurements, to try and find a selection that would trigger the dynamic offset behavior of the woofer. I found such a part on track 15 at 3:41 and 3:44, when the organ is played all-stops-out during the finale; this caused the cone to displace outward significantly. To exhibit the phenomenon, the systems were played at a level of 92 dB ("A" scale, slow averaging), corresponding to 102 dB SPL ("C" scale, slow), as measured on the Simpson 886 sound-level meter at my normal listening position. The offset, however, did not cause any audible problems that I could detect. If any distortion was generated, it was masked quite effectively by the program material.

When played at high levels, the system dealt very effectively with the kick drum on the *Sheffield Track and Drum CD* (CD-14/20). On the Berlioz *Symphonie Fantastique* (Reference Recordings RR-11CD), the 801s created a very realistic soundstage from the complex orchestration. The bass drum in this selection was reproduced with excellent weight and much authority.

The *West Side Story* medley from the National Symphonic Winds' *Center Stage* (Wilson Audiophile WCD-8824) was also re-created with a good soundstage and imaging. The systems' reproduction of the horns on this CD was particularly effective and very clean. The Bach harpsichord music on the CD of *German Harpsichord Music* ("K" Edition, Open Window OW 001, a German import) was very natural and clean, with the systems doing particularly well on the room sound and reverberation.

On pink noise, the systems passed the walk-around, stand-up, sit-down test—for checking evenness of coverage—with flying colors. Both side-to-side and up/down coverage were very good, with only small changes in timbre being noticed at the different listening locations.

On most selections, the effect of the external high-pass equalization filter could not be heard. Only on those selections that had appreciable content at very low frequencies could the filter be heard. With third-octave, band-limited pink noise at 20 Hz, the filter made a large difference in level. This signal also generated much chuffing air noise from the port when played at high level. With more conventional wide-band program material, the chuffing sounds were usually masked by the higher frequencies of the material. The systems were, however, reproducing 20-Hz fundamental signals better than many other systems.

The tonal balance of the 801s as judged on solo piano music was also quite good. I relied very heavily on the *Dick Hyman Plays Fats Waller* piano CD (Reference Recordings RR-33CD) for this evaluaton. The Bösendorfer piano's power and weight came through very strongly on the 801s.

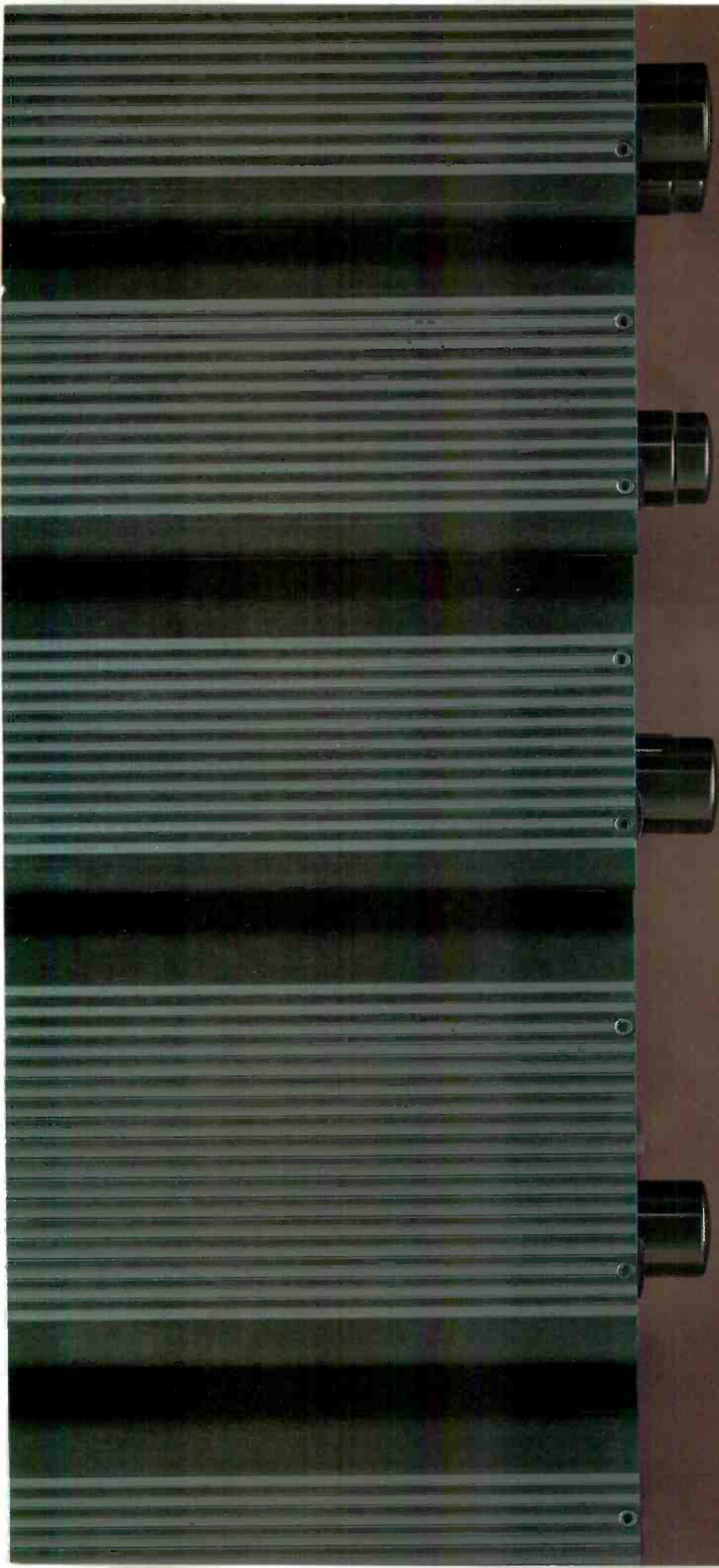
Arleen Augér's soprano singing voice on the *Love Songs* CD (Delos DCD 3029) was reproduced very smoothly, with naturalness and no trace of harshness (this is a great CD, very beautiful singing voice). The 801s do great on the piano on this CD also.

In conclusion, I am very pleased with the performance of the 801s; they are quite stellar in most of the areas I evaluated. It's been a pleasure having them available for serious listening. Some work still needs to be done, however, in controlling the dynamic offset behavior in the woofer and with overload problems in the crossover. If you are looking for systems in this price range, the 801s demand your serious consideration. I highly recommend them.

*D. B. Keele, Jr.*

*Don Keele is an independent consultant with his own company, DBK Associates, and works primarily for Audio as Senior Editor for loudspeaker reviews. He is also a consultant to Crown International, a former employer, working with advanced TEF system development. While working at Crown, he was manager of software development and responsible for the software of the TEF System 12 Time-Delay Spectrometry analyzer.*

*Keele is a member and Fellow of the Audio Engineering Society and has presented and published papers on loudspeaker design and measurement methods. He holds a B.S. degree in electrical engineering and physics from California State Polytechnic, Pomona, and an M.S. degree in electrical engineering from Brigham Young University. He was the primary designer of Electro-Voice's HR series of constant-directivity horns and holds the patent. He also holds two patents on JBL's Bi-Radial series of constant-directivity horns.*



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# 3

# DENON DCC-8970 CAR TUNER & CD PLAYER

**Manufacturer's Specifications**

***Tuner Section***

**FM Usable Sensitivity:** Mono, 14.8 dBf.
**50-dB Quieting Sensitivity:** Mono, 20.3 dBf.
**Alternate-Channel Selectivity:** 70 dB.
**S/N:** 60 dB.
**Capture Ratio:** 2.0 dB.
**Image Rejection:** 50 dB.
**I.f. Rejection:** 110 dB.
**AM Tuner Sensitivity:** 30 μV.

***CD Player Section***

**Frequency Response:** 5 Hz to 20 kHz, ±1.0 dB.
**S/N:** 90 dB.
**Dynamic Range:** 90 dB.
**THD:** 0.007%.

***General Specifications***

**Output Voltage:** 1 V.
**Bass Control Range:** ±10 dB at 100 Hz.
**Treble Control Range:** ±10 dB at 10 kHz.
**Muting:** –20 dB.
**Loudness (Volume at –30 dB):** +10 dB at 100 Hz, +8.5 dB at 10 kHz.
**Chassis Dimensions:** 7 in. W × 2 in. H × $6\frac{13}{16}$ in. D (17.8 cm × 5 cm × 17.2 cm).
**Panel Dimensions:** 7⅜ in. W × $2\frac{5}{16}$ in. H × ½ in. D (18.7 cm × 5.9 cm × 1.3 cm).
**Weight:** 3 lbs., 5 oz. (1.5 kg).
**Price:** $700.
**Company Address:** 222 New Rd., Parsippany, N.J. 07054.
For literature, circle No. 92


More and more manufacturers of car audio products are incorporating the same CD playback technology into their mobile components as is found in their better home CD players. A good example of this trend can be found in Denon's latest AM/FM/CD head unit, their Model DCC-8970. Though incorrectly dubbed a "receiver" (the unit has no built-in power amplifier), the DCC-8970 is in all respects a superbly crafted product.

The CD player section of the DCC-8970 uses Denon's eight-times oversampling, 20-bit digital filter followed by noise-shaping circuitry that moves residual noise out of the audio band and into the high-frequency regions, where it can be easily filtered out. Separate linear D/A converters are used for each channel. Mechanically, I found the player mechanism to be highly resistant to external shock and vibration—a "must" for car use.

The DCC-8970 employs four separate regulated power supplies: One for the transport, servo, and decoding circuits; one for the digital filter and D/A converters; one for the analog circuitry, and one for the system control circuits. Analog circuits are isolated to prevent ground loops that can result in noise.

Convenience features of the CD section include random play, intro scan, repeat playback of the currently playing track, and bidirectional fast search from track to track or within each track. The tuner section has 24 station presets (18 FM and six AM), and its DORS II (Denon Optimum Reception System) continuously varies separation, high-cut filter action, and volume based on signal strength.

There are outputs for connection to front and rear stereo power amplifiers plus a front-panel mini-jack auxiliary input for another program source, such as a personal portable cassette player. This auxiliary input incorporates an isolation amplifier to prevent ground-loop noise that might result when a tape player is powered from the car's cigarette lighter jack. The DCC-8970 also features an interface that


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The FM tuner's response was extremely flat, even more so than most home FM tuners and receivers.

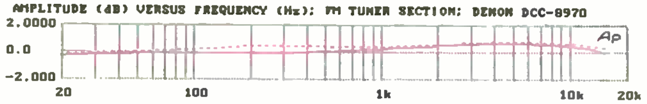



Fig. 1—Frequency response, FM tuner section.

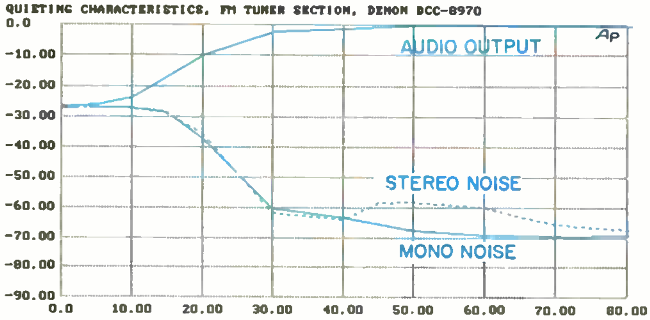



Fig. 2—FM quieting characteristics.

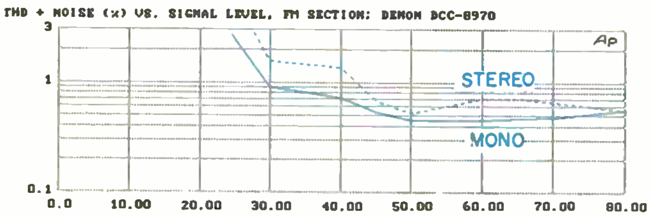



Fig. 3—THD + N vs. FM signal strength.

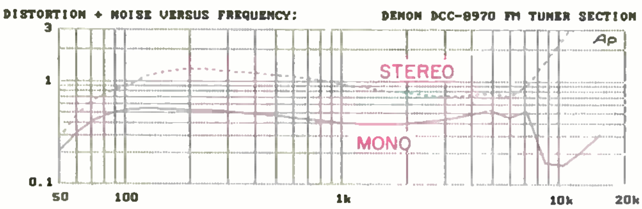



Fig. 4—THD + N vs. frequency.

mutes the audio system when a cellular telephone in the car is in use. The tuner and CD sections and all inputs have buffer amplifiers that isolate them from each other and provide constant low-impedance feeds for the volume control and following amplifier sections. As is true of so many car audio products these days, the DCC-8970 comes in a mounting shell so that the chassis itself can be easily removed to prevent theft.

### Control Layout

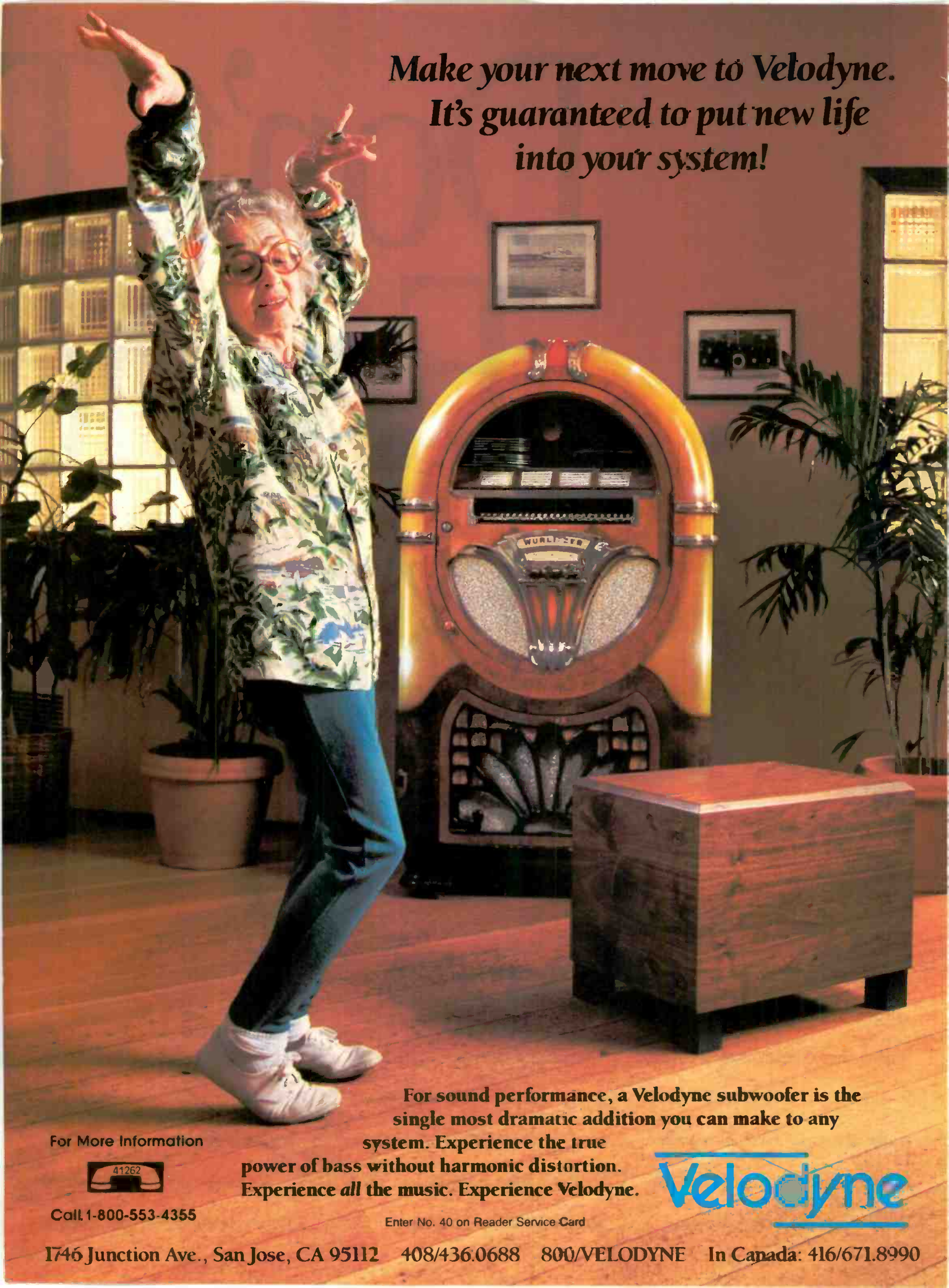
Power on/off, volume adjustment, balance, and fader controls are all combined in a pair of concentrically mounted rotary knobs at the left end of the front panel. Pushing the volume control turns the power on or off, while pulling this knob changes its function to channel balance. The small bass and treble control knobs can be popped out for adjustment and then pushed back to their recessed positions. Each has a well-defined detent at its "flat" position. A pair of pushbuttons beneath the tone controls serve as manual or automatic ("seek") tuning controls for FM and AM and as manual (within-track) or auto (track-by-track) search controls for CD play. For both tuner and CD, the manual or automatic mode for these buttons is selected by a small button just to their right.

