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**NULLING OUT  
AMP DISTORTION**

**INTERVIEW: ISLAND'S  
CHRIS BLACKWELL**

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TONEARM  
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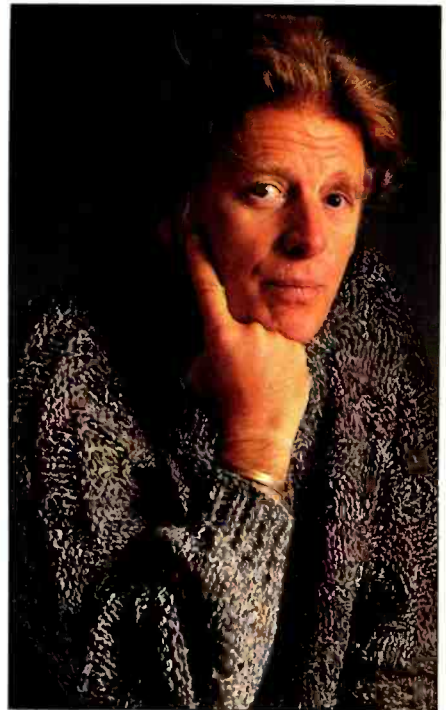
# Audio

FEBRUARY 1987

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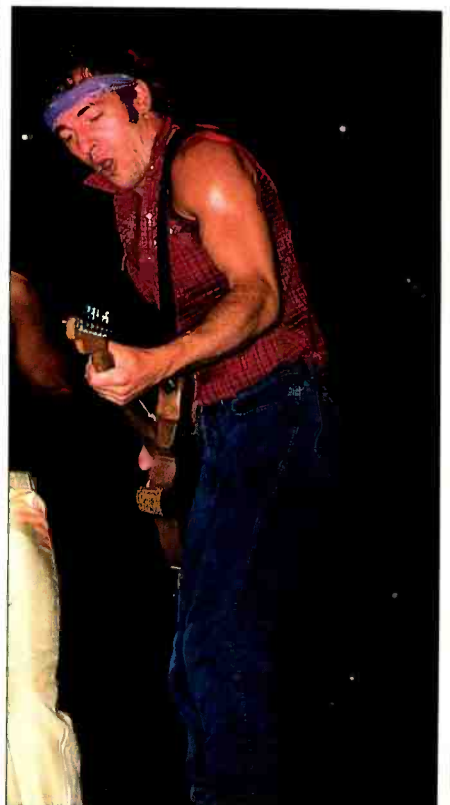
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**Packburn Switcher:  
A Clarification**

Dear Editor:

We were grateful to read in the November 1986 issue of *Audio* of Robert Parker's use of the Packburn Audio Noise Suppressor ("London Letter" by Donald Aldous). But we would like to take this opportunity to add that the Switcher, which is one of three noise-reduction processors incorporated in the Audio Noise Suppressor, is a bit more sophisticated in its operation than Mr. Aldous' description.

Actually, he describes the operation of our first Switcher. But that was shortly superseded by a three-way Switcher which, in its rest position, reproduces the vector sum of the signal-plus-noise from the two groove walls and switches to one or the other side wall when the signal-plus-noise of that side wall is less than that of the sum by a selectable amount.

I might add that the two channels are mixed in the lower frequencies, the crossover being at a rate of 6 dB per octave starting at 300 Hz. This eliminates vertical rumble and various annoyances that could crop up in switching low frequencies. However, some records—notably some of the laminated American Columbia 78s—have vertical components extending above 300 Hz, due to surface irregularities presumably caused by the material in the center of the record "sandwich." It was after discovering this that the three-way Switcher was devised. This eliminated that problem and also yielded a further reduction in the switchable noises.

All Packburn noise suppressors now in service have the three-way Switcher. The above description is for lateral-cut records. The Switcher also has applicability to vertical-cut recordings. The Audio Noise Suppressor, in its entirety, has applicability to any audio medium where noise reduction is desired.

Richard C. Burns  
President  
Packburn Electronics Inc.  
Dewitt, N.Y.

**Too Rich for His Blood**

Dear Editor:

At one time I had decided that among audio magazines yours was the only one worth reading, and so I let all

other subscriptions expire. However, during the past year I have become annoyed at the increase in reviews catering to the wealthy audiophile. Although I spend comparatively large sums on audio gear (over \$2,000 this year on three components), I cannot see why you are reviewing so many multi-thousand-dollar products.

I originally subscribed to *Audio* for several reasons, one of which was its reviews of high-quality, reasonably priced and sometimes "best-buy" products. If I want to read about the most esoteric and expensive equipment available, I will pick up a copy of *Stereophile* or *The Absolute Sound*. (Incidentally, I am presently getting from *Stereophile's* "Cheapskate" column what I used to get from *Audio*.)

May I implore you to return to reviewing equipment of special value, unique features, innovative design, and the like before I let my subscription expire out of frustration!

David Lansdown  
Newhall, Cal.

**Squealing Discs**

Dear Editor:

I have encountered a problem with a Compact Disc. One of my new purchases was failing to load correctly on my Magnavox FD-2041 player. Upon closing the drawer, the player would emit a squealing sound and the error light would come on. With repeated attempts the loading would at last be successful with the player displaying the number of tracks.

I noticed that this disc differed from others in my collection in that it was manufactured in the U.S. at DADC, while the others were made in West Germany. The American-made disc has concentric ridges near the center hole while the German discs are completely smooth from disc edge to center hole. The German discs load flawlessly each time, with no squealing. I exchanged the American disc for another, and so far it loads successfully but still seems to squeal some. I was wondering if the different manufacturing methods have something to do with this. Perhaps the German (Polygram) methods are better. Anyone else have these troubles?

Randy D. Moench  
Watertown, S.D.

# Magnificent Reception.

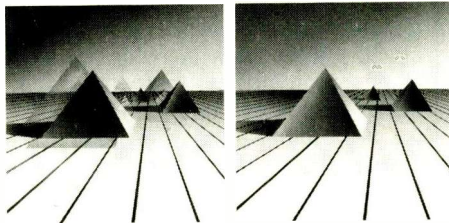
## THE TX-11a COMBINES CARVER'S REVOLUTIONARY ASYMMETRICAL CHARGE COUPLED FM DETECTION CIRCUITS WITH AN AM STEREO SECTION CAPABLE OF FM-QUALITY RECEPTION.

The Carver TX-11a Stereo AM-FM Tuner is the most complete high fidelity broadcast reception component ever offered. It is a technical tour-de-force which further distances Bob Carver's unique products from traditional electronic components. First, by eliminating forms of FM distortion and interference that even the most expensive tuners available can't correct. And second, with a unique additional tuning section capable of making AM stereo sound as good as FM!

**THE SILENT TREATMENT.** While AM stereo may not yet be available in your area, you can receive FM stereo. Including stations so fraught with interference and distortion that you may be tempted to return to mono AM. That's why the TX-11a includes the first circuitry to remove hiss, "picket fencing" and the myriad other unpredictable noises which often disturb FM listening. Without reducing stereo imaging, frequency response or dynamic range.

Part of the FM signal, the left minus right portion, is extremely prone to "ghosting," or multipath interference caused by hills, buildings and other obstructions. Bob Carver's Asymmetrical Charge Coupled circuitry cancels distortion-causing "dirty mirror" images before they can reach your ears. It filters out noise and restores the part of the signal

needed by our ears and brain to construct stereo imaging. Reintroduced into the mono (L + R) signal matrix, a net reduction of 93% — or better than 20dB of noise reduction — is achieved. All ambient and localizing information is recovered. Only hiss and



distortion are left behind. Or, as *High Fidelity* magazine put it, "... clean, noise-free sound out of weak or multipath-ridden signals that would have you lunging for the mono switch on any other tuner."

*Audio* magazine observed that the circuit, "... may well mean the difference between marginal reception of the station signals you've been yearning to hear and truly noise-free reception of those same signals."

Audio magazine called it, "An FM tuner breakthrough."

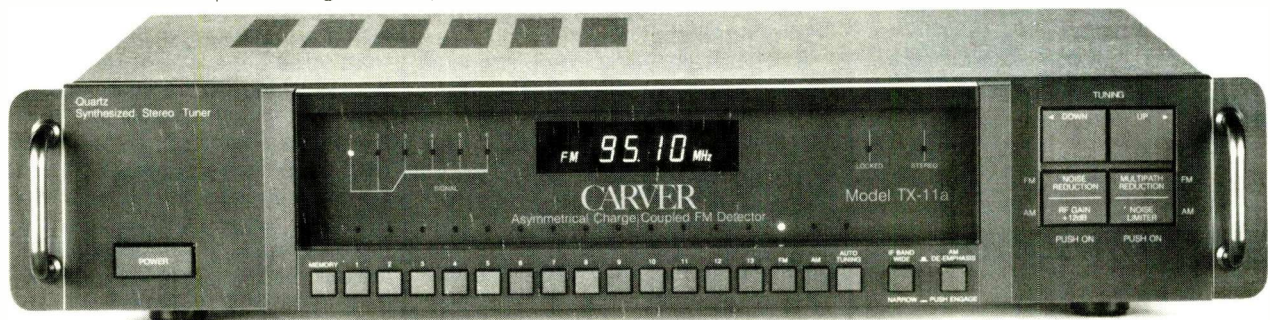
**THE FIRST AUDIOPHILE AM STEREO CIRCUITRY.** Contrary to popular belief, most AM stereo stations have frequency response (20-15kHz), separation (35dB) and signal-to-noise ratios (70dB) audibly indistinguishable from FM stations of equal strength. But only Carver offers the technology to appreciate this hidden performance.

At a press conference in front of America's top stereo writers, Bob Carver unveiled a low powered C-QUAM format AM stereo broadcast transmitter with a Carver Compact Disc Player as a source. The CD source and the TX-11a were also routed directly to a preamplifier and speakers for comparison.

When Bob switched back and forth, most listeners had difficulty distinguishing between the straightwire CD player and the TX-11a's over-the-air AM stereo reception! Many could tell no difference at all!

**HUMAN ENGINEERED FEATURES AND CONVENIENCE.** The TX-11a is designed to make enjoying FM and AM easy, not dazzle you with flashing light and complex programming. Thirteen presets, wide/narrow band selection, automatic/manual scanning as well as Multipath and Noise Reduction buttons are inset into the burnished anthracite metal face. Full instrumentation including digital display, 6-step signal strength LEDs and other monitor functions are tastefully recessed, visible but not garish. The result is performance without theatricality, access without complication.

**CLEAR THE AIR** by visiting your nearest Carver dealer. Ask to hear the most expensive tuner they sell. (It probably won't be the Carver TX-11a). Tune a multipath-ravaged, hiss-filled FM station on it; then the same station on the TX-11a Stereo AM-FM Tuner. Now press the Carver Multipath and Noise Reduction buttons. You'll hear why *High Fidelity* Magazine called it, "By far the best tuner we have tested..."



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INTERNATIONAL AUDIO REVIEW (U.S.A.)  
HOTLINE #31, 1984

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HI-FI ANSWERS (U.K.)  
JULY, 1985

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HI-FI NEWS AND RECORD REVIEW (U.K.)  
JUNE, 1984

"One of the best sounds at the Riviera (Consumer Electronics Show)."

AUDIO MAGAZINE  
MAY, 1985

"Especially with full orchestral music, the MG-III really shows its full potential."

STEREOPLAY (GERMANY)  
AUGUST, 1984

"This speaker will be a classic."

HIGH FIDELITY (DENMARK)  
JULY-AUGUST, 1984

The Absolute Sound Magazine.

SEE REVIEW IN VOL. 9, NO. 35  
AUTUMN, 1984

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## TAPE GUIDE

HERMAN BURSTEIN

### Tape for "Oldies"

*Q. I plan to record the "oldie" records which I have been collecting for about 25 years. What type of tape should I use? Some people say I should use metal-particle, and some say I shouldn't. At present, I use a good-quality Type II tape.—Matthew Franco, West Hartford, Conn.*

*A. I suggest that you stay with Type II. You might even try a high-quality Type I (ferric-oxide) tape. The advantage of metal-particle tape, Type IV, lies principally in its ability to record extremely high frequencies, especially those of high amplitude, without loss or distortion when recording at a high level. This advantage is most apparent when recording live material or from such sources as Compact Discs.*

*On the other hand, the proof of the pudding is in the eating. You might invest in one Type IV cassette and judge for yourself whether the extra cost is warranted. Possibly your ears will detect a worthwhile difference, although the odds are against this.*

### An Attack on the Tape

*Q. Recently my cassette deck has developed a problem. On a number of tapes recorded at home, the audio quality had degraded significantly. On close inspection of the tapes, I found the tape surface covered with wrinkles and creases. The deck exhibits no operating difficulties such as jamming or stalling, yet the tape looks as if the pinch roller has attacked it. The deck is less than a year old, and tape-path components are kept very clean. What might be the problem?—Zachary B. Freeman, Athens, Ill.*

*A. The cause of your problem could be the pressure roller or something else in the transport system, such as improper tape tension exerted by the hubs that drive the supply and take-up reels. The problem you describe might also be caused by a faulty pressure pad, but since that is part of the cassette and you are having trouble with many of your tapes, it wouldn't appear to be the cause here. A trip to a repair shop is indicated. Look for an authorized shop for your brand of deck.*

### Expansion or Compression?

*Q. I plan to purchase a dbx noise-reduction unit and a dbx dynamic-*

*range expander for use with my cassette deck. The dbx NR system claims to preserve the dynamic range of the source material. I can see the advantage of using dbx NR when making a tape from a good Compact Disc, because such a CD usually has a wider dynamic range than a conventional LP. However, when I dub an LP onto a tape and use dbx NR, I can see that I would end up with the original narrow dynamic range of the record. The turner/deck that I have in my car is equipped with dbx NR, but I cannot use a dynamic-range expander in the car. Thus, when I make tapes for playback in the car, I need to expand the dynamic range of the signal before it is fed into the dbx decoder. When recording on my home deck, I plan to feed the signal from the turntable to the preamp, then to the expander, then to the dbx NR unit (for encoding), and then to the cassette deck.*

*Would this way of connecting the units work? Would the overall S/N ratio deteriorate? How much expansion should I apply to the source material?—Kunio Mitsuma, State College, Pa.*

*A. I believe the arrangement you describe will work. However, to be on the safe side, you should have your audio dealer demonstrate this hookup. I doubt that the overall S/N ratio would decline significantly, if at all. The desirable amount of range expansion will vary with the source material and your own listening preferences. However, I wonder whether dynamic-range expansion—which lowers the low-level sounds as well as raising the high-level sounds—is desirable in a car, at least with the motor going. The engine and road noise are apt to obscure the low-level passages of the music unless you play at very high volume, which raises the problem of road safety. The latest (and the earliest) expander units made by dbx can also be set to compress dynamic range. This should be far more desirable when making tapes for the car, for it would limit the loss of low-level information when playing at sensible volume while you drive. **A***

**If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.**



# Reality Realized.

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The difference is dimension: Width, depth, breadth and detail that turn flat sensory input into breathtaking reality. They're the missing ingredients of live musical performance that Sonic Holography restores to records, compact discs and even hi-fi movie soundtracks.

The most experienced and knowledgeable experts in the audio industry have concurred. Julian Hirsch wrote in *Stereo Review*, "The effect strains credibility — had I not experienced it, I probably would not believe it."

*High Fidelity* magazine noted that "...it seems to open a curtain and reveal a deployment of musical forces extending behind, between and beyond the speakers." According to another reviewer, "It brings the listener substantially closer to that elusive sonic illusion of being in the presence of a live performance."

All this with your existing speakers and music collection.

**HOW SONIC HOLOGRAPHY WORKS.** Unfortunately, conventional stereo cannot isolate the output of left and right speakers and send their output only to your left and right ears. Left and right versions of a sound occurrence also cross in the middle of your listening room, confusing your ears with additional extra sound arrivals a split second apart. Stereo imaging and separation suffer because both speakers are heard by both ears, confusing your spatial perception.

The Sonic Hologram Generator in the Carver 4000t Preamp, C-1 Preamp and Carver Receiver 2000 solve this muddling of sound arrivals

by creating a third set of sound arrivals. These special impulses cancel the objectionable second sound arrival, leaving only the original sound from each loudspeaker.

The result is a vast sound field extending not only wider than your speakers, but higher than your speakers as well. Sounds will occasionally even seem to come from behind you! It is as if a dense fog has lifted and you suddenly find yourself in the midst of the musical experience. Or, as the Senior Editor of a major electronics magazine put it, "When the lights were turned out, we could almost have sworn we were in the presence of a live orchestra."

**IMAGINE THE POSSIBILITIES.** Thanks to VHS and Beta Hi-Fi stereo soundtracks (found even on rental tapes), and the increasing number of stereo TV broadcasts, Sonic Holography can put you inside the video experience, too.

It's a breathtaking experience. Without the need for additional rear speakers, extra amplifiers or decoders, the visual experience is psychoacoustically expanded by lifelike sound that envelops you, transforming stereo from monochromatic flatness into vibrant three-dimensional reality. Instead of being at arm's length from the action, you are immersed in it.

Then there are the familiar audio sources which Carver innovation has further improved upon, each of which gains character and heightened impact through Sonic Holography.

Compact discs, whose potential is still trapped in the two-dimensionality of conventional stereo, are even more lifelike with Sonic Holography.

Thanks to the Carver Asymmetrical Charge-Coupled FM Detector, FM stereo broadcasts can be received hiss- and interference-free, ready to take on an astonishing presence and dimension through Sonic Holography.

Even AM stereo can actually become a three-dimensional phenomenon with Sonic Holography and the new Carver TX-11a AM/FM tuner which delivers AM stereo broadcasts with the same dynamics and fidelity as FM.

**ENHANCE YOUR SPATIAL AWARENESS WITH CARVER COMPONENTS.** When considering the purchase of a new preamplifier or receiver, remember how much more you get from the Carver 4000t, C-1 and Receiver 2000. Or add Sonic Holography to your existing system with the C-9 add-on unit.

Each can transcend the limits of your listening (and viewing) experiences by adding the breathtaking, spine-tingling excitement that comes from being transported directly into the midst of audio-video reality.

Visit your nearest Carver dealer soon and expand your range of experiences with Sonic Holography.



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**America, The Dream Goes On** The Boston Pops/Williams. Title song, *America, Battle Hymn Of The Republic*, more. Philips *DIGITAL* 115134

**Handel, Messiah (Highlights)** Musica Sacra/Westenburg. *Hallelujah Chorus, I Know That My Redeemer Liveth*, more. RCA *DIGITAL* 13586



Sir Georg Solti



Itzhak Perlman

**Rubinstein: Rachmaninoff, Piano Concerto No. 2; Rhapsody On A Theme Of Paganini** Chicago Symphony/Reiner. RCA 170232

**Ravel, Daphnis et Chloe (Complete)** Montreal Symphony/Dutoit. "An absolute dream performance."—*Stereo Review London DIGITAL* 115520

**Brahms, Cello Sonatas** Yo-Yo Ma, cello; Emanuel Ax, piano. 1985 Grammy Award Winner, Best Chamber Music Performance! RCA *DIGITAL* 154044

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**Mozart, Requiem** Leipzig Radio Choir; Dresden State Orchestra/Schreier. "Exceptionally satisfying."—*High Fidelity Philips DIGITAL* 115039

**Galway: Clair De Lune (Music Of Debussy)** With Marisa Robles, harp. Sonata for Flute, Viola & Harp; Réverie, more. RCA *DIGITAL* 150499

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**Horowitz In London** Recorded live! Schumann, Kinderscenen, Chopin, Polonaise-Fantaisie & Ballade No. 1; more. RCA *DIGITAL* 162507

**Orff, Carmina Burana** Hendricks, Aler, Hagegård. London Symphony Chorus & Orchestra conducted by Eduardo Mata. RCA *DIGITAL* 144503

**Pops In Space** John Williams leads The Boston Pops in music from Star Wars, Close Encounters, Superman, more. Philips *DIGITAL* 105392

**Mozart, The Piano Quartets** Beaux Arts Trio; Bruno Giuranna, viola. "Absolutely indispensable."—*Stereo Review Philips DIGITAL* 115271

**Pachelbel, Canon in D** Also includes other works by Pachelbel & Fasch. Maurice André, trumpet; Paillard Chamber Orchestra. RCA 133877

**Wagner, Orchestral Highlights From The Ring** Vienna Philharmonic/Solti. *Ride Of The Valkyries, Magic Fire Music*, more. London *DIGITAL* 115426

**Julian Bream: Music Of Spain, Vol. 5** Albéniz & Granados on guitar. "Electrifying...A treasureable disc."—*Gramophone RCA DIGITAL* 114746

**Gershwin, Rhapsody In Blue; An American In Paris; Concerto** Pittsburgh Symphony/Previn (pianist & conductor). Philips *DIGITAL* 115437

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Luciano Pavarotti

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## Who? Where?

I have noticed a growing tendency for correspondents not to write their addresses—and sometimes even their names—on the letters they send me. I suppose they reason that putting this information on their outer envelopes, or the self-addressed stamped envelopes they enclose, is sufficient.

The problem is, I don't work at *Audio* magazine's office, where I'd get these letters one at a time. Instead, packages of letters are forwarded to me. I open a number of letters at a time, then try to sort them by date so I can answer the earliest ones first. (I answer the undated letters last.) Often, the external and/or return envelopes become separated, and I must rely on names and addresses in the letters themselves—so please include that information.

One more thing: If you want a reply, you'll get it faster if you enclose a stamped, self-addressed envelope and put your ZIP code on it. Typing envelopes and looking ZIP codes up in a directory takes time which would be better employed in answering your questions.

Thank you for your help!—J. G.

## Biamplication Hookup

*Q. What hardware is required to hook up a biampified system?*—David C. Bennett, Elizabeth City, N.C.

A. First, you need speakers with accessible woofer and tweeter terminals which bypass any internal crossovers. Then you need a preamplifier, one amplifier channel for each woofer and tweeter (four in all, for stereo), and an electronic crossover. The amplifiers can be stereo or mono models; you can even use the preamp and power amp sections of an integrated amplifier or receiver if the unit has preamp-out and amp-in jacks.

The crossover frequency should be set to match the requirements of your woofers and tweeters. The preamp output is connected to the crossover input. The crossover's high-frequency (or high-pass) output should be fed, via the less powerful amplifier channels, to the tweeters. The low-frequency (low-pass) output should be fed, via the other amplifier channels, to the woofers. The crossover will usually have a level control for the high or low

outputs to match the woofer and tweeter levels. If not, use the amplifiers' input gain controls for this.

## Breaking Glass

*Q. Why does glass shatter when opera singers sing?*—Brenden Mesch, Plano, Tex.

A. If such a thing can happen, I think the scenario would run this way:

The glass used is likely to be thin. Tapping it would produce a ringing sound whose frequency is the resonant frequency of the glass. (All bodies capable of vibrating will do so at some specific frequency, known as the resonant frequency.)

If a source produces a sound at the resonant frequency of a glass pane (or of any other body, such as a drum head or taut string), the glass (or other body) will be made to vibrate. This phenomenon is called "sympathetic vibration." If the source frequency and the driven body's resonant frequency match precisely, very little acoustical energy is required to keep the driven body (the glass, in this case) vibrating. If sufficient energy is imparted to the vibrating glass, the elastic limit of the material will be exceeded and the glass will shatter.

Whether an opera singer (most of whom have wide vibrato—meaning that their output frequencies are not constant) can impart sufficient energy to a glass to cause it to shatter is, to me at least, suspect.

## Bypassing Preamp Stages

*Q. I recently obtained a Compact Disc player. I tried operating it through the balance and volume controls of my preamplifier, bypassing the earlier portions of the circuit. The results were not successful. The slightest raising of volume from minimum resulted in a large amount of output which sounded harsh as well as loud. Undaunted, I lowered the output from the disc player, but this did not help significantly.*

*The volume pot is 50 kilohms per section; the balance control is a 20-kilohm pot. I can't imagine why this would load down the CD player, but would pots of different values solve the problem?*—Name withheld

A. I do not believe that different values for either the balance or the volume control can help your situation. My

suggestion is for you to restore your preamplifier to its original state. I suspect that the output impedance of your player is much lower than the d.c. resistance of the pots; thus, the player may not be properly loaded in your current system.

I wonder if the volume circuit that you are working with is a feedback control rather than the more conventional signal attenuator. The low impedance of the player may change the operation of the circuit to such an extent that feedback is virtually shorted out, leading to uncontrollable volume adjustment.

In summary, I can only repeat that you will obtain less distortion and better overall performance by restoring the circuit to its original state.

## Problems with an FM Stereo Adaptor

*Q. I recently equipped my 1962 tube FM tuner with a modern, multiplex stereo adaptor. For about five minutes after a cold start, sound is great! Then I hear a high-pitched whistle. This whistle gradually descends in pitch to below 1 kHz. If I wait long enough, the tone fades to inaudibility. Of course, switching to "mono" at the preamplifier kills the tone entirely. What's happening?*—John H. Lowry, Terre Haute, Ind.

A. The only likely cause of the problem you have described is an unstable 19-kHz oscillator in the adaptor. I have noticed such symptoms in instances where the oscillator is misaligned; otherwise, I have not seen one of these oscillators drift.

It's a stab in the dark, but inasmuch as you say that your adaptor is a modern unit, it is probably designed to work with low-level signals. Tube-type detector circuits usually generate quite high voltages, on the order of 1 V or so. The detectors in recent tuners develop one-tenth of this value. Thus, it may be that your tuner feeds more signal into the adaptor than it was designed to accept. Try padding the adaptor down with a voltage divider having a 10:1 ratio. Perhaps it will then behave.  $\Delta$

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at *AUDIO Magazine*, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.



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always better than would be achieved by conventional speakers". High Fidelity said, "Mind Boggling...Astounding ... Flabbergasting...we have yet to hear any stereo program that doesn't benefit". With SDAs every instrument, vocalist

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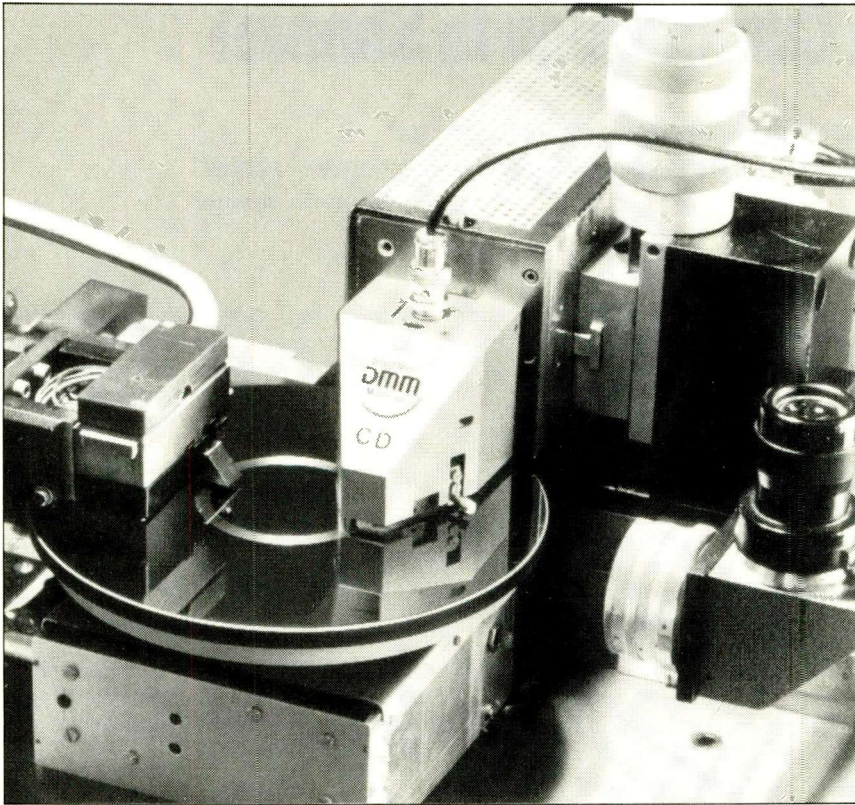
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BERT WHYTE

## AES YOU LIKE IT



Master-embossing recorder used in Teldec's DMM-CD process

**A**fter meeting elsewhere for several years, the Audio Engineering Society returned to Los Angeles for its 81st convention, November 12th through 16th. The ever-increasing growth of professional audio necessitated two separate venues, the Los Angeles Hilton Hotel and the nearby Los Angeles Convention Center. The AES billed the convention as "The Digital/Analog Fusion: A Rainbow of Technology." A tour through the exhibits and the high quality and diversity of the technical papers soon confirmed that this slogan was most apt.

Although the convention showcased a number of important advances in audio technology, the indisputable star of this meeting was the Teldec Direct Metal Mastering process and its application to production of Compact Discs, which I described in the December 1986 issue. The technical paper on the Teldec CD system was presented by its developer, Dr. Horst Redlich, before a standing-room-only crowd. I had a chance to talk to Dr. Redlich and dis-



A Teldec DMM-CD blank

cuss several aspects of the DMM-CD process. In addition to what I reported in December, I elicited the following facts:

The DMM-CD Embossing Recorder uses a piezo-ceramic transducer element to drive a diamond embossing stylus which is shaped like the bow of a ship. In the CD master, a glass disc is used as the substrate. The glass disc is coated with a proprietary mate-

rial which forms a separation layer only a few nanometers thick; this allows the glass disc to be removed from the metal part and reused. Upon this separation layer an evaporation process deposits approximately 300 nanometers of amorphous copper. After the copper surface has been embossed with the pits of the recording, it is electrolytically plated with a few micrometers of a precious metal, and then further plated with nickel to a thickness of 0.25 mm. Removing the glass disc from this metal part leaves a metal "sandwich," with the recording completely protected between the copper and precious-metal layers. Obviously, this sandwich is a safe medium for storage and for shipping.