The upper section of the panel is taken up by the CD slot and, to its right, an eject switch. Beneath the slot are a local/distant switch (that doubles as a repeat play switch during CD operation) and an FM mono switch (that doubles as a random play switch during CD play). Below these is a row of five switches for CD play/stop, tuner "Band," loudness, preset scan, and display mode (for track number or elapsed time for the current CD track). When in the CD play mode, the preset scan switch controls intro scan. Six numbered preset pushbuttons are arranged along the lower section of the front panel. To their right is the miniature auxiliary input jack mentioned earlier. During FM or AM listening, the display area at the right of the panel shows tuned-to frequency, stereo reception, status of the loudness control and the local distant/switch, as well as preset number selected.

### Measurements

I measured the characteristics of the FM tuner section first. Figure 1 shows the frequency response of the FM tuner section to be extremely flat—more so, in fact, than that of most home FM tuners and receivers, which usually roll off by 1 or 2 dB at 15 kHz. Figure 2 is my usual plot of signal-to-noise ratio versus input signal level. As is typical of most car audio tuner sections, limiting was deliberately made somewhat more gradual than in a home tuner. In this case, it took some 30 dBf of signal input for the audio level (top solid curve in Fig. 2) to reach the −3 dB point relative to maximum audio output. At this signal level, there is no stereo effect. In mono, 50-dB quieting required 25 dBf of input signal, as against 20.3 dBf claimed by Denon. Signal-to-noise ratio for strong signals was just short of 70 dB in mono and 63 dB in stereo. Increasing signal strength beyond the standard 65-dBf measurement point resulted in a further increase in stereo S/N, to approximately 68 dB.

Figure 3 shows how THD + N varied with input signal levels. This plot also enables me to ascertain the usable sensitivity point, which turned out to be 25 dBf rather than the 14.8 dBf claimed by Denon. The usable sensitivity point in this DCC-8970 sample was determined more by the distortion level than by noise. This was evident because an unmodulated 25-dBf signal yielded a full 50 dB of quieting (Fig. 2), while a modulated signal of the same strength brought THD + N down only to the 3% point, equivalent to around −30 dB (Fig. 3). I suspect that slight misalignment of the i.f. section or the FM detector was responsible for this relatively poor usable sensitivity figure and the higher than expected THD levels. Even at 65 dBf, where noise was clearly not a factor in the reading, THD was 0.48% in mono and 0.7% in stereo.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**I measured an S/N ratio of 94.8 dB for the left channel and 93.4 dB for the right, both well above Denon's figure of 90 dB.**

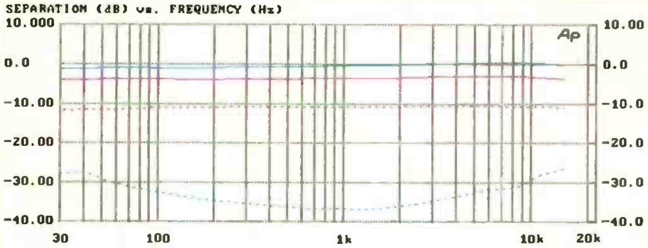


Fig. 5—Frequency response (solid curves) and stereo separation (dashed curves), FM tuner section. Note the effects of blending at low signal levels, as shown by the two middle curves.

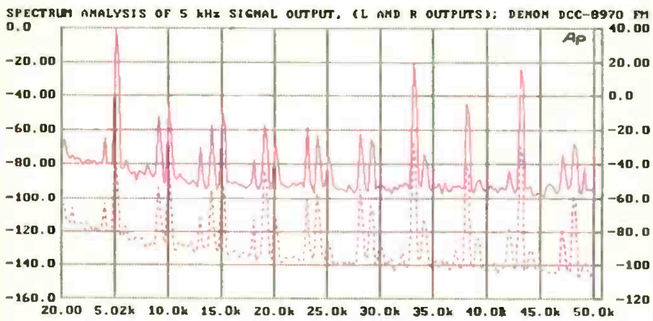


Fig. 6—Spectrum analysis of crosstalk and subcarrier products for FM stereo signal with one channel modulated by 5 kHz (solid curve) and the other channel unmodulated (dashed curve).

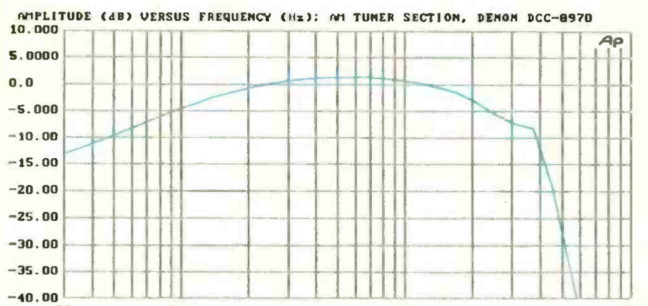


Fig. 7—AM frequency response.

The plots of THD + N versus frequency in Fig. 4 offer reasonably close confirmation of the readings obtained in Fig. 3. These plots also show that distortion levels were fairly uniform at all frequencies from 50 Hz to around 6 kHz. Mono THD measured 0.55% at 100 Hz and 0.48% at 6 kHz, and stereo THD was 0.9% at 100 Hz and 0.73% at 6 kHz.

Figure 5 shows separation for two levels of signal strength. For strong signals, separation was 37 dB at 1 kHz, 32 dB at 100 Hz, and 28.5 dB at 10 kHz, as shown by the distance between the upper solid curve and the lower dashed curve. When signal strength was reduced to 45 dBf, separation was no more than 7 dB at all frequencies of interest, as shown by the two middle curves. In other words, at that low signal level, the blending circuitry had almost caused the tuner to revert to monophonic reception in order to reduce background noise.

Figure 6 shows results of a spectrum analysis conducted with the FFT function of my Audio Precision System One test equipment. With a 5-kHz signal fully modulating one stereo channel, the solid curve shows the desired 5-kHz output reaching the reference level (0 dB), while other harmonic and spurious components are visible all the way out to the end of the sweep. Notice that the sidebands associated with the L − R difference signal (visible at 33 and 43 kHz) are only down about 20 dB with respect to the desired 5-kHz signal. Denon, like so many other car audio manufacturers, makes no attempt to filter out these components or the 19-kHz pilot carrier component (also visible in the graph). The presumption, of course, is that no one will record from a car FM tuner, and since these subcarrier components are generally inaudible, there's no reason to filter them out. I have never been convinced of this, especially since many people can detect the presence of 19 kHz if it is attenuated by only 58 dB, as was the case here.

The dashed curve in Fig. 6 represents a spectrum analysis taken at the output of the unmodulated channel. Although it is not apparent because of the overlap of the two 5-kHz peaks, the cursor readout of the Audio Precision system showed me that separation at 5 kHz was really 40.5 dB. The diminished separation readings seen in Fig. 5 are actually the result of spurious harmonics and other components. Still, all of these harmonic-distortion and subcarrier components appear at the output of the unmodulated channel as well, with the 19-kHz residual output down by no more than about 43 dB in this case. (Use the right-hand scale to read levels for the dashed curve.)

Alternate-channel selectivity measured 68 dB, as against 70 dB claimed. Capture ratio was 3 dB, and the i.f. rejection value of 75 dB fell far short of the claimed 110 dB.

Figure 7 shows that the response of the AM tuner section of the DCC-8970 extended from 80 Hz to 2.3 kHz between −6 dB points. Apparently, Denon has not yet joined the growing list of manufacturers adhering to the new NRSC-1 Standards that mandate response to 7.5 kHz.

Turning next to the CD player section, I measured response using sweep signals available on my CBS CD-1 test disc. Results are shown in Fig. 8. The difference in output between the two channels in the midrange frequencies amounted to no more than about 0.6 dB. Since there was no difference in response between channels when I tested the

**The CD section is so well isolated from the outside world that it takes almost a hammer blow to make it mistrack.**

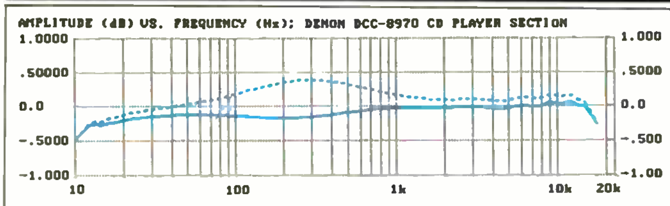


**Fig. 8—Frequency response, CD section, for left channel (solid curve) and right channel (dashed curve).**

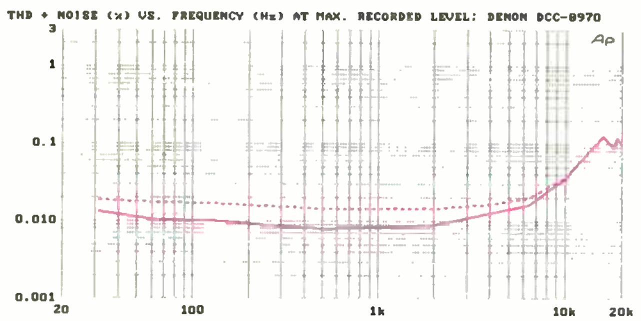


**Fig. 9—THD + N (%) vs. frequency at 0 dB (maximum) recorded level.**

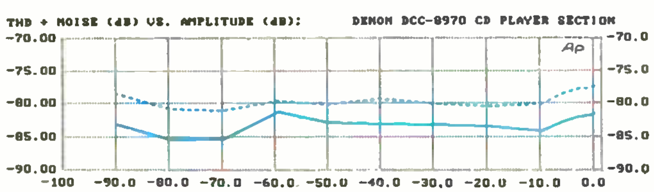


**Fig. 10—THD + N vs. signal level at 1 kHz.**

FM tuner section, I can't blame it on any component tolerances in the analog stages of the unit but must attribute it to the CD circuitry itself.

Figure 9 shows how THD + N varied with frequency. At 1 kHz, THD + N was 0.008% for the left channel and just over 0.013% for the right channel. Figure 10 is a plot of THD + N versus recorded level, with 0 dB corresponding to maximum recorded level. At this level, THD + N for the left channel was −82 dB, corresponding almost exactly to the reading of 0.008% obtained in Fig 9. The same held true for the right channel, since its reading of −77.5 dB corresponds to slightly more than 0.013%. There was no significant decrease in THD + N at lower recorded levels, indicating that the post-D/A analog stages were not being overloaded at 0 dB. SMPTE-IM distortion at maximum recorded level was 0.021% for the left channel and 0.05% for the right.

To differentiate between the harmonic-distortion and the noise components observed in the previous tests, I ran a spectrum analysis of the output of the left channel while playing a 1-kHz test signal at maximum recorded level. Results are shown in Fig. 11. The major harmonic component is at 2 kHz and is at a level of −86 dB; several smaller harmonic components are visible at 4, 9, and 11 kHz. Calculating the square root of the sum of the squares of these harmonic components, I came up with an actual THD figure very close to the 0.007% claimed by Denon.

Using the "silent" track of the CBS CD-1 test disc, I obtained signal-to-noise ratios of 94.8 dB for the left channel and 93.4 dB for the right channel. Both figures are well above Denon's claimed 90 dB. A spectrum analysis of this residual noise reveals that much of the noise is at the low-frequency end of the spectrum (see Fig. 12).

Separation was considerably worse than I have been obtaining for most home CD players: 60 to 62 dB at mid-frequencies, decreasing at 125 Hz to 51.5 dB and at 10 kHz to 47.5 dB for one channel and 53.5 dB for the other. These results are shown in Fig. 13.

My major disappointment in the DCC-8970's CD performance came when I tested its linearity, or, to put it more correctly, its deviation from linearity. Figure 14 reveals the problems. Using undithered signals, deviation was off by nearly 5 dB at 80 dB below maximum recorded level. The deviation was greater when I tried to measure down to −100 dB, using the dithered signals available on the CD-1 test disc. At a level of −90 dB, the left-channel linearity was off by +7 dB while the right-channel deviation had already "run off the graph," which is calibrated to a maximum deviation of ±10 dB!

Using the "better" of the two channels, results of the fade-to-noise test, shown in Fig. 15, confirmed these readings. This test did, however, reveal that dynamic range, applying the EIA Standard, was far better than claimed, or about 111 dB, while the EIAJ method yielded figures of only 83.6 dB for the left channel and 82.8 dB for the right.

My usual single-pulse test showed that the CD section of the DCC-8970 does not invert signal polarity. The only other electrical measurement made for the CD player section was a check of its clock accuracy. Using a 20-kHz test signal (actually, 19,997 Hz), I found that pitch was off by 0.014%. Middle A, having a pitch of 440 Hz, will therefore be reproduced at a frequency of 439.9384 Hz, just in case you are concerned about such minuscule deviations from "perfect pitch."

All that remained for me to test was the performance of the DCC-8970's preamplifier section, or, more specifically, the range of its tone and loudness controls. Tone control range is shown in Fig. 16. In my view, the bass control's range seems a bit excessive considering that not every car audio user is going to install hundreds of watts worth of power amplifiers. I have no problem with the 10-dB boost and cut values available at 100 Hz (they correspond to Denon's published figures). However, I am a bit troubled by the fact that output continues to rise instead of "shelving"

On FM, the DCC-8970's sound was notable mainly for its spaciousness; the Denon presented a wider sound stage than my reference unit.

below 100 Hz, reaching around 13.5 dB at 30 Hz in the maximum boost setting.

The action of the loudness control was likewise somewhat strange, as seen in the plots of Fig. 17. At a volume control setting of 30 dB below maximum, bass compensation is exactly +10 dB, as claimed. Treble boost, however, is also about +10 dB at the high-frequency end of the spectrum and continues to increase even further at super-audible frequencies. I have been emphasizing for some time that treble loudness compensation, if required at all (and most experts maintain that it is not needed), should be far less than this.

In view of the fact that Ivan Berger would be listening to this head unit in its "natural" car environment, I saw no point in conducting extensive listening tests in the "unnatural" environment of my lab and office. Yet I did want to check out the tracking stability of the unit when subjected to external vibration and shock. My tests can hardly be described as scientific, since they consisted largely of tapping the case of the DCC-8970 with ever-increasing ferocity. I am always amazed when I encounter a car CD player mechanism that is so well isolated from the outside world that it takes almost a hammer blow to cause it to mistrack. Such was the case with the Denon, and I was very pleased with its stability when subjected to this kind of abuse. As for the DCC-8970's performance on the road, I will be most eager to read Mr. Berger's comments concerning tuner sensitivity and CD player linearity. If his assessment is totally positive, it may well suggest that things are not nearly as critical to listeners in a car environment as they are in the quiet environment of a home listening room. That's a conclusion I have suspected for some time anyway! *Leonard Feldman*

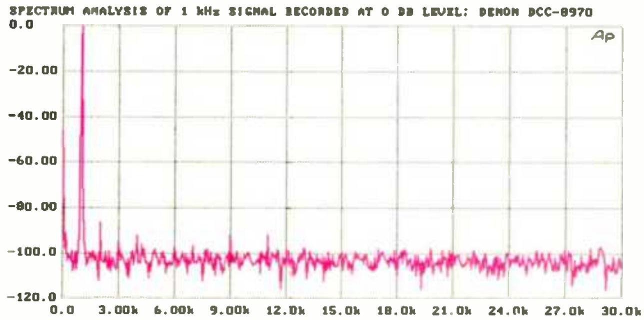


**Fig. 11—Spectrum analysis of 1-kHz signal at 0-dB (maximum) recorded level.**

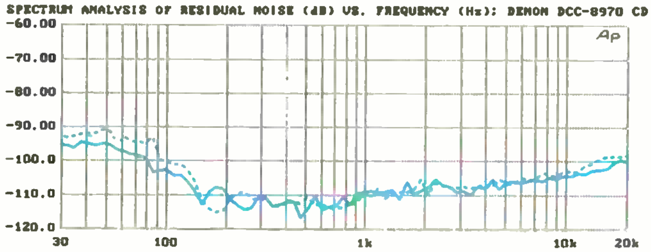


**Fig. 12—Spectrum analysis of residual noise when playing "no-signal" track of test CD.**

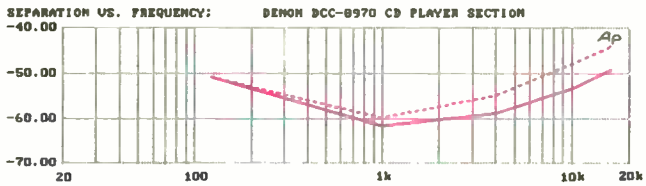


**Fig. 13—Separation vs. frequency for left channel (solid curve) and right channel (dashed curve).**

### Behind the Wheel

The DCC-8970 shows Denon's usual attention to ergonomics: The display is large and clear, and the control buttons are well differentiated by touch. I especially liked the sculptured up/down buttons at the lower left, which change radio stations or CD tracks, and the raised bars at the left edge of each of the six station-preset buttons. The only real lapse in human engineering was the near-universal one of putting more than five buttons in a single long row and making them identical. That's a neat-looking *style* solution (especially in CD players, where the long loading slot nudges the designer towards a horizontal layout), but it's not good *design* unless you make the buttons distinguishable by touch from each other—as Denon did with a shorter, four-button row just above. As our mothers told us all incessantly, just because everybody does it doesn't mean *you* have to. On the whole, however, the controls were very well laid out and the control functions quite well chosen.

Night illumination was very good. With the system off, the ends of the CD slot (though not the slot itself) glow, as do the display and a ring around the volume control. With the system on, the ring glows more brightly, and rings around the bass and treble controls turn on. The eject button looks as if it should light, but the one in my sample didn't. I would have liked better illuminated and larger legends on the subsidiary controls (especially preset scan, which I hit several times by accident), but I understand the difficulty of providing them. The "DSP" legend on one button, incidentally, stands for display mode, not digital signal processing.

"This was one of the more straightforward CD/tuner units to install," according to Tony Igel of Stratford Sound Room in New York, who does all of my test installations. The leads are all marked very clearly, with contrasting black lettering on white plastic collars, and there are no outboard chassis aside from two small boxes (probably filters) in the power leads, each measuring only about 1 × 1¼ × 2 inches.

As to FM performance, neither in the city nor the country did the DCC-8970 I road-tested (a different unit than the one Len Feldman used for his measurements) receive as many

**All in all, I found the DCC-8970 to be a good CD player and a decent FM tuner, packaged with Denon's usual ergonomic expertise.**

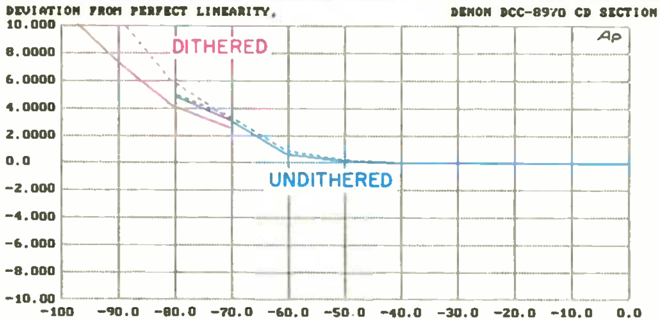


Fig. 14—Deviation from perfect linearity for undithered signals from −80 to 0 dB and for dithered signals from −100 to −70 dB.

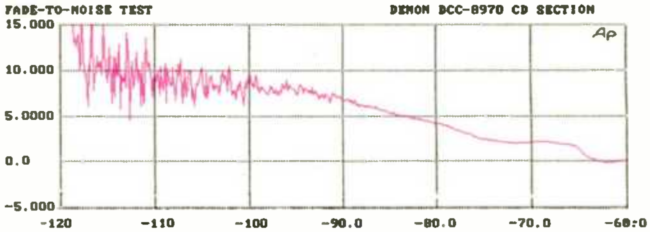


Fig. 15—Fade-to-noise test for linearity deviation.

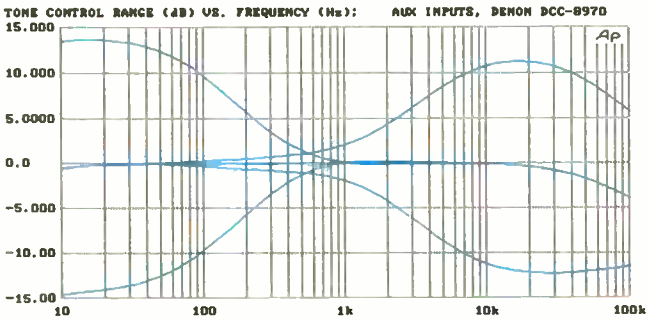


Fig. 16—Bass and treble control range.

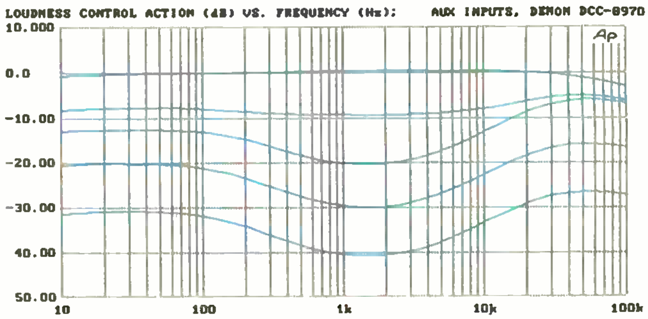


Fig. 17—Loudness compensation for volume control settings from 0 dB (highest setting) to −40 dB.

stations as clearly as my Soundstream reference unit did. The Denon sounded more spacious, with a wider soundstage, but did not sound as warm or clear as the reference did. Still, bear in mind that the Denon, with CD, costs only $21 more than my reference unit, with tape, last sold for; Denon obviously put more of their efforts into the CD section than the tuner.

I didn't do much AM listening with the DCC-8970. Its extreme treble roll-off helped cut interference, but it also made the sound too dull for pleasurable listening. Car stereo manufacturers should realize that AM performance is far more important in car radios than in home units, but perhaps this is true only in this country—I note that good AM is most often found on Delco tuners, which are among the few still made here.

If the tuner was a disappointment, the CD section was, by and large, a pleasure, even though the Denon did not sound quite as clean as some other CD players I've used. This was most noticeable on some discs of soprano voices; the innate shrillness I could hear when playing these discs on home and other car systems seemed slightly exaggerated through the Denon. With all other discs, however, the sound was fine.

The Denon's CD section handled all but major bumps quite well; when a bump did mute it momentarily, it would soon pick up again from the spot where it had left off. It also began from its last stopping place when it was shut off (either by its own knob or by turning the ignition off). When it was removed from the car and reinserted, it would restart from the beginning of whatever track had been interrupted.

Pausing or ejecting the CD does not automatically turn the tuner on, which I find a blessing. You can, however, put the CD into pause at any point and turn the tuner on. If a CD is still loaded, you can resume play from tuner operation whenever you like.

All in all, I found the DCC-8970 a good CD player and a decent FM tuner, packaged with Denon's usual ergonomic flair. *Ivan Berger*

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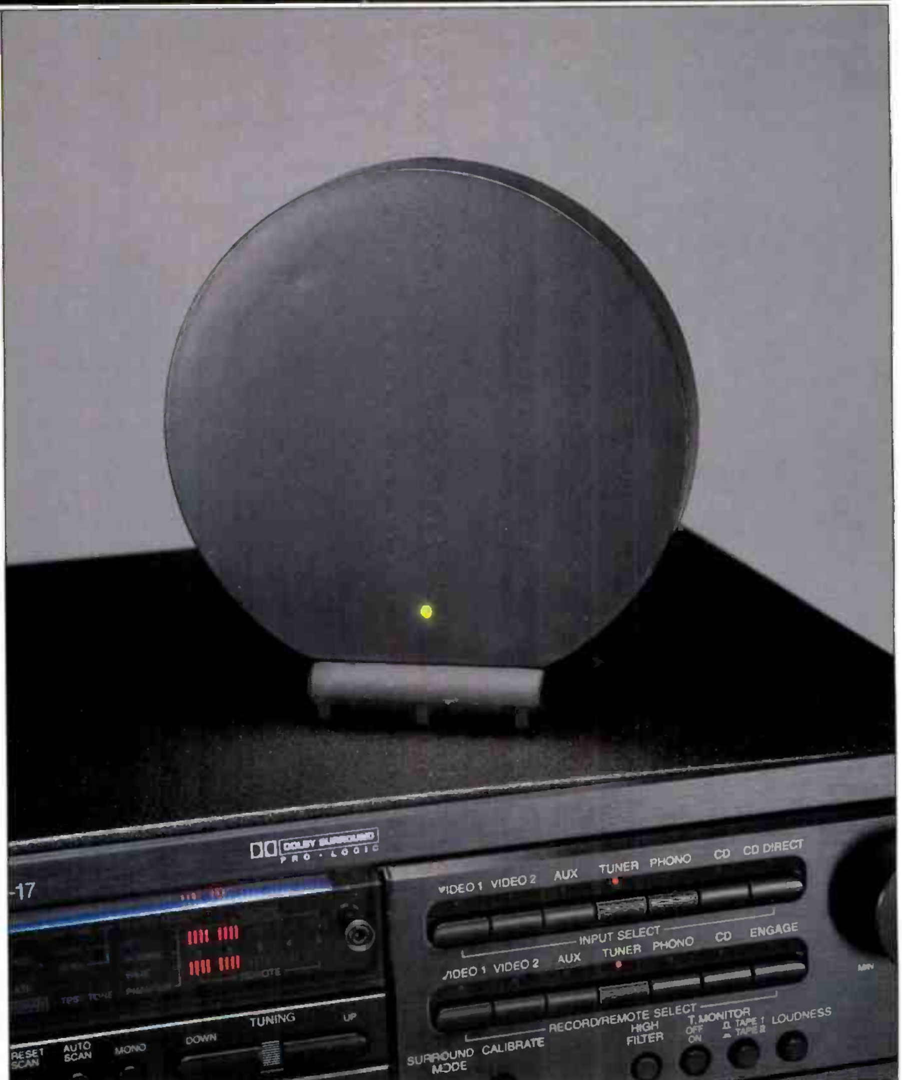
# TERK TECHNOLOGIES MODEL Pi$^2$ FM ANTENNA




**Manufacturer's Specifications**
**Amplifier Gain Range:** –20 dB to +38 dB.
**Twin-Tone Modulation Distortion:** Less than 0.1% at 100 mV input.
**Noise Figure:** 1.5 dB.
**Impedance:** 75 ohms, adaptable to 300 ohms.
**Output Matching Accuracy at 75 Ohms:** SWR (Standing Wave Ratio) less than 1.2:1.
**Operating Frequency Range:** 88 to 108 MHz.
**Pickup Pattern:** Directional or omnidirectional.
**Dimensions:** 5 in. in diameter by 1 in. thick.
**Price:** $79.95.
**Company Address:** 56 Harrison Street, New Rochelle, NY 10801.
For literature, circle No. 93

It's been some time since I tested the Terk Technologies Pi indoor FM antenna, and when Editor Gene Pitts asked if I thought it might be worth testing the second generation model of that unique amplified indoor FM antenna (appropriately called the Pi$^2$), my first reaction was that it probably was only a cosmetic change over the earlier design. Just to make certain that I wasn't being too cynical, I put in a call to Larry Schotz, the well-known designer who created the electronics for the original Pi antenna and who was also responsible for its redesign. Schotz assured me that the Pi$^2$ had a lot more going for it than did the original Pi. Since I have never known him to exaggerate (when it comes to his r.f. designs, if anything, he tends to be too modest), I decided a test of the new design might be in order. In terms of its appearance, the Pi$^2$ is about the same size as its predecessor—not much larger in diameter than a Compact Disc. Its size and shape make it possible to place the unit anywhere, even on top of your tuner, receiver or on the shallowest of shelf arrangements.

About the only physical difference I could detect between this model and the earlier Pi was a small foot on the rear of the circular antenna housing, near the top of the housing when the antenna is upright, in its directional receiving mode. When the Pi$^2$ is laid flat for omnidirectional reception, it rests on this foot and the edge of the smartly styled built-in stand. I soon discovered, however, that this little supporting foot is also the knob of a control that varies the gain of the amplified antenna from –20 to approximately +38 dB. Why would you ever want to have "negative gain" (otherwise known as a loss in signal strength) with an indoor FM antenna? I'm sure anyone who lives within a few hundred yards (or even a mile or two) of an FM station's transmitter can answer that. As my late mentor Murray Crosby used to say, under those conditions, "you can pick up the signal with a wet string for an antenna." There are times when so much signal is an undesirable thing, and that's when the counterclockwise setting of the little knob on the Pi$^2$ is welcomed.

Still, most purchasers of this little indoor FM antenna will probably choose it for its ability to amplify weak FM signals without adding noise, and it was with that purpose in mind that most of my tests were conducted. The circular

**This Pi² carries the same price as the Pi antenna, yet runs rings around it in actual performance.**

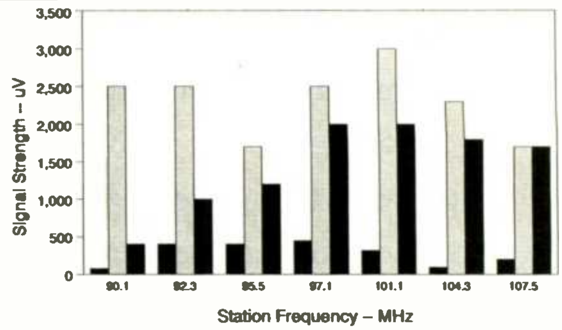
antenna rests in its horizontal position for omnidirectional reception or, optionally, it can be positioned vertically and oriented for best reception of weaker signals. A single 75-ohm shielded cable to the antenna provides operating power for the antenna and also carries the received r.f. signal back to the FM tuner or receiver. As was true of the earlier model, the Pi² comes with an impedance-matching transformer and with a separate power adaptor. If your tuner or receiver is equipped with a switched a.c. receptacle, the adaptor can be plugged into such a receptacle and will then only draw power when the tuner or receiver is turned on. However, even if you leave the a.c. adaptor plugged into a live receptacle at all times, it's not likely to affect your electric bill much, as the Pi² consumes only a watt or so of power.