The next step in the DMM-CD process is the release of the electroplate from the sandwich. This is done by removing the separation layer and the copper layer in a ferric chloride solution, leaving the precious-metal surface on the nickel backing. Using the precious-metal part as a "father," mothers and stampers can be prepared by electroplating—like the fathers, mothers, and stampers used in conventional record pressing. It is also possible to use this metal part directly as a stamper. However, if this is contemplated, during the sandwich process rhodium should be used as the precious metal, as its hardness makes it more suitable as a stamper. Incredibly, by using the master as a stamper, it is possible to proceed from the digital tape master to the CD pressing stage within two hours!

Teldec stressed that no clean room is necessary in their system and that costs are only one-third those of the usual laser photo-optical CD process. They expect to begin deliveries of DMM-CD equipment by this June.

Everywhere one looked in the exhibit area, one encountered glittering new jewels of advanced audio technology. I could fill six columns just describing these new products, but a highly selective sampling will have to suffice.

Over the past several years, you may recall, I have lamented that no manufacturer seemed to be addressing the need for a portable digital mixer that could be used for location recording. I am happy to say that this problem has been neatly resolved with





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A speaker representing the record companies said no label will manufacture prerecorded R-DAT tapes, but Sony gave a paper on duplication anyway.

one of the most exciting new products at the convention, Yamaha's DMP-7 digital mixing processor. It measures just 18 $\frac{7}{8}$  in. W x 16 $\frac{7}{8}$  in. H x 4 $\frac{7}{8}$  in. D and weighs in at 22 pounds. The DMP-7 has A/D and D/A converters, with 16-bit quantization and a 44.1-kHz sampling rate. The processor has eight in-

puts and a stereo output, plus an auxiliary stereo output. The slide-type faders are motor-driven. There are three effects systems, handling such things as reverb, delay, echo, and flanging. A three-band parametric equalizer is also provided. All the effects and equalization settings can be

stored in 32 memories, and the DMP-7 can be controlled from a MIDI (Musical Instrument Digital Interface). An LCD display shows the status of each channel. Yamaha states that the DMP-7 will be available in June for under \$4,000, an amazingly low price for such a device. This could be a real boon for a great many studios. I would be particularly interested in it for location recording of classical music. About the only additional feature one might want is a means of powering it from a battery pack, permitting even more versatility.

Sony showed a prototype of a professional R-DAT portable recorder. The unit can be a.c. powered or will operate two hours on a built-in rechargeable battery. It has both 1610/1630 and AES/EBU digital interfaces. The unit also provides a 48-V phantom power supply for microphones. Maximum recording time is two hours on an R-DAT cassette, with 16-bit quantization, and a sampling rate of 44.1 or 48 kHz. Thus, the recorder will be suitable for mastering for CD. As is usual with R-DAT, no one at Sony would commit themselves to projected prices or delivery dates.

In fact, R-DAT was having tough sledding at the convention. The guest speaker at the awards banquet, Stan Cornyn, while admittedly a semi-official spokesman for the record manufacturers, was quite blunt in stating that "the record companies will never produce prerecorded R-DAT cassettes." Perhaps Sony doesn't agree, for they gave a paper on high-speed duplication of R-DAT prerecorded cassettes (using a contact-printing process, with special high-coercivity metal mother tape and a new barium-ferrite copy tape). Although the future of R-DAT seems a bit clouded at the moment, the idea of mating Sony's professional R-DAT recorder with the Yamaha DMP-7 is intriguing and attractive.

Sony exhibited other digital equipment of a more immediately practical nature—for example, their new PCM-3402, a two-speed DASH digital audio recorder. The unit operates at 7 $\frac{1}{2}$  and 15 ips. With 12 $\frac{1}{2}$ -inch reels, 1 $\frac{1}{2}$  hours of recording is possible at 15 ips. While razor-blade editing can be performed, electronic editing is also possible. The machine operates at 16 bits, with selectable sampling frequencies

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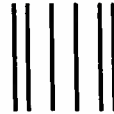
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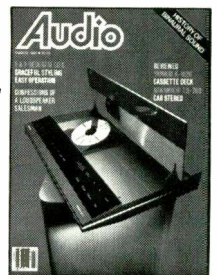
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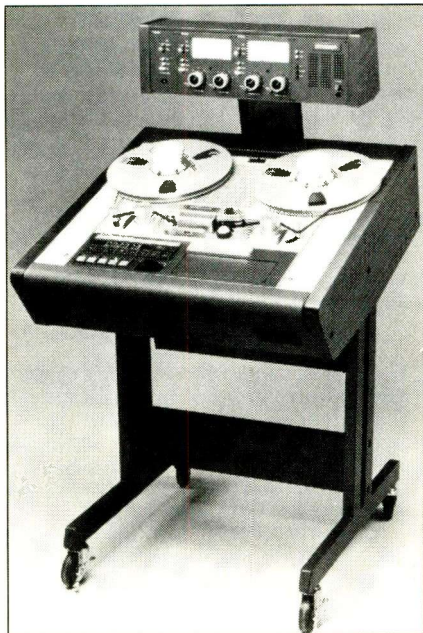
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5A03

Lexicon's Opus system can perform overdubbing, nondestructive editing, mixing, panning and more, all in the digital domain.

of 44,056, 44.1, or 48 kHz. It is expected to sell for around \$28,000.

Also new at Sony are the DFX-2400, a sampling-rate converter, and the K-1105, an eight-channel digital mixing system. Meant for heavy-duty studio work, the K-1105 is a much more elaborate unit than the Yamaha digital mixer and is much more expensive. Last, Sony showed the ultimate device for those who must have never-ending background music in their lives. This is the CD-006, a changer with a capacity of 60 Compact Discs, permitting one to select, in any order, from more than 1,000 cuts! It is all yours for about \$3,500.



Studer A812 professional recorder

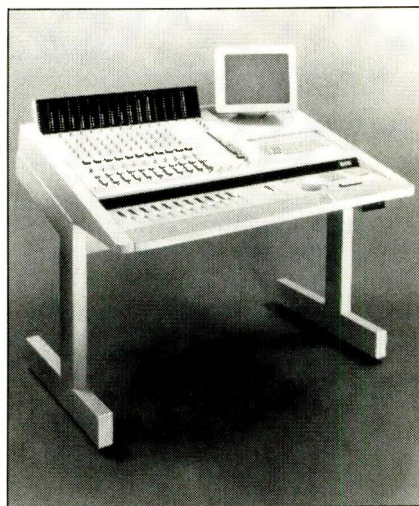
Studer caused quite a stir by introducing a new 24-track analog tape recorder, the A820, and quieted critics (as well as their tape noise) by offering the new Dolby SR recording system as an option. With the SF system, Studer is claiming a dynamic range of over 100 dB. The A820 incorporates many refinements and much automation, including simultaneous and automatic alignment of all 24 channels, and two digital memories for storing all the alignments for two different tape formulations. The A820 is expected to sell for \$59,950 without Dolby SR. Studer

also introduced a new quarter-inch analog tape recorder, the A812. This unit also incorporates many automated and microprocessor-controlled functions, including automatic tape alignment. Four tape speeds are standard, and up to 12½-inch reels can be accommodated. The A812 is available now, at \$9,950.

From dbx came an interesting prototype, the Professional Real-Time Analysis System, that can use music, as well as pink noise, to analyze frequency response. This will allow one to analyze the frequency response of a concert sound system while the audience is present or to check the response of a broadcast station without taking it off the air. Using the standard 31-band, third-octave configuration, the unit has a high-resolution CRT for display, a built-in pink-noise generator, an output port for connection to a printer, and a menu-driven operating system. The company hopes it can market the system within a year, for less than \$10,000.

Lexicon created a lot of interest with its Opus unit, a random-access audio production system. The Opus can perform such functions as recording, non-destructive editing, time alignment, mixing, panning, overdubbing, and signal processing, all in the digital domain. Opus offers up to eight hours of on-line random-access storage on magnetic hard disks. Up to eight events can be simultaneously record-

Lexicon's Opus work station



ed to or played back from the hard disks, in any combination. An optional write-once optical disc system provides archival storage and off-line recording facilities. According to Lexicon, the first Opus units will be available this spring.

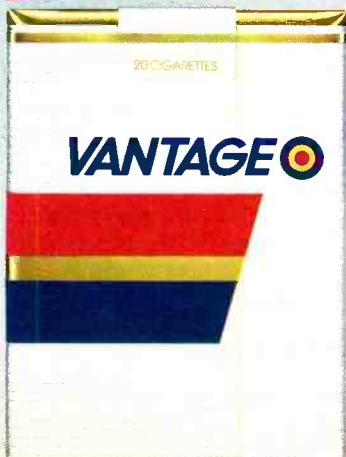
The Colossus four-channel digital recorder that created such a lot of interest at the New York AES convention a little more than a year ago continues to evolve. Colossus, from By the Numbers, uses a four-channel signal format, allowing four monophonic channels, two stereo pairs, or discrete four-channel. That signal can now be encoded on a laser videodisc, which can be played back on a videodisc player interfaced with the Colossus recorder. This system will be used to store and retrieve a very large library of digitally recorded sound effects now being prepared by Brad Miller of Mobile Fidelity Productions.

I would be remiss if I didn't mention some of the more interesting papers presented at this 81st AES convention. The redoubtable Stanley Lipshitz and John Vanderkooy gave everyone the lowdown on "Digital Dither" (AES Preprint No. 2412), while the good Dr. Floyd Toole held forth on "The Perception of Sound Colorations Due to Resonances in Loudspeakers and Other Audio Components" (Preprint No. 2406). You may get some great ideas on room treatment by reading how "New Types of Acoustical Materials Simplify Room Designs," by Peter D'Antonio of RPG Diffusor Systems (Preprint No. 2365).

Last, but hardly least, my dear friend and colleague, Associate Editor B. V. Pisha, was made a Fellow of the AES at this convention, in recognition of his contributions to the testing and evaluation of audio components. (*Editor's Note:* I am extremely proud to state that B. V. Pisha becomes the sixth person associated with *Audio* to be recognized as a Fellow of the Audio Engineering Society. Previously, C. G. McProud, the late founder of this magazine; Associate Editors Edward Tattall Canby and Bert Whyte; Senior Editor Richard C. Heyser, and Contributing Editor John M. Eargle have been so honored. In addition, Richard C. Heyser is now President-Elect of the AES.—E.P.)

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## MIKING A POINT



**T**he development of Denon's new "super-one-point" stereo digital recording technique (using many mikes), and of the prototype Denon Digital Time Alignment Console, had directly to do with the music of Gustav Mahler. The technique was shaped for Mahler during the year and some months it took to record his nine-plus giant symphonies, with the Frankfurt Radio Symphony Orchestra under Eliahu Inbal, in Frankfurt's Alte Oper concert hall.

The symphonies do differ. And so the technique was worked out gradually according to need, reaching its final definition, appropriately enough, in the huge Symphony No. 8 with some 700 performers, as I described in this space last month.

Out of the six-language control-room briefing for journalists held at the time of that recording session, and from some helpful Denon fact sheets (in English), I have learned enough about the procedures to fill out the picture for you. Yes, all these recordings, including No. 8 with some 24 mikes, are in the true sense "one-point" jobs, picked up by a single pair of stereo mikes at a

single optimum location in the hall—the sort of recording style that became famous in the 1950s with Mercury's Olympic series of mono LPs. That magic spot, not always easy to pinpoint in actual practice, was definitely located in the Alte Oper just before the recording of Mahler's "littlest" symphony, No. 4, says Denon. This work, featuring a soprano soloist, was recorded entirely without extra mikes, from a single point only. Not only that: The two mike signals were fed directly into the digital recorder, not even going into a mixing console. How's that for purity?

As per last month's account, No. 5 was almost as pure, with only a very spare, occasional use of "assistant mike" coloration. But there were still the biggest symphonies to come, and they were a problem, obviously, since they required vast assemblages, immense spatial layouts, acres of musicians. Wisely, these symphonies were recorded more or less in order of size and complexity, through the big No. 8. That way, the developing time-delay technique, beginning with Nos. 6 and 7, recorded last spring, could increasingly be used to "conquer space," so

to speak, compensating for all those vast distances from close-up mikes to the main stereo mikes. With time delay, the entire orchestra, chorus and soloists could be brought within a few feet of the central spot—and yet simultaneously remain in their proper perspective out in the hall.

In No. 6 and No. 7, for instance, there is a cowbell, a snapped whip, a mandolin, a guitar, a tinkly celesta, and even a hammer (hammering on something that sounds like a good two-by-four). In recording, all of these needed some extra definition, and they got it, time delayed. So did the big percussion, far to the rear of the huge stage.

Denon is a bit confusing in its use of singular and plural, but a moment of study makes all clear: There were of course two omni mikes in stereo, up front, mounted a couple of feet apart for more realistic ambience. In a huge hall, that's a single point. On the other hand, the assistant mikes, which I now find were indeed B & K cardioid prototypes first used in these sessions, were *not* stereo—each was a single pickup and thus directionless. Mixed into the two front stereo channels—with digital delay—they merely added color, definition, roundness, presence, without affecting the stereo spread. Nor, thanks to the well-known cardioid "sonic spotlight," did they appreciably add to the recorded ambience. Not even with the large choral forces in No. 8; each choir sang within the spotlight of its own assistant mike.

These B & K cardioids, by the way, apparently have unusually clean "fringe" response off their central axis, which is why they blend well with the B & K omnis used for the main stereo.

Now for the follow-up. Denon's PCM digital recorder has only four tracks. Enough for 700 performers? With ingenuity, yes.

The main stereo channels took priority, each mike going to its own separate track, unmixed. These two channels are the vital core of the recordings. For most of the Mahler, the other two tracks took the combined mix from the assistant mikes, whether few or many. For these, obviously, some mix-down was necessary at the recording session, done in the normal manner. But the result was kept strictly separate from the main channels.

Illustration: Donald Keene



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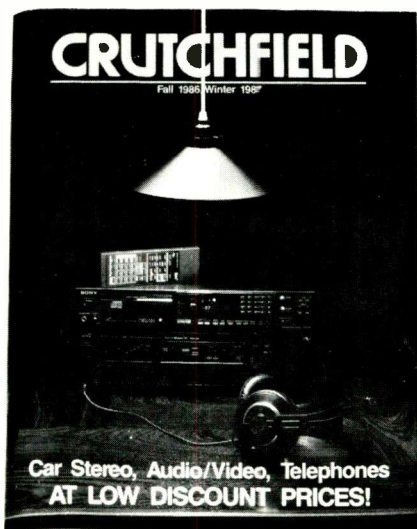
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**CRUTCHFIELD**

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Denon's time-delay technique was increasingly used to "conquer space," compensating for vast distances between mikes.

On special occasions this distribution may be changed. For possible future surround sound, to take an example, at the enormous final climax of Symphony No. 8, with all 700 performers going full blast and a brass choir far up in the rear balcony, the brass was given its own track (presumably the assistant mikes were lumped together; it wouldn't matter much in that roar of sound!). Later on, that brass can be "placed" wherever desirable for a surround effect.

I did not get to learn which assistant mikes were mixed into which track with which others. Too many people, too many languages. But this is not important, since the mix would be different for each work of music, in any case. What matters is that ingenious time delay to bring all those mikes, no matter how many, into phase with the front stereo mike pickup. For the entire 700 performers (more or less, mind you—I didn't count them), Denon got away with only three groups, organized according to distance, using only three of the nine available delay modules in the console. That's ingenuity.

The Frankfurt Radio Symphony does indeed go on the air, in addition to giving regular concerts on a par with those of our best orchestras. Therefore, the Mahler performances were recorded for broadcast as well as for Denon's CDs. From something said by Peter Willemoes, Denon's Danish associate engineer, I gather that at first the Mahler concerts were miked separately for broadcast by the Hessischer Rundfunk, the local public radio. Later, it seems, they switched to a mixdown taken from Denon's tapes, which conveniently have the pure stereo one-point pickup—ideal for broadcast—on separate tracks, and the assistant material available to be added according to the Rundfunk's taste. Their radio must be mono-compatible, and no doubt compressed to bring Mahler to radio size—a very different mix from the final Denon product, yet out of the same tapes.

The outward recording schedule for all this Mahler is interesting. It was set up to allow an interchange, for repairs, between concert recordings at the superb Alte Oper and no-audience sessions at the same place. That is vitally helpful in case of disaster, major or

minor. Considering its vast space, the hall has a relatively small number of seats, and every one of them is padded with a species of plush or pile fabric which simulates the sound-swallowing effect of an average human body. Thus the reverberation changes minimally with an audience on hand, and a mix can be made, for repairs, with only a small adjustment of the ambience. A mistake or an unwanted noise in a concert recording? It can be removed with a segment of nonconcert rehearsal, or even with a special retake if feasible.

Thus Denon got down as many as five complete performances of the Mahler symphonies, several concerts plus a rehearsal/run-through session ahead of time and even a retake session as an extra. There were two concerts of the big Symphony No. 8 on successive nights while I was there, and both were recorded. There was also an earlier run-through, with starts and stops, and no audience—I heard someone on that tape say "take 24," in English. It is dangerous to depend entirely on concert performances, where stops are impossible. The same mistake can happen twice—the same bus can roar past at exactly the same moment. With interchangeable stop-and-go studio-style sessions, there is ample insurance.

I should note again that the German audience was astonishingly quiet and cooperative. That helps enormously, as every recordist knows.

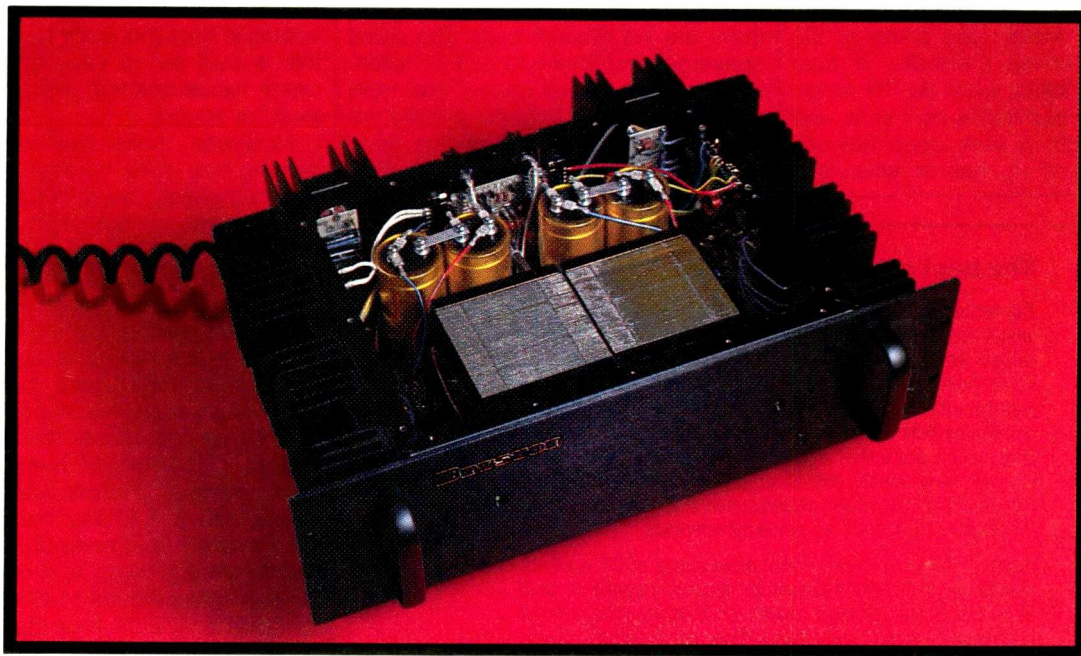
Ah, that hall! As I've said, it was recently built inside the bombed-out shell of the old opera house, which had been standing in picturesque ruins for more than 40 years, ever since WWII.

The new concert hall opened only in 1981, long after—thank heavens—the disastrous postwar period when "modern" halls, one after the other, proved to be acoustic monstrosities in spite of all the glass and metal, the geometrical curves and the flat planes, the bizarre acoustic "island" reflectors hung in space. This time out, the designers knew what they were doing, even in a space that might be the biggest ever.

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Walls at the Alte Oper converge slightly and are asymmetrical, but there is astonishing harmony, a prize example of order within calculated chaos.

vider halfway down to double the whole. If you fumble long enough against that mirror, you discover the restrooms behind. Opposite, a coat check half a block wide. Big thinking.


Inside, the hall seems very wide, and it is very high. A vast, deep balcony structure takes up half of what is a

semi-rectangle, though the main hall seems squarish. I soon noticed that there are no parallel walls; the sides converge, and the ends do not match. Balcony extensions curve out from each side and all the way around the front, beyond the stage on the floor. Nothing is geometrical; the two side

walls are covered with various levels of box-like balconies and enclosed glass booths in front (not used by Denon). All this is built out of expensive wood—deep russet-colored mahogany. Superb for sound.

Moreover, those two slightly converging side walls, I gradually realized, are completely asymmetrical. Not a single shape on one side is matched by the same on the other. Complementary for the eye—but different for reflected sound. The high ceiling appeared to be hung, sloping forward (?), with rows of small reflecting planes at various angles. Down below were those plush seats, a dull greenish color to balance the russet mahogany. All this is astonishingly harmonious, a prize example of order within deliberately calculated chaos, and one wonders why it hasn't been done this way before. When you come down to it, that postwar architectural style didn't allow for good acoustics. Now there are new styles of building, and we can apply our acoustical knowledge to good effect at last.

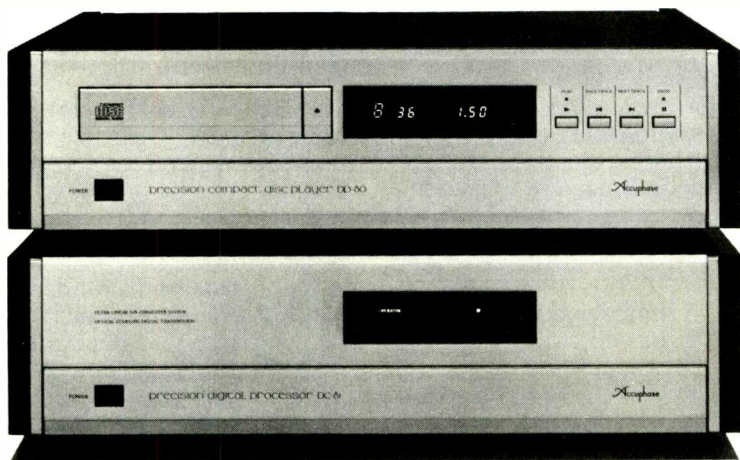
All this may help explain the extraordinary sonic effect of this big space. Directionality is perfect, never confused; you see, and you hear what you see. Everything is ultra-clear and sharp, never dry and dead, always with good presence. But what surprised me most, as I've already said, is that the hall sounded like the Denon recordings, not the other way around.

To illustrate: From my seat in row 8 on the floor, the seven solo singers were lined up across the front of the stage, each with a close-up solo assistant mike, from maybe 25 to more than 50 feet away from me. But every one of them, in that purely acoustic transmission, sounded crisp and clear, their words sharply defined—as though those individual mikes were shaping a close-up sound. Indeed they were, but only for the recording! We at the concert heard 100% acoustic sound. Nevertheless, the effect was *exactly like a good recording* of solo voices. I could hear other solo sounds, far in the orchestra rear, even segments of chorus still more distant, that had exactly the same "assistant mike" clarity, as heard in the best recording. But this was strictly the hall itself! In such a place, how can you go wrong? 

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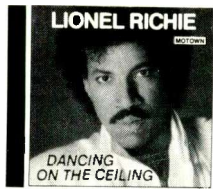
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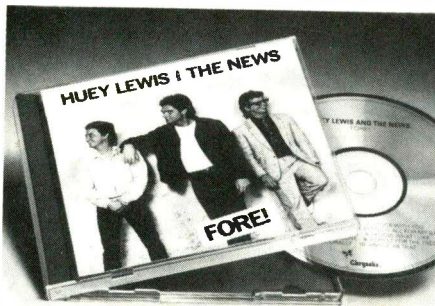
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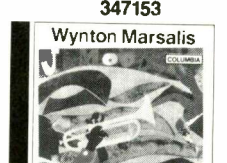
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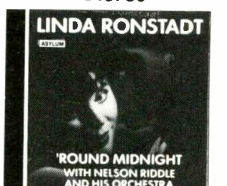
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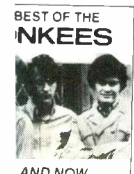
CK9/C3



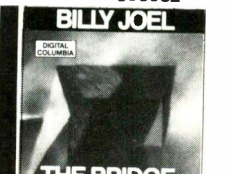
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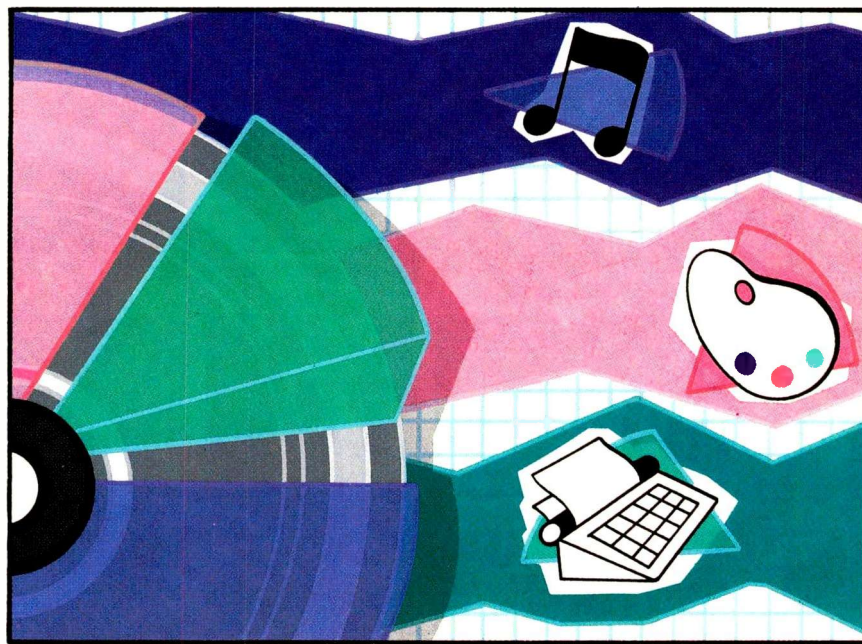
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## DISC OF MANY (INTER) FACES



**A**s we observed last month, the CD-I format opens diverse new applications for the Compact Disc storage medium. Its ability to simultaneously store audio, video, text, and data could create a wholly new publishing medium, read through the tiny laser beam in your new CD-I player. Let's continue our introduction to this new format (with thanks to Philips International's helpful text, "A General Introduction to CD-Interactive," which provided much of the information in this and last month's columns).

To make room for video and text, CD-I must compress the audio information which otherwise would occupy the entire disc space, as it does in the CD-Audio format. Adaptive delta pulse-code modulation (ADPCM) accomplishes the feat. ADPCM is an efficient variation on pulse-code modulation (PCM) and is extremely useful because of its ability to store digital audio data with fewer bits. On the other hand, ADPCM requires more processing than regular PCM for both encoding and decoding.

Pulse-code modulation encodes the absolute value of each signal sample as a digital (usually 16-bit) "word." Delta modulation encodes relative values, comparing each sample to the previous one and using a one-bit signal to indicate whether the next level lies up

or down the digital audio staircase. This saves a lot of data space, but it encodes signal-level changes only in fixed amplitude increments for each sample. With *adaptive* delta modulation, the amplitude of the step size may be varied to more closely approximate the waveform. In ADPCM, a PCM word is substituted for the one-bit correction signal. Now there are several quantization levels available, each with its own step-size scale factor. The result? Even better audio performance, with a relatively small number of bits.

The ADPCM used in the CD-I format uses four- or eight-bit PCM words, depending on the level of sound quality required. With a four-bit system, correction information is available at one of 16 levels. An eight-bit word provides 256 levels, for even better performance, at the price of more bits. Each of the quantization levels is assigned a step-size scale factor; because considerable step-size information is available, step sizes may be adapted with great accuracy. The scale factors themselves are based on the statistics of the signal itself. For example, scale factors for an ADPCM circuit designed to process speech would be selected differently from those for a system designed to process music. The CD-I format calls for three levels of ADPCM fidelity: "Hi-Fi" (LP quality), "Mid-Fi"

(FM quality), and "Speech" (AM quality). In addition, regular 16-bit PCM audio can be encoded.

By using efficient ADPCM for the lower fidelity modes, more space is made available on the disc for accompanying video or computer data, or for more channels or more recording time. PCM recordings, like CD-Audio, are stereo, and fill the disc. The three ADPCM modes, however, can be stereo or mono. The number of possible channels increases as the fidelity level decreases, as shown in Table I. Of course, there are always twice as many monaural channels as stereo channels. For example, in Mid-Fi mode, there could be four stereo channels or eight monaural channels. In Speech mode, a disc could have up to 16 72-minute monaural channels. There is a pause of 1 to 3 seconds when switching from the end of one channel to the beginning of the next.

The audio quality level chosen determines how much storage capacity is left for video information. As Fig. 1 shows, a disc can be all audio or all video, split 50-50 (using Hi-Fi stereo sound) or divided to give more space to video by using the Mid-Fi or Speech audio quality levels. Using Speech mode, up to 94% of the disc space is available to hold video or other nonaudio information.

A CD-I disc can store video material with varying quality levels for resolution and pixel coding. Two standards of video resolution are supported: Normal resolution of 384 × 280 pixels (picture elements) and high resolution of 768 × 560 pixels. Normal resolution corre-

Illustration: Cameron Wasson

Table I—Levels of CD-I audio fidelity and resultant channel availability.

Audio Level	Coding	Stereo/Mono	Number of Channels
CD-Audio	PCM	S	1
Hi-Fi	ADPCM	S	2
		M	4
Mid-Fi	ADPCM	S	4
		M	8
Speech	ADPCM	S	8
		M	16

As soon as  
the dealer said,  
"To/without/and,"  
I said  
"Okay Akai."

There were other  
things about  
Akai's CD-A70  
Naturally, I loved  
the 3-beam laser  
pick-up, digital  
filter subcode ter-  
minal, and insu-  
lated floating  
mechanism.

Loved em.