My tests consist of measurements and comparisons of the antenna against the performance of a standard indoor wire-dipole antenna. Once I've satisfied myself that the powered antenna actually increases signal levels available at the antenna input of a tuner, I subject the antenna to extensive use and listening tests. I'll have more to say about those tests shortly.

**Measurements**

To conduct the comparison tests, I mounted a simple dipole antenna on an outside wall of the lab, orienting it for best reception for station signals arriving from the west. (The lab is located almost 20 miles directly east of New York City, where most of the station transmitting antennas in my area are located.) Using a Blonder-Tongue Model FS-2 field-strength meter, I tuned in several signals with the dipole connected to the field-strength meter and noted their frequency and their signal strength.

Next, I connected the Terk Pi² antenna to the field-strength meter and tuned to the same frequencies as before, alternately orienting the Pi² for strongest signal when it was vertically positioned and also measuring signal strength when the antenna was mounted horizontally (flat on the test bench). The results, depicted in the bar graphs of Fig. 1, pretty well speak for themselves. For all of the signals checked, the Pi² outperformed the dipole, regardless of the Terk antenna's orientation. For one signal frequency (107.5 MHz), the horizontal (omnidirectional) orientation provided the same signal strength as I got from the vertical (or directional) orientation after I had aimed it for maximum signal strength. Table I shows the maximum improvement in signal strength, compared to the reference dipole, when the Pi² was oriented for greatest signal strength.




**Signal-strength comparisons. For each station, left-hand bar shows signal strength with standard dipole, center (shaded) bar shows results with Pi² in directional mode, and right bar shows Pi² in omnidirectional mode.**

I checked back to my test results for the original Pi antenna and found that for those station frequencies common to both tests, results were consistently better with the Pi²—in some cases by as much as 6 dB or more.

**Use and Listening Tests**

As impressive as the lab results may be, the real proof of performance comes in the listening tests. FM performance is judged primarily in terms of signal-to-noise ratio, and if an amplified antenna adds as much noise as it does increased signal levels, it is worthless. The nice thing about this latest Schotz-designed circuit is that, while it amplifies the incoming signal, it adds less noise than my tuner's front-end, so I get quieter results listening with this amazing little antenna than when using a passive dipole. (*Editor's Note:* Under worst-case conditions in mid-town Manhattan, I found that the Pi² was a touch noisier than a set of passive rabbit ears, that the Pi²'s attenuator was effective in dealing with overly strong stations, and that antenna orientation wasn't a question with the Pi² because of the extreme level of multipath in my area.—*I.B.*) However, perhaps the most amazing fact about this new and much improved version of the Pi antenna concept is that it carries the same suggested retail price as the earlier model, yet runs rings around it in actual performance.

**Table I**—Increase in signal strength with Terk Pi² in directional mode, oriented for maximum pickup, compared to reference dipole.

| Station Frequency, MHz | Maximum Increase, dBf |
|---|---|
| 90.1 | 29.9 |
| 92.3 | 16.0 |
| 95.5 | 12.6 |
| 97.1 | 14.9 |
| 101.1 | 19.5 |
| 104.3 | 27.2 |
| 107.5 | 18.6 |

In my listening tests, with the Pi² hooked up to my reference tuner, I was able to log 48 usable signals, 45 of them in acceptably noise-free stereo. Since I am at a pretty good distance from most station transmitters, I found no need to turn down the gain of the amplifier stage to overcome overload conditions. I am fairly certain, however, that many users of the Terk Pi² will find this "negative gain" capability to be a very positive feature. As in all my previous tests of indoor FM antennas, I am not suggesting that the Terk Pi² can adequately replace a multi-element outdoor FM antenna. But as was true with the less formidable Terk Pi, for the apartment dweller who can't install such an outdoor antenna or even for the homeowner who prefers not to, the Pi² goes far beyond any similarly sized antenna that I've measured. Its small size should appeal to the less technically oriented members of the family, while its performance is sure to please the FM radio enthusiasts in the household. *Leonard Feldman*

# MEMOREX COMPACT DISC REPAIR AND MAINTENANCE KIT


**Company Address:** Memtek Products, P.O. Box 901021, Fort Worth, Tex., 76101.
For literature, circle No. 94

More than two years ago, Editor Gene Pitts sent me a crudely packaged CD repair kit which, he said, had been developed by Harald Schmid of West Germany. I was to try it out on some damaged CDs that would no longer play through, even on my best reference CD player. There was no shortage of such discs in my collection, so I decided to give the repair kit a try. I must admit, however, that when I first read the English-language instructions (rather poorly translated from the German), my skepticism increased. Included in the kit were four grades of *sandpaper*! They were labeled X (for the coarsest grade), 1, 2, and 3. For minor scratches, I was to start with the number 2 sandpaper, first moistening the scratched area of the CD with a few drops of water. I was then to proceed to sandpaper number 3, with sanding motion applied at a different angle from the back-and-forth motion used with the coarser sandpaper. This was to be followed by an application of a special polishing fluid, supplied in a small packet similar to those towelette packages we are sometimes given on airplanes. The polishing was to be done using a special yellow cloth, with the cloth moved in a straight line, back and forth, until all evidence of the preceding sanding steps was gone. After polishing, the CD was to be washed with warm water and dried by dabbing it with a lint-free paper towel or tissue.

I wanted to make the test as tough as possible, so instead of trying to repair a minor scratch, I deliberately put a major scratch into the surface of a CD that I hadn't cared too much for in the first place and was ready to sacrifice to the cause of scientific research. For a scratch this serious, the instructions told me to start with sandpaper X, followed by sandpapers 1 through 3 in that order. Before I even began the repair, I wanted to make sure that this damaged CD would not play on any of the machines I had on hand. It didn't! Then, fully convinced that this was another "magic kit" that would fall far short of expectations, I grudgingly but carefully followed the instructions.

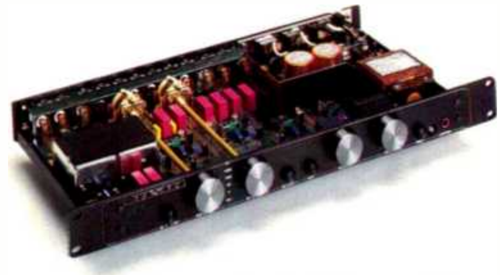
To my utter amazement, when I was finished, not only was there no evidence of the deep scratch on the surface of the disc, but it played through the section that had been scratched even on the most inexpensive portable CD player that I had on hand (a player—I might add—that mistracked and muted when asked to play through even the most minor, almost invisible surface scratches). My skepticism turned to complete enthusiasm as I proceeded to repair several other damaged discs.

**My skepticism about this CD repair kit turned to complete enthusiasm as I began to repair several other damaged discs.**

Since that test nearly two years ago, I have been inquiring of Editor Pitts as to whether the repair kit was available in the U.S. All that time, Mr. Schmid kept seeking proper distribution of the product and now, happily, Memorex is the winner. All of us who own treasured CDs that have become useless because of accidental scratches are winners as well. Memorex has retained all of the elements that were in the original kit, now nicely packaged in a CD "jewel box," with enough material to repair a dozen CDs. As an added attraction, they've also included packets of cleaning solution for those discs that merely have accumulated finger prints, oil stains, or other dirt on their surfaces. The only other change from the original kit that I noticed was the fact that the English instructions were now easier to understand! Oh yes, the suggested retail price of the Memorex kit is $14.95. That's a lot cheaper than having to replace 12 damaged discs with new ones.

*Leonard Feldman*

## ANNOUNCING THE BRYSTON TWENTY YEAR WARRANTY



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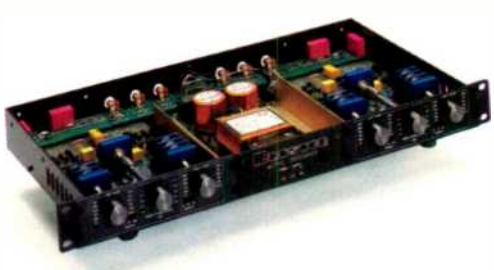

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# FAMILY BUSINESS


Illustration: Rick Tulka

**C.P.E. Bach: Cello Concertos.** Anner Bylsma, cello; Orchestra of the Age of Enlightenment, Gustav Leonhardt.
**Virgin Classics VC 7 90800-2,** CD; DDD; 70:11.

In two generations, the Bachs covered three generations of composers. Papa Johann Sebastian was, of course, a (nay, *the*) towering figure of the high baroque. His youngest son, Johann Christian, 3½ years younger than Haydn, was a composer of the classic school. He learned his trade at his father's knee until he was 15, when J.S. died. He then moved in with his older half brother, from whom he also learned, before moving on to Italy to complete his musical education.

That half brother, Carl Philipp Emanuel Bach, was of a distinctly different generation from either: His was the era of the enlightenment. Indeed, the most important period of his life was spent as a resident accompanist and, less importantly, composer to that most enlightened of monarchs, Frederick the Great of Prussia. The duties demanded of the accompanist by the flutist/king were sufficiently onerous that Bach had already begun seeking another post by the time these concertos are believed to have been composed, in the early 1750s.

The disc's excellent notes by Mark Audus point out that it is unknown what instrument may have appeared as solo in the original scores of these concertos, since several versions exist. The only extant autograph is that of the cello version of the A major—the first of the three as presented here. Nor is it known for whom they may have been written, though Audus presents a reasonable hypothesis. But that one autograph gives particular legitimacy to the cello versions. In any event, arrangements were hardly disparaged two centuries ago the way they are now.

As a child of the humanist enlightenment, C.P.E. was not given to anything like his father's cosmic spirituality. The contrast and drama in his music are of an altogether neater, more self-contained sort. And the material is handled with professional craftsmanship, if not with anything that smacks of genius.

Gustav Leonhardt leads the proceedings with a stylish hand; one would expect no less of him. The Orchestra of the Age of Enlightenment plays with little vibrato and much security. (Of particular interest to specialists, the booklet lists the provenance of each instrument.) Anner Bylsma, by contrast, allows a touch of Romantic sentiment to creep in from time to time. The disparity is not disturbing, however, and his more personal style helps keep his somewhat woolly cello sound out in front, clear of the accompaniment's clean cutting edge.

The recording, which was made in All Saints' Church, in Petersham, England in November of 1988, preserves very accurately the perspective of hearing a performance from, perhaps, the third row in such a space. The band is near but surrounded by plenty of reverberant space. The space is so live, in fact, that the engineers evidently had a problem with the pauses between movements. This is noticeable particularly after the A major concerto's opening allegro, where you can hear the "air" being closed down for several seconds. Since this destroys the illusion of continuous performance, it is regrettable—particularly when the engineering is otherwise immaculate.

*Robert Long*

**Giuseppe Taddei Singt Arien und Lieder.** Giuseppe Taddei, baritone; Orchestra of the San Carlo Theatre, Ugo Rapalo; The Gian Stellari Orchestra.
**Preiser 90020,** CD; AAD (mono); 70:39.

Taddei was a fine singer with an engaging personality, but he was not a great international star. Preiser, which is among the most impressive of independent labels specializing in the reissuing of "old" records on CD (or, formerly, LP), has combined groups of arias and Neapolitan songs to create this souvenir. As far as I can tell, they've done a fine job with it, and the arias include only a very few hackneyed numbers.

That half of the recital begins with "Ah per sempre" from *I Puritani* (Bellini) and "Vien, Leonora" from *La Favorita* (Donizetti), continues with a Verdi group ("Eri tu" from *Un Ballo*, "O Carlo, ascolta" from *Don Carlos*, and "In braccio alle dovizie" from *I Vespri Siciliani)*, and concludes with three *veris-*

mo excerpts, from *Andrea Chénier* (Giordano), *Adriana Lecouvreur* (Cilea), and *L'Arlesiana* (also Cilea). Taddei sings some of them in rather rough-and-ready fashion, but his hearty, unfettered style is very agreeable.

The songs suffer from rather overblown accompaniments, however, and Taddei's habit of pushing the final note to punctuate the end is more obvious here than in the arias. Again, he's hearty and agreeable.

But what of the provenance of this material? The only clue is a line on the back cover containing a vague allusion to PolyGram Records. The notes (in German only) in the one-sheet "booklet" state coyly that solo recordings of Taddei are few and far between (he appeared almost exclusively in complete opera recordings) but leaves it at that. There is quite audible hiss, which could actually be surface noise from those superbly quiet postwar 78s from Deutsche Grammophon, or it could be from the master tapes from a pair of LPs. I just can't tell. The consistency of the sound within each half argues in favor of LP originals; the rather boxy orchestral sound at times argues in favor of an earlier date.

If Preiser is going to retain its place as an important supplier of such material, it will have to become more fastidious in its documentation. For one thing, it will have to avoid the appearance of conning the public into buying such mono CDs on the assumption that they are modern recordings. This one certainly is not. *Robert Long*

**Reubke: Sonata for Organ in C Minor, "The 94th Psalm"; Sonata for Piano in B-Flat Minor.** Jean Guillou, piano and organ.
**Dorian DOR-90106,** CD; DDD; 49:50.

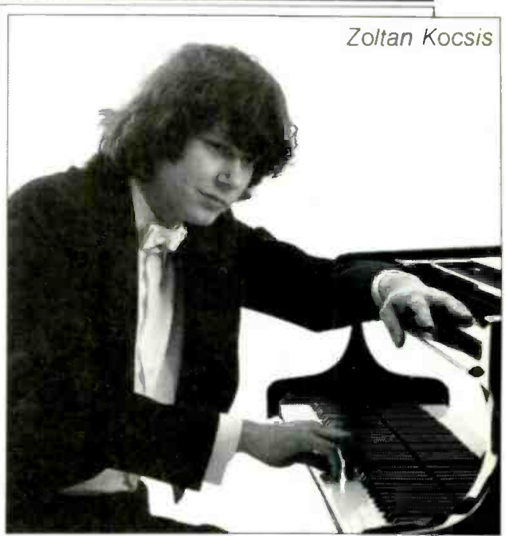
Julius Reubke's famous C-Minor Organ Sonata, "The 94th Psalm," has been a dramatic display piece for organ virtuosos for many years. This Dorian CD combines the sonata with a Reubke piano sonata, which is not of the musical caliber of the organ work and is best regarded as an adequate "filler" on this disc.

Organist Jean Guillou provides a dazzling performance of "The 94th Psalm," showing off his mastery of registration and emphasizing the orchestral elements of the work. He is aided by the truly awesome organ sound captured by engineer Craig Dory. The organ is a huge Aeolian-Skinner instrument housed in Trinity Church in New York City. The church has a reverberation time of about 3.5 seconds, but even rapid passages do not evolve into an amorphous wash of sound. This organ has a particularly impressive pedal division: The Untersatz, Violone, and Contra Bombarde each have a dozen 32-foot-long pipes! The 16-Hz fundamentals of these pipes are accurately recorded, and if you have the requisite loudspeakers and amplifiers capable of reproducing these frequencies, their seismic output will rock the foundations of your listening room! Add to this all the other resources of this great organ, including some extremely brilliant, high-intensity trumpet stops, played "en Chamade," and you will hear sound of immense power and majesty. For organ afficionados, this CD is a must! *Bert Whyte*

**Liszt: The Piano Concertos; Dohnányi: Variations on a Nursery Song.** Budapest Festival Orchestra, Ivan Fischer; Zoltan Kocsis, piano.
**Philips 422 380-2,** CD; DDD; 60:37.

Young Hungarian pianist Zoltan Kocsis might well be the reincarnation of Franz Liszt in his exciting and tempestuous performances of Liszt's two piano concertos.


*Jean Guillòu*


*Zoltan Kocsis*

This is piano virtuosity in the grand Lisztian manner, with the flamboyant and extravagant scoring of these piano concertos played with the florid embellishments and fustian bravura needed to convey their essence. Kocsis has technical security, quicksilver responsiveness, and clean articulation even in the most intricate passages. Ivan Fischer provides a most sympathetic accompaniment with the Budapest Festival Orchestra.

To make this CD even more attractive, Kocsis provides a brilliant reading of Ernst von Dohnányi's great "fun piece," his "Variations on a Nursery Song." From its portentous large-scale orchestral introduction and the quoting of the nursery theme on the piano (based on "Twinkle, Twinkle, Little Star"), through the 11 delightful variations covering a wide gamut of musical styles and textures to the wonderful complexities of the fugal Finale, this is a most ingratiating work.

Ernst von Dohnányi was the grandfather of Christoph von Dohnányi, the current conductor of the Cleveland Orchestra. I recorded the elder von Dohnányi in some Beethoven piano sonatas and his own "Ruralia Hungarica" in Everest's studio in Bayside, New York, in 1960. Three days after the sessions, he died at age 83! Fortunately, his music lives on in this splendid recording.

Throughout this CD, the sound is exemplary, always clean, clothed in a warm ambience, and with just the right balance between piano and orchestra. *Bert Whyte*

In these two new works, John Adams attains a level of intensity matched by only a few of his contemporaries.

**Adams: "The Wound Dresser"; "Fearful Symmetries."** Sanford Sylvan, baritone; Orchestra of St. Luke's; John Adams, conductor.
**Nonesuch 792182,** CD; DDD; 47:09.

How long since a new work by a contemporary composer moved you? A quotation from John Adams in the accompanying leaflet sent me back to Ernest Jones' three-volume biography of Sigmund Freud, where he reports a four-hour psychoanalytic stroll Gustav Mahler took with Freud in Leyden in 1908: "In the course of the talk Mahler suddenly said that now he understood why his music had always been prevented from achieving the highest rank through the noblest passages, those inspired by the most profound emotions, being spoilt by the intrusion of some commonplace melody. His father, apparently a brutal person, treated his wife very badly, and when Mahler was a young boy there was an especially painful scene between them. It became quite unbearable to the boy, who rushed away from the house. At that moment, however, a hurdy-gurdy in the street was grinding out the popular Viennese air 'Ach, du lieber Augustin.' In Mahler's opinion the conjunction of high tragedy and light amusement was from then on inextricably fixed in his mind, and the one mood inevitably brought the other with it."

Now listen to Adams: "Only recently have I noticed an odd fact about my work. It seems to alternate between two opposing polarities: Along with every dark, introspective, 'serious' piece there must come the Trickster, the garish, ironic wild card that threatens to lose me whatever friends the previous composition might have gained. . . . 'The Wound-Dresser' seemed to flow directly out of 'Fearful Symmetries.' . . . It's more like being engaged in a kind of psychic balancing act, dark alternating with light, serene alternating with jittery, earnest alternating with ambiguous."

"Fearful Symmetries" (which has nothing to do with William Blake's "Tyger") chugs along like an occasionally jazzy dynamo, with saxophones, synthesizer, and other instruments seemingly improvising against an implacable ostinato background; Graham Greene would have called it an "entertainment." It amuses and intrigues the listener, but for musical importance it can hardly hold a candle to "The Wound-Dresser," the most affecting piece of music to come my way in a long time.

One would not expect Adams, a family man, to empathize so sympathetically with the emotions that almost pulled Walt Whitman apart as he ministered to wounded young Civil War soldiers (and which he recorded in "Drum Taps"), but he has infused this concert aria (19:06) with an almost excruciating poignancy. As Sarah Cahill writes in her exemplary commentary, "Critics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**Imai and Goldsmith infuse these works with joy, while balancing the resignation and taut playing required by the sonatas.**

have already noted its relevance to the issue of AIDS, and we will all feel personal resonances when hearing the poem to Adams' setting. While he was working on this piece, his own father was dying of Alzheimer's disease and his mother was devoting her life to vigilantly caring for him. 'I was plunged into an awareness,' remembers Adams, 'not only of dying, but also of the person who cares for the dying. The responsibility is tragic and also incredibly exhausting, and the bonding that takes place between the two is one of the most extraordinary human events that can happen—something deeply personal of which most of us are completely unaware.' "

John Adams' music, performed to perfection here, makes all of us aware—and with an intensity few composers today have attained. "The Wound-Dresser" gives rise to the hope that John Adams, now 43 and already imposing, may with time develop into a great composer. *Paul Moor*

**Brahms: The Two Viola Sonatas; Two Intermezzi; Capriccio.** Nobuko Imai, viola; Harris Goldsmith, piano.
**Stradivari Classics SCD-6097,** CD; DDD; 52:13.

This is gorgeous music that has not yet been overrecorded. If you do not know these two sonatas, originally written for clarinet and later scored by Brahms for viola (and less successfully for violin), you have a rare treat in store.

The viola poses problems as an instrument. To obtain the best sound, its range and tuning actually call for an instrument of great size, such as Ritter's viola alta of the 19th century or the viola pomposa of Bach's time. Today, these are uncommon instruments. The standard viola is still a sizable member of the violin family and is about as big as an under-the-chin instrument can be and remain playable. In less than capable hands, it's an embarrassment. Nobuko Imai, one of the top players of her instrument, is not only technically impeccable but musically insightful and possessed of the sort of lyricism absolutely necessary in Brahms.

Pianist Harris Goldsmith, well known as a tart-tongued and perceptive music critic, is far more than a sometime pianist. Here, his way with Brahms is totally convincing and conveys a deep understanding of this heartfelt idiom. To Imai's supple, warm playing of the alto part, he brings a substance and conviction completely free of mannerisms and idiosyncratic notions. This is about as honest and rich Brahms playing as you will find on record. Given that these sonatas are Brahms' final chamber music, there is a special quality to be evoked. (These works were composed after a return from a self-imposed withdrawal from public life—self-imposed because Brahms thought he had no more music to


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Robert Shaw's dozens of big choral performances now set the norm from which other performers may deviate, but only at their own risk.

write.) Imai and Goldsmith infuse these works with joy while balancing the resignation and taut ensemble playing required by the sonatas. Goldsmith is both reflective and clear-eyed in the two very late Intermezzi for solo piano (Op. 116, No. 4 and Op. 118, No. 1). The Capriccio (Op. 76, No. 2) dates from 1878, and, says the pianist in his fine notes, "the charmingly treacherous piece bounces along in the fashion of one of the 'Hungarian Dances.' "

Veteran producer and engineer Max Wilcox recorded the sonatas in 1983 and the three piano pieces in 1988. As one would expect of a man of his caliber and experience, the piano sound in both sets is superb and consistent. The American Academy of Arts & Sciences, in New York City, provides a quiet, generous acoustic backdrop for the music on this excellent disc.

*Christopher Greenleaf*



**Vivaldi: Gloria; Bach: Magnificat.** Atlanta Symphony Orchestra, Robert Shaw; Dawn Upshaw, soprano; Penelope Jensen, soprano; Marietta Simpson, mezzo-soprano; David Gordon, tenor; William Stone, baritone.
**Telarc CD 80194,** CD; DDD; 56:15.

Robert Shaw, the celebrated ex-boy wonder of American choral music and the inventor of the "chorale," is now an amiable gray-haired leader of a medium-city symphony and its associated chorus, tapping for its audiences a reasonably large if yeasty cultural megalopolis around the big Georgia city—where he can do the Shaw "thing" to knowledgeable musical listeners and at the same time make CDs with a sympathetic and affluent record company, Telarc. Result: Shaw is doing up the entire big-piece standard choral repertory (American division) in dozens of CD performances that are precisely, and benignly, as standard as the works themselves. Not exactly venturesome. But worthwhile in a high-level standard way.

The quantity of output is astonishing—I can only write a sort of omnibus guide and review for all of them, stemming from the two particular works above. Shaw has done, for instance, all the Requiems from Mozart to Duruflé via Verdi, Brahms, Fauré and more; also the large masses: Beethoven Missa Solemnis, Bach B minor, and Mozart C minor, as a matter of course; also, needless to say, Messiah. And with these whopping biggies, much of the ancillary—practically all of it—from Borodin's "Polovtsian Dances" to Orff's "Carmina Burana," Stravinsky's "Symphony of Psalms," Hindemith's "When Liliacs . . . ," the shorter heavy Brahms pieces, and on. You name it, Shaw's taped it. Or is in the process. Sort of a recorded encyclopedia of big-chorus music with solos and orchestra.

It isn't easy to evaluate this present mature Shaw. Standard is the best word, and in numerous ways this is not

In Chandos' Ravel and Fauré recording, the excellent piano sound is well served by excellent hall acoustics.

at all derogatory. His conducting is precise, the music well tailored and rehearsed, beautifully controlled, the chorus accurate and indefatigable, just that Shaw-ish combination of "amateur" blending and professional exactitude that he originated in his Collegiate Chorale so many years ago. His tempi are right and never disturbing, very much of today, the externals are up-to-date (harpsichords, etc.) if not exactly pioneering—an excellent continuo section, for example, in this recording of Vivaldi and Bach.

And yet nothing is really penetrating or profound. It is all very smooth and well oiled, but not inspired. Nor taut, where tightness means musical communication in-depth. His soloists are strictly of the current standard popular sort for these big works, with no apparent thought as to what more could be done for a deeper, more affecting vocal impact. Standard all the way—to the usual American heavy vibratos and, without exception, each and every high note belted out at top volume. *Is this right, for Vivaldi or for Bach?* It may not be right, but it is standard 1990, and that's Shaw.

Would a more profoundly inspired, even controversial, penetration of the music be preferable? Yes and no. Shaw certainly sets the norm from which others may deviate, plus or minus, at their own risk.

*Edward Tatnall Canby*

**Ravel: Concerto for Piano in D (left hand); Concerto for Piano in G; Fauré: Ballade.** Louis Lortie, piano; London Symphony Orchestra; Frühbeck de Burgos, conductor.
**Chandos CHAN-8773,** CD; DDD; 56:55.

Ravel's two great piano concertos are well served on this Chandos CD. Pianist Louis Lortie offers readings of the "Left Hand" and G major that are taken at a somewhat slower pace than usual, but he concentrates more on the dynamic contrasts, rhythmic expression, and tonal colors of these works. De Burgos is always comfortable with French music, and his accompaniment is entirely convincing.

Chandos rarely gets to use Walthamstow Town Hall as a recording venue. Here they make the most of the opportunity, with the piano just slightly forward of the orchestra, both well projected, with plenty of presence in the warm acoustics. The opening low-level contrabassoon and low strings of the "Concerto for the Left Hand" are very clean, and the subsequent rolling fortissimo bass chords of the piano introduction have huge sonority. Throughout, piano sound is bright and cleanly articulate. The Finale of the G major concerto is exciting, with its jazzy scoring evoking echoes of Gershwin.

The Fauré piece is an odd filler but an interesting contrast to Ravel's sophistication. *Bert Whyte*

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# a.k.a. EAST LOS ANGELES

**The Neighborhood:** Los Lobos
**Slash/Warner Bros. 26131-2,** CD; AAD; 45:23.

Sound: A Performance: B

It's a beautiful day in the barrio . . . .

So it's painted in Los Lobos' latest album, a country-meets-southwest ode to the simple things—you know: Love, family, romance, babies swinging in our arms, and weekends spent dancing the "Georgia Slop." That the music and lyrics are tough, sincere, and only vaguely sweet is a telling sign that the picture comes from a life that these guys know well, one that isn't tainted by stereotype even in the crack-dusted title track about the neighborhood's poor and haunted.

It doesn't hurt that the *The Neighborhood* also brims with guest performers like John Hiatt, Levon Helm (providing substantial vocals on various songs), and drummer Jim Keltner (on just about every cut here). They help give the album a hard-edged sound without adding unnecessary grit. These are, for the most part, rowdy life-affirming songs of celebration and longing, which could have easily gone wimpy on one hand or angst ridden on the other. The balance isn't always perfect—you get lyrics about "turning my night into day" and the occasional dose of instrumental syrup—but there's a solidity here that feels good.

That's evident right from the first track, "Down on the Riverbed," a folk-tinged but dark and ominous song in a minor key. The lyrics abound with nature imagery, and the accompanying rhythm is as driving and inexorable as a thunderstorm. When they uptempo the rhythm even more—as on the rambunctious swing tune, "Georgia Slop," and the rave-ups, "I Walk Alone" and "Jenny's Got a Pony"—well, it's party time.

Los Lobos, true to form, remains big on such traditional Latin American instruments as the guitarrón (an immense guitar), the huapanguera (a large guitar with eight to ten strings), the jarana (slightly smaller than a regular guitar), the requinto jarocho (even smaller), the ukulele-like tiple, and the Japanese koto guitar. The band also employs a smattering of traditional Spanish percussion. Except for the lovely, largely acoustic "Emily," on which Levon Helm plays mandolin, *The Neighborhood*, like the band's previous albums, nestles these traditional elements within a solid rock/pop framework that lets them breathe and play and have fun without turning this into a PBS documentary. In fact, "Angel Dance," a sort of hip nursery rhyme, sounds inspired by Jamaican ska of all things, and the guitar line in "Deep Dark Hole" is as twangy as in any good country song. Throughout the album, the playing is tight, precise, and unshowy, but with well-placed flourishes—clean, real clean.

About the only clunker in the whole package is, sad to say, "Little John of God," a well-meaning but treacly ode to, apparently, an autistic child. (It's dedicated to the kids of the St. John of God School for Special Children, in Westville, N.J.) Nevertheless, this is one *Neighborhood* I'd be glad to hang around. *Frank Lovece*

**Goodbye Jumbo:** World Party
**Chrysalis/Ensign F2 21654,** CD; AAD; 53:36.

Sound: B+ Performance: A

Welcome to 1968!

Karl Wallinger, the force behind this project, released his first World Party album almost four years ago and showed plenty of promise as an artist well-heeled in the mid-'60s music ethic. Although the album was recorded in demo facilities (home recording studio enthusiasts, take note), it fared well on the rock charts and almost managed to yield a hit with "Ship of Fools." Since then, Wallinger has managed to sift through his songs and come up with a batch of consistent and quite pointed observations on *Goodbye Jumbo*, an album that would sit well between *Beggar's Banquet* and *Magical Mystery Tour* as reference points. This is one of those records that would have gained acceptance on the newly created album-rock radio back then and would have spawned several controversial hit singles besides. Whether his record company can pull off a similar coup in today's reactionary climate is questionable, but there are very few followups to promising debut albums that deliver like this one does.

Wallinger's musical history dates back to a stint with The Waterboys, with whom he remained until he found his own voice, sunk back in his chair, and came out sounding like Jagger, Lennon, and Dylan all at once. Not since Tom Petty has rock produced a visionary with such reverence for what preceded him who still has something of his own to say. The first three songs literally quote from "Baby Please Don't Go," "Sympathy for the Devil," and "Please Mr. Postman." Wallinger flaunts these references with style. The man is proud of the records he's listened to, but he does more than just lie back and regurgitate them; he's got something to say both lyrically and musically.

What is his message? With song titles like "Sweet Soul Dream," "Thank You World," "Is It Too Late," and "When the Rainbow Comes," it's not hard to guess—Wallinger is into peace and love, overt ecological consciousness, and is probably the most politically correct (by 1968 rock standards) lyricist we've seen since . . . err . . . Michael Stipe. But World Party's records are the type that shouldn't really offend anyone except major polluters, Charles Keating, and Jesse Helms (he's on the green side more than the left or right side). Those who knew John Lennon say that what really killed Beatle John was knowing that the same people who bought his records voted for Nixon. Karl Wallinger may run into this same dilemma—he's that good. *Jon & Sally Tiven*

**Women in the Room:** Zachary Richard
**A&M 75021 5302 2,** CD; AAD; 41:49.
Sound: B+ Performance: A−

**Where There's Smoke There's Fire:** Buckwheat Zydeco
**Island 422-842-925-2,** CD; AAD; 41:34.
Sound: C+ Performance: C+

The peculiarly American strain of music known as zydeco originated in the bayous of Louisiana with the Cajuns who descended from French colonists who left Acadia for Louisiana. Its lead instrument is the accordion, but not played in any way like the esteemed Lawrence Welk would wield it. In zydeco, the squeeze box has learned to rock, swing and moan the blues.