But then the  
dealer showed me  
the Natural Logic  
Operation.

Three buttons  
take me to the  
music I want to  
hear without the  
music I don't And  
play all that's in  
between just like  
a CD should.

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FUNCTION  
DISPLAY  
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INDEX NO.  
INDIVIDUAL  
TIME  
TOTAL TIME

MUSIC NO. INDEX NO.

2 1  
TIME  
0 MIN 07 SEC

PROGRAM  
||

SELECTED REPEAT

DISPLAY CLEAR

POWER

DIGITAL

PHONES

COMPACT DISC PLAYER CD-A70

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A single CD-I disc can hold 19 hours of audio, 41,000 color pictures, 300,000 typed pages, or a combination of the three.

sponds to best achievable resolution with normal television receivers, while high resolution is the best that's likely to be achieved with future enhanced or digital receivers. Pictures are generally noninterlaced, although interlacing can be used.

The CD-I specification for pixel coding provides for three picture qualities: Studio (natural) quality and two graphics levels. Natural pictures normally occupy about 325 kilobytes per picture without interlacing (650 kilobytes with interlacing). However, the CD-I system uses a data-compression technique to reduce storage requirements to 108 kilobytes. At a data rate of 174.6 kilobytes per second in CD-I's Form 2 configuration, one full-frame natural picture is transferred in just over 0.6 second. That's no competition for videodisc or videotape, which transfers one frame every 0.033 second.

The first of the two graphics modes is designed for applications that involve image manipulation by the end user. This mode is based on absolute RGB (red-green-blue) coding. It supports either eight-bit color coding, yielding 256 different colors, or 15-bit coding for 32,768 colors. A 15-bit RGB graphic would occupy about 215 kilobytes per picture. No compression is used in this mode.

The second graphics mode, designed for animation, is based on color look-up table (CLUT) graphics. This

mode permits full-screen animation with four-, seven-, or eight-bit coding for 16, 128, or 256 colors, respectively. The eight-bit CLUT mode requires 108 kilobytes per frame, but compression can reduce this to typically less than 10 kilobytes per frame. With compression and the interleaving of sound and picture, this graphics mode can provide animation at a rate of 17 frames per second. That's about the same frame rate as silent films (16 or 18 frames/S) but slower than sound movies (24 frames/S) or television (25 frames/S in Europe, 30 frames/S in the U.S., Canada, and Japan).

Text can be stored with bit-map or character encoding. The bit-map process, which draws pictures of each character, can handle any character (including math symbols, foreign alphabets, astrological symbols, or miniature smile buttons), but requires five bytes per character for storage. With the bit-map process, if the characters are drawn in an 8 x 10 matrix of dots in 16 colors, a disc can hold a maximum of 120 million characters. These characters cannot be manipulated under program control. However, it is possible to place them electronically onto transparent or translucent overlaying planes. The system specifically allows for superimposing bit-mapped text onto external video, or pointing at portions of the text with an externally controlled cursor.

Character-encoded text can handle only characters for which codes have been standardized. This mode requires only one byte per character for storage, thereby limiting the number of different standard characters to a maximum of 256 but allowing storage of up to 600 million characters on a disc. Text can also be encoded with two bytes per character, with the second byte specifying such factors as color, font type, and size. This would allow a total of 300 million characters per disc. In both character-encoded modes, it is possible to manipulate text via software—copying text from the disc into a document being written on the user's computer, for example.

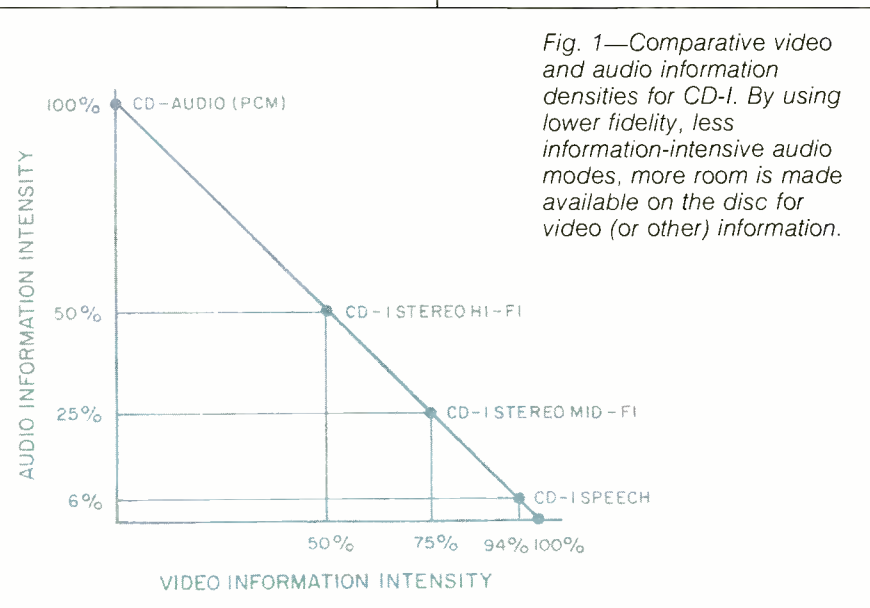
In the normal-resolution mode, text is limited to 40 characters on 20 lines to allow display on ordinary TV sets. The high-resolution mode allows 80 characters on 40 lines for display on computer monitors (which currently handle only 25 lines of 80 characters) and future digital TVs. A wide range of visual effects is defined, including cuts, scrolls, overlays, dissolves, and fades.

CD-I is not a peripheral but a self-contained system. To ensure universal disc and drive compatibility, dedicated hardware and interfaces are specified. A CD-I player will contain a disc drive, decoder chips (for text, graphics, video, and audio), and microprocessor controllers; it could be interfaced to your television and stereo. Although a CD-I player could also be interfaced to a personal computer, it would not be cost-effective if used for that alone, and it would also miss the medium's intent. A CD-ROM drive and interface alone would make a better computer peripheral.

The CD-I system uses the Motorola 68000 microprocessor family. The CD-I real-time operating system (CD-RTOS) is based on the OS-9 real-time operating system. This ensures that all CD-I players will be able to search, retrieve, process, and output any information stored on any CD-I disc.

Because the CD-I format recognizes 16-bit PCM data, a CD-I player will be able to play regular CD-Audio discs. A CD-Audio player will not be able to play CD-I discs, however. As specified in a proposal from the High Sierra Group (an industry committee), CD-

*Continued on page 45*



*Fig. 1—Comparative video and audio information densities for CD-I. By using lower fidelity, less information-intensive audio modes, more room is made available on the disc for video (or other) information.*



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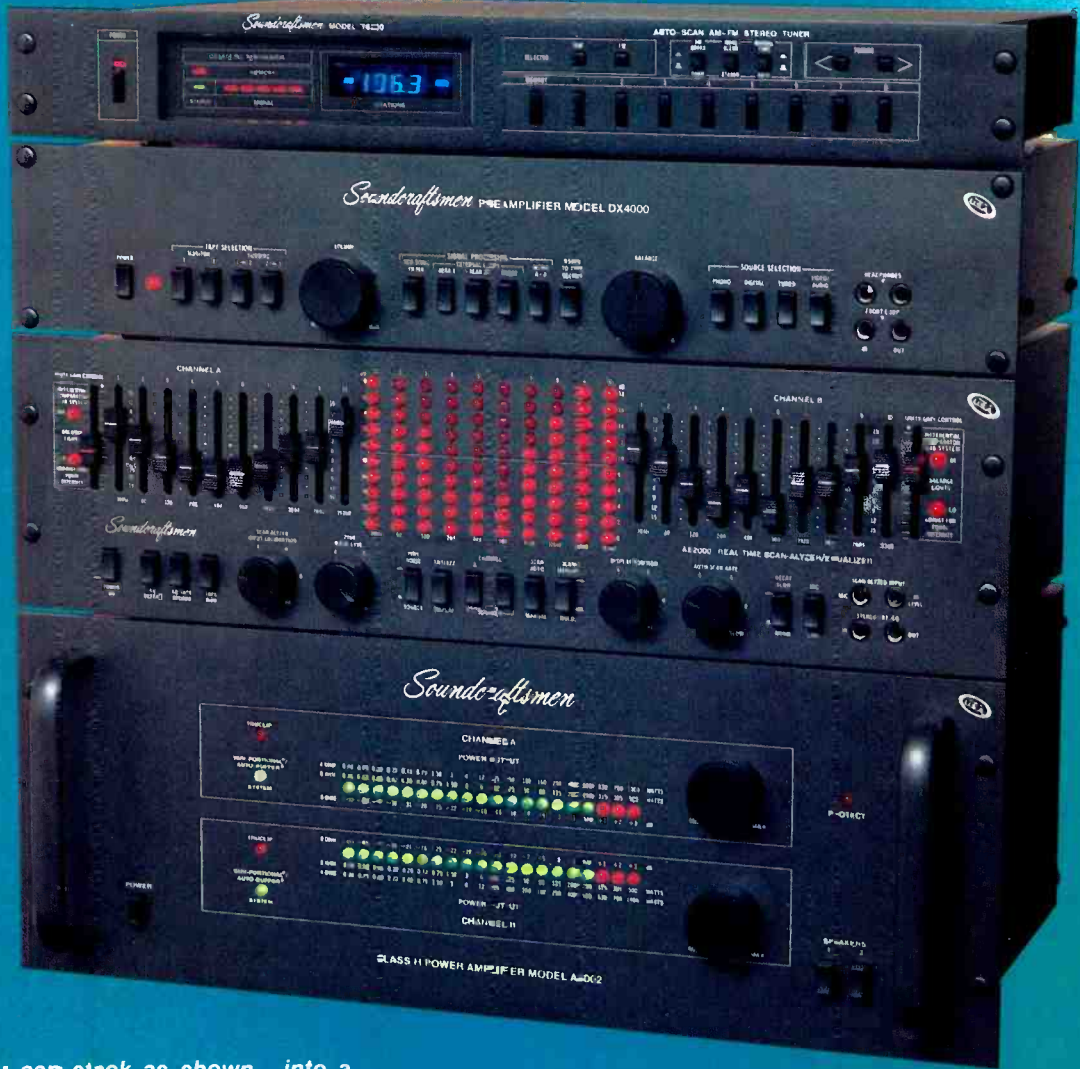
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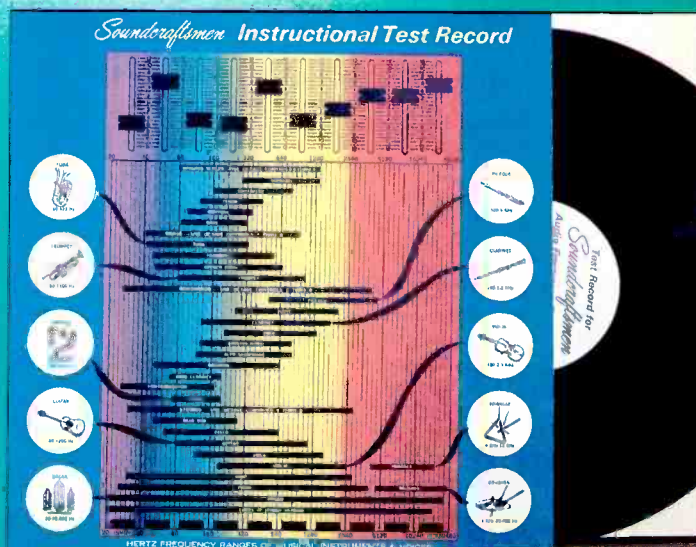
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It's what we call a soundstage. This third dimension (an audible depiction of a recording's spatial cues) is the designer's ultimate goal. At Infinity, it has obsessed us throughout our 18 years of designing and building loudspeakers. Above all, it is a goal which we have approached systematically, through unremitting attention to drivers, cabinets and crossovers.

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 The logo features the word "CALIFORNIA" in white, serif, all-caps font on a dark green rectangular background. Below this, the word "SOUNDS" is written in a large, bold, yellow, serif font with a slight glow, set against a dark, abstract background that resembles a close-up of a textured surface, possibly wood or stone, with some purple and red highlights.
 

# CALIFORNIA SOUNDS

## By Keith Yates

The French have a term for "Once upon a time. . . ." Not coincidentally, "Jadis" (*zhah-dees*) is also the name attached to one of the world's rarest and most exquisite amplifiers, an \$11,000 160-watt sculpture in brass, chrome, and vacuum tubes. In reality as well as fantasy, Jadis is the logical launching pad for a journey into *high-end* audio—that singular, beckoning world at the end of every music lover's rainbow.

For all the polished metal, glowing circuitry and exotic names, it is the sound that seduces one into making the journey. Most any stereo system can relay the rudiments of

musical expression: melody, harmony, and rhythm. The mission of the high-end is to probe beyond the obvious, to reveal music's indescribably rich shadings of color and texture, its interplay of forms and spaces, its dimensions, movements, details. The high-end is a sphere of massive amplifiers striving for the fleeting, fragile nuances; of monolithic speakers delivering delicate delineations of depth and timbre. It's a world of jewellike preamps reaching for a velvety-black silence between riotously colorful splashes of notes, of tiny, exquisitely crafted phono cartridges capturing the crushing bru-

tility of a final, all-out orchestral crescendo.

It is the sonic nuances, the details and finesse, that distinguish the state-of-the-art from the run-of-the-mill. Unless you're a confirmed audiophile with pockets as deep as your passion, you will be forgiven for wondering what would drive a person to spend such lavish sums on, say, a 7-foot-high pair of Apogee ribbon speakers, a Jadis preamp, four Mark Levinson No. 20 monaural power amps, Goldmund Reference turntable system, Koetsu

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## The System...

by *N. Nakamichi*



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The OMS-7A II Compact Disc Player expands the horizons of digital sound with a smooth transparency and the incredible depth and detail that only Nakamichi digital technology could impart.

And now, the CA-7A Control Amplifier—arguably the most sophisticated preamplifier ever conceived—places control of the entire Series-7 System at your command... from wherever you happen to be.

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Rosewood Signature cartridge, Tandberg 3001A tuner, Accuphase DP80/DC81 compact disc player, and Siltech connecting cables. The fact is that, no matter what the medium, artistic genius reveals itself in the details. Sonically, it's only the minutiae of timbre, texture, depth, and responsiveness that distinguish a Stradivarius from a department store violin. Yet those details yield a palpably different artistic effect.

In home audio, it's the details that account for the illusion of music with a real pulse and personality—of a dialogue with flesh-and-blood musicians in a real concert hall. At roughly \$60,000, our hypothetical system is far from inexpensive, but then try imagining what it would cost to hire Herbert von Karajan, Wynton Marsalis, and Dire Straits to breathe musical life into your living room every night.

Over the past 10 to 15 years, the high-end has blossomed from a group of tinkers and dissidents into a full-fledged industry, with its own lexicon, posh salons, and roster of big-name designers. Richard Vandersteen, whose speakers have figured among the audiophile references for a decade, recounts a common theme: "Ten or 15 years ago, when we started talking about the

three-dimensional aspects of sound—sound-staging, depth, imaging—the mainstream stereo world thought we were kooks, the lunatic fringe. Dealers didn't want to hear another come-on. Magazines weren't interested. There weren't many kindred spirits. Now there's a whole high-end community. The mainstream uses our terminology, looks at our computer-aided designs, and tries like hell to figure out how we make the gear sound the way we do."

Vandersteen is one of a network of innovators that includes Alan Hill (Plasmatronics), William Z. Johnson (Audio Research), Nelson Pass (Threshold), Keith Johnson (Entec, Reference Recordings), John Curl (Levinson, Lineage), Jim Winey (Magnepan), Leo Spiegel (Apogee), Harold Beveridge (California Audio Technology), David A. Wilson (Wilson Audio Specialties), Peter Walker (Quad), and John Iverson (Electron Kinetics). These mavericks—and many others—are linked by a restless dissatisfaction with existing technology, as well as a knack for coming up with unique solutions to long-standing design problems.

Like many of the brighter lights in the field, speaker pioneers Spiegel, Beveridge, Hill, and Iverson initially made names for

themselves in aerospace. Spiegel developed the inertial navigation systems for the B-1 and B-2 bombers; Beveridge had technical charge of advanced ballistic missile defense at the Pentagon during the Kennedy administration; Hill, whose distinguished plasma physics career later gave birth to his \$10,000 helium-fed plasma loudspeaker, started out overseeing high-powered "directed energy" systems that are now part of the Star Wars program; and Iverson, at 18, invented critical components of the control and command system for Apollo's 1969 lunar approach.

In a nutshell, the challenge facing the would-be audio genius is to fashion products that display linear (perfect) performance from nonlinear parts. Whether transistor, tube, magnet, or speaker diaphragm, the traditional raw stuff of audio gear strains to cope with audio's extraordinary demands—demands that include a loudness ratio of more than 100 million to 1 (80 decibels), a frequency ratio of 1,000 to 1 (20-20,000 Hertz), and a human hearing system whose

*Nakamichi's high-end equipment brings remote possibilities to life.*



Photo courtesy of Nakamichi





Photo courtesy of Boston Acoustics

*Boston Acoustics' wall mounted speakers envelope listeners in musical experience.*

intricacies are only just beginning to be fathomed.

Overlayed on pure physical and psycho-acoustic constraints are the diverging viewpoints of the designers. One veteran speaker designer asserts, "You can't have high fidelity without getting the deep bass right. It's the foundation of music, the same as the foundation of a house. You don't bother with the walls or roof unless the foundation is right."

Other designers disagree and willingly trade deep bass response for other goals—dynamics and clarity in the mid-bass, for example. "There isn't enough musical content in the deep bass to get excited about," says one. "The real goal is to replay music's dynamics: the loud and soft contrasts," says another.

Beveridge maintains that talk of bass, midrange, dynamics, and the like, misses the more fundamental point of how the speaker spreads sound into the room. "A line-source radiator [a speaker with either a single very tall drive element or a continuous stack of them] is the only way to truly illuminate a room with music," he insists.

Amplifier designers who favor vacuum tubes often cite the importance of achieving smooth, "liquid" midrange reproduction at all costs, while those who gun for a tight,

"authoritative" sound, insist that it can only be had with bipolar transistors. In short, there are as many lists of sonic priorities as there are designers to implement them.

Opinions also vary on purely practical considerations. A Vandersteen considers it important to design speakers that amplifiers will find easy to drive; yet Spiegel's highly acclaimed Apogee Scintillas can throw all but the most armor-plated power amps into fits.

### Choice Choices

The variety of viewpoints and the products they inspire make the high-end a haven for the music lover who has outgrown his or her first stereo system and is looking for a wider range of options than is available in the standard stereo emporiums. Most stereo enthusiasts begin with conventional gear and over time develop sonic standards and preferences that are not met by the more pedestrian hardware. One listener may become especially sensitive to reproduction of the female voice; another focuses on the attack and shimmer of percussion instruments. No matter how specialized—or even idiosyncratic—an audiophile's philosophy of sound, there are probably a dozen designers who share that view and produce high-grade components to address it. Walking into a high-end shop for the first time is likely to

open the eye, soothe the ear, and quicken the pulse. A political scientist might consider the high-end world pluralistic or even anarchistic; the music lover is more likely to describe the sheer richness of opinions and options as utopian.

### Under the Hood

While designers set their own sonic destinations and routes to get there, there is a broad consensus that legitimate high-end gear is at least partially the product of old-fashioned concepts of superior materials and construction quality. Capacitors, for example, come in many types, from garden-variety electrolytics to an entire array of "polys"—polycarbonate, polyester, polystyrene, polypropylene.

Wholesale prices may range from a few cents each for electrolytics to a couple of dollars for polypropylenes, depending on specification. Each Teflon capacitor in a Levinson, Spectral, or the like, can easily cost \$20 wholesale. They're used because, among other advantages, they don't smear the signal passing through them. (The "dielectric absorption" of other capacitor types indicates that they remember and faintly replay the signal that passed through a split second before, causing notes to be "smudged" by the preceding ones.)

A volume-control assembly or “potentiometer” can cost less than a dime; the British-made Penny & Giles pots used in Levinsons, Rowlands and Krells can cost \$50 to \$100 each. What the money buys is a precision, calibrated mechanism made of platinum, palladium, and conductive plastics. The designers are satisfied that lesser parts compromise the music’s integrity. Similarly, circuit boards can range from standard phenolic resin composition to military-grade glass epoxy; resistors come in standard 20-percent-tolerance carbon composition types for a penny apiece to 1-percent-tolerance metal-film types for a dollar or more each.

Production-oriented corporations in the bulging middle of the market generally choose to use integrated circuits (ICs or “chips”) because they’re far cheaper and easier to load onto a circuit board than a vast complement of discrete transistors, resistors, and the like. However, the chip’s fixed internal workings reduce the scope for the designer’s control over his creation, amounting to a 1980s version of the old one-size-fits-all philosophy. “Asking an audio designer to use ICs in place of separate transistors is like asking him to put on a straitjacket,” says Iverson. “No one worth his salt is going to take pride in plugging in an off-the-shelf chip instead of figuring out a more clever way to configure circuit components.”

Christopher Russell of Bryston Ltd., a Canadian preamp and amplifier maker, agrees: “If there’s a row of cheap little chips and a scrawny power supply off in a corner somewhere, chances are good the manufacturer’s money ended up in the advertising department, not the engineering lab.”

### Purity

High parts quality is more of a mechanical requirement of elite status than a philosophical one. Yet high-end audio as a phenomenon is defined more by ideas than anything as mundane as capacitor quality and absence of integrated circuits. Central to the high-end aesthetic is the tenet that less is more, that music in its unadorned, purest state is more glorious and compelling than any electronic jiggery-pokery could ever make it. In his movie *From Mao to Mozart*, the great violinist Isaac Stern (himself a high-end equipment owner) remarks that “Music is every color of the rainbow . . . and some that even painters don’t have.” This sense of wonder and reverence for music is at the heart of the notion that audio best serves music by getting out of its way and letting it pass through unfettered and “unimproved.”

Thus, filters, tone controls, equalizers, expanders, and the other nearly ubiquitous paraphernalia of the broader market, are almost completely absent in the high-end.

### History

It’s not clear when the mainstream manufacturers first took serious notice of the budding high-end phenomenon. Some say it was in the mid-1970s when several Japanese firms began emulating the thin, black rack-mount look of Levinson’s first preamplifiers. Later, several major Japanese firms launched limited-distribution “audiophile” lines of their own. A few have found commercial success, but it is clear that, with few exceptions, the high-end belongs to the Americans,

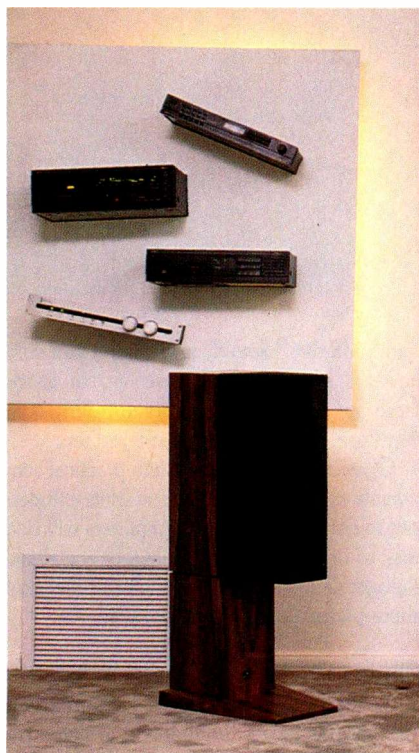


Photo courtesy of Christopher Hansen

*Custom installations combine artistry with acoustics to maximize listening pleasure.*

Canadians, British, and Europeans, not the offshore volume producers. Nowhere is this clearer than in Japan itself, where the most sought-after brands have names with a distinctly non-Japanese ring: Mark Levinson, Audio Research, Classe, Rowland, Krell, Klyne, Conrad-Johnson, Vendetta Research, Counterpoint, Jadis, Vintage McIntosh, Marantz, and JBL. Given that Japanese producers dominate the vast middle tier of the

audio market, their low profile in the high-end puzzles many. Those looking for signs of national or cultural prejudice will be frustrated, for Japan has its mavericks too: Koetsu, Kiseki, Goldbug, and a handful of others that produce the world’s most revered phono cartridges; Stax Kogyo turns out the electro-static headphones by which all others are measured; Accuphase quietly markets premium electronics; Nakamichi has pushed cassette and CD technology to new heights; and TEAC has redoubled its efforts in the upscale CD and cassette deck categories.

### Improving Room Acoustics

Previously just accepted as is, room acoustics can be manipulated through absorption, reflection, or diffusion. A proper diffusion system randomizes (or scrambles) sound impinging on it in a nonfrequency-selective way; this technique enriches and deepens the apparent soundfield. Perhaps best known is the RPG Diffusor Systems’ “reflection phase grating” units, which are based on mathematician Manfred Schroeder’s work in “quadratic residue number theory.” Higher math aside, the actual units are 2 feet by 4 feet by eight inches deep, and are most often mounted on the walls behind and alongside the main listening areas. Because the diffusors interrupt sound’s normally predictable pattern of reflection, rooms treated with them tend to sound more spacious and musically dramatic. Listeners often have the impression of being enveloped in the musical experience.

Absorption is perhaps the most common treatment for troublesome acoustics and is especially effective for overly clanky or reverberant rooms. Owens-Corning, Monster, Distech, and Audioquest offer freestanding or wall-mount absorbers made of spun fiberglass and other sound-soaking materials. Sonex offers sculpted foam tiles in a variety of colors and depths for similar applications. As with any single acoustic treatment, it is possible to have too much of a good thing; excessively damped rooms sound eerie and “listener unfriendly.”

No matter how judiciously one treats room surfaces, the corners will strongly amplify (reinforce) low frequencies, resulting in droning, muddy bass. Acoustic Sciences, RPG, and others manufacture freestanding cylindrical or triangular “bass traps” for corner placement to soak up excessive bass pressure. Their effect can make dense musical passages—cellos, double basses, tympani, and low brass, for example—more intelligible and expressive.



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*Modular cabinetry can be adapted to suit a variety of individual design needs.*

### Domestic Harmony: High-End Sound, California Style

State-of-the-art audio furnishes more seductions than most music lovers can resist. And it is in California that these seductions become furnishings. The familiar tangled-wires-and-equipment-on-orange-crates arrangements of the past are steadily yielding to the tailored, finished look. From San Diego to Sacramento, audiophiles are demanding that audio systems look and “integrate” as well as they perform. Perhaps more than anywhere else, it’s in California that you spot Spectrals in tony showcases, Contrads on custom consoles, and Rowlands in artsy armoires. Treatments of equipment range from spectacular displays of hardware/sculpture to sublime integrations with the room’s symmetry and balance.

For the dealer, who generally coordinates the process, system detailing can range from simple advice on hookups and cabinetry to daily involvement in executing a complete, acoustically fine-tuned audio room from the ground up. Designing and overseeing a “dream” room for music means juggling room layouts, acoustics, traffic patterns, sight lines, wiring systems, ventilation, even lighting and color balance. Along the way, the dealer (or independent consultant) coordinates with architects, acousticians, carpenters, electricians, cabinetmakers, and interior designers. Orchestrating such environments is fast becoming the major thrust of some of California’s most experienced high-end dealers.

Christopher Hansen, proprietor of a West Hollywood audio salon, confirms that demand for comprehensive services—from design concept through installation and even

selection of software—is high and increasing. “High-end audio has matured to the point where we’re getting involved in some truly sweeping installations. We’re now custom-fabricating an integrated unit for switching audio, video, and lighting systems: Push a button and it switches from a two-speaker audio to six-speaker video, dims certain lights. It’s even programmable to operate at predetermined times.”

While Christopher Hansen, Ltd., the Audible Difference in Palo Alto, and Keith Yates Audio in Sacramento are increasingly called in at the very beginning, at the concept and blueprint stages, there is much that can be done to enhance the function and appearance of existing hardware collections. Without modifying walls, ceilings, and the like, electronic equipment can be ensconced in custom cabinetry with pneumatic, vibration-damping turntable shelving; temperature-controlled air-flow systems; magnetic shielding; adjustable lighting; grounding strips; concealed wire conduits; slide-out and swivel shelves; and separate, high-current, filtered electrical services. Given enough lead time and sufficient coaching, a good custom cabinetmaker can turn out an installation to be savored, not just endured. The more popular route, through, is to shop around for a cabinet, or modular system, from existing aftermarket electronic furniture suppliers, such as CWD (Custom Woodwork & Design), Barzilay, or Xylophile. All offer a range of sizes and features in a variety of finishes for flexibility and future expansion. CWD and Xylophile in particular adhere to a “building block” con-

cept, which allows modules to be added as needed. CWD’s list of options includes wine rack inserts; drop-leaf doors; drawers for CDs, cassettes, and videotapes; rack mount hardware; door locks; and glass tops. For video gear there’s a projection screen cabinet with hideaway flipper doors; a projector cover; and even a “magic lowboy” motorized lift for video monitors—just push a button and your TV screen rises up from the cabinet’s hidden depths. For the sybarite bent on pampering the equipment and the eye of its owner, Talwar offers exquisite, hand-finished cabinets of solid cherry, mahogany, walnut, and other woods; and marble, granite, onyx, petrified wood, and leather-inlay tops. Options include “management systems” for air circulation, cables, power cords, structural vibrations, magnetic interference, AC line purity, and static buildup.

#### Remote Possibilities

Although minimalism has been a traditional underpinning of high-end design, room is being made for at least one popular creature comfort—remote control. Meitner Audio of Canada supplies their highly regarded pre-amp with remote, and Nakamichi’s ambitious 7 series—comprising their tip CD player, cassette deck, tuner, preamp, and Stasis power amp—is operable from a single master remote. With this ensemble, even the tuning tape head alignment (azimuth) can be performed from across the room. To keep noise, phase shift, or other distortion from contaminating the musical signal, the volume control on Nakamichi’s remote operates a

small motor inside the preamp, which physically turns the knob.

Among European suppliers, Revox and B & O already have integrated remote systems, and Tandberg plans to introduce one soon. Honors for the most comprehensive of the integrated remote systems must go to Sony for their new Access System, which includes a high-resolution 36-inch projection video monitor.