Buckwheat Zydeco is the nom de guerre of Stanley Dural, Jr. His album, produced by David Hidalgo of Los Lobos, is his third for Island records. It kicks off in overdrive with "What You Gonna Do?" followed by the steaming instrumental "Buck's Hot Rod." But, it then bogs down as it tries for the crossover hit. A duet with Dwight Yoakam on the Hank Williams standard "Hey, Good Lookin' " sounds like a fun idea, but it comes off feeling pedestri-


Buckwheat Zydeco

Photograph: ©David Gahr

an. Later, a go at The Rolling Stones' "Beast of Burden" also plods, and Buckwheat's drive down "Route 66" isn't anything very special either. "Pour Tout Quelqu'un" and the title track liven things up again, but as a whole *Where There's Smoke* doesn't really jell. It's a good-time party music album that works best when it sticks closest to the party music that zydeco traditionally is. It stumbles trying to make grand gestures that attempt to widen its appeal

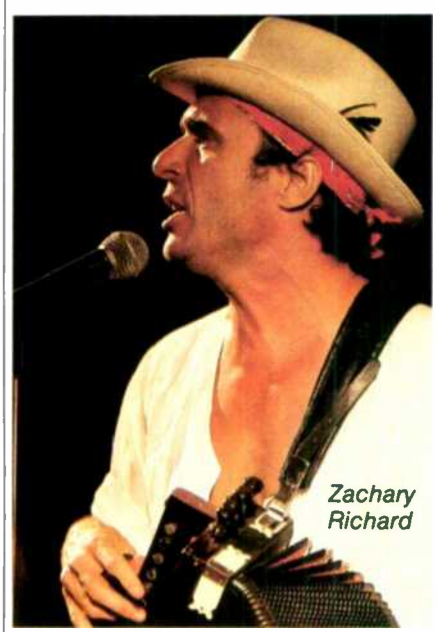
Zachary Richard's album is his first for a major label after more than a decade of putting out albums for independent labels, sometimes microscopic ones. More than Buckwheat, Zachary takes risks attempting to extend the thematic range of zydeco beyond let's party-type songs and in so doing, he reveals some super songwriting chops. The opener, "Who Stole My Monkey," cooks mercilessly. It is a sly and funny song about a very unfaithful woman. "No French, No More" is about how traditional Cajun ways, like speaking French, are being forsaken for mainstream American ways and the pain an older generation feels watching their children change before their eyes. There's a lot of pride in this one as it sports one of Zachary's most chilling vocals over an aching, yearning melody. "Manchac," a lovely and mysterious ture, spins a folk tale of a Creole maiden in love with an Indian brave. It spotlights the Dobro of Louisiana guitar wizard Sonny Landreth. "La Ballade de Howard Herbert," sung in French, is in the grand tradition of the zydeco waltz, while "Zach's Zydeco" and "Take Me Away" are both great zydeco party songs.

Richard's soulful singing and songwriting are very strong throughout, as is his band. That he is not as dependent on zydeco tradition as Buckwheat frees him to make a more personal statement with his music. Additionally, the Richard album has a fuller, brighter recorded sound than the Buckwheat album, which sounds thin by comparison. This may partly be the result of better mastering, but nonetheless it contributes greatly to the excellence of his album. *Michael Tearson*

**Stuck Together with God's Glue:** Something Happens
**Charisma 2-91365,** CD; AAD; 47:53.
Sound: B Performance: B+

Listening to the American debut of the splendid young Irish band, Something Happens, several words spring to mind: Brash, upbeat, and energetic.

*Stuck Together with God's Glue* (smartly produced by Ed Stasium whose credits include Living Colour) displays a song-oriented band which relies on hooks far more than riffs. This band really has a knack for making ear-catching songs that are hard not to


Zachary Richard

Photograph: ©Philip Gould

**Something Happens is a tight little band that keeps its music direct and straight on—no tricks or gimmicks here.**

like, and they have the sense to open their album with two of their best, "What Now" and "Hello, Hello, Hello, Hello, Hello, (Petrol)."

Something Happens is a tight little four-piece band that keeps its music straight on and direct. There are not a lot of gimmicks or tricks here. Just a lot of mostly guitar-driven songs zestfully played. On this record, what producer Stasium does best is stay out of the band's way and let the musicians do what they do best—play.

Back home in Ireland, these guys are already winning favorite-band polls and beating out the heavy hitters. *Stuck Together* shows why.

*Michael Tearson*

**Puta's Fever:** Mano Negra
**Virgin 91352-2,** CD; AAD; 41:16.

Sound: A — Performance: A–

Fasten your seatbelts and get set for a high-speed transcontinental musical juggernaut with ecclectic worldbeaters Mano Negra. While the worldbeat movement shows signs of growing strength and influence, it's unlikely that you've encountered anything like *Puta's Fever* before this.

Mano Negra is a Paris-based rock band—the brainchild of a French-raised Spaniard named Mano Chao—that mixes a blend of exotic rhythms from around the globe, adds a liberal amount of nose-thumbing attitude, and invents a genre that might be called "punk worldbeat." Just to keep you oriented, Mano Negra sings in English, French, Spanish, and Arabic. The band refers to its music as "patchanka," which is a term derived from a provocative Spanish dance. What you'll encounter is a raucous romp through go-go punk on "King Kong Five," rai punk on "Sidi H'Bibi," salsa punk on "Malavida," gospel punk on "The Rebel Spell," reggae punk on "Peligro," polka punk on "Magic Dice," and other punkish hybrids that cover everything from flamenco to heavy metal.

All of this is performed with a raw energy that makes up with enthusiasm anything it may lack in instrumental finesse, resulting in a delightful chaos that somehow makes sense and is awfully fun to listen to. It's certainly original music—a rare thing in these days of highly structured music marketing. Nevertheless, if you're game for a little *outré* for your next party, I suggest *Puta's Fever*.

*Michael Wright*


*Mano Negra*

**Friendly As a Hand Grenade:** Tackhead
**TVT 4060,** CD; AAD; 36:12.

Sound: B– — Performance: B

"Tackhead" is just one of several *nom de tunes* to which guitarist Skip McDonald, bassist Doug Wimbish, drummer Keith LeBlanc, and engineer/mixologist Adrian Sherwood will collectively answer. As frontmen or sidemen, these gents have been known to operate under such musical monikers as Fats Comet and Mark Stewart & The Maffia [*sic*], among others. Working under different names with different band leaders has allowed Tackhead the opportunity to regularly play diverse forms of music and thus stay musically fresh. However, a negative byproduct of using multiple names is a lower degree of fan and industry recognition—a problem the group suffers from in the United States. One problem these guys don't suffer from, though, is a lack of talent.

In a previous musical life, Wimbish, LeBlanc and McDonald were the rhythm section responsible for much of the groove emanating from the New Jersey studios of Sugar Hill Records, once the primary mover in the development of rap. Sherwood (Depeche Mode, Prince Far I), meanwhile, was developing independently in England—engineering, mixing and remixing, and becoming the leading master of dub records. (Dubbing is the art of electronically dissecting and reassembling songs.)

Together, these four create a singularly inventive artistic signature. Their musical emphasis is on the groove, with an ear toward achieving maximum danceability, but this music cannot be casually dismissed as simple "dance" music. It crosses into territory previously unknown in dance/funk.

Including former Golden Palomino vocalist Bernard Fowler, Tackhead's first U.S. release might best, although not simply, be described as astral/sociopolitical/funk 'n' rock. All 10 songs contain electronic samples of percussion, voices, sound effects, even political speeches, which are

If this artistic success turns Iggy Pop into a corporate rebel, surely he'll be the best one we've seen in some time.

knitted flawlessly (sometimes abruptly) into the fabric of the main melody and groove. Often the songs are broken down into pure rhythm parts (the beat) and then rebuilt, not necessarily back to the originally stated melody but perhaps into a completely new or related groove and melody.

Listeners may find similarities on this album to the music Living Colour and George Clinton are presently producing. On several levels—groove, politics, funk vocals—the comparison would be accurate. But Tackhead incorporates more musical styles into its sound, resulting in an undefinably quirky musical potpourri where technology and music are inseparable. Where else are you going to find pitch-modulated military chants layered over marching rhythms or a danceable jibe at televangelists?

Despite its U.S. release, Tackhead's *Friendly As a Hand Grenade* probably will still find its greatest popularity in Europe and England, where, unlike here, substance generally prevails over style. TVT Records deserves major credit for bringing this recording to these shores. Given a chance, *Grenade* could rise out of the more astute dance clubs and radio stations to pounce on and refresh America's tired ears. *Hector G. La Torre*

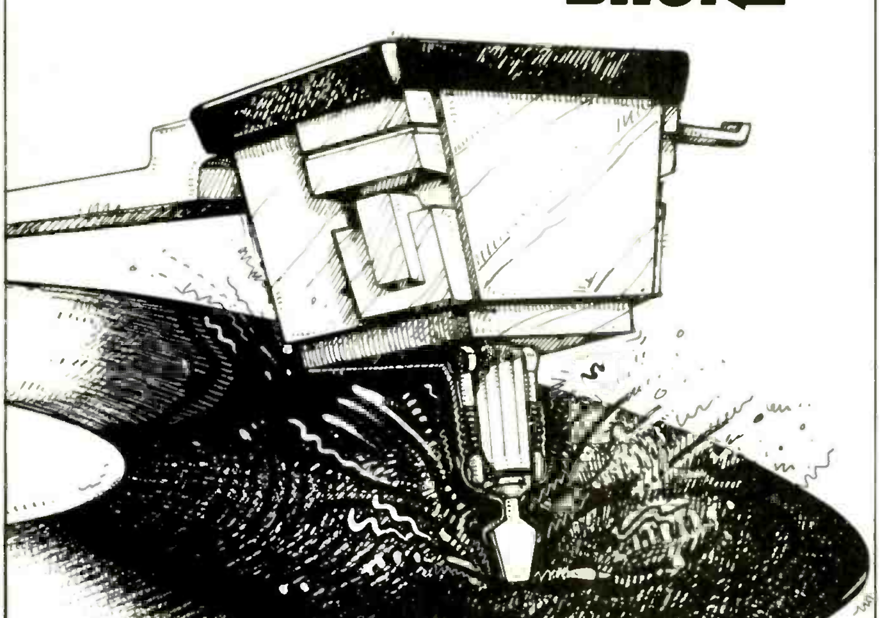
**Brick by Brick:** Iggy Pop
**Virgin 91381-2,** CD; AAD; 54:24.
Sound: B+ Performance: A−

Whether Iggy Pop is a victim of his image or a beneficiary of it depends on where you stand. Most people give him credit for being the godfather of punk, but radio has avoided him like the plague from day one, as his image stood for everything radio despised. Iggy was the ultimate bad boy before it was acceptable. He made trashy sounding records when cleanliness was more the going trend and had bands that cloned The Stones before you were allowed to. Today, Iggy's former Stooges back up people like Jackson Browne, while Iggy allows Don "Producer of the Year" Was to chair his record. Some of yesterday's punks have become today's radio station executives and have embraced *Brick By Brick*, making it Iggy's most played record on commercial radio. The inevitable question: Has he sold out?

Hardly. Curse words abound and the guitars are as raunchy as they've ever been on an Iggy record, thanks to Slash and Duff from *Guns 'N' Roses* who do a super job of complimenting the vocals. There are some concessions made to the L.A. "Old fahts," with guest appearances by such non-punking entities as David Lindley, Waddy Wachtel, Kenny Aronoff, and John







**Bonnie Raitt's collection is a superb release put together with respect and love; it positively sparkles.**

Hiatt, but this doesn't dilute the power of Iggy's performance. Songs like "Home" and "Butt Town" rank with the man's most potent recorded offerings, and he refuses to compromise his talent time and again. In fact, of Iggy's recent albums, this one is easily the truest to his art. The last thing he did was a lousy tip of the hat to metal that didn't pay off. The one before is a slicked-up "modern pop" record that had its moments, but none of which rang as true as the high points of *Brick By Brick*. It's as if Don Was' faith in Iggy Pop gave Pop the confidence to go for the throat every time, and most of the time it works. Not that simply letting the tape roll is all it takes to make a record with Iggy, as his voice often confounds some of the finest engineers available. One can also credit Was for encouraging Iggy to come up with some of his most thought-out and entertaining lyrics in some time and not back down on any controversial issues.

If this artistic success turns Iggy into a corporate rebel, surely he'll be the best one we've seen in some time.

*Jon & Sally Tiven*

**The Bonnie Raitt Collection:** Bonnie Raitt
**Warner Bros. 26242-2,** CD; AAD; 76:01.

Sound: B+ Performance: A

This 20-song retrospective gives an excellent and generous overview of Bonnie Raitt's long association with Warner Bros. records. Far from a quick knockoff intended to capitalize on Raitt's recent success, it is a well-planned and executed collection compiled with the artist's input. In fact, Raitt chose the selections and contributed notes about each song with Jim Maloney adding historical perspective.

Of special note is a magical version of "Women Be Wise" recorded in 1976 with the song's writer, Sippie Wallace (one of Raitt's blues heroes). "Angel from Montgomery" is a live duet with writer John Prine. This recording was on the *Tribute to Steve Goodman* and *John Prine Live* albums.

This is a superb release put together with respect and love. Lee Herschberg's remastering positively sparkles.

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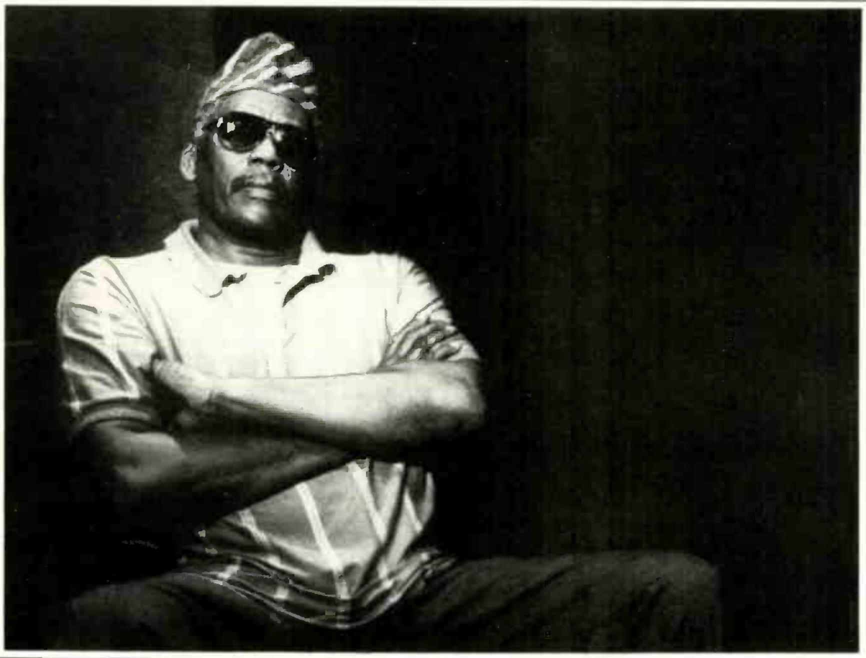

**Portraits of Duke Ellington (Caravan):** Randy Weston
**Verve 841 312-2,** CD; DDD; 53:39
Sound: A– Performance: A

**Portraits of Thelonious Monk (Well You Needn't):** Randy Weston
**Verve 841 313-2,** CD; DDD; 53:03
Sound: A– Performance: A

**Self-Portraits (The Last Day):** Randy Weston
**Verve 841 314-2,** CD; DDD; 49:24
Sound: A– Performance: A–

Recorded in Paris on June 3 to 5, 1989, Randy Weston (one of jazz's great internationalists, not to mention one of the genre's most dignified and elegant pianists) unveils a most important and ambitious trilogy, a series of "portraits," each delivered definitively and consumately with purpose, resolve, and conviction. Contained are auspicious odes to Duke Ellington, and Thelonious Monk. The final recording of this trilogy, comprised of six original compositions, is appropriately titled *Self-Portrait*.