### Hiding Speakers

The biggest puzzlement with custom-installation projects remains managing to get great speakers to be heard but not seen. Building them flush into, or even just against, a wall generally skews tonal balance and disrupts special performance because of acoustic "comb filter" reflections and cancellations off adjacent surfaces.

Many loudspeakers are engineered for "whole space" placement (raised off the floor and sighted at least 2 feet from back and side walls). Popular exceptions to this restriction include the flagship offerings from Snell, Boston Acoustics, and Allison, which are targeted for floor-standing, against-a-wall applications. Dipole radiators—unenclosed panel designs like the Quad and Martin



Photo courtesy of TEAC Corp. of America

TEAC's high-end CD player.

Logan electrostatics, Apogee ribbons, and Magneplan planar magnetics—deliberately direct half of their acoustic output behind them, making wall placement tantamount to sonic homicide.

Concealing high-performance loudspeakers is a dilemma that few audio manufacturers, high-end or otherwise, have addressed head-on, although a consensus has formed that demand for high-performance concealed or flush-mount designs is headed for dramatic increase. "If the constant pressure from my California dealers is any gauge of the future, the reference-quality phantom speaker goes to top priority," Vandersteen allows.

Meanwhile, it's usually the dealer, not the manufacturer, who comes up with the solutions. The dealer may bring in freelance speaker engineers for one-off custom projects. Encouragingly, KEF, ADS, and a

handful of other firms with strong technical resources recently have set up in-house design teams to produce true high-performance concealed speakers, while Duntech and Sonance prepare to move into their second generation of wall-mount designs.

Since most high-end preamplifiers are no-frills, purist designs, the task of switching a "fully populated" system (turntable, tuner, cassette decks, player, reel-to-reel, Hi-Fi VCR, and video) usually devolves onto an outboard signal router. The Roumanis FS-1 will accommodate up to 11 inputs, including four tape decks, and is available in finishes to match Levinson, Spectral, or Krell faceplates, while a dbx offers two popular signal routers at \$400 and \$250. ●

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# Nulling Out Amp Distortion

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DAVID HAFLER

**T**hroughout the history of sound reproduction, there has always been uncertainty as to what degree of distortion and what types of distortion are audible. At one time it was thought that 5% total harmonic distortion was the threshold of audibility. Later, 2% was considered to be the goal to be reached to make distortion inaudible.

Now, high-quality amplifiers routinely specify distortion of less than 0.1% over the band from 20 Hz to 20 kHz. Despite this low distortion, many critical listeners claim to hear differences in performance which, if correctly identified, show that conventional distortion measurements are inadequate for indicating whether an amplifier's distortion is audible. This has led researchers to seek forms of distortion other than THD and IM, and some emphasis has been placed on transient distortion. However, this has still not given us the possibility of making a measurement and assigning a numerical value above which distortion may be audible and below which it is inaudible.

What is clearly needed is a method of determining whether distortion is audible in a given piece of equipment.

This determination should be made using music as a source, and not limiting the investigation to steady-state signals such as sine or square waves.

If a listener could compare the reproduced sound with the *original*, he could judge for himself whether the degree of distortion is detectable. This, however, is a test of the entire audio chain, including microphones and loudspeakers. One could not separately determine whether the amplifier produced audible distortion or not. To listen for an amplifier's distortion, one must have a reference for comparison. The most accurate and convenient reference is the traditional straight wire. A straight wire has infinitesimal distortion and must, by its nature, be more accurate than any active device such as an amplifier. It immediately opens up the possibility of A/B comparison between it and the amplifier being tested. This can be done by putting two amplifiers in series, with the gain of the second one reduced to unity to match the gain of the straight wire; then the amplifier under test can be bypassed by switching the straight wire across it.

Figure 1 illustrates the simple setup for making this A/B test. One channel

of a stereo amplifier can be used as the driving source for either the other channel or for the straight wire. Two subtle points must be observed in this experiment. First, there should be a loudspeaker load on the driving amplifier when the switch is in the "A" position. If that speaker load is not used, the test is less stringent, as the effect of the speaker on amplifier performance is not taken into consideration. As we shall see later, a change in loudspeaker load can indeed change the performance of an amplifier. Figure 1 shows the driving amplifier with its own speaker load when switched to "A" and with the test amplifier's load when switched to "B." Naturally, both loudspeakers should be identical. A second requirement is that the speaker load for the driving amplifier must be isolated by putting it in a separate room. Otherwise, sound from that speaker will mask the sound of the amplifier-versus-wire comparison.

A/B testing is a valid and scientific method of comparison. However, it requires judgment, and it has been criticized as being confusing, fatiguing and artificial. There is no question that what one person hears on an A/B test

**W**e have no set value for the threshold of audibility. Clearly, what's needed is a way to determine if distortion is audible in a given piece of equipment.



L I S T E N

*Nicks 86'*

# To listen for an amplifier's distortion, one must have a reference for comparison. The most accurate and convenient reference is the traditional straight wire.

is not necessarily what another hears. There is considerable dissension about the merits of A/B testing. Since it is not universally accepted, it is fortunate that there is a more sensitive listening test for distortion. The preferred way to listen for distortion is to use what I call the straight-wire differential test (SWDT). Its arrangement is illustrated in Fig. 2. Here again, one channel of the stereo amplifier is used to provide a low-impedance driving source, and the gain of the other channel is set to unity to match the straight wire. In practically all power amplifiers, the input and output are in phase, so a transducer such as a loudspeaker can be connected from input to output in a differential mode. It is obvious that if input and output are identical, there will be no signal in the loudspeaker. Any sound that is audible after careful adjustment of the level will therefore be distortion.

What happens here is that the original signal is removed by subtracting the output from the input; this un.masks the distortion generated in the second (test) amplifier. This remainder includes nonlinearities such as THD and IM, all types of transient distortion, and amplitude and phase aberrations. In fact, it includes *not only all known distortions, but also any which may be identified in the future*. What it does not do is separate the types of distortion, so no weighting can be given to the more obnoxious ones.

When this test is performed on most amplifiers, one can hear grundle, harshness, edginess, grain, and other irritating sounds. One can also hear some relatively clean sounds which come mainly from amplitude and phase errors. These are not necessarily annoying, but they are inaccuracies, and the best amplifier designs should minimize them as well as the irritating factors.

The SWDT is elegantly simple, requiring no instruments. Its merits are obvious, but it is extremely difficult to apply because of its great sensitivity: A few minutes (fractions of a degree) of phase shift or a few millibels (hundredths of a decibel) of amplitude variation will show up as significant sound.

When a similar approach to amplifier testing was explored in the past (see "Testing Amplifiers with a Bridge" by Andrew R. Collins, *Audio*, March 1972), experimenters found relatively high levels of sound due to phase and amplitude variations. They did not consider these to be important, and they compensated the straight wire to minimize such variations. They made the assumption that phase variations were inaudible. This is disputable and controversial. I prefer to correct the amplifier to eliminate these aberrations, rather than to eliminate them from the signal source.

The SWDT gives the amplifier designer a tool for improving the sonic performance of his designs. My own

company's first amplifier to be designed with the aid of this technique was the Hafler XL-280. Our approach was very conservative yet still innovative; we aimed for a wide-band, low-distortion design before the application of overall negative feedback, and before tweaking the final elements for minimum phase shift simultaneous with minimum distortion and adequate stability margin. Components were selected, bias currents were tested, phase compensation was added—all to get minimum sound output with the SWDT.

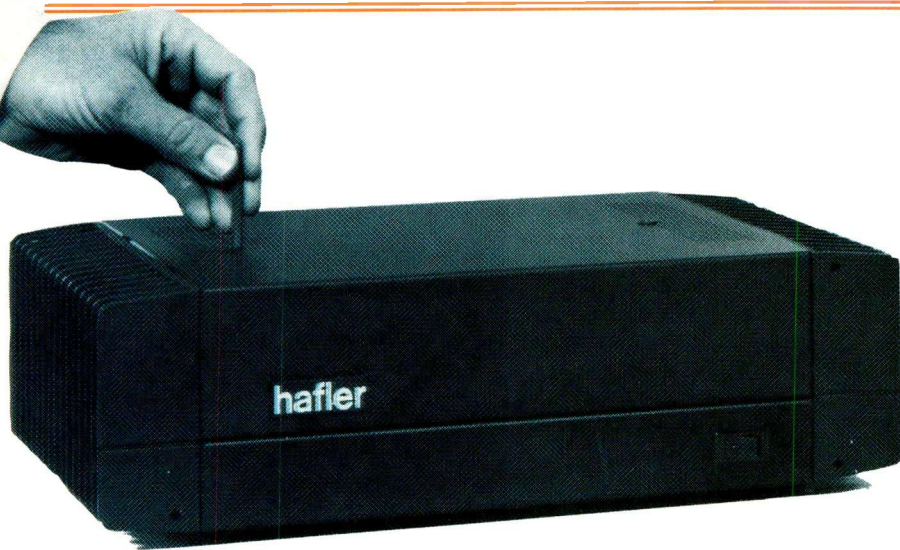
The XL-280 amplifier is completely symmetrical from input to output. It uses multiple power supplies with a common power transformer. There is a supply for each channel, and separate supplies for the Class-A driver stages and for the Class-AB output stages.

The input transistors are J-FETs in a cascode configuration. This provides a high degree of linearity with very low noise. The high input impedance of the J-FETs permits a higher impedance input point for the negative feedback loop.

A driver stage follows, with current mirroring back to the first stage. This drives the emitter-follower stage, which provides a low-impedance source for the relatively high input capacitance of the multiple output section.

The output stage consists of two complementary groups of three MOS-FETs in parallel, operating as source followers. These MOS-FETs are used because of their high speed, high degree of linearity, and extreme robustness; we have experienced minimal failures out of the hundreds of thousands we have used in predecessor amplifiers.

The XL-280 uses a *moderate* amount of negative feedback in an overall loop, plus local feedback such as in the source-follower output stage. Though there are some who unjustly accuse negative feedback of being detrimental, I think it is safe to say that negative feedback, *when properly applied*, is always beneficial. Proper application involves using it with a very linear amplifier and assuring an adequate stability margin. Used in that way, negative feedback will reduce distortion and widen band-pass. Most important, it will also stabilize operating characteristics so that perfor-



When the straight-wire differential test gives a substantial null on music at normal levels, the sonic accuracy of the amplifier cannot be improved.

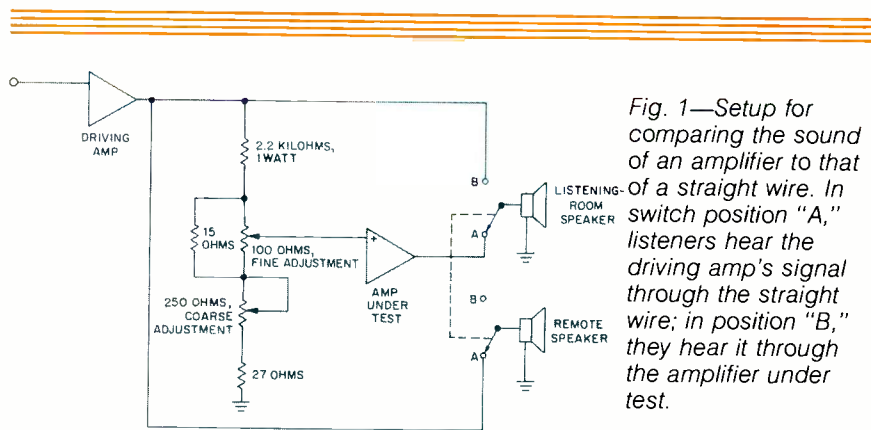


Fig. 1—Setup for comparing the sound of an amplifier to that of a straight wire. In switch position "A," listeners hear the driving amp's signal through the straight wire; in position "B," they hear it through the amplifier under test.

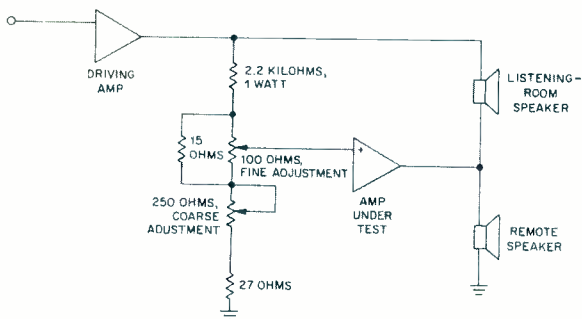


Fig. 2—Setup for straight-wire differential test (SWDT). When the pots are adjusted for minimum sound output from the speaker, only the distortion and phase and amplitude errors are heard.

formance will not drift in use and so that there will be negligible variation from one production unit to another.

Phase compensation is used in the XL-280 to achieve minimum phase shift in the audio band, in order to get maximum sensitivity from the SWDT. Achieving the goal of very low phase shift at high frequencies precludes the use of the customary output coil found in most amplifiers. To carry the control of phase to the ultimate, a phase "tweaker" is positioned so that it is accessible from outside the amplifier. This network consists of a series resistor and capacitor trimmer which adjust a small peak in the range above 200 kHz. We have aimed for a maximally flat amplifier in the audio range, and maximum flatness leads to a slight ringing—at ultrasonic frequencies, fortunately, where it cannot affect the sound quality. Putting a peak of 3 or 4 dB at 200 kHz is a good exchange for obtaining essentially no phase shift in the 5- to 10-kHz range.

In testing the amplifier under many conditions, it was observed that the optimum point of operation, as determined by the SWDT, shifted with a change of loudspeaker. This was due to variations in loudspeaker impedance and the fact that the amplifier's internal impedance increased at high frequencies. A change in loudspeaker impedance made a small change in amplitude response. These small variations may be the cause of some of the sonic differences which are heard by "golden-ear" listeners. Fortunately, these small deviations can be readily compensated with the variable phase-shift "tweaker" built into the amplifier. The result is that, by using the SWDT, it is practical to compensate the individual system for the specific type of loudspeaker in use.

For most listeners, the minute difference due to the final tweaking is unimportant, and a check using the A/B test of Fig. 1 confirms this. Most people can be satisfied with an adjustment

based on any conventional speaker load, rather than the specific speaker they are using. However, for perfectionists and the most critical "golden ears," the XL-280 amplifier can be adjusted to its ultimate capability with specific loudspeakers, using the SWDT as the measuring tool.

As mentioned earlier, when we applied the straight-wire differential test to many amplifiers, the residual noise we heard included both grungy, irritating sounds, which were products of annoying distortion, and "clean" sounds which were the result of phase and amplitude aberrations. Phase and amplitude distortions, while not unpleasant to the ear, can affect the tonal balance and timbre of the sound and also influence the imaging and sound stage of the stereo performance. Applying the SWDT to the XL-280, we have found that when playing music above normal listening levels or when seated very close to the loudspeakers, there may be slight whispers of residual sound which are clearly identifiable by their cleanliness as phase and amplitude distortions. Their amplitudes are less than we have found in any other amplifier, and they are sufficiently minor to be completely masked by normal musical content; this is verified by the A/B test, which affirms that the XL-280 is indistinguishable from a straight wire. After tweaking for the individual loudspeakers being used, measurements show up to 70 dB of nulling in the mid-band and about 60 dB over the rest of the audio spectrum. This means that the total distortions do not exceed 0.1% over the audio band and confirms their inaudibility.

When the SWDT gives a substantial null on musical material at normal listening levels, the sonic accuracy of the amplifier cannot be improved. Any other amplifier which does not produce as deep a null on the SWDT, or which sounds different from one that does, is less accurate, regardless of whether its sound is pleasing. Once this level of amplifier performance is reached, further improvements in sonic quality must be obtained from elements in the hi-fi chain other than the power amplifier, although, of course, designers will still face the challenges of reliability, efficiency and economy in amplifier designs.

# CHRIS

# Treasured Island Chronicles

TED FOX

Chris Blackwell is one of the most fascinating figures in the history of the music business. He is both the most modern of men, in terms of taste and technology, and one of the last of the old-fashioned record industry entrepreneurs. His epic career began in Jamaica where, as the sole importer of American rhythm-and-blues records, he provided a unique and invaluable link between the sidewalks of New York and the streets of Trenchtown. Later, in England, he began producing and importing Jamaican ska music and built up his fledgling record company, Island.

After hitting it big with Millie Small's "My Boy Lollipop," Blackwell began signing seminal British rock bands, notably The Spencer Davis Group, which featured 15-year-old Stevie Winwood. When Winwood formed Traffic, he signed with Island. Soon many of the best British bands of the late '60s, such as Jethro Tull, King Crimson, and Emerson, Lake and Palmer, joined the Island roster. Blackwell also inherited the finest of Britain's folk movement, including Fairport Convention and John Martyn.

In 1970 Blackwell helped underwrite the excellent reggae film *The Harder They Come* starring his artist, Jimmy Cliff. Then came his most important artistic find, Robert Nesta Marley. He became close with Bob Marley and other reggae artists, and almost singlehandedly broke reggae music as an international sensation. Moving his home from Jamaica to Nassau in the Bahamas, he set up the lavish and popular Compass Point Studios.

In the mid-'70s Blackwell signed Roxy Music and then a host of top new artists such as The B-52's, Grace Jones, Robert Palmer, Malcolm McLaren, and U2. He also tried to do for African music—namely the Nigerian phenomenon King Sunny Ade—what he had done for reggae. Now he's moving actively into film. This is Chris Blackwell's first feature-length interview.

T. F.

*What did you do before you were in the music business?*

I was in the waterskiing business, teaching waterskiing in Jamaica. I wasn't really doing anything much—just hanging out. But I was a very, very keen jazz fan. My jazz interest started at school with boogie-woogie piano records—Pine Top Smith, then Jelly Roll Morton, then all the way up through traditional jazz to the contemporary jazz that was being played at the time by Eddie Condon and Wild Bill Davison. I compressed it into about five or six years as my tastes evolved through these different styles of jazz. Then I met Miles Davis in New York, in 1959, when he had his unbelievable band with John Coltrane. I spent some time with Miles, maybe five or six occasions over the course of a year. But they were so burned into my head that I felt I'd spent a year with him.

*At the time, that music was on the cutting edge. Your tastes have always seemed to be on the edge.*

I was never interested in pop music. I never bought any pop records. The first sort-of pop records I bought were R&B. Even Chuck Berry wasn't my thing. I'd like the odd Little Richard record, but I was never a huge fan of Elvis Presley. The music I always liked was jazz. By definition almost, jazz is on the cutting edge of music, because that's what jazz has always been doing—breaking new ground.

*Let's talk about how you got started in the record business.*

Before I started making records I used to import them into Jamaica. The first record I made was with this jazz band that played in Jamaica at the Half Moon Hotel. It was led by a jazz pi-

Chris Blackwell (left) with one of his major artists, Robert Palmer.

# BLACKWELL:



Photograph: ©Andrea Bianchi/Outline Press

anist, Lance Haywood, who came from Bermuda. He plays in New York now. I liked what he was playing, and I figured that at worst we could make the records and sell them at the hotel. I made the tapes, took them to New York, and got them mastered. I had some artwork designed and the covers made. Then I took the masters to Jamaica and had the covers printed there. I went to the pressing plant and watched them press the records; then I picked them up and took them around to the shops. They didn't buy any—hardly any. We also sold some in the hotel. But I just liked the whole process of seeing something all the way through. I made another record with the same artist, adding the brilliant Jamaican guitarist Ernest Ranglin, and it didn't do well either. But I had caught the bug.

It was after that that I found myself in the record business. I'd go to the pressing plant and press up my 250 albums, and I'd see the press next door was for singles. I became very aware that there were lots of singles being pressed, lots more than the albums. I saw another sort of excitement—the excitement that happens when you have a hit record. It was a whole different thing from the whole process of actually making a record. Then, what I started to do was hang around all the sound systems.

**You should explain what the sound systems in Jamaica were. They were basically travelling disc-jockey parties, right?**

Yes. They were like travelling discos. The sound systems were owned by the various liquor distributors and run by guys called King Edwards, Duke Reid, Sir Coxsone Dodd, Prince Buster—all these characters in Jamaica. So suppose somebody wanted to have a dance. They would book these guys, and they'd come and play. The people would charge admission and these guys would then also supply the liquor. There became a great competition over who would book which sound system, and which sound system would draw the most people. There'd be sound system wars to see who could get everybody to leave the other's party. These guys would play music through huge boxes of speakers. It was before stereo, but they'd have

three or four speakers. It had a very bright treble. You'd hear them from miles away. They still have sound systems in Brooklyn. I was sort of the singular white character hanging out at these. It was a whole sort of nether world. Middle-class black Jamaicans didn't go there, and white people certainly didn't. It was just a Jamaican street thing.

**Was this a Rastafarian thing? Or hadn't that come along yet?**

Not really. Rasta was there, but it hadn't really evolved as much as it did in the '70s. At this time whoever had the best amps and speakers—and, of course, the best records—would draw people. So what I used to do was come up to New York and buy 78s. I'd buy them for 60¢ or something, scratch off the label, take them down to Jamaica and sell them for \$50. Because if this guy had a hot record and that guy didn't . . . it became worth that kind of money. I'd scratch the title off because if they could see the title they could also buy them for 60¢. So that's how I first started in the record business.

After a bit, the sound system guys and myself, at around the same time, said maybe we should make some records ourselves. That is essentially what happened. You'd make the record and just release a certain amount on a blank label. A blank label had the same value as it would if it were scratched off. That's how the blank-label thing happened. Obviously, since it was a record made in Jamaica, people would know how to get it, if they knew the title, but making it blank you could charge, let's say, \$20 for the first hundred or so. That was called "pre-release." Then after a bit you'd release some more, let's say 1,000, at a quarter of that price. Then you'd release it to the general public. Also, around this same time, there became sound systems in England and New York for Jamaicans who had emigrated. So these Jamaican records would be exported, or people would come down and buy a whole pack of the new, key-release records. I was one of the first people in Jamaica to make records for this market. Before that, records made in Jamaica were calypso records, or records made for tourists.

**So it was records for the sound systems that you saw when you were at**

**the pressing plant making your Lance Haywood albums?**

Yeah. That's where I met these sound system guys. They'd wonder what this white guy was doing in a pressing plant. I got to hang out with them, and they'd say, "Why don't you come along to the sound system?" I discovered the whole nether-world music scene in Jamaica from people I met in a pressing plant. So the next three records I made each went to number one in Jamaica. I thought, "My God, this is unbelievable. This is easy." Then I started to try to make the records better, more polished, more carefully done.

**Did you just learn your studio technique as you went along?**

Oh, yes. But what happened was that as I tried to make them better and more refined, I started to lose the feel for the market, and my records were now not selling in Jamaica. They were ballad records with people like Jackie Edwards. People would say, "Boy, they're great," but in general they weren't selling. Now and again we'd have one which would sell a good amount. What happened was that in England the import market for them began to pick up until someone contacted me and wanted the rights to press them. So I found that I was, in fact, selling more records in England than I was in Jamaica. Also, the competition in Jamaica had gotten very stiff because lots of people were now making records there; they were basically ska records at that time. So on one trip I made to England, I thought maybe what I should do is start a company there.

I went to all my competitors in Jamaica and said, "Listen, I'm going to start in England." I made deals with all of them, with the exception of Prince Buster, to release their records in England. Buster and I never really got on too good. Also, he worked with the guy who owned the main record company in England for Jamaican music—his name was Emile Shallit, and he owned a company named Melodisc which released the ska records under a label called Bluebeat. People used to call it bluebeat music. When I started in England [with Island Records] I had to get over the fact that I was like a vacuum cleaner company trying to go against Hoover. The generic name for



the music was another person's label! So in England we really pushed the name ska music, which is what it was called in Jamaica. We really had to get that across.

***But there was no difference between bluebeat and ska?***

It was the same thing. The difference was that the artists on the Bluebeat label never went on my label. When I pressed my first record in England, I took it around to the shops. I developed a kind of system of distribution which was essentially me. But it was a very efficient system.

***What kind of quantities are we talking about here?***

I pressed 500 of the first record in England. It was "Darling Patricia" backed with "Twist Baby," by Owen Grey. I sold out the first day. I pressed some more. I developed a system of going around to each of the shops in London twice a week. I carried my stock in my car, a little Mini Cooper. This was great service for the shops. Here I was with the new releases, then while I was there I'd say, "Well, how about this one? Do you have enough?" I'd make it my duty to be sure that I sold at least as much as what the last order was. I'd be able to do that all the time. I developed a very good relationship with the shops, and I'd guide them as to what records to buy. If I guided them wrong, I'd take the records back and exchange them. There was no actual exchange thing, I just worked it out so they never bought a record from me they couldn't sell. They loved my service. They couldn't lose. This was essentially what I did from May 1962 until the end of '63.

***Then you really hit it big.***

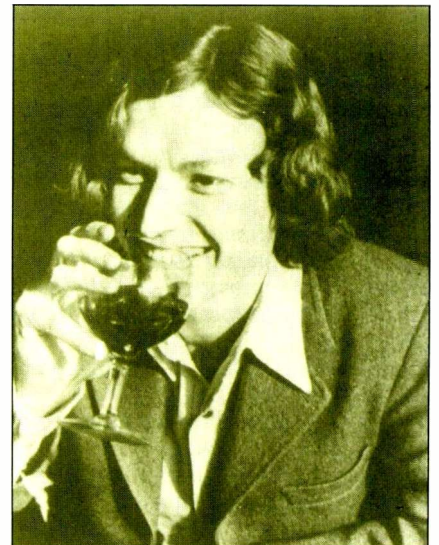
At the end of 1963 I brought over Millie Small from Jamaica. She had sung on some of these Jamaican records. She sang on one of the first we released, "We'll Meet." It was a boy-and-girl song; the boy sang the first verse and she sang the second. Whenever she came in and sang everybody used to go into fits of laughter because she has this pipsqueak voice. But everybody loved it. So I thought, "I should really bring her over and see what I can do with her in England." Now, before I scratched the labels off the 78s I sold, I used to tape them in case I couldn't get a record again. I had a



*Traffic (above), the band formed by Steve Winwood (right) after the breakup of The Spencer Davis Group.*

Photograph: Frank Driggs Collection

**WHEN I FIRST HEARD Steve Winwood sing, I couldn't believe it. It was like Ray Charles on helium. I wanted to sign The Spencer Davis Group then and there.**



7½-ips reel of these tunes, and one of them was a song called "My Boy Lollipop." So Millie was over in England and I just happened to be playing this tape of these old records, and I said, "Boy, that's a tune we should record with her." We recorded it and it came out in early '64.

***This was really at the height of the girl groups in the United States. Did their popularity make you think that maybe this was a way for a black act to cross over?***

Not really. What I thought was that Millie's voice had such a charm to it that you just had to smile when you heard it. Then, when I met her, she had such an engaging personality that I thought we really had a shot with her. In fact, when that record went out, the press really went crazy for Millie. She was a dream for English people. She was an unthreatening little black girl, and they loved her. Her record is what put me in

the pop music business. I never even knew what the pop business was.

***That record was a smash. Didn't it sell six million copies?***

Yes. But I didn't put it on my own label in England because I didn't think I could handle a hit. I licensed it to Philips, who released it on a label called Fontana. Then, essentially, I left the whole Jamaican business for a bit. I got drawn into the pop business. See, I managed Millie as well. In fact, I was doing pretty much everything for her. In this period I was concentrating specifically on how to promote her. As she became more successful, I just became more busy and more into that side of things.

***You've said you were never really interested in pop music, and all of a sudden you were this pop mogul. Didn't that strike you as odd?***

Well, it doesn't happen like that. I was just a guy who produced one pop hit.



King Crimson, which Blackwell calls "a leap forward in rock."

Photographs: Frank Driggs Collection

My main thing was still Island Records, but I got drawn into this because it was widening one's horizons. It was still essentially the same thing. It was still Jamaican music I was promoting, but it was now becoming a worldwide phenomenon with this particular record. We toured the world, basically.

*Do you think people recognized it as Jamaican? I remember when it came out; to me, it was just another neat little pop song.*

It was recognized as being Jamaican in England because it was a ska rhythm, although a very polished ska rhythm. I think in America there was no knowledge of the Jamaican music scene at all. Whatever existed would have been very underground, in Brooklyn. Here in America that record would have been classed with something by Little Eva, or some other pop singer.

**YOU CAN'T EXPECT**  
a major company to  
send out 200 records;  
that's exciting for you  
but not for them. Your  
job as an independent  
is to get them interested.

*As you were touring with Millie in Birmingham, England, you first heard The Spencer Davis Group, right?*

That's right. I went to this club with Millie; she was doing a television show in Birmingham. Somebody told me there were these two bands in Birmingham I should really see. I don't know why this person rang me up, but he did. He was keen on one band and took me to see them first. They were called Carl Wayne and The Vikings. That band became The Move. I didn't really like them; they were dressed in suits and they were very polished. You know, it was the same era as the early Beatles. They were very "smart" and dressed in suits like the Swinging Blue Jeans or The Hollies. It was good, but it was pop, and I don't really *feel* straight pop music. Then I went to this other club, and the guy said, "Well, this group draws a lot of people, but they're kind of rough and ready." It was The Spencer Davis Group with 15-year-old Stevie Winwood.

*Was he singing when you saw them?*

When I walked in, he wasn't singing. Spencer Davis was singing, but it was great. The tune was great, and I really loved that. Then Steve sang and I couldn't believe it. It was like Ray Charles on helium [laughter]. Unbelievable.

*Did you approach them right away?*

Absolutely. Right then and there. I said I wanted to sign them and make a record with them. These were the days when bands used to go out and play, develop fans, then try and get a record contract. Nowadays people get a record contract, buy the instruments, make the record, and then have videos force-fed to the media. These were real people. I was really able to sign them

because I promised them that I would be able to get a record out within a month. They were amazed. I produced the first record of theirs and took it to Philips. It was a great tune called "Dimples," a John Lee Hooker song. I was really excited about it. I don't know if you've heard it done by The Spencer Davis Group, but I'm very proud of it. If you hear it right now, it sounds great, like it could have been cut yesterday. I really thought it could be a hit. Then John Lee Hooker decided to tour England. He essentially took all the shine off it. We had no hope for our version of the record.

*Were there other rock bands you were signing at this time, in '64 or '65?*

I'll tell you who I signed in '64—John Martyn. He has a new record that's just come out, so many years later, which is his best. I also signed a band that was so great, a band that slipped through the cracks—they were called The VIPs. They played the Star Club in Hamburg. That's where I first saw them, on tour with The Spencer Davis Group. They were *unbelievable*. Energy. Drive. Raw. They were the most exciting band. They broke up, then became a band called Art, then Spooky Tooth. Mike Harrison was their leader. Spooky Tooth was never as good as The VIPs. But The VIPs were impossible to handle and control. I think now, today, having much more experience in putting these things together, what was needed was really to find the right producer and manager for them. What was needed was somebody to spend 24 hours a day with this band and drag out what they had in them. At the time, I was running a record company and managing Millie, and I was just overstretched.

*What did Philips, to whom you licensed your records, do for you?*

They got them on the radio, distributed them nationally, and collected. I would never have been able to collect the money for Millie's hit [on my own].

*What does an independent record company look for in a distribution deal with a major company?*

It depends. If you're doing just a straightforward distribution deal, what you want is for them to be able to give you the records when you need to get them pressed. Also, they can get records into a marketplace when you

have some activity in that marketplace—a band touring, or promotion on the radio. The problem is always in motivating a large distribution company. It's very hard, in the early stages, to get them interested in sending 200 pieces of something somewhere, because they're geared up for moving hundreds of thousands. In the early stages, you've got to take the time to get the records into those markets yourself. If you shout and scream and go crazy, it doesn't really help you because it means that you're not being sensitive to the facts of how the business is run from their point of view. They can't be expected initially to get that excited about sending 200 records somewhere. That's exciting for you, but it's not that exciting for them. Your job as an independent is to get them interested.

**When The Spencer Davis Group broke up in '67, Stevie put together Traffic, which became your first big rock act.** Right. I was always worried about Island as a name. It was formed in Jamaica, just after that movie, *Island in the Sun*. In my head I was always scared—since all our initial records had been Jamaican records—that we would never be able to get over the perception of being an "island music" record company. I tried another name, Aladdin Records, in England. There had been another Aladdin, but it was long gone. That didn't really work. Finally, what I thought I'd do was change the design. I had a pink label and a very pop-image pink sleeve made up. We started using that with Traffic's "Paper Sun," which was Island's first go at being a pop record company.

**What happened to your Jamaican stuff at that point?**

The Jamaican stuff continued on a different Island label. Actually, at that particular time I drifted away from the Jamaican side. I was really occupied full-time with the pop mainstream business. During that time there was a merger with another record company, Trojan Records. Trojan dealt with all the Jamaican stuff, and Island had very, very few Jamaican releases in that period—from about '66 to '69. I got back into Jamaican music with Jimmy Cliff's *Wonderful World, Beautiful People* in '69.

**Was it just automatically assumed that**



*Jethro Tull, the first group on the Chrysalis label, an Island spinoff.*

**Steve Winwood would stay with Island after the breakup of The Spencer Davis Group?**

No. I was also managing Stevie. EMI came up with a really good offer to sign him. I presented him with the offer from EMI, and also said that I felt we could now do it ourselves. We had this kind of P&D [pressing and distribution] arrangement with Philips. We'd evolved from a licensing deal to a P&D deal. So I felt we could now handle it. Steve said he would come on Island.

**What was he like as a teenager?**

He was pretty wild as a teenager. He was like he is now. When I say wild, I mean full of life, full of zest for living.

**Was he sharp in business dealings?**

He was never really involved in business dealings because his brother Muff looked after all his business. He's now one of the main directors of CBS Records in England. As soon as The Spencer Davis Group broke up, Muff came to Island running promotion. It was also because of that connection that Steve decided to stay.

We were really the first independent in England to go out and have the trust of the groups as a full-scale record company, as well as just a label. Andrew Oldham's Immediate label and Chris Stamp and Kit Lambert's Track label also came out at approximately the same time, but neither of them had the sort of depth of catalog that we did. They were both just labels. They were in fact very, very good. If those two hadn't sort of disappeared. . . . They were real talents in the record business. But Traffic became Island's flagship group, and that enabled us to attract other rock talent, because Steve was the hero of all these guys. He was really adored by them.

**After Traffic you went on to sign other great English rock bands of the late '60s such as King Crimson, Jethro Tull, and Emerson, Lake and Palmer. Good musicianship seemed to be the link there. Is that what you were after in those years?**

Yeah, musicianship and good singing ability were really important to me. I think that's because, as I said earlier, the records I always liked were jazz records.

**Let's talk about King Crimson.**

King Crimson had a really spectacular use of sound. Their music would really create images. I think they were a seminal group—a leap forward in rock music. Robert Fripp was a brilliant musician. What also started to happen in music at this time was that more of the well-educated, university-graduate types were coming in as musicians and band members. So you were starting to have a different sort of input into the music. Robert Fripp really represented that new type of performer.

**How did you first hear about the group?**

They were just one of the bands that were around that you heard about. They were building a spectacular reputation very quickly. All the different record companies wanted to sign them. Their two managers went to the same school as I did in England, so we sort of got on, on that basis. They were both motorcyclists and I was so determined to sign this band that I also bought a motorcycle and nearly killed myself on it, trying to hang out with them [laughter]. But I eventually signed the band, and put down the motorcycle from then on.

**How did you find Jethro Tull?**

I would have bands touring—Traffic or



Emerson, Lake and Palmer, "a great group to watch," says Blackwell.

Spooky Tooth—and they'd come back and I'd say, "Did you play with any bands or see anyone that was interesting?" Gary Wright, who was one of the singers of Spooky Tooth at the time, said, "Oh yeah, we saw this guy who was really great. He was kind of weird, though. He played flute and stood on one leg." That sounded intriguing to me, so I checked it out. I found out they were a new band managed by Terry Ellis, who at the time had a partnership with Chris Wright. So I tracked him down. I made a deal with Terry Ellis. He wanted to start his own label. I told him that was great, I could really show him how to do it and guide him. He wanted to start it right away with Jethro Tull and I said, "No, that doesn't make any sense. Island is really hot now and our name is strong. It will help Jethro Tull to be on Island. What we'll do is this: When you have five chart entries, records in the top 40—from Jethro Tull or any other acts you bring through on the same deal—we'll start the Chrysalis label. All the acts will then go on Chrysalis." Needless to say, Terry signed some other acts and worked them really hard and got five chart entries within a matter of a year. Then Chrysalis started and it was with us for about 10 years. Now they are one of our main competitors. Chrysalis kind of outgrew us, and we made a few mistakes. There came a time when we really couldn't be of use to them anymore, so they left.

**Who else was on Chrysalis at that time?**

At the beginning it was just Jethro Tull. Then there was Blodwyn Pig. Ten Years After, who were managed by Chris Wright, were on Decca; they only came to Chrysalis later. A group called

Clouds, which never made it. Terry Ellis really liked Clouds, spent a fortune on them. But Jethro Tull became a very big band.

**Did you ever regret that you didn't keep them for yourself?**

Not really. I think it's good for people to grow. If Island grows to contain their growth, that's great. But if they outgrow us, then they should go on.

**How about your involvement with Emerson, Lake and Palmer?**

They came after King Crimson's demise, which was a disaster for us. There was such great promise with King Crimson. Greg Lake [from King Crimson] and Carl Palmer from Atomic Rooster joined Keith Emerson, who had become a star with a group called The Nice. When ELP first came on the scene, I remember they had a special show for Ahmet [Ertegun, head of Atlantic, which released the group's records in North America] and myself at the Lyceum in London. It was great. Did you ever see Emerson, Lake and Palmer? Emerson used to stab the keyboard with a knife, then lift it up and throw it against the wall. At the end of it Ahmet said, "Boy, that's the first band I've ever seen play with a piano." [Laughter.] They were great at the beginning.

**They were one of the first major bands to use synthesizers. How did you feel about that?**

I liked synthesizers from the beginning. I'm very keen on them. I love the new technology in music and everything. Pink Floyd would also have synthesizer sound. But it was never used as Emerson, Lake and Palmer used it—in a sort of cathedral-rock fashion. Emerson, Lake and Palmer had incredible dynamics. Where I fell out with them—

and I fell out with them very badly—was when they started touring with a big orchestra. I felt that the whole brilliance of ELP was all these different textures and colors of sound which were created just by these three guys on stage. When the audience saw all this sound from three guys, they were really impressed. We parted company. They were selling a lot of records, and I just said, "I don't want to deal with you anymore. Let's forget it." They were just a huge drag to deal with at the time. We were so rich in talent that it was easier just to say, "Let's split." Nowadays I wouldn't, perhaps, feel the same way.

**Emerson, Lake and Palmer were really presented as one of the first new-generation supergroups.**

Yep. Definitely. They really delivered on stage, and were very exciting. It was theater, really. Personally, I don't think Carl Palmer is a particularly good drummer; he doesn't keep time, which is of the essence. But he looks great—a lot of drums, a lot of flash. Keith Emerson had a lot of flash, and also good musicianship. Greg Lake had good songs and a great sort of stage persona. They were a great group to go and watch.

**How do you feel about today's heavy-metal music?**

I'm not a fan of heavy-metal music in terms of listening to it. I don't listen to it much, though I'm a fan of the attitude of it. I think the true spirit of a huge part of rock 'n' roll exists only in heavy metal today—real go-for-it, flat out, crazed—and it's great that it's there. A lot of this art rock and fashion rock and all this stuff is sickening to me.

**How involved were you as a producer with your rock bands in the '60s?**

In the late '60s I was involved as a producer with Traffic. No, actually, in the late '60s Jimmy Miller was producing Traffic. He produced their really wonderful records: *Mr. Fantasy* and *Traffic*. The one I produced was *Low Spark of High Heeled Boys*. But producing Steve Winwood is walking into the studio and just being somebody that he can bounce off. That's it, because he's so good. He's such a talent that he just has to play or sing or whatever. I would be involved in what songs would go on the album. I would work with them. I wouldn't say, "This

goes, that doesn't go." I would come up with the running order of the album, and I'd work with them to mix it. If Winwood was performing, he'd perform. Then he'd come into the studio booth and we'd discuss it. I was a sounding board. When the other guys were doing their parts, Winwood would be in the booth with me. I'd be the one who actually put into words. . . . I'll tell you the best way to describe how it was, producing those groups: They needed somebody to actually say what needed to be said. The group would never really say it, because they were the group and I was the record company. See, if one group member was not happy with what another member did, he would never really say it or he'd spend four hours saying it, rather than just stating, "Listen, it's not very good. Do it again."

**Right. This was the '60s, and I guess it wasn't cool if you weren't mellow enough to go with the flow.**

Particularly our groups [laughter].

**Did you run up some hefty studio time then?**

The record that all studios should have up in their reception area, framed, is *Sgt. Pepper*. That's the record that took six months to make. After that, everybody had to spend six months to make a record. Before that if you were going to make an album, you'd take maybe two or three weeks. Suddenly that was no longer possible. It had to take six months. It got to be so absurd that Emerson, Lake and Palmer, in the mid-'70s, spent \$2 million making a record in Switzerland. I think the last Foreigner album also cost \$2 million. It's just out of all proportion. As there are more and more tracks available to record, if you have people who don't really like to make a decision, and they're not prepared to take the responsibility. . . . When a group gets big, a producer doesn't want to take responsibility, and none of the members of the band do, and the leader of the band probably wants to keep everything so he can decide later. Therefore you'll have 14 takes of a vocal, and eight takes of this, and more of that, until you have 48 tracks. You spend all this time not making decisions. When I started making records it was in mono, so you made the decision right there whether it was a good take or not. I still adopt that



*Fairport Convention, which Island "inherited" from a folk label.*

kind of approach of making a decision right on the spot, and getting it right on the spot. To me the mix shouldn't be something that takes a real long time. Everything should pretty much be in shape by then.

**So you made sure things didn't get out of hand.**

They never did get out of hand at that time. If I felt they were going to, I changed the structure of the deal so that the royalty rate was increased, but the artist was responsible for the recording costs. For example, Cat Stevens' first album for us cost £4,000, the second one cost £7,000, and the third one cost £5,000. Now, those three albums have sold over 20 million worldwide for us. But I foresaw explosions in costs. So in the renegotiations we made the royalty rate higher, and he absorbed the costs. In fact, those first three records were his biggest selling ones. The record after that cost £100,000, the one after that £300,000. It just went crazy and sales fell down. As the act gets stronger and more powerful, the less control you have anyhow. So if you want control, you should pay the penalty if you're wrong, and also be able to get the reward if you're right.

**Whatever happened to Cat Stevens?**  
He is now a fully practicing Moslem in London. He teaches in school and spends his entire life in the Moslem community. He's not recording anymore. Well, the last recording he did was a cassette which you could buy if you went into a mosque. It would tell you how to behave in a mosque and find your way around.

**That brings up another Island artist, Richard Thompson, who was a Sufi for many years. How did you come to sign his '60s group, Fairport Convention?**

There was this American guy in London, Joe Boyd. He was and is a very, very tasteful person. He was involved in one of the key clubs of the late '60s where all the new acts would perform—the UFO Club in London. He started a kind of English folk label called Witch Season. On this label, which he had with Polydor, was Fairport Convention and, I think, The Incredible String Band. I met him in a studio and we struck up a deal. Then he put all his productions through Island. One of the artists who I initially had, John Martyn, let his contract with Island lapse because the kind of music I was going into wasn't really this [English folk] kind of music, even though I really liked it. But I didn't really feel I knew it or knew how to make the records. John ended up on Witch Season, then with me again, and is still with me today. John first recorded with

**AS THERE ARE more tracks available, producers spend all this time not making decisions. My approach is to make a decision right on the spot.**



Photograph: Frank Driggs Collection

Cat Stevens, whose first three records for Island were his biggest, selling more than 20 million worldwide.

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**TO ME THE GREAT labels are the ones with an identity of style, like Atlantic in the early years, and Motown. That's what I've always wanted to have.**

---

me in 1965 or '66. Nick Drake also came through Witch Season. Nick Drake was at Cambridge and he had come to see me and play me stuff. I said, "I love it, but I just don't know how to make these records." By chance he ended up on Witch Season. I got very involved in this label and this music. I got to really like it. Then Joe Boyd was offered a job in the Warner Bros. film department. He sold me his company and we inherited all these acts. I'm afraid we weren't really able to continue what he had done. I wasn't of that much value to any of those artists I inherited. Like, I don't think I was much

help in guiding Sandy Denny or Fairport or any of them.

*I don't see why it's important for the head of a record company to be attuned to a particular type of music. Couldn't you just hire managers and producers who did know that kind of music?*

I think you're right; I don't think it is important. But I think in that period everything would sort of emanate from my tastes. I was the only A&R guy, right? An A&R guy is the one who chooses who should be the producer for these bands. But if you don't really have the right feel for how they should go, you might pick the wrong producers. Now I don't think I necessarily picked the wrong producers, because I just stuck with the same ones they already had. But perhaps if I had a better feel for that music, I might have been able to put them with a producer who could have enhanced what they had and given them a chance to go to a wider audience. So I think I failed on those particular acts.

*Is that kind of thing a problem for Island, or for any record company so closely associated with the direction and tastes of one man?*

I think it's a problem if you try to sign too many acts, and be too many things to too many people. I think the key for

an independent company is to be narrow, honestly, in what it's doing. I don't think you should be wide and have things all over the place. You can't possibly deal with it. If an independent company has one person's taste, if the taste is reasonably commercial you'll stay in business. If it's not, you'll go out of business—unless your costs are related to that taste, and to the narrowness of the audience you're going for. To me the great labels are the labels that have an identity of style: Atlantic, in the early years and in the '60s and '70s with Led Zeppelin and Cream; obviously Motown in the '60s, with the album artists, the sort of icons they built, and Blue Note—you knew what kind of music you would get when you saw Blue Note. Those labels to me are great labels. It's the kind of label that I always wanted to have. We've wavered backwards and forwards at times, because one gets lured into one thing or another. But in general my philosophy is to try to have very few acts that you genuinely like, acts that are in the forefront of your thoughts all the time—not because you have a huge financial commitment to them, but because they're people that you know well and can represent in the way they like to be represented.

*Couldn't your singularity of focus also be a danger for an artist? Say you get bored with an artist and decide you personally aren't interested anymore. So they no longer have your support, and that's it for them.*

That's no more a danger than it is at any other company. The danger that exists in a major company is that the A&R person in charge is an employee, and as such can easily go and work for another company. So the person who sat down with you and said, "You must come and sign with me, I love your stuff, we'll do this and that," could be working for another company. Or he could get out of favor with his company because he hasn't been successful enough. Therefore, even though he may be championing his bands, he might have lost his credibility within the company, and therefore not be able to get anything done. There's no perfect way. **A**

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*This concludes the first half of a two-part interview.*

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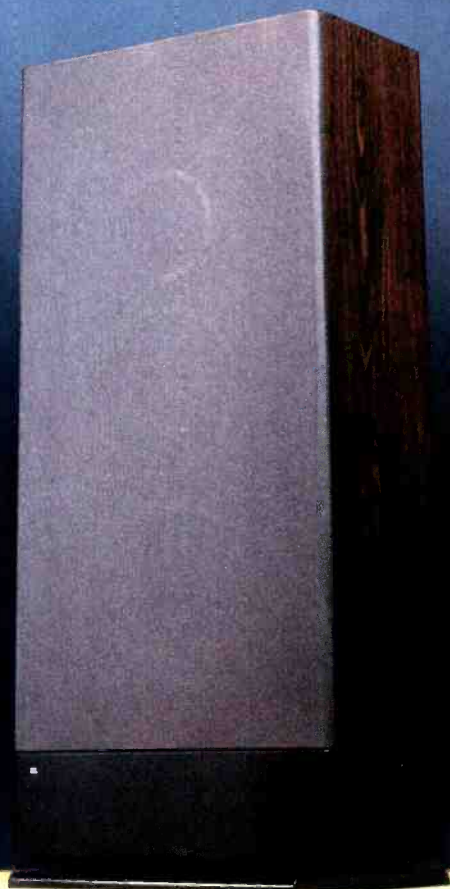
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1

## SHURE HTS5000 SURROUND AUDIO PROCESSOR

### Manufacturer's Specifications

**Operating Modes:** Dolby Surround, stereo-synthesized surround, mono-synthesized surround, stereo bypass, and mono bypass.

**Frequency Response:** Front left, center, and right outputs, 20 Hz to 20 kHz,  $\pm 0.5$  dB; surround left and right outputs, per Dolby Surround specifications (50 Hz to 7 kHz, +0, -3 dB); subwoofer output, 12 dB/octave low-pass, -3 dB at 80 Hz.

**THD for 1 V Out at 1 kHz, with Volume Control at Maximum:** Front channels, less than 0.1%; surround channels, less than 0.3% with "Surround Level" control centered.

**S/N Ratio (A-Weighted):** Front channels, -90 dBV with volume control centered, -80 dBV with volume at maximum; surround channels (with "Surround Level" control centered), -85 dBV with volume control centered, -68 dBV with volume at maximum.

**Surround Delay Range:** 16 to 36 mS.

**Input Balance Control Range:**  $\pm 9$  dB.

**Output-Level Trim Adjustment Range:** 20 dB.

**Signal Polarity:** Noninverting in all modes.

**Input Sensitivity:** 0.18 V with input level control at maximum, 1.8 V with input level control at minimum, for red level indication in Dolby Surround mode, one channel driven.

**Input Clipping Level:** 2.8 V.

**Output Clipping Level:** 4.0 V.

**Input Impedance:** 50 kilohms.

**Output Impedance:** 5.5 kilohms.

**Operating Temperature Range:** -20° to 135° F (-29° to 57° C).

**Power Requirements:** 120 V a.c.,  $\pm 10\%$ ; 60 Hz; 36 watts.

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

**Weight:** Processor, 9 lbs., 13 oz. (4.5 kg); remote control, 3 oz. (91 grams).

**Price:** \$699.

**Company Address:** 222 Hartrey Ave., Evanston, Ill. 60202.  
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Over the years, beginning with the earliest phonographs, there have been all sorts of devices said to re-create the listening experience of a live performance. Each real improvement has been followed by an assortment of let's-make-it-better gadgets.

Stereo reproduction became well established, for good reasons, but most systems designed to expand or enhance home stereo's spatial effects have not. Carver and Polk have made very worthwhile contributions to the re-creation of accurate sound fields for stereo listening, but four-channel sound never fulfilled the hopes of its proponents. Varieties of image enhancers and reverberation/delay units have appeared, ranging in quality from very good through not bad to really bad (did anyone actually *like* hearing a center soloist stretched from speaker to speaker?).

Movies, however, have been expanding their sound stage since Walt Disney's *Fantasia* gave many moviegoers their first taste of multi-channel sound in 1941. That expansion continued with Cinerama and, to a lesser extent, with Cinemascope. Dolby Laboratories introduced their cinema surround-sound processor in 1975, and since that time nearly 10,000 theaters have been equipped to present films in Dolby Stereo.

Quite a few of these theaters are equipped to show 70-mm Dolby Stereo movies, which are made on 70-mm film with six discrete magnetic soundtracks (left, center, and right front, plus a surround track and two low-frequency channels). The majority of Dolby-equipped theaters, however, use a process which encodes the four directional channels (with the low-frequency information mixed into them) in a matrix on two optical tracks, on 35-mm film. Both theater formats employ three full-range speakers (left, center, and right) behind the screen, and a U-shaped array of surround speakers placed about the rear half of the theater. There may be additional speakers for bass reproduction.

Today, hundreds of feature films have been made with Dolby Stereo sound. When these films are distributed on stereo videocassettes or videodiscs, or transmitted via stereo TV or cable, the matrix encoding of the two-track 35-mm format is automatically retained. Thus, the original surround effects are available at home, once the two stereo channels are properly decoded. Products licensed by Dolby for home decoding of these films bear a "Dolby Surround" logo and must meet certain minimum standards (which some products, such as Shure's HTS5000, exceed).

I expect that at this point some readers are thinking there is little of interest to them if video is involved. I do hope, however, that you not only accept but appreciate the fact that all sorts of productions (movies, plays, musicals, etc.) are most fully enjoyed when they satisfy both our aural and our visual senses. We should not accept poor-quality sound with movies just because we are more interested in music.

#### Functional Description

The Shure HTS5000 is designed primarily to decode Dolby Surround material in the home. The encoding and decoding circuits of both Dolby Stereo 35-mm theater processors and Dolby Surround home equipment are designed to meet three major goals: Creating stable sound localization across the widest front stage over the widest listening

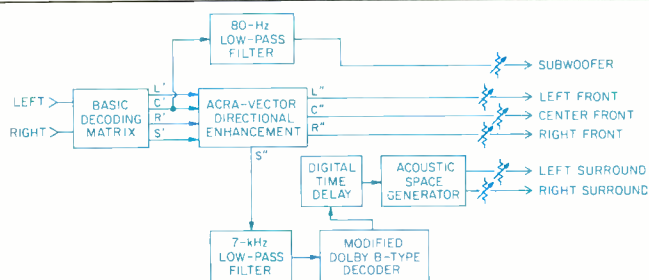


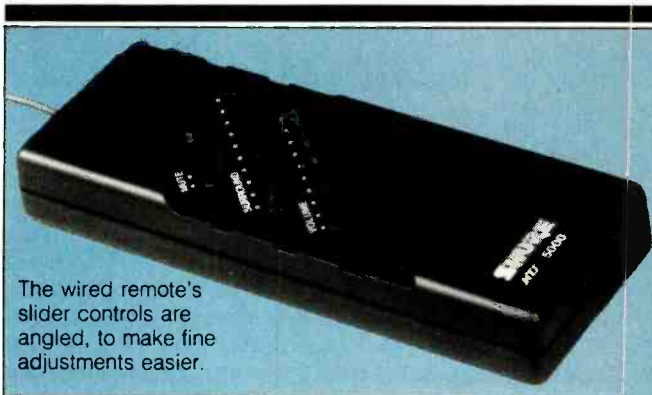
Fig. 1—Block diagram of the Shure HTS5000 in Dolby Surround mode.

area, maintaining stable front-center dialog localization without confusing rear-speaker output, and reproducing interior sounds that appear equally in all four speaker signals. The main benefit of a center speaker is that it gives greater stability of front localizations with changes in listening position. Appropriate phase shifts that enable the creation of equal-level interior sounds are included in the directional encoding. Directional-enhancement circuitry works best when used with material specifically mixed for it, such as movie surround sound.

The Dolby Surround manufacturing license specifies only the basic matrix and the use of a delay line, Dolby B noise reduction, and a 7-kHz low-pass filter for the surround signal. As shown in Fig. 1, Shure has gone beyond that minimum, adding directional enhancement, a subwoofer output, and a proprietary Acoustic Space Generator to diffuse the rear image.

The Acra-Vector directional-enhancement circuits of the HTS5000 are designed to improve the localization of sounds in any encoded direction, including sounds panned between left and center or between right and center. Switching the center speaker output on and off modifies the directional-enhancement circuitry to match whatever speaker complement is in use. The unit also has an output to feed frequencies below 80 Hz to a subwoofer, which can add greatly to the audible and visceral impact from some sources. The Acoustic Space Generator's diffusion of the rear image is intended to reduce possible localization at the surround speakers, which are normally closer to listeners than the main speakers. (The mandatory delay line also helps reduce rear localization of front signals by ensuring that those signals arrive from the front speakers first.) The purposeful rear diffusion does not reduce the ability of the

I found the seven trimpots on the unit's bottom very worthwhile; they help match the system to the user's tastes and setup.



The wired remote's slider controls are angled, to make fine adjustments easier.

directional-enhancement circuitry to direct sounds solidly rearward.

The HTS5000 is designed to be inserted into a recorder/processor loop and has switching for regular mono and stereo playback of any source. To further utilize the amplifiers and speakers added for surround sound, the HTS5000 offers surround-sound synthesis capability for both mono and conventional stereo signals.

#### Control Layout

The unit's width is close to the nominal standard of 17 inches; its height, with feet, is just 2½ inches, so the front-panel profile is relatively small. On the other hand, the processor is quite deep, at a bit more than 15 inches, but some VCRs and other audio/video equipment have about the same depth.

At the lower left of the front panel is the mini jack for the wired remote control. The remote itself is typical in size for a hand-held unit, although it has just three controls. The "Volume" and "Surround" sliders are set at an angle relative to the sides of the control; this makes fine adjustment much easier, both because of the increased slider length and because of the natural movement of the thumb when making adjustments. "Surround" controls just the level of the surround speaker channels, and "Volume" adjusts the levels of all channels simultaneously. The remote control also includes a "Mute" slide switch which attenuates all channels by 25 dB when actuated. A red LED indicates when the system is muted. The remote control's thin black cord is 20 feet long, which would be sufficient for most users; it can be extended if greater length is needed.

At the left end of the HTS5000's front panel are five thin, bar-type buttons. The first three ("Dolby Surround," "Stereo," and "Mono") are interlocked, and the other two ("Synthesized Surround Defeat" and "Tape Mon") are the push-on/push-off type. "Dolby Surround" would be used for material specifically encoded for this format and could also be used to yield surround effects with some conventional stereo sources. "Stereo" and "Mono" would normally yield synthesized surround sound, unless the defeat switch is pressed. The HTS5000 has jacks to replace the main system's tape in/out jacks that the processor is presumably connected to.

Along the center of the front panel are four rotary controls and one switch, all with thin-bar knobs. From left to right, they are "Input Level," "Input Balance," "Digital Delay

(mS)," "Surround Level," and "Volume." Above "Input Level" is a horizontal LED ladder-type level indicator with four green bars and a single red bar at the very right. "Input Balance" has a single yellow LED bar above its center of rotation (which is not detented); the bar illuminates when left and right levels are balanced. "Digital Delay" has six positions, for delays of 16, 20, 24, 28, 32, and 36 mS. "Surround Level" and "Volume" perform the same functions as the sliders on the remote control; these two front-panel pots are disabled when the remote is plugged in.

At the right end of the front panel is a grid that at first looks like a simple surface overlay. It is labeled "Left," "Center," and "Right" along the top and "Left," "Surround," and "Right" along the bottom. When the processor is turned on (by being plugged in; there is no power switch) and operating, red lines appear in the grid that show which channels are active. There is a horizontal center line and left and right "shoulder" lines at the top; if there is surround information, a rounded L-shape illuminates at the bottom left and a rounded reverse-L at the right. When all lines are illuminated, the display looks like a round-corner trapezoid with its top narrower than its bottom.

On the back panel, from right to left, are a jack for the remote control; stereo phono jacks for "Input," "Tape Send" (record), and "Tape Return" (play); "Front" and "Surround" stereo outputs, and single phono jacks for "Center" and "Subwoofer" speaker channels. On the left is a slide switch ("Out/In") for the center speaker, with a white line from the switch to the jack to remind the user of its function. The white designations on the black panel are very easy to read, much better than the burnt orange on brown used for the front panel.

On the underside of the HTS5000 are seven trimpots. One, toward the front ("Mono Enhance Adjust"), is for adjusting the amount of stereo synthesis applied to a monaural signal. The other six, toward the back, aid in balancing surround (L/R), front (L/R), center, and subwoofer levels. These are worthy inclusions, for personal tastes do vary, and matching a number of amplifiers and speakers can be more than troublesome with some combinations.

A look inside showed a single p.c. board close to full chassis size. The components and the board itself were of excellent quality. There were many ICs, some in sockets, and one fuse in clips. The soldering was excellent.

#### Measurements

Somewhat limited tests were run, mostly to get a fast confirmation of some of Shure's specifications. All of the responses were as expected, and the surround outputs showed the effect of the required modified Dolby B NR decoding. The balance control was unusual and good in that it maintained a fairly constant total (L + R) sound power from one extreme to the other. Harmonic distortion was 0.3% or less at all of the points and levels tried. Delays were accurate at all settings of the switch, usually within 3%. The measured muting was 25 dB.