For these sessions, Weston called on bassist Jamil Nasser, drummer Idris Muhammad, and percussionist Eric Asante. Examining the situation more closely, it appears that Weston picked his associates not only because he had worked with them previously, but because they exude certain musical qualities.

Nasser, originally from Memphis, Tenn., is well versed in gospel and soul, and possesses ties to the late Phineas Newborn, Jr., the influential pianist from Memphis. Newborn is one of Weston's heroes, and the person to whom *Self Portrait* is dedicated. Some 25 years ago, drummer Idris Muhammad arrived on the jazz scene via New Orleans. Having worked with everyone from the Neville Brothers to Pharoah Sanders, it's easy to understand why, a long time ago, he attracted Weston's attention. Eric Asante, from Ghana, crossed paths with Weston in the pianists' adopted continent, Africa, where to this day he spends much of his time. Asante also introduces elements, such as polyrhythms, which are paramount to any Weston endeavor.

Consequently, what results from these four immensely compatible musicians is a magnificent and comprehensive affair, one that swings, knows the blues, and is at home with soul and the musical roots of improvisation. Given Weston's history, one expects a kingly, uncompromising endeavor from him.

Realistically, of course, nothing's perfect. For instance, the recording quality, while quite good throughout the three sessions, occasionally comes across as slightly muddled at points; some listeners may find the piano microphone placement objectionable. Still, even to the audiophile or technocrat, these shortcomings should register as minor complaints. Despite some weak sequencing and occasional meanderings amidst two solo piano pieces—"Africa Night" and "Night in Medina"—*Self Portraits*—the trilogy is nearly perfect.

Weston's treatment of Monk melts with readings of "Ruby My Dear" and "Off Minor/Thelonious." Weston shows great understanding of the blues tradition on "Functional," an appropriately slow-moving and exaggerated progression that in true Monk fashion maximizes space, layers of sound, and dynamics. The title track of this volume, steeped in, of all things, funk, clearly shows deference to the composer *and* demonstrates wit, while "I Mean You" rocks—relatively speaking—in quartet. Asante's congas set a quick pace that provides Weston with ammunition to percussively attack the piano somewhat in McCoy Tyner style. Weston marches chords up and down the keyboard before he gives way to one of Nasser's many bouncy solos.

For this reviewer, the Monk volume may sit as the best of trilogy's entries. However, Weston's interpretation of Ellington is something to revel in, something to behold. If the Monk portraits give the impression that they focus on and examine music's various elements and styles, then it's fair to say that Weston designed the half dozen trips through Ellingtonia to demonstrate a global and sophisticated approach. Each composition exudes a kind of patience and diplomacy, characteristics fitting for a complex musical mediator.

"Caravan" begins with Weston's a cappella declarative statement followed by bells, chimes, finger snaps, and wood instruments. Again, Weston's multi-cultural experience comes into play. This isn't just another hackneyed reading of a very popular Ellington work. Weston, with the help of Muhammad's pounding toms and Asante's aggressively played congas, slowly paints a rhythmic picture before Nasser's bass outlines a familiar melody. Ultimately, all pave the way for the pianist to gush forth forcefully. The passage stands as one of the date's


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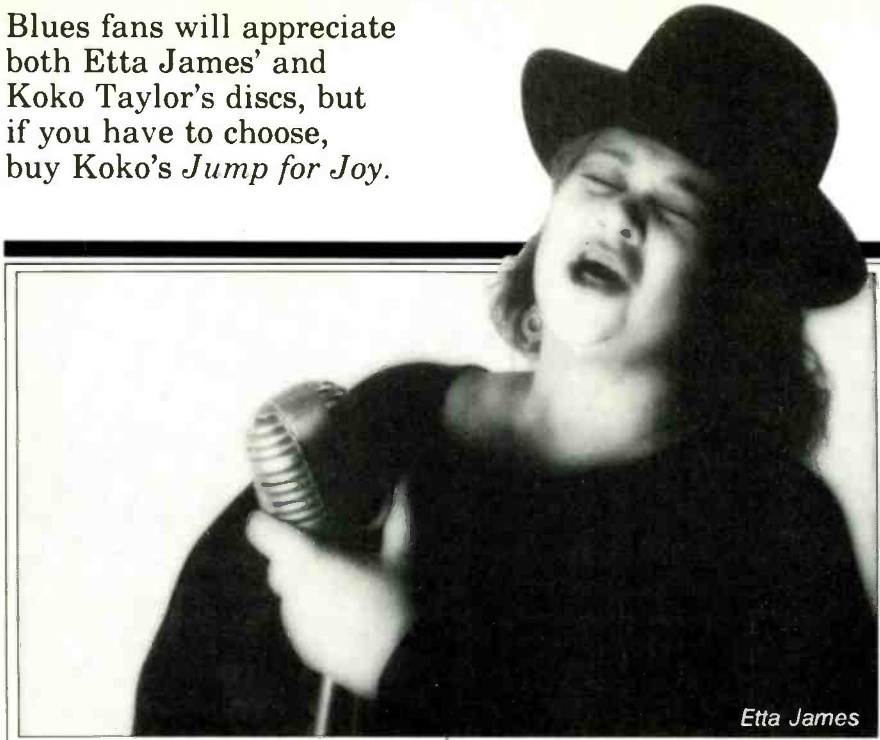
**Blues fans will appreciate both Etta James' and Koko Taylor's discs, but if you have to choose, buy Koko's *Jump for Joy.***



*Etta James*

most important. Weston's "Caravan" is an aboveboard and quite meaningful presentation.

Truly, this rendition of "Caravan" sums up what Weston has attempted to accomplish here: Melding a past master's works and historical traditions with present global conditions. He has succeeded. The more you listen to Portraits of Duke Ellington, the more obvious the set's worldliness becomes. After an accompanied "Heaven," Weston shows great patience via another slow, dynamic walking blues; Ellington's serious-in-tone "Sepia Panorama." Weston, as did Ellington, makes time to rejoice. Some of these moments are best represented initially during a reading of Duke's fun, calypso-tinged and Caribbean-influenced "Limbo Jazz," which is followed immediately by the buoyant "C Jam Blues." Both precede the more austere "Chromatic Love Affair." A serene and gentle composition, Weston uses nearly eight minutes to close his book on Ellington.

*Portraits* are being issued as three separate volumes. Each, unquestionably, stands on its own. However, to grasp their full depth—to grasp *Randy Weston's depth*—one should own the entire set. *Jon W. Poses*

*Koko Taylor*

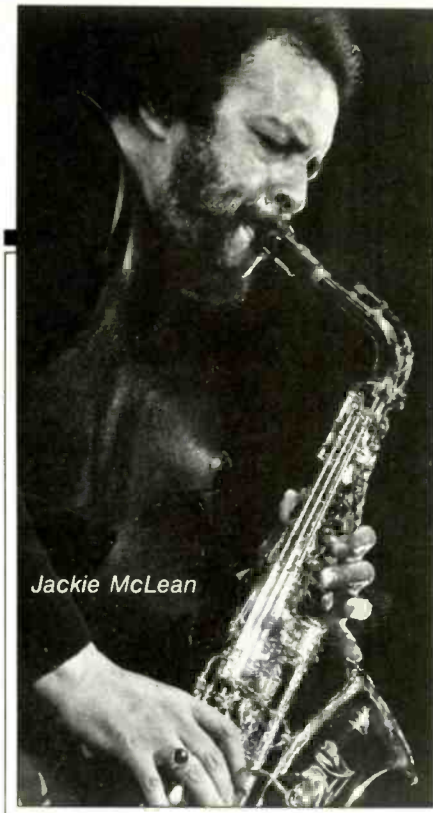
**Stickin' to My Guns:** Etta James
**Island 842 926-2,** CD; AAD; 40:06
Sound: B+ Performance: B−

**Jump for Joy:** Koko Taylor
**Alligator ALCD 4784,** CD; AAD; 47:02
Sound: A− Performance A−

Despite their difference in age, Etta James has a longer and more heralded career than has Koko Taylor. In fact, Taylor has even bowed to James in the past by recording some of her hits. All that aside, Taylor has clearly recorded the better record this time around. Both traffic in the brassy style of the southern moll—big voiced, bodacious, embittered, forlorn—and the soul and blues music of the deep south. But at least for these two albums the similarities virtually stop there.

Taylor's *Jump for Joy* is more of a grind and shout in memory of her late husband Robert "Pops" Taylor, and is some of the best work by Koko since she led a band with guitarists Lurie Bell and Johnny B. Moore. Her voice buzzes and whines with the aural edge of a tool and die shop, while her group bristles with the lean efficiency of a seasoned, crack Memphis-to-Chicago road band. Though the melodies and rhythms are often fused into a familiar stomp and the lyrics provide some age-old advice, the song selection avoids treading into the cliches of blues standards. Taylor's "Stop Watching Your Enemies" emphatically warns about best friends and lost lovers, while the slow, rolling "Fishing Trip" plays with a double-entendre and a social norm—the for-male-members-only outing. But, on *Joy*, it's not so much the songs as it is the directness of Taylor's massive voice; the crisp leads of Criss Johnson; a tasteful cameo by Lonnie Brooks on a novelty tune about an escort for pay ("It's A Dirty Job"); Billy Branch's sweet, understated harp, and artful, bouncy horn arrangements.

Unfortunately, such is not the case with *Stickin' to My Guns*. Much of the album is bloated with MOR production qualities of a southern rock record. Thus, *Guns* lacks the reassurance and warmth of Taylor's more gospel-influenced record, or even some of James' previous work. It would be easy to lay the blame on producer/keyboardist Barry Beckett, but his other work with James—including her last album, *Seven Year Itch*, and her '60s signature "I'd Rather Go Blind"—has ranked among her best recordings. No, blame it on the placebo syndrome that has always plagued her career, whether recording Alice Cooper's "Only Women Bleed" or maudlin jazz standards that would swamp Billie Holliday or Dinah Washington. James' powerful voice is in fine form, but these attempts to transmit emotion via material that is devoid of anything except the cloyingly mundane sentiments of a jingle seem a worthless salvage operation. Initially, a few tunes—"Whatever Gets You Through the Night," "The Blues Don't Care," and "Beware"—are haunting and good-natured enough to pass. But these stand out more because of the other songs. For instance, the ballad "Stolen Affection" brings to mind some ready-made-for-a-Michelob commercial, while the rockers "Love To Burn" and "A Fool In Love" echo Steve Winwood's squalling antiseptic R&B. To make matters worse, the horns sound thin and screechy—like a synth—and the inclusion of "Get Funky," a duet with Def Jef, is pandering at best and a sucker rap to boot—even with some digital sampling of the Meter's.


Jackie McLean

*Healing the Pain* from Bunky Green and *Dynasty* from Jackie McLean do great jobs of correcting their underexposure.

Taylor has rebounded from some lackluster efforts, a series of personal mishaps, and health problems. James appears to have made the mistake of aspiring for a larger following with one of those hoped-for multiple single albums. So while Taylor has rediscovered her niche, James has abandoned the groove. *Don Palmer*

**Healing the Pain:** Bunky Green
**Delos DE 4020,** CD; DDD; 65:52
Sound: A– Performance: A–

**Dynasty:** Jackie McLean Quintet
**Triloka 181-2,** CD; DDD: 70:19
Sound: A– Performance: A–

In recent times, Bunky Green and Jackie McLean—both noted for their alto saxophone prowess and both arrivals from the bebop/hard bop school—have been severely under recorded and generally speaking, underexposed. Despite their respective under recognition each prevails, Green teaching in Florida and McLean leading the jazz program at University of Hartford, in Connecticut. This is not a compare and contrast scenario. Their concurrent releases—Green's *Healing the Pain* and McLean's, *Dynasty*—stand on their own and remind us why these two reedmen should be better recognized.

Green, for his part, has openly dedicated his recording to his parents, both who passed away recently. *Healing the Pain* features pianist Billy Childs (delivering some of the best piano he has ever played), Art Davis, the respected bass player, and veteran drummer Ralph Penland. As the title indicates, this is a catharsis of sorts for the reedman who occasionally doubles on soprano sax. While the opening track, "The Thrill is Gone," (not the well-known blues tune) strikes as a masterful piece of ensemble work before building amidst Green's wailing alto, the following composition, the more modern "Walter's Theme," opens with an unaccompanied soprano solo and contains several lonely, angular, and pensive passages. This composition is followed by a classically read ballad rendition of the aptly chosen "Who Can I Turn To," which casts Childs' warm piano, Davis' soft bass, and Penland's brushes as a cushion for Green's alto. It's gorgeous.

These are the two strains heard prominently in Green's highly successful endeavor. Green counterbalances Cole Porter's "I Concentrate on You," an upbeat standard where his alto, whose modernisms rekindle thoughts of David Murray's original "Ming's Samba," with "Love Theme" and "Love Theme—Reprise," two introspective soprano saxophone outings.

There is not a weak spot on *Healing the Pain*. An engaging, challenging, and complex group of selections, Green's presentation requires several listens. There's simply a lot of music here.


Bunky Green

McLean's recording, *Dynasty*, allows us to hear just how good his quintet is. It's a unit that features son René on other winds—tenor, soprano, and flute. A strong rhythm section that the leader selected, in part among his Connecticut crop, includes South African pianist Hotep Idris Galeta, a McLean teaching colleague, and bassist Nat Reeves. The quintet is rounded out by Carl Allen, a solid and steady drummer whose skills, in the very competitive East Coast scene has landed him some prized gigs—with Freddie Hubbard and Terence Blanchard-Donald Harrison among them. When McLean brought this troupe to New York's Village Vanguard earlier this year for a rare appearance, his ensemble, shrouded in bop energy, nearly blew the roof off of the place.

Fortunately for the rest of us, *Dynasty* is an accurate studio replica, although for some reason there's applause heard at the end of each selection. This is an excellent representation that, at several junctures, blisters. The first of these moments occurs during the set's initial tune, McLean's "Five," where Galeta demonstrates (which he does throughout) how he's the stylistic embodiment of—are you ready?—James Williams' and Horace Silver's gospel and soul, and McCoy Tyner's and John Hicks' fluid percussiveness. René McLean on tenor all but outblasts his old man.

The driving pace kicks up a notch during "Bird Like," McLean's homage to the man who most influenced him when his career began some 40 years ago. The alto- and tenor-armed McLeans tussle in unison before the frenzy gives way to an interpretation of Burt Bacharach's "House Is Not A Home," a medium tempo romance. With the best jazz players, weak choice of material can be overcome via chops and interpretive exploration. In this case, it's vintage Jackie McLean. This is the sound that Christopher Hollyday admirably strives so hard to absorb and achieve; notes are bent until they sound almost off key.

McLean, of course, recorded for Blue Note records in the early '60s and in many ways, the intense sound of *Dynasty* captures those early days. For instance, listen to "Third World Express" and René McLean's "J. Mac's

*Sense of Place* isn't the breakthrough disc we'd love to see from John Mayall, but fans won't be disappointed.