#### Setting Up

The installation and operation manual is quite lucid, even though it discusses, in considerable detail, information that

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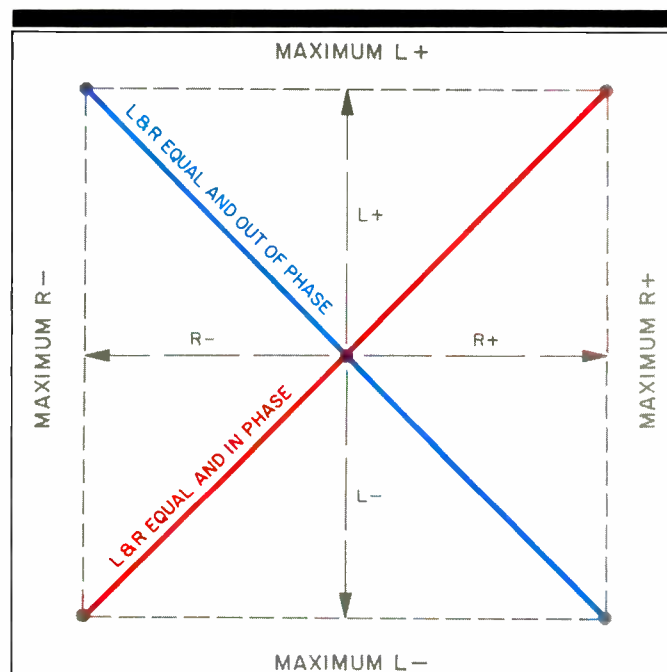
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On videocassettes with good Hi-Fi tracks, the HTS5000 really re-created the theater experience, but only about half of the tapes were good.



**Fig. 2—Vector indications of X/Y oscilloscope displays shown in Figs. 3, 4, and 5. Left-channel signal amplitudes are indicated by height of trace, right-channel amplitudes by trace width. Equal, in-phase signals from each channel (monophonic information) create trace from lower left to upper right; out-of-phase signals (stereo difference information) create trace from upper left to lower right.**

will be new to most users. A number of illustrations help to guide the set-up process. In my eagerness to get things going, I skipped over some of the material on balancing and then found it best to start over, sticking to the manual when setting levels.

I used the HTS5000 with a variety of amplifiers and speakers. These included amplifiers from QSC, Hafler, and AB Systems and even an old Lafayette, plus various Ramsa and JBL speakers and some old Dynaco A25s. I also used a Triad subwoofer at times, whenever the source was judged to benefit from its use. A Sanyo VCR7200 Beta Hi-Fi VCR was borrowed from a local store so that I could use its MTS decoder to check stereo TV broadcasts. The video monitor was a 25-inch Zenith TV set. Laser videodiscs supplied by

Pioneer were played on a Yamaha LV-X1 Digital videodisc player. Checks were also made of stereo audio tapes, some from Mobile Fidelity Sound Lab but more that I had recorded myself.

### Use and Listening Tests

I found that it was important to set up and balance carefully whatever combination of amplifiers and loudspeakers I used, in order to get the maximum benefit from the front sound stage as well as the surround sound. I involved other people in the listening (and viewing) tests; this aided in judging dialog localization, the best surround levels, and the success of the diffusion of this field.

The first sources that I tried were Beta Hi-Fi videocassettes. *Return of the Jedi*, from CBS/Fox Video, produced impressive sound in many respects. The Dolby Surround format was definitely better than stereo without surround, and the improvement over monaural video was emphatic. The subwoofer added considerable impact with many of the sound effects and some of the music. *Greystoke: The Legend of Tarzan, Lord of the Apes*, from Warner Home Video, showed the value of both surround sound and a good front stereo stage with well-placed sound effects and off-camera dialog. I heard traces of distortion on loud portions but then found that, with the levels I had set, the surround amplifier's input was being overdriven. Changing my levels to agree better with Shure's instructions cleaned up the sound immediately.

*The Adventures of Buckaroo Banzai*, from Vestron Video/20th Century Fox, delivered good sound with a good spread of special effects, but much of it was pallid in comparison to *Return of the Jedi*. I was very disappointed with *Amadeus*, from Thorn EMI (HBO); the right channel was completely missing in playback of the videocassette. *Tootsie*, from RCA/Columbia Pictures Home Video, got the Beta Hi-Fi light to go on, but I never detected any surround sound. In fact, I was never certain that there was any stereo information on the tape.

When the videocassettes had good Beta Hi-Fi tracks, I was very much impressed with the sonic results produced by the HTS5000. There really was a re-creation of the theater experience in my listening room. In a number of ways, I felt that the resulting sound was much better than what I had heard in most local theaters. The poor results with about half the videocassettes pointed up the problems that renters might have in getting movies with quality audio tracks. (My local dealer was quite uninterested in quality sound, or the lack of it, from his rental tapes.)

Robert B. Schulein, Shure's Chief Development Engineer, suggested to me that videodiscs would be a superior source of movie material, so I added the aforementioned Yamaha videodisc player to the system. I also incorporated a two-channel oscilloscope in X/Y mode, fed from the left and right inputs to the processor—another suggestion from Schulein. The display was instructive during the rest of my listening and viewing. Figure 2 shows how the left and right signals add and subtract to make patterns on the 'scope. A source that has all possible values of left and right would cover all points within the square outline at one time or another.

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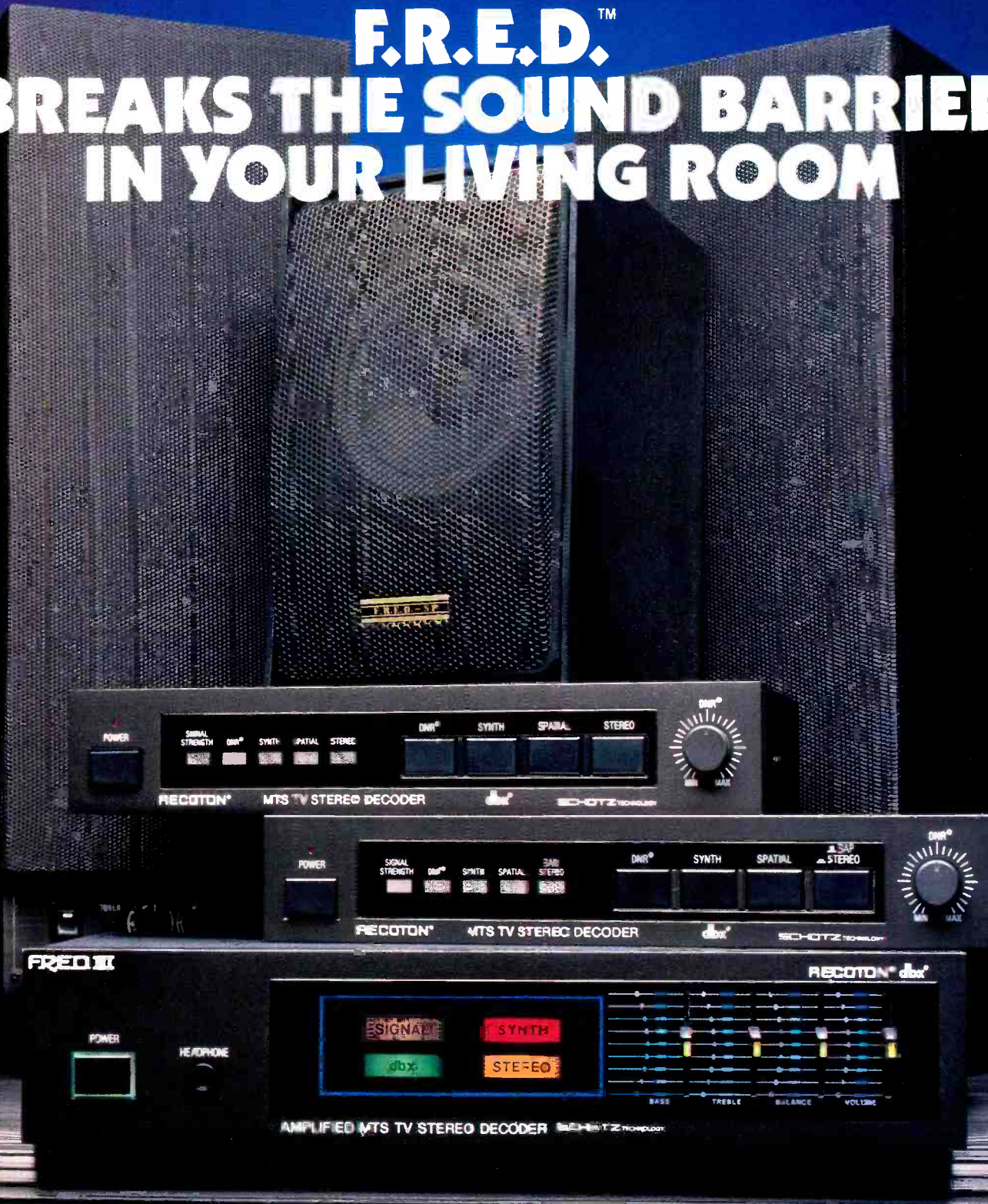
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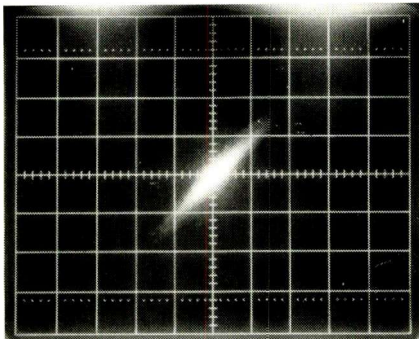
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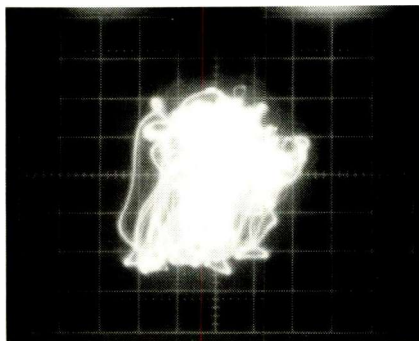


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On live stereo recordings made with just two mikes, I preferred Dolby Surround to synthesized surround; it created a feeling of being immersed in sound.



**Fig. 3—**Dialog on typical TV-network "stereo" program (*Valerie*, NBC) is almost completely monaural. Exposure is 1/30 S.



**Fig. 4—**The considerable variation in left and right amplitudes and relative phase during *Orange Blossom Bebop* on PBS shows substantial stereo information.

With the start of the videodisc version of *Return of the Jedi* (CBS/Fox Video 1478-80), I was immediately struck by both the outstanding video quality on my 25-inch screen and the dynamic range and detail of the audio, far superior to what I had experienced with the videocassette version. There was an excellent spread in the front stereo plane and good use of surround sound without any discrete speaker location being revealed, even to the nearest listeners. On-screen dialog was well centered, and there was less need for the

center channel, in this regard, than there was with the tape version. The chase on jet sleds through the forest on the moon of Endor had very effective across-the-stage sound effects. There was considerable benefit from using the sub-woofer throughout this movie.

I was also very impressed with the Dolby Surround on *Ladyhawke* (Warner Home Video 11464LV), a medieval story that featured background music with contemporary elements, including synthesizers. There was very good integration of video and sound and story, making an excellent demonstration of the importance of good sound for the most satisfying movie experience. The surround sound was very smooth, and there was a wide range of acceptable levels. *Rustlers' Rhapsody* (Paramount Home Video LV1781) and *Back to the Future* (MCA Home Video 40196) were not as satisfying to me, but they did make good use of the stereo sound stage with off-screen dialog and sound effects. The use of Dolby Surround was effective in both films, although I noted a few spots in *Back to the Future* where the scene called for surround information and there was none.

Videodiscs of *Gremlins* (Warner Home Video 11388LV) and *Beverly Hills Cop* (Paramount Home Video 1134) were certainly quite superior to videocassette versions, but I didn't feel that these two were a match for the others discussed above. *Gremlins* did, however, have a good stereo sound stage and effective use of Dolby Surround, in general. In comparison, *Beverly Hills Cop* did not make use of stereo and surround effects where they could have been very effective.

The videodiscs most clearly demonstrated that the aural experience of a movie in the home can be dramatically improved with use of the HTS5000. (The fact that there was a significant improvement in the picture quality from discs compared to that from videocassettes should not be disregarded.) I should note that all of the videodiscs used had digitally encoded audio. There was no doubt that the best results were obtained with the fine associated equipment, but the improvement in the stereo sound stage and the much more satisfying listening environment with Dolby Surround stood out very clearly even with the poorer speakers and amplifiers.

I found that many network TV programs which were billed as "stereo," and which turned on my video system's MTS pilot-tone detector, actually carried very little stereo information. Dialog was centered in the sound field, with none of the left-right localization that would have made for better stereo. Even when on-screen characters were supposedly reacting to off-screen voices, those voices came from dead center. Some programs, including *The Tonight Show*, had stereo music. One program had stereo only in the laugh track. An exception to these generalities was *Amazing Stories*, which had good stereo information in most of the music and made good use of simulated surround. Figure 3 shows the typical 'scope display during the network "stereo" programs: It's almost completely monaural, with very little difference information.

On the other hand, PBS provided a great deal of well-placed stereo information in a performance of Tchaikovsky's "Queen of Spades" and in a program called *Orange Blossom Bebop*. Figure 4 is a 1/30-S snapshot of the 'scope

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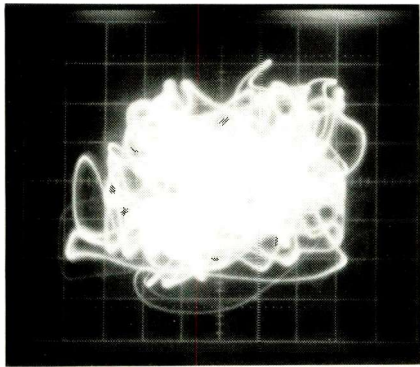
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The HTS5000 provided the most satisfying listening I have had at home. My wife asked, "Can we keep it?"



**Fig. 5—A stereo recording made with only two microphones shows a range of interchannel amplitude and phase differences even wider than that of Fig. 4. Sample shown here is 1/30 S from the final "jah" of Handel's "Hallelujah Chorus" from "The Messiah."**

display during *Orange Blossom Bebop*. Even in this short time, there are many combinations of left and right amplitude and phase.

The simulated surround worked well and made TV watching and listening much more enjoyable. I tried Dolby Surround a few times, but the simulated version was better on a long-term basis. These two PBS programs demonstrated what MTS is capable of, and the addition of the surround-sound processing was most worthwhile. PBS was also using stereo synthesis on strictly monaural programs, such as one on the wildebeest, but it didn't cause negative effects. In fact, it sounded better.

Any stereo audio-only source can be processed by the HTS5000, but I decided to restrict such trials to commercial tapes from Mobile Fidelity Sound Lab and to those that I had recorded myself. I found the simulated surround a very satisfying addition to the MFSL tapes. I tried Dolby Surround for most of these tapes; sometimes I preferred this, and other times I preferred the synthesized surround. I did recognize that the originals had not been encoded for Dolby Surround, and really good results involved a bit of luck.

From my own open-reel originals, I selected recordings of Verdi's "Requiem" and Handel's "Messiah" that I had made in the 1960s, and of Fauré's "Requiem" and Kastle's "Mass" that I had taped during the 1970s. The recordings had been made in three different locations, with different microphone setups, though each had been made with just two microphones. All of the recordings showed a wide range of sum-

and-difference combinations of left and right signals on the 'scope display; Fig. 5 shows a 1/30-S sample taken during the Handel tape. With these tapes, I generally preferred to use Dolby Surround rather than the synthesized surround; for much of this material, the former was better for creating a feeling of being immersed in the sound, while the latter was better for detailing the music. I found that with either mode a wide range of surround-sound levels proved completely acceptable to all listeners. On occasions when I quickly reduced the surround level to zero, collapsing the sound field to the front stereo stage, the listeners all protested.

It was quite fascinating to use the "Surround Level" control to re-create the original recording site's acoustics or to set it so the sound was a closer match to one of the other locations. Accurate delay settings helped to expand the range of possible surround levels.

#### **Conclusions: Solid and Otherwise**

The benefits of surround sound varied with the source material; the greatest improvements over regular stereo were obtained with videodiscs and my own tape recordings. Some of the videocassettes were very successfully played back with Dolby Surround, but most of them were disappointing in one way or another. Stereo TV was a mixed bag, with PBS broadcasts quite superior to most of the major-network fare. PBS did demonstrate what the format is capable of achieving.

The improvements with both Dolby Surround and the synthesized version were definitely desirable, even with inexpensive amplifiers and loudspeakers. There certainly were the usual benefits to be gained from using better equipment. I found that with surround, I sometimes set levels for a higher total sound level than I would without surround, requiring more power from the surround amplifier than I had thought was likely.

The need for a subwoofer was questionable a good part of the time, but it helped more frequently than might be expected. Its contribution seemed to be essential in *Return of the Jedi* and for the organ on some of my tapes. Personally, I felt that the center speaker, even at low level, was a positive influence in two ways: It did lessen the tendency for listeners on the side to be distracted by the nearer stereo speaker, and it also served to point up (sharpen) the on-screen dialog. Center-channel signals are produced only in Dolby Surround mode; since I thought it would be worthwhile to have center-channel signal output in stereo-synthesized surround, I summed the left and right output externally and set the level for my taste.

After having said so much about sources and external equipment, I must summarize my experience by saying that the Shure HTS5000 provided the most satisfying listening (with and without video) that I have had in my home. Investment and attention are required to get the benefits of the Dolby Surround and synthesized surround sound, but the changes are both significant and rewarding.

The final comment on the processor is a quote from my wife, who *listens* to music rather than analyzing it or the equipment it is played on. After hearing what the HTS5000 could do for the sound of movies and tapes, she asked, "Can we keep it?"

Howard A. Roberson





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## 2

## EPI STAT 450 SPEAKER

### Manufacturer's Specifications

**System Type:** Two way; sealed-box woofer, electrostatic tweeter.

**Drivers:** 10-in. (25-cm) woofer; three electrostatic panel tweeters.

**Crossover:** 1 kHz.

**Nominal Impedance:** 4 ohms.

**Frequency Response:** 44 Hz to 20 kHz,  $\pm 3$  dB.

**Practical Power Range:** 20 to 250 watts.

**Dimensions:** 17½ in. W x 10½ in. D x 37½ in. H (44 cm x 27 cm x 95 cm).

**Weight:** 50 lbs. (23 kg).

**Price:** \$350 each.

**Company Address:** Epicure Products, 25 Hale St., Newburyport, Mass. 01950.

For literature, circle No. 91



The EPI Stat 450 combines a conventional 10-inch woofer with an electrostatic tweeter array to produce an affordable system with exotic technology. Many audiophiles believe that only electrostatic speakers offer the ultimate in transparency and definition, and insist on using the principle in full-range configurations despite the resulting high cost, large size, and compromised bass performance. The Stat 450 avoids these drawbacks by using electrostatic panels only above 1 kHz, a range which they handle easily.

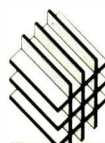
The technology of electrostatic loudspeakers may seem exotic, but it is not new. Electrostatic loudspeakers were invented in the early 1920s, before the moving-coil type with which we are most familiar. The early 'stats were not commercially successful because the insulator and diaphragm materials then available were unable to cope with the high operating voltages required.

The modern electrostat era began with the Janszen tweeter array in 1954 and the Quad full-range system in 1955. Since then, well-received systems have been marketed by Pickering, KLH, Dayton Wright, Acoustat, Infinity, SoundLab, Stax, Martin-Logan, and many others. The three panels used in the Stat 450 have a strong resemblance in size and construction to those of the innovative Janszen speaker of 33 years ago.

I find electrostatic loudspeakers intriguing because the underlying physics implies a natural compatibility between this kind of force generator and the air next to it. Consider that in a conventional moving-coil loudspeaker, the interaction of magnetic fields produces a force on an electrical conductor (the voice-coil). The dense copper- or aluminum-wire conductor tends to have a small surface area, which prevents it from transferring this force efficiently to the sur-

Your loudspeakers may well have some of the most advanced drive units and crossovers in the whole world.

Even so, something is still standing between all the natural sound they produce and your ears.



The loudspeaker cabinet walls.

When the drive units vibrate, they will make the cabinets vibrate as well. Stopping the complete sound spectrum that comes from the drive units from ever reaching you.

This effect is known as colouration. And it's the reason you're always conscious that you are listening to music produced by two loudspeakers rather than a truly live concert performance.



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Colouration is a great barrier to pure sound reproduction. Loudspeaker manufacturers all over the world have been searching for a way to break through it.

Now B&W have finally done it. With an invention that's the most exciting and important breakthrough in loudspeaker technology that even they have made in the last 20 years.

It's the Matrix series of new digital monitors. The first ever loudspeakers to totally eliminate the colouration from the loudspeaker cabinet.



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The familiar, but greatly unloved hangover effect is dead. Long live the Matrix.

This revolution was achieved with an idea so very simple that B&W practically invented the Matrix by accident.

They discovered that all that

is required to virtually eliminate unwanted sound radiation from the cabinet is a honeycomb-like structure of unique design inside it.

They also discovered that this so improved the performance of the cabinet that they also had to improve the quality of all the drive units.

Consequently, as well as the drivers with homopolymer cones manufactured under licence from CBS Inc., Matrix also features a newly designed ferrofluid tweeter.

The new Matrix series itself features three digital monitors.

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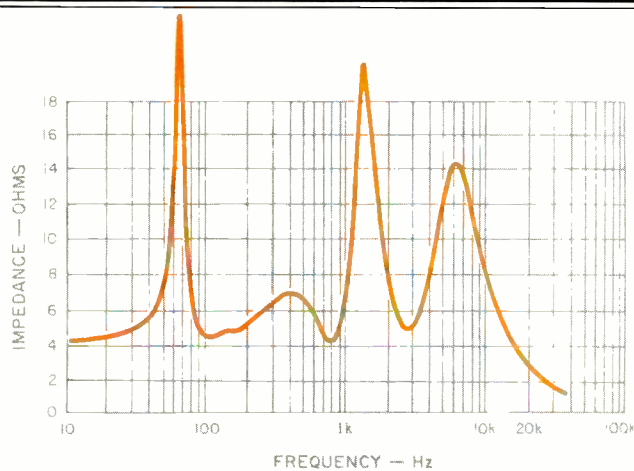


## LISTEN & YOU'LL SEE

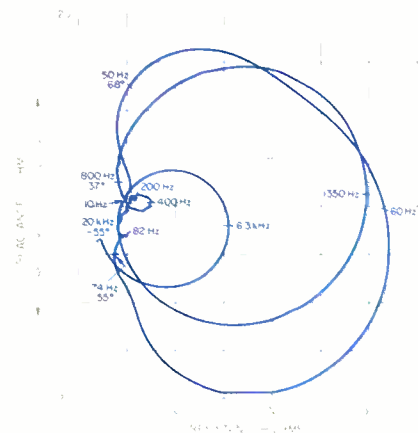
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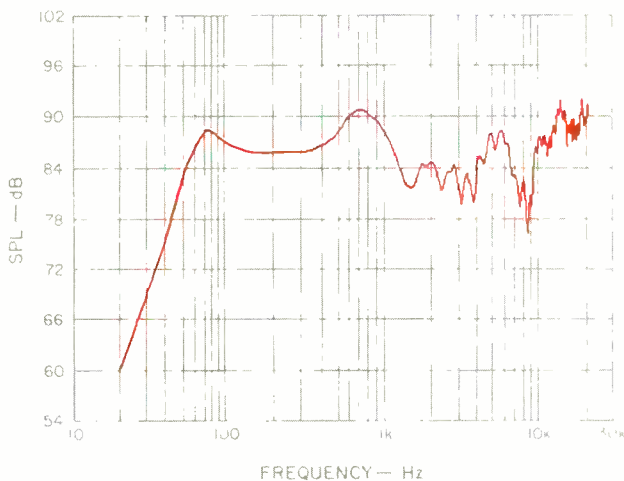
By using electrostatic panels only above 1 kHz, the Stat 450 avoids the high cost, large size and compromised bass of some electrostatic designs.



**Fig. 1—Magnitude of impedance.**



**Fig. 2—Complex impedance.**



**Fig. 3—One-meter on-axis frequency response, with 1.0 watt input into 4 ohms (2 V).**

rounding air in order to radiate sound. The moving voice-coil is therefore attached to a diaphragm (cone) whose size allows a more effective coupling. Sometimes a further acoustical transformer (a horn) is used.

The direct sound-producing action of the electrostatic force generator is a sharp contrast to the magnetic/cone/horn system. The electrostatic loudspeaker is essentially a capacitor, one of whose plates is free to move in response to a changing electric field. The audio signal, amplified to around 1,000 V, produces the changing field; a thin conductive plastic film is the movable plate. Unlike a voice-coil, this plate is a surface, so it naturally couples to the air next to it.

So much for ideal theory. The electrostatic loudspeaker has plenty of difficulties in the real world. Amplifiers designed for moving-coil loudspeakers are not optimum for the high-voltage, capacitive-load demands of an electrostat. Fortunately, a transformer can be used to step up the voltage (one is used in the Stat 450), and modern amplifiers are tolerant of the capacitive loading. A low-current, high-voltage polarizing supply is also needed. It is ironic that the inherently high operating voltage of tube-type amplifiers is stepped down with an output transformer and back up again with the transformer in the electrostatic loudspeaker. Direct drive from a tube amplifier would be a natural for an electrostat, but such systems are not available today as off-the-shelf items.

The related problems of directivity and large size must also be addressed in the design of electrostatic loudspeakers. The large radiating surface of an electrostat is dictated by practical electrode spacing and acoustic output requirements. If all portions of this surface move in the same direction, radiation will be directional when acoustic wavelengths are small compared to the size of the surface. Some electrostats combat this tendency with individual arrayed panels, curved construction, narrow vertical panels, or, in the case of the Quad ESL 63, a simulated point source.

Acoustic radiation from the rear of the panel is also a problem for electrostats, just as it is for moving-coil speakers. When wavelengths are long (low frequencies) compared to the size of the panel, front-to-back cancellation occurs. Even a large enclosure for the rear of the electrostat can produce an unacceptable air-spring stiffness. The most common solution is to do without an enclosure, letting the speakers be large in area but thin, so the panel acts as its own baffle. This technique has a secondary benefit: High frequencies radiated from the rear tend to be dispersed as they are reflected back into the listening area.

The Stat 450 has its own ways of maximizing the benefits of electrostats and minimizing the deficiencies. Polarizing voltage is obtained from a small d.c.-to-d.c. converter, located inside each cabinet and powered by a wall-plug transformer. The power requirement is very small, and no power switch is provided. The same circuit board, inside the cabinet, also carries the crossover and audio step-up transformer. This transformer is of modest size because it only handles signals above 1 kHz.

No attempt to control the front radiation pattern is evident in the Stat 450, other than an angling of the three vertically stacked electrostatic panels slightly upward toward the listener. Rear radiation from the three electrostatic panels is

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Smooth room response below 1 kHz is a tribute to the lack of floor-bounce interference from the low-mounted woofer.

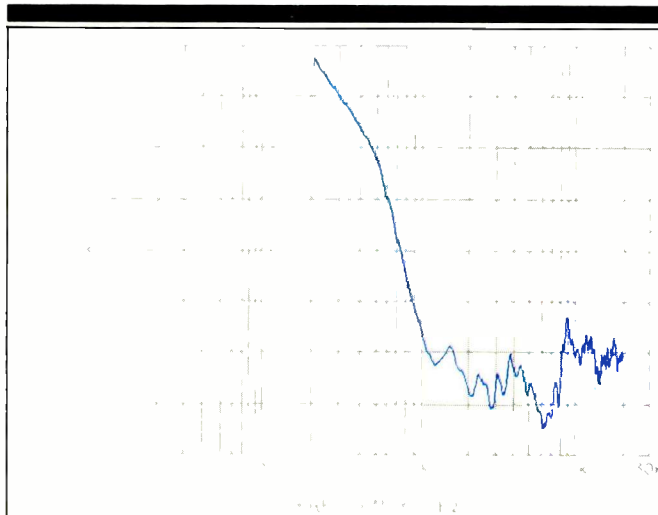


Fig. 4—One-meter on-axis phase response.

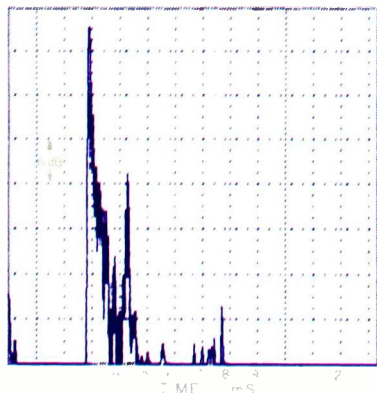


Fig. 5—One-meter on-axis time response. Arrival at 4.3 ms is rear tweeter radiation reflected off back of cabinet and passing through tweeter panel.

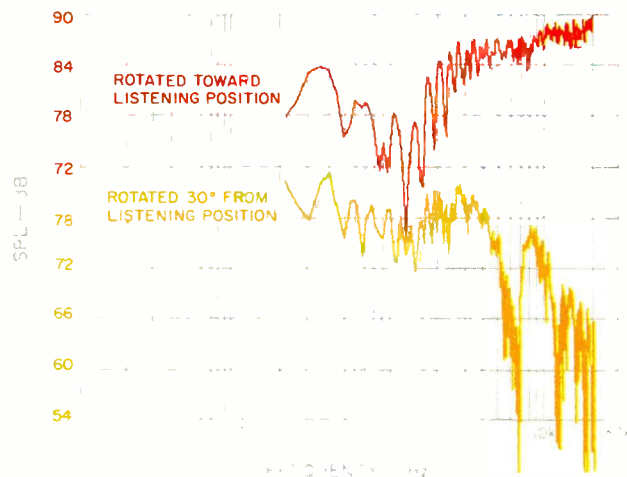


Fig. 6—Three-meter room response.

absorbed in a partitioned-off section within the cabinet, accounting for about 60% of the total internal volume.