Dynasty," which is highlighted with an extended Allen solo (a quarter century ago it would've been Art Blakey). Furthermore, "King Tut's Strut," a Galeta composition, "Muti-Woman," written by René McLean, both containing an appropriately percussive, energetic, almost cluttered sound, draw from the late Woody Shaw. The same applies to Galeta's "Knot The Blues," with its integrated and complimentary horn lines. While Charlie Parker's presence is strongly felt, let's not forget that Jackie McLean crossed paths with John Coltrane. Witness René McLean's "Dance Little Mandissa" and his "Zimbabwe." Both ring true to 'Trane's brief, heavy chord structure modal period.

I don't know whether *Dynasty* is the appropriate title, nonetheless, the session is praiseworthy. Hopefully the album will shed a deservedly brighter and more contemporary light on Jackie McLean. *Jon W. Poses*



**A Sense of Place:** John Mayall
**Island 842 795-2,** CD; AAD; 40:28.

Sound: B+ Performance: B+

In an age when record company A & R men are more likely to scout managers than talent, John Mayall has remained a fine recruiter of blues talent. In the '60s he brought guitarists such as Mick Taylor, Eric Clapton and Peter Green to the attention of the public and also popularized the music of Freddie King, J.B. Lenoir, and other blues giants. During the past two decades he has been less successful at recruiting guitar heroes, but this album finds him in fine form with an inspired band consisting of Coco Montoya on guitar, Freebo on bass, and Joe Yuele on drums. With a reservoir of strong songs by great contemporary bluesmen such as Don Nix and J. J. Cale, this isn't the kind of breakthrough record Mayall used to make during his London Records tenure (guitarists of Eric Clapton's stature are getting a little hard to find) but *A Sense of Place* remains a fine piece of work.

Mayall is not the world's greatest blues singer, but the man has worked many long years and knows what he can and cannot do with his voice. He can take on a song like J. B. Lenoir's "I Want To Go" and really make it work with a great guitar arrangement. Mayall makes songs like Jim Liban's "Without Her" and Gary Nicholson's "Jacksboro Highway" his own. He is less successful with Don Nix's "Black Cat Moan." Jeff Beck's version is far too familiar (and good) to be challenged simply by adding a few new verses.

It's nice to see this staple of the '60s British blues boom back in action with a band worthy of him. One can only hope he continues to provide a base for great new players and songwriters. Fans will surely not be disappointed by this record, and he should be able to win over some converts this time around. *Jon and Sally Tiven*

In the end, Carmen McRae merits credit for delivering a forthright product with no gimmickry.

**Carmen Sings Monk:** Carmen McRae
**RCA/Novus 3086-2-N,** CD; ADD; 66:02.

Sound: A– Performance: A–

The beauty of this session is that it's real. With some selections recorded live in San Francisco at the Great American Music Hall, and most of the others done in the studio, vocalist Carmen McRae legitimately presents an all-Monk program. Including two CD-only tracks—alternates of "Suddenly," from *In Walked Bud*, and "Get It Straight," from *Straight, No Chaser*—the 15 selections are predominantly laid out in tribute to the late pianist. But the album also serves to recognize several lyricists—primarily Jon Hendricks—who valiantly (and successfully, for the most part) set words to and respectfully alter titles of what must be characterized as difficult music.

For the most part, McRae's voice lands squarely on its feet; she shows range, employs appropriate phrasing, and sounds deep and rich throughout.

As for her accompanists, McRae could not ask for much better. In the studio and during the live selections, George Mraz on bass and Al Foster on drums handle their instruments impeccably.

Piano duties are shared by Eric Gunnison on the studio cuts and Larry Wills on the live takes. Since only two of the 15 cuts are live, Gunnison's work dominates. Yet while he is competent, even good, Gunnison does not match Willis, who like Mraz and Foster, can interpret the Monk book almost as well as anyone does.

Meanwhile, two tough tenors—unfortunately one no longer alive—split the horn part. The late Charlie Rouse, like Willis, is heard during the live set. And if we want to talk about reading Monk, Rouse, having spent a decade as a member of the pianist's quartet, is all but synonymous with the name Monk. Clifford Jordan, also on tenor, may be the best among many good reasons to listen to this set. His solos rate as the date's strongest; the veteran Chicagoan, like his colleagues, *can* play Monk.

In the end, McRae must be credited with assembling two top-notch ensembles and delivering a forthright product. There's no exploitative gimmickry on *Carmen Sings Monk*. *Jon W. Poses*

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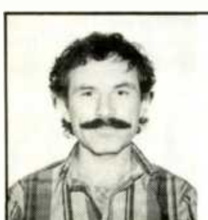

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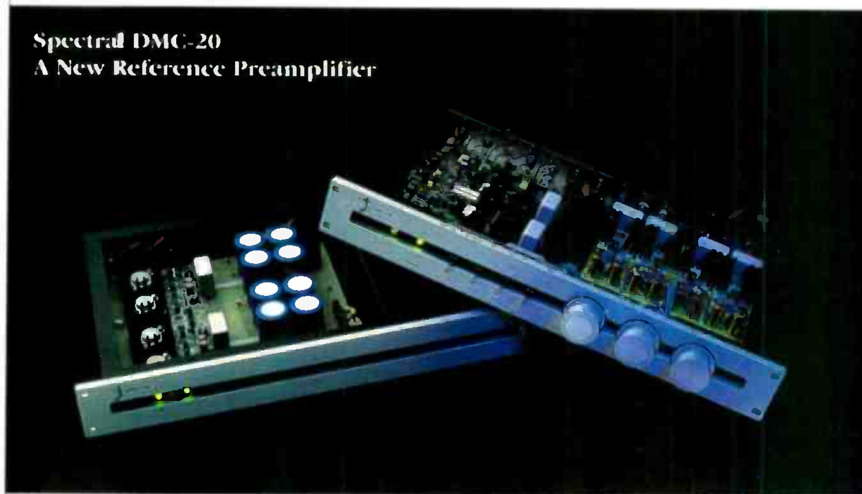


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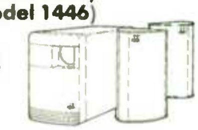

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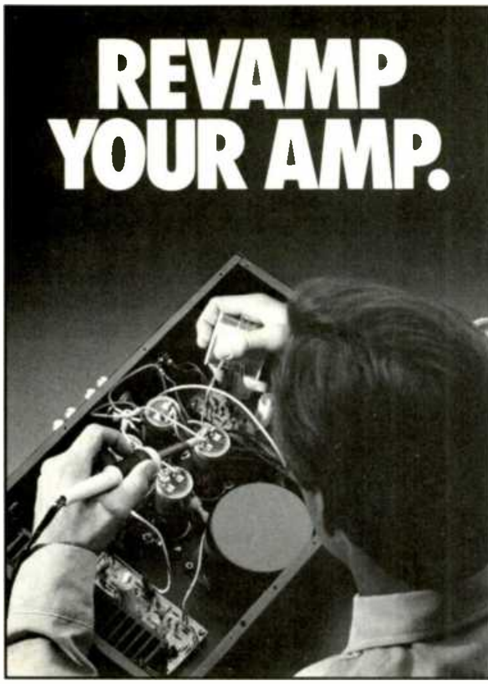

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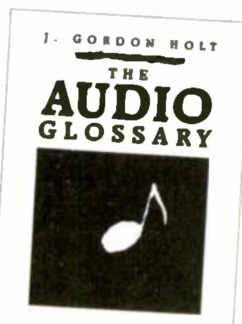


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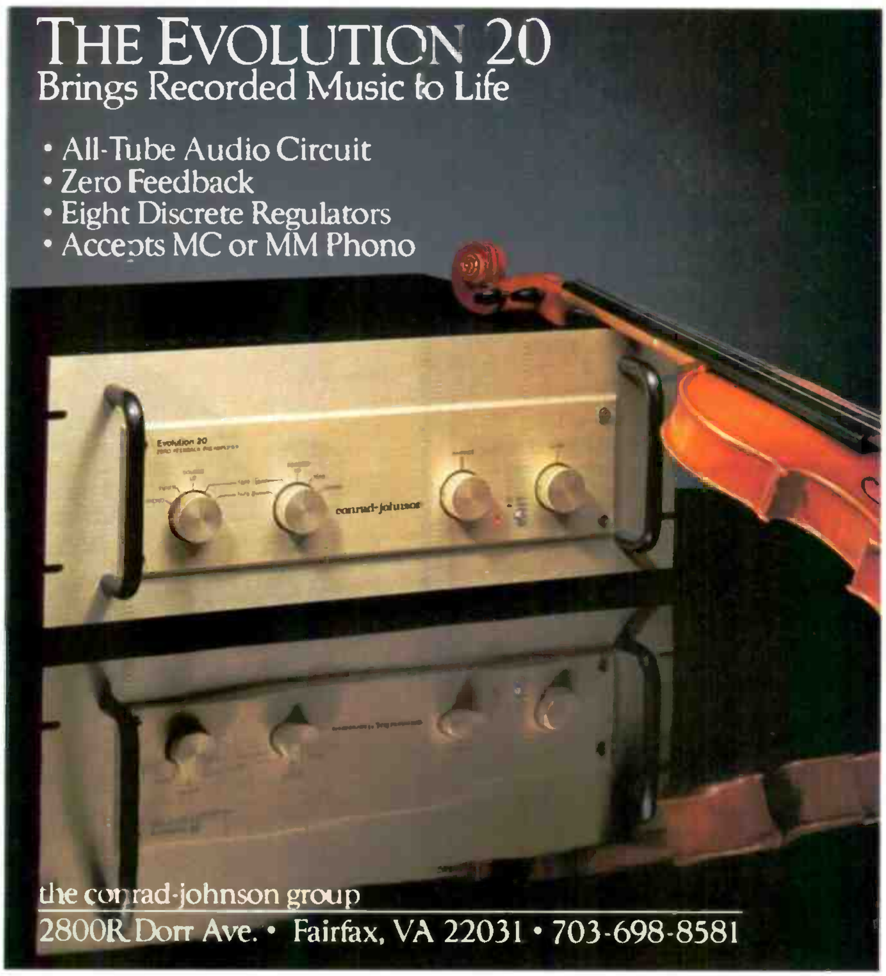

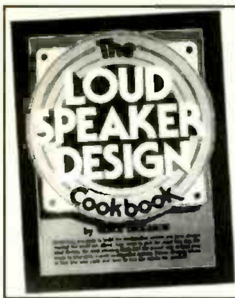

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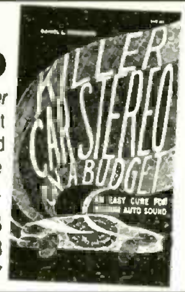

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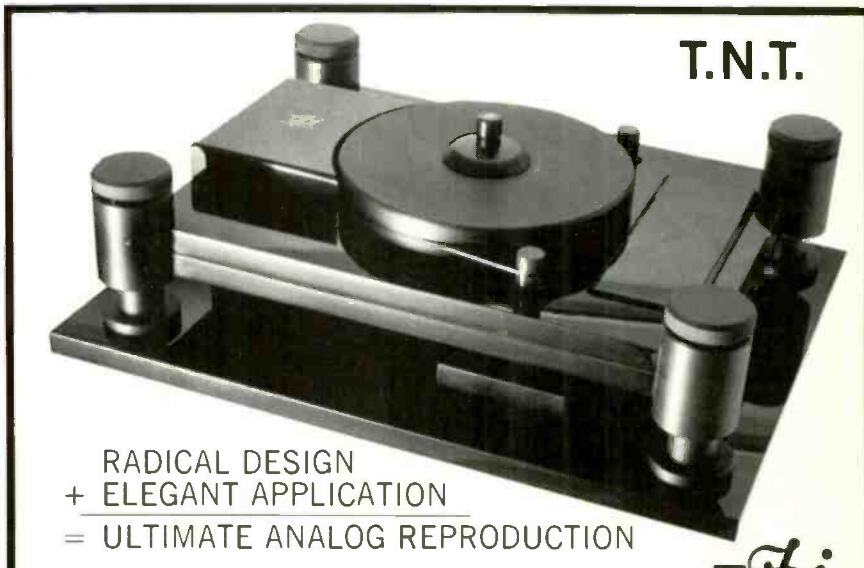

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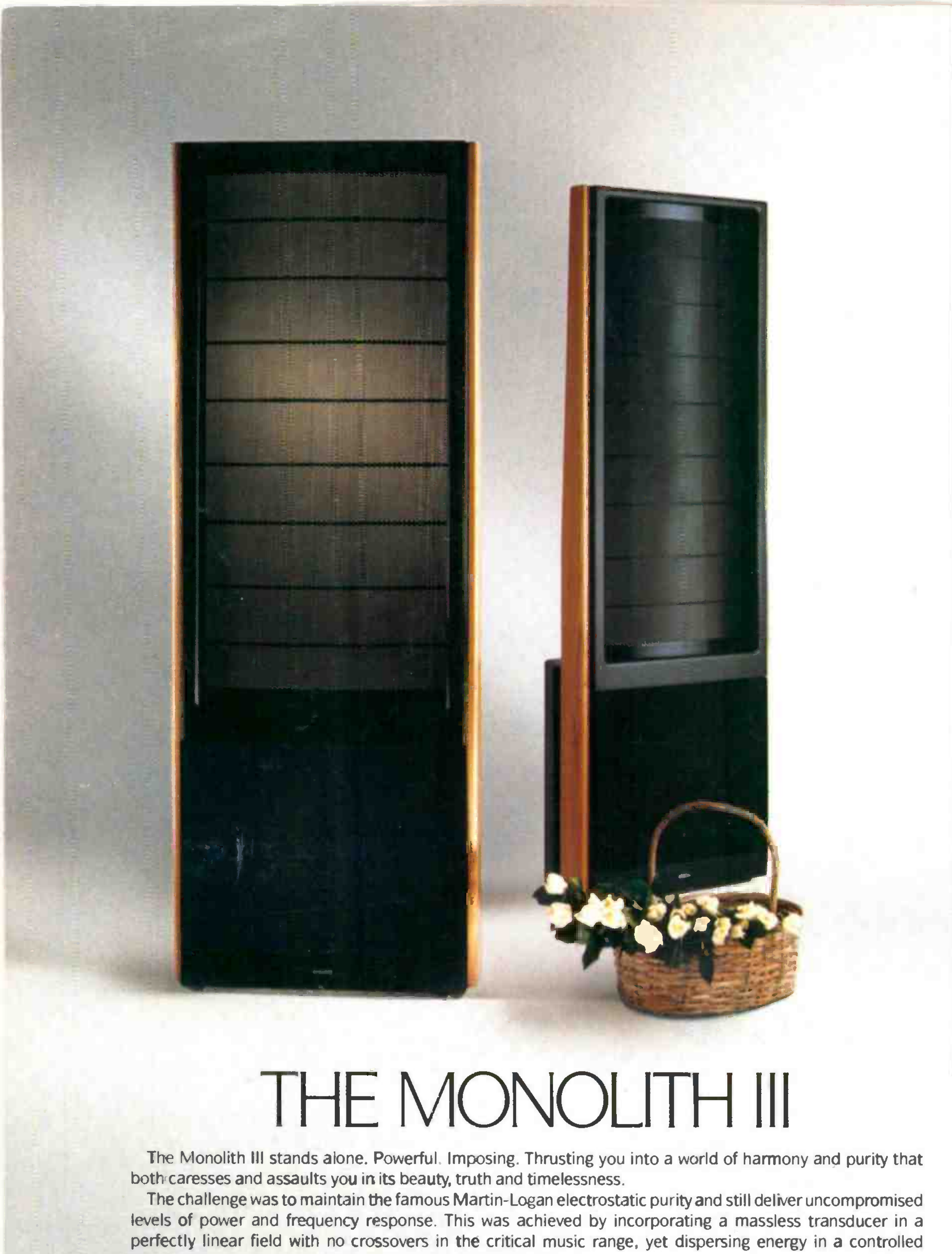

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