The woofer portion is a conventional sealed-box type using a 10-inch driver with a special cone construction said to possess nearly ideal damping and stiffness properties. The same closed-cell foam material which forms the half-roll surround at the cone's outer edge continues all the way to the cone's apex. On the cone proper, a clear, stiff, plastic material is laminated to this foam, producing a composite with the desired properties.

The tall and fairly light cabinet is finished in walnut-grain vinyl and has a detachable brown-cloth grille. Amplifier connection is made to spring-clip connectors in a recessed panel on the rear of the cabinet. While easy to use for zip-cord up to about AWG 12, these connectors will not directly accept the heavier gauge audiophile cables. The wall-plug polarizing-supply transformer has its own mini power connector on the same plate. A high-frequency level control and nameplate reside near the top of the attractively finished front panel. I suspect that this loudspeaker system will frequently be used without the grille attached, in order to show off the front panel's exotic look.

#### Measurements

This system's nominal impedance rating of 4 ohms is an appropriate one, even though the capacitive load of the tweeter brings it below this value at 20 kHz, as shown in Fig. 1. As can be seen in the complex impedance plot of Fig. 2, the upper frequencies lie primarily in the lower or capacitive half of the plot. The expected woofer and crossover resonances produce high impedance peaks with both capacitive and inductive phase angles. The sharp impedance peak at 65 Hz is due to the woofer's primary resonance. Its high magnitude is merely an indication of low mechanical loss in this system, which relies primarily on amplifier damping to control resonance. Other frequencies are harder to drive because they have a high positive or negative phase angle combined with a low impedance magnitude. However, even these more stressful points should be well within the capabilities of modern amplifiers.

Figure 3 shows the 1-meter, on-axis, anechoic frequency response. *Audio's* anechoic plots are made 1 meter out from the geometric center of the front panel, for consistency. The low-frequency portion of Fig. 3 shows a bump in the bass response around 70 Hz and a 16-dB/octave cutoff below 50 Hz.

Figure 4 shows the 1-meter on-axis system phase response. The positive phase shift at extremely low frequencies (not shown) followed by a negative shift through the crossover range is a usual trend in a two-way system. The Stat 450 dives past  $-180^\circ$  a little faster than usual and levels out at  $-270^\circ$  rather than continuing downward. A plot like this looks bad by amplifier standards, but if it is smooth and gradual, I believe it is not a problem to the ear.

Time response of the Stat 450 under the same 1-meter conditions is shown in Fig. 5. Although the primary sound arrival from the tweeter is very compact in time, it is followed by another arrival 1.3 ms later. This is the tweeter's rear radiation reflecting off the inside rear of the cabinet and passing out through the electrostatic panels. Neither the

....*remarkable!*



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

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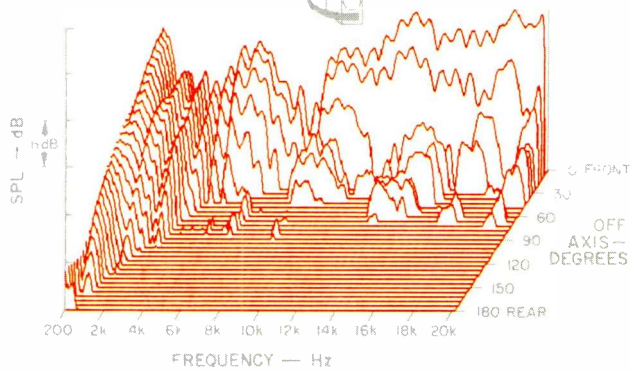
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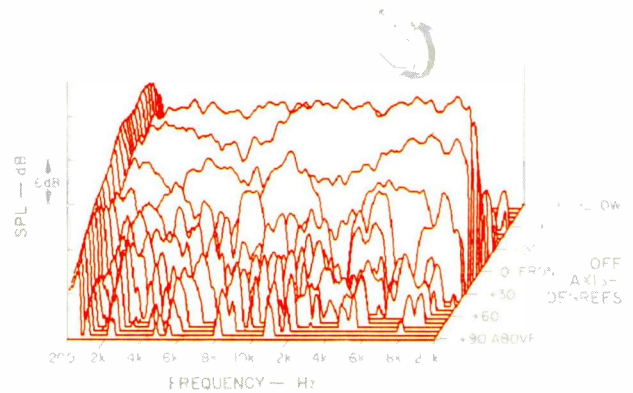
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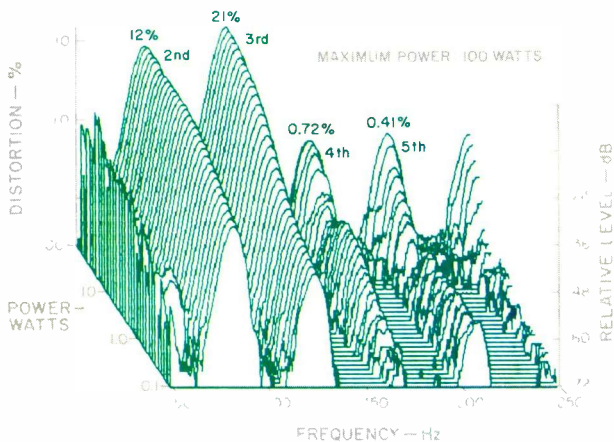
At high frequencies, and particularly vertically, these speakers are the most directional I have yet encountered.



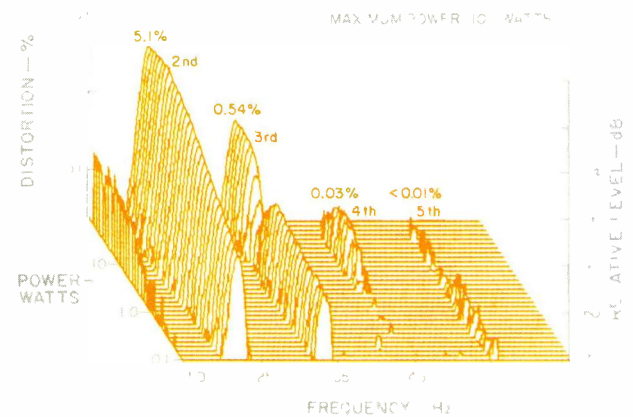
**Fig. 7—Horizontal off-axis frequency response, front to rear.**



**Fig. 8—Vertical off-axis frequency response, from below, up front, to directly above speaker.**



**Fig. 9—Harmonic distortion products for the tone  $E_1$  (41.2 Hz).**



**Fig. 10—Harmonic distortion products for the tone  $A_2$  (110 Hz).**

fiberglass in the compartment nor the panels themselves prevent this. This sound combines with the primary radiation to produce the regular peaks and dips in the response at frequencies above 1.5 kHz.

The 3-meter on-axis room response, shown in Fig. 6, includes room reflections that occur within 10 ms at a typical listening position. The relatively smooth portion below 1 kHz is a tribute to the lack of floor-bounce interference from the low-mounted woofer. Higher mounting would cause the signal reflected off the floor to travel a significant-

ly longer path to the listener than the direct sound, and the result would be cancellation at frequencies as low as 300 Hz. Low mounting forces the first cancellation notch to be much higher, and it allows the signal hitting the floor to possibly just be absorbed by a carpet instead of reflecting. The upper range is affected by a side-wall reflection up to about 4 kHz. Above that frequency, the tweeter becomes sufficiently directional to eliminate this interference.

Figure 6 also shows the 3-meter room response measured 30° off-axis. While the plot is again relatively free of



When the Stat 450s were sharply angled toward each other, the sound stage appeared, like magic. Highs were there, and the image was stable.

early reflection problems, interference notches and a general roll-off of the upper range are seen.

Horizontal directivity is seen in the "three-dimensional" plot of Fig. 7, showing frequency response from 200 Hz to 20 kHz measured at 6° intervals from front to back. Listening even 6° off-axis causes a noticeable loss in the upper octave. At 12° or more, the upper octave is just not there.

Vertical directivity is shown the same way in Fig. 8. Thirty-one plots are made from directly below the speaker, up the front, to directly over the speaker. Again, high-frequency radiation is confined to a narrow angle.

Figures 9, 10, and 11 show the harmonics of tones at 41.2, 110, and 440 Hz ( $E_1$ ,  $A_2$ , and  $A_4$ ) produced by the Stat 450 at applied power from 0.1 to 100 watts. The 41.2-Hz tone is below system resonance and may be considered at the edge of the effective range of the Stat 450. At high power, suspension or magnetic nonlinearities limit both ends of the cone travel, as indicated by the high third-harmonic content. The low percentages of upper harmonics indicate that this action is gentle and controlled. The higher frequencies, 110 and 440 Hz, have respectably low percentages of predominantly low-order harmonics, even at high power input. In sum, this is respectable linearity for a 10-inch woofer system.

Woofer linearity can also be evaluated by looking at Fig. 12, which shows modulation of 440 Hz ( $A_4$ ) by 41.2 Hz ( $E_1$ ). This is essentially a test of linearity at 41.2 Hz. As we might expect, the 440-Hz tone gets somewhat squashed when the 41.2-Hz tone strokes the cone to its limits. Ten-percent modulation of the 440-Hz tone occurs at 20 watts of combined input, and is audible, but at a high output level.

Power linearity, shown in Fig. 13, is a wide-band test for system power-handling and distortion. Frequency response measured at 1 watt is the reference. The response at 10 and 100 watts should be the same, but 10 and 20 dB higher. For clarity, only the differences in response (which ideally should be straight lines shifted up) are shown in Fig. 13. Since the receiving analyzer tracks the swept tone sent out, distortion products are ignored. The Stat 450 does well at 10 watts input but shows some compression throughout the audio range at 100 watts. I would say this is reasonable performance considering the fact that the speaker's high sensitivity makes 10 watts quite loud.

### Use and Listening Tests

The well-written instruction sheet that comes with the Stat 450 states that its high-frequency radiation is "rather directional." I agree with this statement because, at high frequencies, and particularly vertically, these are the most directional speakers I have yet tested. Most of my initial setup efforts dealt with this characteristic, and eventually I achieved a reasonably successful setup.

I started by placing the Stat 450s out from the wall and angled inward toward the listening position, as recommended by EPI. Even with the high-frequency level control turned down, there was a tizzy top-end which prevented me from accepting an imaginary sound stage between and behind the speakers. In addition, image locations, for a centered listener, shifted with the slightest head movement.

Loudspeaker directivity can often be used to enhance the

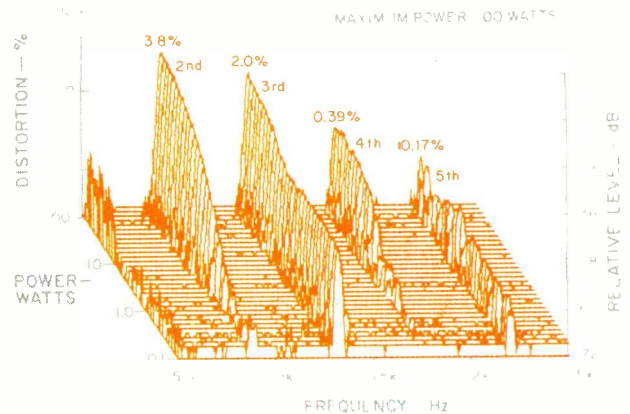


Fig. 11—Harmonic distortion products for the tone  $A_4$  (440 Hz).

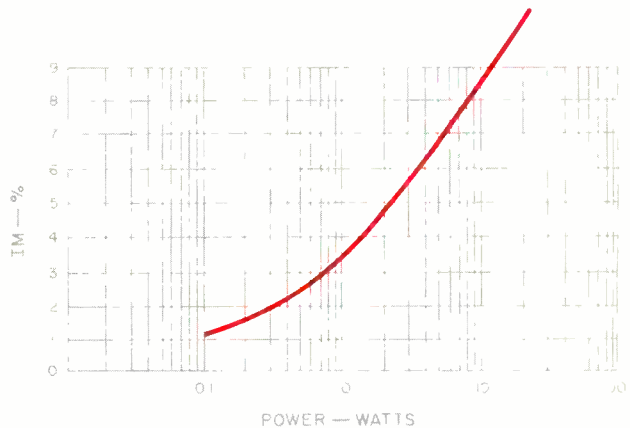


Fig. 12—IM distortion on 440 Hz ( $A_4$ ) produced by 41.2 Hz ( $E_1$ ) when mixed in one-to-one proportion.

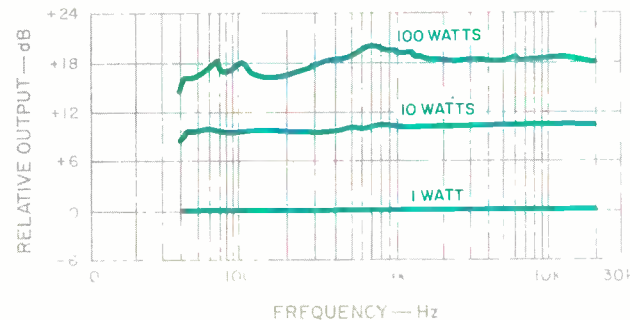


Fig. 13—Power linearity at 10 and 100 watts. Reference is response at 1 watt.

For would-be electrostatic enthusiasts, the Stat 450 provides an entry-level opportunity to indulge in an exotic technology.

sense of a realistic sound stage over a larger listening area by rotating the cabinets even farther inward than one would usually expect. With this slightly "cross-eyed" orientation, a listener physically close to one speaker is more on the axis of the opposite speaker. This setup operates somewhat like an automatic balance control in that a channel level difference re-centers the sonic images. Applying this idea to the Stat 450s helped but was not the final answer. The high-frequency energy from the farther speaker would hit the listener, while the high frequencies from the near speaker would miss the listening position. Mid- and low frequencies were little affected by the angles used. The result was unstable image locations.

I even tried an extreme angle in which the speakers ended up looking more at each other than at the listener, and about 3 feet out from the wall. Like magic, the sound stage appeared; the highs were there, and image locations were stable! It turned out that the extreme angle projects each speaker's beam of highs across the room into the opposite wall, where it is reflected back to the listening position. To optimize the effect, I placed large, acoustically diffusing objects along the two side walls at which the speakers were now aimed. An audio equipment cabinet or a partially filled bookcase works very well as a diffuser. What I perceived was an unexpected sense of "air" and a widening of the sound stage on complex sounds like applause.

With the speakers 3 feet out from the wall behind them, the bass was a bit thin. After experimenting with positions closer to the wall, I ended up with the back of the cabinet about 1 foot out. Bass was now in balance but not as extended as I would like. Upper bass was smooth, but the midrange exhibited some unevenness. There was no sense of coloration, just a bit of aggressiveness in one octave and a bit of suppression in the next. Highs were extended and airy, as long as the listener remained seated.

The open sound and image locations of these speakers were more consistent with side-to-side changes in listener position than that usually found in front-directed setups. Depth of sound stage was a bit shallow at times, and one's ability to differentiate between large hall ambience, club sound, and dry recordings was less than with some other good speakers. Selections from Sheffield's *Drum Record* were reproduced without a sense of strain or compression at quite respectable levels with the speakers driven by a 250-watt amplifier. Focus and sharpness of attack on this percussive material were somewhat lacking, however. Many listeners gave strong praise to the sound from the Stat 450s in the final orientation.

For the would-be electrostatic loudspeaker enthusiast who has never been able to afford a pair, the EPI Stat 450s provide an entry-level opportunity to indulge in this old but still-exotic technology.

David L. Clark

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## 3

## EMINENT TECHNOLOGY TONEARM 2 AND TALISMAN VIRTUOSO B CARTRIDGE

### Manufacturer's Specifications

#### Tonearm

**Type:** Straight-line, air-bearing arm with fixed headshell and interchangeable, tapered armtube.

**Pivot-to-Stylus Distance:**  $7\frac{3}{8}$  in. (18.7 cm).

**Tracking Error:**  $0^\circ$ .

**Effective Mass:** Vertical, 7 grams; horizontal, 25 to 35 grams.

**Height Adjustment:**  $\frac{3}{4}$  in. (19 mm).

**Vertical-Tracking-Angle Adjustment:** Arcuate,  $\pm 2^\circ$  from center of range.

**Overhang Adjustment:**  $\frac{1}{2}$  in. (12.7 mm).

**Cueing:** Adjustable-height, eccentric-bar mechanism.

**Azimuth Adjustment:**  $\pm 2^\circ$  from vertical.

**Tracking-Force Range:** 0 to 7 grams.

**Pivot Damping:** Vertical, none; horizontal, motion damped at counterweight assembly.

**Bearing Surface Area:** 6.8 square in.

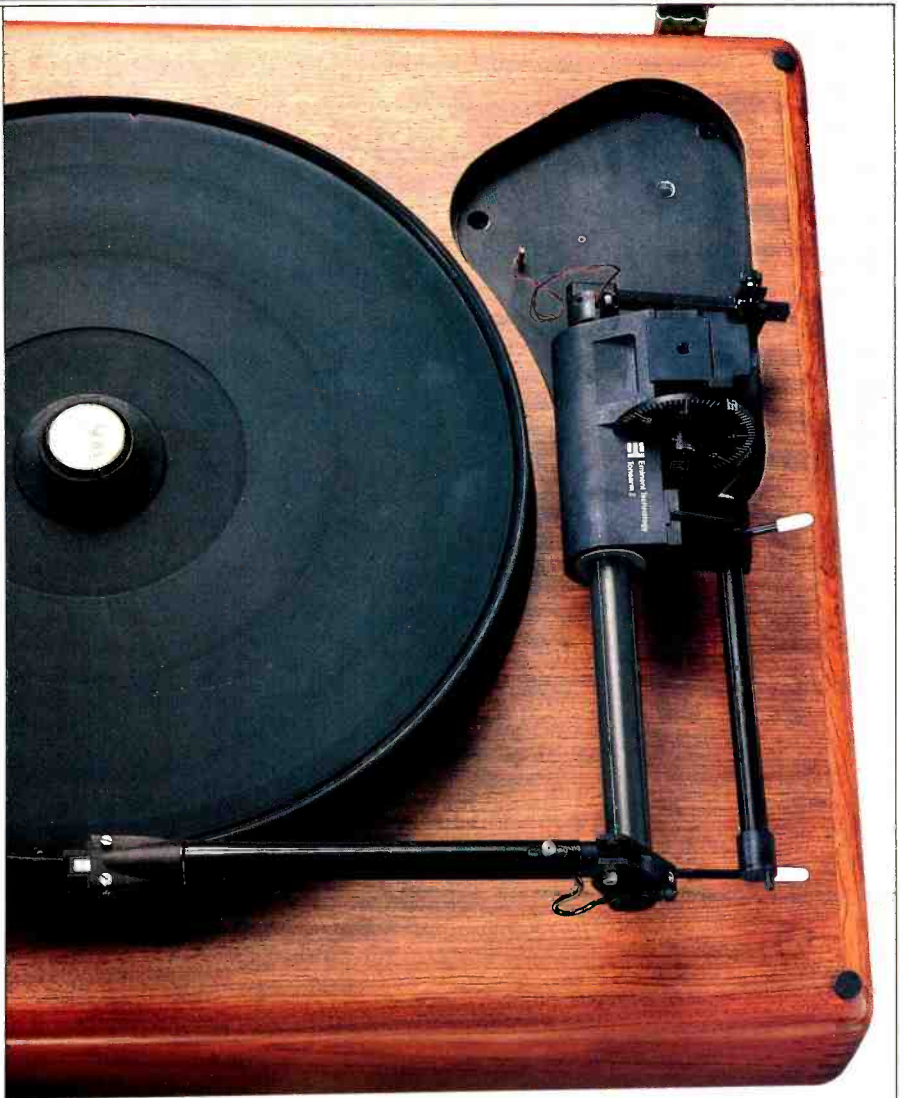
**Overall Arm Weight:** 14.25 oz. (405 grams).

**Lead Wire:** Van den Hul linear-crystal silver; oxygen-free litz wire optional.

**Capacitance:** 40 pF.

**Resistance:** 0.9 ohm.

**Materials:** Hard-anodized aluminum armtube and bearing spindle; high-



modulus carbon-fiber composite armtube joint, glass-fiber and mineral-filled composite bearing housing.

**Air Filter:** Disposable, 2 to 3 years average life expectancy.

**Price:** \$850 including air pump.

**Company Address:** 508 Cactus St., Tallahassee, Fla. 32301.

For literature, circle No. 92

#### Cartridge

**Type:** High-output moving coil.

**Stylus:** Van den Hul Type I.

**Cantilever:** Boron rod.

**Output:** 1.8 mV for 5 cm/S at 1 kHz.

**Recommended Load Impedance:** 47 kilohms.

**Internal Impedance:** 105 ohms.

**Frequency Response:** 15 Hz to 32 kHz,  $\pm 2$  dB.

**Channel Separation:** 35 dB at 1 kHz.

**Channel Balance:** 0.5 dB.

**Compliance:**  $15 \times 10^{-6}$  cm/dyne.

**Recommended Tracking Force:** 2 grams,  $\pm 0.25$  gram.

**Weight:** 7.5 grams.

**Price:** \$800; replacement stylus, \$465.

**Company Address:** c/o Sumiko, P.O. Box 5046, Berkeley, Cal. 94705.

For literature, circle No. 93

The quest for a way to retrace the grooves of a phonograph record as perfectly as possible always leads back to "linear" or "straight-line" tracking. The original master lacquer, which is used to produce the record, is made by a cutterhead which is driven across its surface in a straight line, so it seems obvious that the best way to retrace a record would be by using a straight-line method. This is easier said than done, and the fact that most tonearms in the world are pivoted certainly bears this out. It is much easier to produce a low-friction conventional arm, which has bearings only at its pivot, than to produce a good straight-line arm which must maintain low friction along a bearing that runs across the record from the outside to the inside grooves.

Many really great innovations are the result of someone's desire to produce something that seemed impractical, at least to the "bean counters" or money-oriented mentalities of the time. The Eminent Technology Tonearm 2 is the result of Bruce Thigpen's desire to produce a linear-tracking tonearm which would overcome the biggest problem of such tonearms: Friction. It was a long time coming and makes an interesting story.

When Bruce was still a student at Florida State University, in the late 1960s, he met Lew Ekhart. Lew was developing air bearings which could be used by students to perform physics experiments. When Bruce mentioned that such a bearing would probably be just the thing to make a really great turntable, Lew told him that he had made one and asked if he would like to see it. I can just imagine Bruce's excitement at the prospect!

In the early 1970s, both Lew and Bruce were employed by the Wayne Coloney Company, which worked on military contracts. The company was looking for other products to manufacture, and Lew's air-bearing turntable was developed. (This turntable is now being produced by the Mapleknoll Company.) In 1982, Bruce decided to start his own



The Eminent Technology Tonearm 2 on a SOTA Star Sapphire turntable.

## MEASURED DATA

### Eminent Technology Tonearm 2

Pivot-to-Stylus Distance: 7.0 in. (17.8 cm).  
 Pivot-to-Rear-of-Arm Distance: 2.75 in. (7.0 cm).  
 Overall Height Adjustment: 0.8 in. (2.0 cm).  
 Tracking-Force Adjustment: 0 to 5 grams.  
 Tracking-Force Calibration: None; separate gauge required.  
 Cartridge Weight Range: 0 to 12 grams.  
 Counterweights: Lead; two 4.8 grams, two 14.9 grams.  
 Counterweight Mounting: Leaf spring for horizontal, solid vertical.  
 Sidethrust Correction: None needed.  
 Lifting Device: Lever, no damping.  
 Headshell Offset: Not needed.  
 Overhang Adjustment: Slot in armtube (see text).  
 Bearing Alignment: Excellent.  
 Bearing Friction: Very low.  
 Lead Torque: Slight near inner and outer grooves.  
 Arm-Lead Capacitance: 47 pF.  
 Arm-Lead Resistance: 1.9 ohms.  
 Structural Resonances: 1,100, 1,550, 2,650, and 5,700 Hz.  
 Base Mounting: Single center hole.

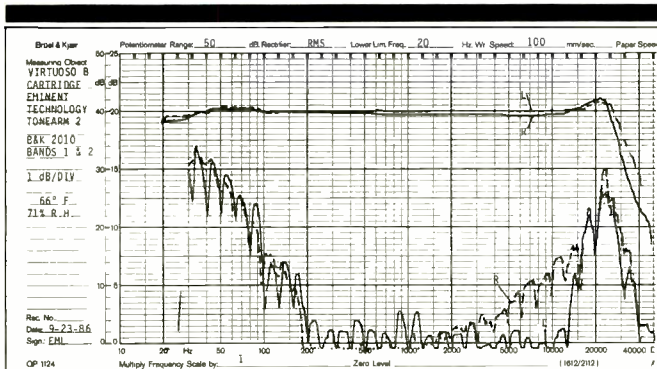
### Talisman Virtuoso B Cartridge

Coil Inductance: Left, 310  $\mu$ H; right, 280  $\mu$ H.  
 Coil Resistance: Left, 103.8 ohms; right, 102.3 ohms.  
 Output Voltage: Left, 0.36 mV/cm; right, 0.38 mV/cm.  
 Tracking Force: 2.0 grams used.  
 Cartridge Mass: 7.5 grams.  
 Microphony: Excellent.  
 Hum Rejection: Excellent.  
 High-Frequency Resonance: Left, 20.8 kHz; right, 22.7 kHz.  
 Rise-Time: 15  $\mu$ S.  
 Low-Frequency Resonance: 10 Hz (in Eminent Technology Tonearm 2).  
 Low-Frequency Q: Less than 1 (in ET2 tonearm).  
 Response to Load Capacitance: Unaffected by normal input capacity.

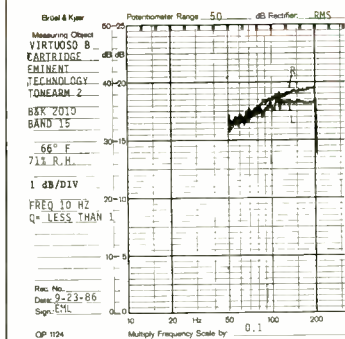
company and use his expertise in air-bearing technology to produce a linear-tracking tonearm. The air bearing, which is the main feature of the design, results in almost zero friction.

The first version of the tonearm lacked some of the refinements of the present version. Many of these were the result of input from Edison Price, the owner of an engineering company in New York City, who bought one of Thigpen's first tonearms. Price applied some of his mechanical engineering expertise to add some features which he thought would make the tonearm easier to adjust and use. Bruce welcomed these design improvements and has incorporated them into the present version of the tonearm. Most small companies rely on good word-of-mouth advertising by satisfied customers; Edison Price has proved to be the ultimate satisfied customer, because he actively promotes the tonearm and has even set up a demonstration listening room in his own facility in New York.

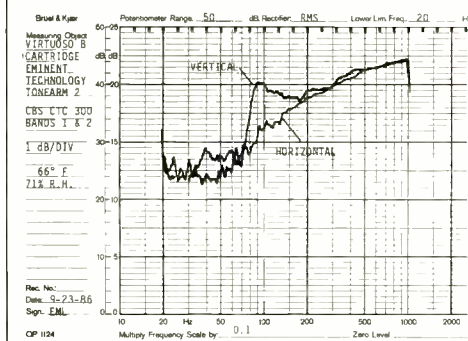
With its air pump on, the arm feels slippery, its friction reduced to practically nothing.



**Fig. 1—Frequency response and crosstalk, Talisman Virtuoso B cartridge in Eminent Technology Tonearm 2, using B & K 2010 test record.**



**Fig. 2—Low-frequency tonearm/cartridge resonance is at 10 Hz with a Q of less than 1, B & K 2010.**



**Fig. 3—Response to vertical and horizontal modulation from 2 to 100 Hz (slow sweep). Note differences between horizontal and vertical response due to arm and counterweight construction (see text).**

## First Impressions

“Solid” and “massive” were the first adjectives that came to my mind when I first encountered the Eminent Technology Tonearm 2 (which I will refer to as the ET2, for the sake of brevity). It is finished entirely in black, with white markings. The horizontal bearing is composed of a long spindle or tube which slides back and forth inside a rather large, solid housing. This housing is called the bearing manifold because it is the device into which air is pumped. When the air pump is turned off, there is a bit of friction between the horizontal bearing tube and the bearing manifold as the tube is moved back and forth. I was surprised that there is so little play in the bearing when the air pump is off, and even less when the pump is on. But the main surprise, to me, was how slippery the bearing felt when the air pump was on. The friction was reduced to practically nothing.

Unlike some other linear-tracking tonearms, whose horizontal bearings are located out over the record, the ET2 has its main bearing set back along the right edge of the turntable. Because of this, it doesn't have to be moved out of the way to change a record, but it does require that the armtube that carries the cartridge be longer and therefore have greater effective mass. The armtube of the ET2 still has a lower effective mass in the vertical plane than most pivoted tonearms.

I was at first both impressed and disheartened by the large number of adjustments offered by the ET2. Being able to vary many parameters allows the tonearm to be adjusted perfectly, but it also means that great care must be taken. As I proceeded with my evaluation of the ET2, I began to appreciate what could be accomplished by carefully manipulating each of the interrelated adjustments. Eminent Technology offers some optional set-up fixtures that can make the job easier, but if you have any trepidation, the dealer should be able to set up the ET2 on your turntable.

## Features

The main feature of the ET2 is the air bearing, which has 6.8 square inches of surface. The moving part of the air bearing, which is called the spindle tube, is made of 6061-T6 hard-anodized aluminum. It has a 0.6110-inch outside diameter and a 0.014-inch wall thickness, and is machined to a tolerance of  $\pm 0.0003$  inch. The stationary part of the air bearing, which is called the manifold assembly, is made of carbon-fiber composite material. The armtube is 5052-T5 hard-anodized aluminum with an outside diameter of 0.5 inch and a wall thickness of 0.035 inch. The cartridge end is tapered to a flattened surface and has a compressed Teflon insert. The armtube also has a vinyl sheath on the outside and closed-cell foam inside to control resonances. The interconnect plug for the phono leads and the fastening screw for the armtube are located near the vertical pivot; this lowers their contribution to the effective vertical mass. The armtube is interchangeable and performs a function similar to that of the headshell on other tonearms. The armtube slides over a solid-aluminum joint insert, located at the end of the bearing spindle, which expands to meet the inside of the hollow armtube when the single fastening bolt is tightened. Because the joint insert is relatively heavy, it too is located near the vertical pivot to reduce its contribu-

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You should also appreciate the video enhancement features built into the AVC-50. Three front panel controls give you continuously variable control over picture detail, sharpness and video level. Meaning you can not only improve the quality of the video signal during the recording process, but you can also improve the picture quality during playback.

There is one thing the AVC-50 can't do, however, and that is usher you to your seat. But once you are seated, with one of these at your command, you may never have to get up again. Or want to.



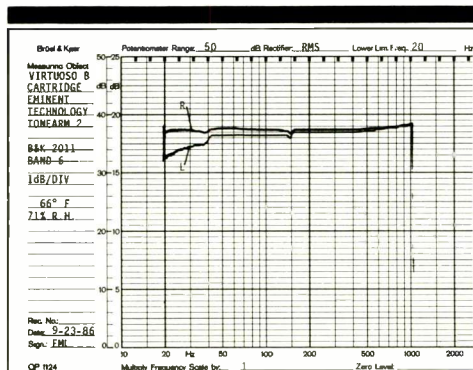
\*45 watts RMS per channel, both channels driven into 8 ohms, from 20-20,000 Hz, at no more than 0.05% Total Harmonic Distortion.

\*\*Dolby is a trademark of Dolby Labs, Inc.

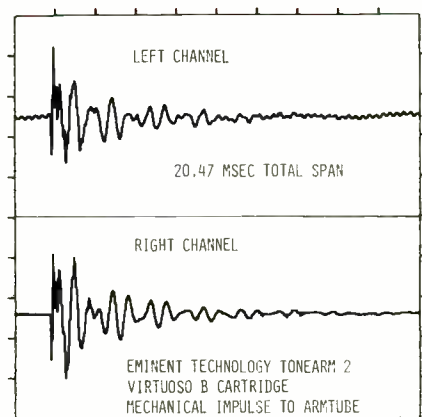
Yamaha Electronics Corporation, USA  
 P.O. Box 6660, Buena Park, CA 90622



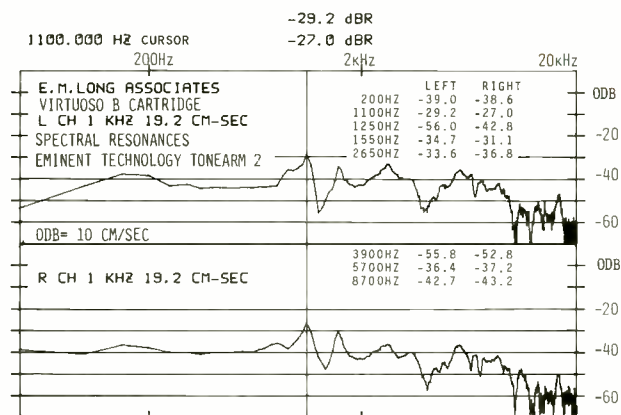
The large number of adjustments on the arm is impressive and, at first, disheartening. This allows perfect alignment but requires great care.



**Fig. 4—Slow sweep from 20 Hz to 1 kHz. Note resonances at about 40 and 150 Hz.**



**Fig. 5—Output vs. time of arm/cartridge when mechanical impulse was applied to armtube, with arm on rest.**



**Fig. 6—Spectral output (average) of arm/cartridge due to 16 mechanical impulses applied to armtube.**

tion to the effective vertical mass. To allow for different cartridge heights, the spindle bearing end of the joint insert can be located in any of three vertical positions, and it is locked in place by a bolt. A slot in the armtube, over the joint insert, allows the overhang to be adjusted over a 0.5-inch range to allow for different cartridges' stylus-to-mounting-hole distances. Because this slot is slightly wider than the locking screw, the armtube can be rotated slightly. This allows adjustment of the vertical azimuth (the stylus' perpendicularity to the record, as viewed from the front).

The bearing manifold is indirectly attached to the mounting post, which is also made of carbon-fiber composite material, through a vertical gear system which allows the vertical tracking angle to be adjusted. Since a straight up or down movement of the bearing manifold would cause the position of the stylus to move back or forth, the tracking-angle control lever moves the bearing manifold through an arc. This causes the overhang adjustment to remain constant. The VTA can be adjusted while a record is playing if the turntable suspension permits it. A supplied snap-on gauge allows adjustments as fine as 0.1°; the company offers an even higher precision gauge at extra cost.

The counterweight, located at the end of the spindle bearing away from the armtube, is an I-beam with graduated markings. These are for reference only and are not calibrated in grams. The beam is attached to the spindle bearing by a leaf spring, which is compliant only in the horizontal plane. To balance the arm, two 15-gram and two 5-gram lead weights are supplied, allowing adjustment from 5 to 40 grams in 5-gram steps. For fine dynamic balancing, the counterweight assembly can be raised or lowered and moved in and out along the I-beam track. After balancing the arm, tracking force is set by sliding the counterweight assembly along this track.

The lead wires inside the armtube are van den Hul linear-crystal silver, with oxygen-free litz wires available on special order. The cartridge ends of these leads are attached to gold-plated connectors which can be slipped over the cartridge pins. The wires are color-coded to match the coding on most cartridges. The other end of these wires exit the armtube near a slot in the joint insert and are attached to a five-pin plug. After the armtube is slipped over this joint insert, the plug can be inserted into the socket in the end of the bearing spindle. The leads then continue across the inside of the bearing spindle and exit on the side near the counterweight assembly. They are then looped down through a hole, which must be drilled in the tonearm mounting board, and routed to the outside of the turntable base. There they are terminated to two gold-plated phono jacks which are mounted on a small plastic box. This box can be attached to the rear of the turntable base.

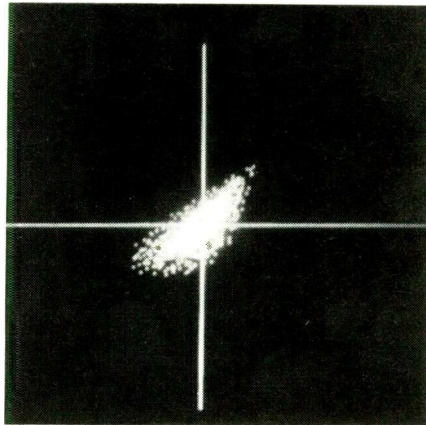
The air pump is a bit noisy. However, since it is supplied with a 24-foot hose, it can be located in another room. That is what I did during the listening tests.

### Measurements and Listening Tests

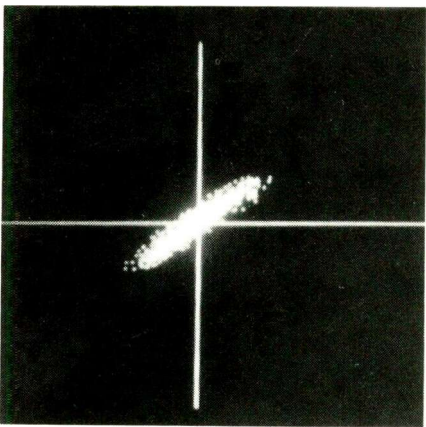
The Talisman Virtuoso B cartridge was used with the Eminent Technology Tonearm 2 to obtain the data shown in the technical measurements (Figs. 1 through 14) and also during the listening tests. I did use some other cartridges



This arm and cartridge put out less bass than other combinations do, but after listening a while, the others sound bass-heavy!



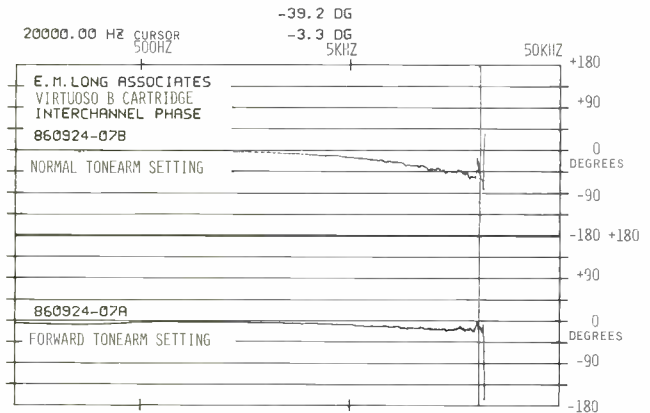
A  
B



**Fig. 7—Interchannel phase difference, using pink noise from B & K 2011, band 7. With arm aligned so stylus is on the radius that runs at right angles to the armtube, slight phase errors appear (A); with arm adjusted so stylus is 0.125 inch ahead of this radius, channels are better synchronized (B).**

during the technical measurements to double-check some results. The Virtuoso B is a high-output moving-coil cartridge with a boron rod cantilever, which accounts for the "B" designation. It was operated directly into the phono preamp with a 47-kilohm resistive load shunted by about 200 pF of capacitance from the leads and phono preamp input. The Virtuoso B has a moderate compliance, and it worked very well with the ET2 tonearm.

Figure 1 shows the frequency response and separation of



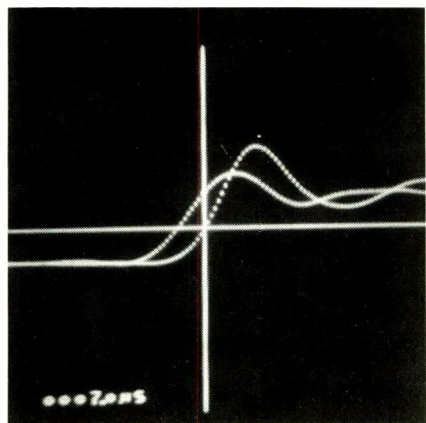
**Fig. 8—Interchannel phase difference vs. frequency for B & K 2011, band 7, pink noise. Top curve, for normal stylus location on radius at 90° to armtube, shows phase error of 39.2° (equivalent to 5.4 μS) at 20 kHz; bottom curve, for stylus 0.125 inch ahead of this radius, shows error reduced to 3.3° (0.5 μS).**

this arm/cartridge combination. Most of the drop in separation at the low frequencies is due to crosstalk on the B & K 2010 test record. At higher frequencies, there is a bit more crosstalk from the left channel into the right than vice versa, but it is still very good, less than 30 dB at frequencies up to a little above 6 kHz. The image stability was considered by the listening panel to be excellent.

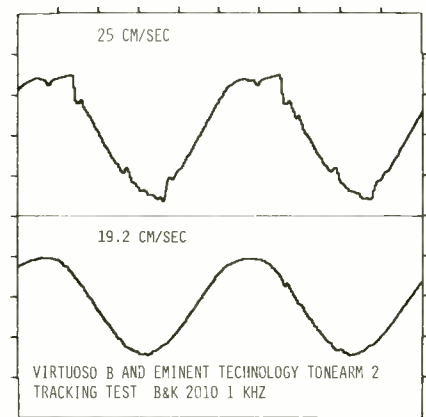
Figure 2 confirms that the low-end response of this arm/cartridge combination does indeed drop off below 20 Hz, as suggested by Fig. 1. The slow sweep from 5 to 20 Hz provided by band 15 of the B & K 2010 test record shows that a very well-damped resonance occurs somewhere around 10 Hz with a Q of less than 1. The consensus of the listening panel was that the ET2 had slightly less bass than my reference system but that the bass was of exceptionally good quality. For some panel members, the difference in timbre between the tuba and trombone was more easily distinguishable on the reference system, and the double bass sounded deeper and more powerful.

Figure 3 is a test of the ET2/Virtuoso B combination's response to vertical and horizontal (lateral) modulation from 2 to 100 Hz. The response of the combination in the horizontal plane is very low, with a tiny, low-Q resonance at about 4 Hz and another at about 9 Hz. The response to vertical modulation is more pronounced, with a resonance of about 9.5 Hz and a Q of about 1.9. This confirms that the ET2 does have more mass in the horizontal than in the vertical plane and that the counterweight, which has more compliance horizontally than vertically, is working properly.

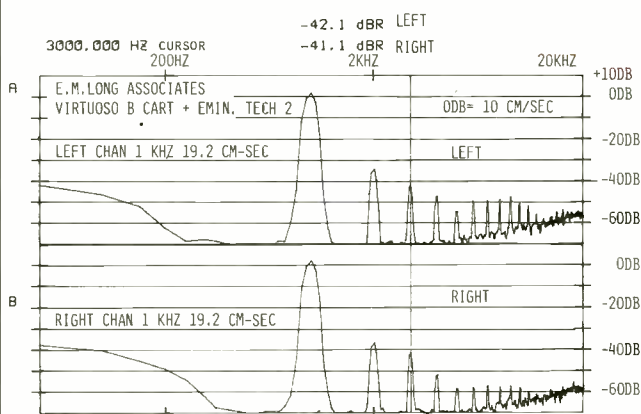
Output from a linear arm such as this can remain very symmetrical under difficult conditions. The cartridge, not the arm, sets the tracking limits.



**Fig. 9—** Time delay between right and left channels. Right channel leads left by 7  $\mu$ S.



**Fig. 10—** Tracking of arm/cartridge with 1-kHz test tones at 25 cm/S (highest level on B & K 2010, top) and 19.2 cm/S (bottom).



**Fig. 11—** Spectral analysis of the cartridge output when reproducing the 19.2-cm/S signal of Fig. 10. The third harmonic (at the cursor position) is 0.78% in the left channel and 0.88% in the right.

Figure 4 shows resonances in the ET2 at about 40 and 150 Hz. This indicates that there are mechanical interruptions to the flow of energy which cause cancellations to occur at these frequencies. I do not know exactly what effect the air-bearing interface has upon this flow of energy, but because it acts as a barrier, it doesn't allow energy to be transferred and dissipated in the tonearm board, as is the case with other tonearm designs. These resonances tend to correlate with most panel members' perception of a slightly brighter sound from the ET2/Virtuoso B combination for voice, trumpet, and strings. This is not to be taken as a negative statement, because most panel members rated the combination as being slightly preferable to the reference system when reproducing these sounds.

Another test for the effect of delayed mechanical energy is the mechanical impulse test, shown in Figs. 5 and 6. Figure 5 shows the output versus time for a mechanical impulse applied to the tonearm near the cartridge. There are some oscillations with a time period of about 2 mS which exhibit alternating polarity reversals. This is a clue that reflected energy is present. Figure 6 shows the spectral output due to a series of mechanical impulses applied to the ET2 near the cartridge. Averaging the output produced by 16 separate impulses imparts a greater reliability to the test and therefore greater validity to the results. The graph shows the reinforcement and cancellation of energy and the relative levels at the peaks. One panel member commented that rapid piano tones were a little more distinct when reproduced by the reference system as compared to the ET2, and this would correlate well with the data of Figs. 5 and 6.

Figures 7A and 7B show an interesting phenomenon for which I have not discovered a satisfactory explanation. Figure 7A shows the left- versus right-channel output for the pink noise of band 7 of the B & K 2011 test record. If the channels were perfectly synchronized, with no time delay between them, the pattern would be a straight line at 45°. Moving the cartridge forward in the armtube, creating an overhang of 0.125 inch between the stylus and the record radius that runs at right angles to the armtube, produced the output shown in Fig. 7B. This more closely approximates the 45° line that should result when the channels are synchronized. Figure 8 shows the difference in interchannel phase versus frequency for the two cartridge positions, averaging 16 samples of the B & K 2011 test record. Further tests with other cartridges and overhang settings indicate that it is not simply a cartridge or overhang problem. Tests with other records (which had music and test signals) made with different cutting systems also indicate that the type of cutterhead isn't the answer either. The dimensional discrepancies which cause these interchannel phase or synchronization errors are extremely tiny, however. The 7- $\mu$ S error at 1 kHz shown in Fig. 9 (the leading edge of the 1-kHz square wave on band 1 of the CBS STR-112 test record) represents a difference between the left and right channels of 0.00014 inch for a record rotating at 33 $\frac{1}{3}$  rpm with the stylus in a groove at a 5.75-inch radius. The dimensional difference for the same signal at an inner groove of the record is even smaller, because the information density is greater. All of this may seem trivial, but since interchannel differences are

The Eminent Technology arm feels very different and takes time to get used to, but its performance is well worth it in the end.

being shown for Compact Disc players, I thought that a comparison might be interesting. I think further investigation by others might lead to some interesting insights and might even allow further advances in the quality of analog record reproduction.

Figure 10 shows the output of the combination when trying to track the high-level 1-kHz test tones of the B & K 2010 test record. There is some mistracking at the highest level (25 cm/S), but it is very symmetrical. I think this is interesting because it shows how a linear-tracking tonearm, which neither has nor needs any sid thrust correction, can produce a very symmetrical output under difficult conditions. The limit to tracking ability, in this case, is the cartridge, not the tonearm. The Virtuoso B cartridge is very good, however; the lower trace, representing the output at 19.2 cm/S, and the spectrum of the distortion (shown in Fig. 11) verify this.

The output of the ET2/Virtuoso B combination produced by the 10.8-kHz tone burst of the Shure TTR-103 test record is shown in Fig. 12. Even at the highest level, which is for a 30-cm/S groove modulation, the results are quite good. The spectra produced by both the 30- and 15-cm/S levels are shown in Fig. 13. The distortion levels listed in the figure are very low and indicate that the high-frequency tracking capability of the combination is excellent. No adverse comments were made by any of the listening panel members regarding the sound of cymbals, bells, or other difficult-to-reproduce, high-pitched instruments. In fact, one panel member said that the sound of these instruments from both the ET2/Virtuoso B combination and the reference system were really fabulous.

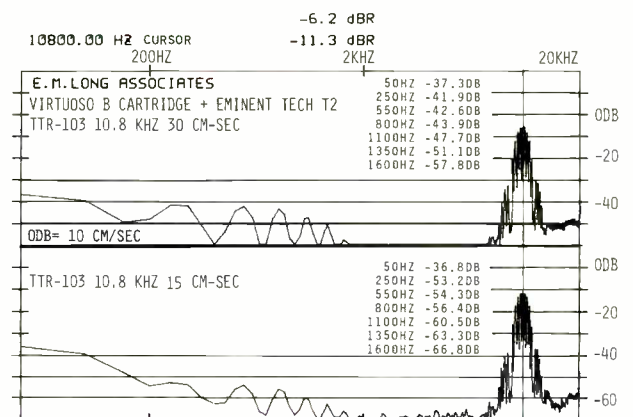
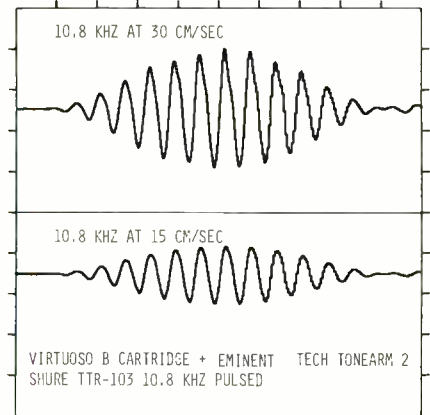
Figure 14 shows the output of the combination for the square wave on band 1 of the CBS STR-112 test record. The characteristic decrease in output immediately following the sharp initial transient is normal for a cartridge which exhibits the type of roll-off shown previously in Fig. 1. This type of characteristic is also associated with the phase or time delay exhibited by any band-limited device or circuit. It would be interesting to determine whether any difference could be heard if a phase-correction circuit were inserted between the cartridge and the loudspeakers.

### Conclusions

My initial trepidations about the apparent complexity of the Eminent Technology Tonearm 2 were completely gone by the time I finished the technical measurements and the listening tests. The Talisman Virtuoso B cartridge is practically identical to the Virtuoso/DTi, which I reported on in the June 1986 issue of *Audio*, but less expensive. The ET2 does have a feel that's different from the usual pivoted tonearm, and it takes a little time to get used to it. However, it is certainly worth the effort, because the ET2's performance is excellent. The level of low bass from the ET2/Virtuoso B combination is less than that from other tonearm/cartridge combinations, but after listening to this setup for a while, the others sound bass-heavy! The final judgment of the listening panel and myself is that the Eminent Technology Tonearm 2 and the Talisman Virtuoso B cartridge make a fantastically accurate and musically pleasant combination. If you love music, you will love them.

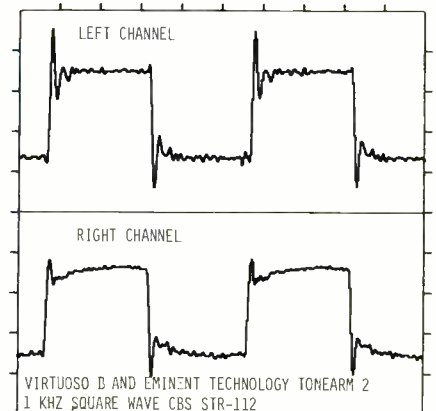
Edward M. Long

**Fig. 12—**  
Output from  
30- and 15-cm/S,  
10.8-kHz  
pulse test,  
Shure TTR-103  
test record.



**Fig. 13—Spectral analysis**  
of distortion products  
from signals shown in  
Fig. 12 (average of 16  
samples at each level).  
Distortion is highest  
(1.5%) at 50 Hz on  
15-cm/S level.

**Fig. 14—**  
Output from  
1-kHz square  
wave, using  
CBS STR-112  
test record.



## AR POWERED PARTNERS ACTIVE SPEAKERS

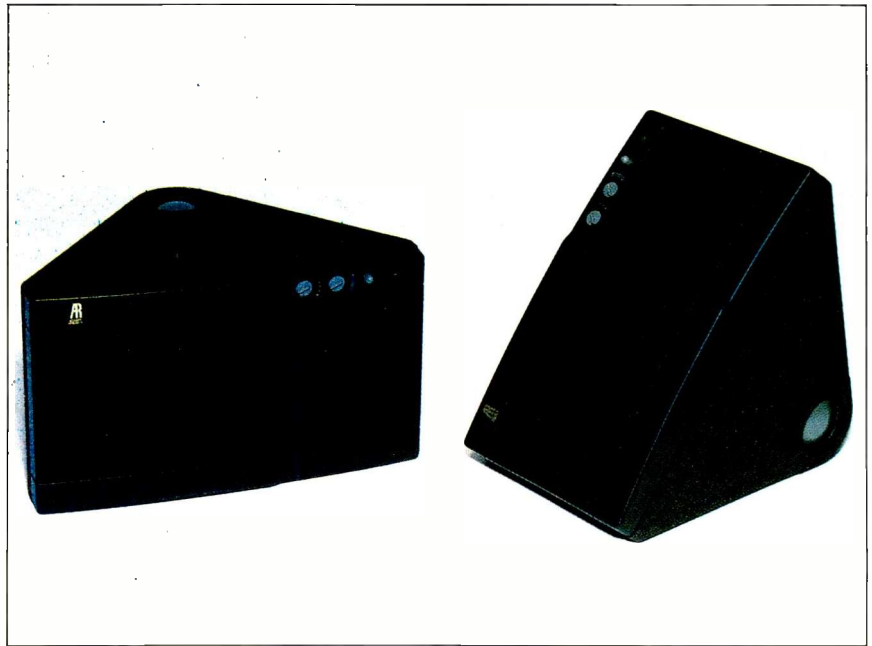
**Company Address:** 300 Turnpike St., Canton, Mass. 02021.  
For literature, circle No. 94

I've had only two business partners in my professional career. The first teamed with me when we were both teenagers in a venture that involved trying to record weddings and other notable events on—would you believe?—a 1949-vintage wire recorder. (Those too young to know what a wire recorder is had best ask their elders.) The second partnership—years later—involved what is sometimes laughingly called an “angel” who backed me financially—and inadequately, it turned out—in my first efforts at manufacturing hi-fi and stereo components in the late 1950s. Both partnerships ended disastrously, but that's a story for another time.

You can imagine that anyone sending me a product purporting to be my “partner”—powered or otherwise—is going up against some pretty strong preconceptions. All of which makes my enthusiasm for the Powered Partners by AR even more significant than the ensuing kind words may convey.

The pair of small active or amplified loudspeakers that constitute the Powered Partners are not the first of their kind. Credit for the idea of a pair of powered loudspeakers for use with personal-portable signal sources must go to Bose, AR's neighbor in nearby Framingham, Mass. But being first doesn't always mean being best, and my own listening and bench tests convinced me that the AR Powered Partners are the very best-sounding units of their kind that I have heard to date.

The Powered Partners are fully self-contained, powered, two-way loudspeakers with shielded drive units that make them compatible with video systems even if they're positioned right up against a TV set. Rather than use plastic molded enclosures, AR chose to use die-cast aluminum cases and end



caps; only the front panels are made of molded plastic. Each triangular-shaped system measures just 6 in. H x 10½ in. W x 7¾ in. D and weighs approximately 7 pounds. The internal volume of each enclosure is a mere 0.105 cubic foot (2.97 liters). Yet each speaker is capable of delivering well over 100 dB of acoustic output, and of doing so over a relatively wide audio frequency range—from around 50 Hz to well beyond the limits of audibility.

The built-in amplifier in each enclosure is claimed to deliver 15 watts over a frequency range from 50 Hz to 20 kHz with less than 1% THD, less than 0.3% IM, and a signal-to-noise ratio of better than 81 dB. As with all active loudspeaker designs, a tremendous advantage accrues to the designer, since the amplifier's response can be tailored or equalized to compensate for whatever discontinuities in response that the drivers and crossover network exhibit.

An input of 500 mV to each Powered Partner will drive it to maximum output. Happily, AR saw fit to provide the user with the means for varying both the input sensitivity and the overall response. Portable CD players, for example, deliver upwards of 2.0 V at maximum recorded level, and many don't have volume controls to pad down that output. The Powered Partner

units do have volume controls—a tiny one on each module. So if it's a CD player you're planning to use with them, you'll be able to turn down the volume so that you don't overdrive the systems.

The wedge-shaped modules just cry out to be placed in corners for best bass response, but not everyone will comply with the Partners' demands. (Which of us has not had disagreements with partners from time to time?) If you have to place the units away from the optimum corner location, you can use the bass control on each to help make up for the missing “free” bass added by corner placement.

The volume and bass controls are only two examples of AR's solutions to the inconveniences found in some earlier miniature powered-speaker pairs. The audio cable that AR supplies with the Powered Partners is another. One end is terminated by a miniature (3.5-mm) stereo plug, ideal for connection to the headphone outputs of personal-portable cassette players or portable CD players. After a foot or so of cable run, the twin conductors split into separate lines so that you can position the speaker modules nearly 8 feet apart for stereo imaging. And since each module is completely self-contained—with its own amplifier, a.c. power cord, input jack, and controls—the units can

be positioned as far apart as you like, using ordinary audio extension cables.

A.c. powering is not the only way to enjoy these very adaptable and cooperative Partners. Each Partner is equipped with a d.c. input jack, so you can power it from a car battery or from the rechargeable battery pack that's available from AR (for \$69.95). AR has

tion. They talk about using the Partners as second, stand-alone stereo systems in locations other than your primary home listening room but neglect their use as extended or flanking speakers for increasing the stereo spread of your main stereo system. This application involves nothing more than plugging them into the head-

ck of your existing amplifier or (providing that doing so automatically shut off your speakers). In short, the possibility of employing these Partners, and you'll probably wish with some that neither AR nor thought of.

I was willing to commit to speakers as my own Partners, I

like any cautious entrepreneur investigate them a little more fully. Ignoring the usual warning here being "no user-service-its inside," I disassembled Partner in turn. Inside, I found a long-throw, low-frequency driver, a long-throw liquid-cooled tweeter; a cabinet containing the circuitry that handles low-level signals, and neatly separate power amplifier, crossover, and crossover modules, surrounded by a generous wad of acoustic sound-absorbing material. During this internal investigation I discovered that the aluminum cabinet accounted for only a fraction of the speaker's weight. That long-throw driver with its heavy magnet and rugged construction contributes its weight too! It is to AR's credit that I was able to reassemble the Partners without introducing any air leaks, so

perfect is the fit between the rear casting and the gasketed front panel.

The Partners' innermost essence now having been subjected to my gaze, my last task was to listen to the Partners and let them have their say. This I did with a wide variety of classical and pop music, most of it played via my portable CD player. My first pleasant discovery was that the bass control, when turned up fully, did not introduce a lot of the false "doubling" that's so commonly associated with the bass tone controls found on many portable stereo systems. I have one negative comment about the volume control on each module—albeit a minor one. The taper on these controls is such

that even a slight reduction from maximum setting lowers volume drastically; this confines the practical range of control to a rather narrow angle of rotation. My portable CD player has its own output-level control, so for my listening tests using that program source I simply rotated the Partners' controls fully clockwise and adjusted listening levels using the control on the CD player. If your program source lacks a level control, though, you may find it a bit tricky to adjust the Partners' levels.

Positioned in corners, or with the bass controls fully clockwise, the Partners delivered significant amounts of energy at 50 Hz, as claimed. My own sound-level meter registered peaks of about 108 dB measured at a distance of 1 meter when I drove the system to a point just below audible distortion. Perhaps AR should call them Powerful Partners instead of Powered Partners! Since AR makes a point of shielding these speakers, I dutifully held them right up against the cabinet of my TV monitor/receiver; as I expected, there was absolutely no degradation or alteration of color values on the TV screen, either near its edges or anywhere else. I used my spectrum analyzer, hooked up to a calibrated microphone via a narrow-band tracking filter, to plot a response curve for the unit, one that would be least influenced by room reflections. The response was surprisingly smooth except for a notch at about 2.5 kHz. This notch was nothing more than phase cancellation; sounds from the woofer and tweeter cancelled each other out at the point where the microphone was positioned. Moving the mike just a few inches caused the apparent notch in the response to vanish almost entirely, thereby absolving the Partners of guilt.

Frankly, the few measurements I made were more to satisfy my curiosity than anything else. I knew all I needed to know about the Partners after examining their construction and listening to the kind of accurate, well-balanced musical reproduction they were able to provide in a variety of applications. At their suggested price of \$339.95 per pair, I wouldn't be surprised if the Partners are snatched up as fast as AR can turn them out. I wouldn't mind having them as my Partners any time.

*Leonard Feldman*

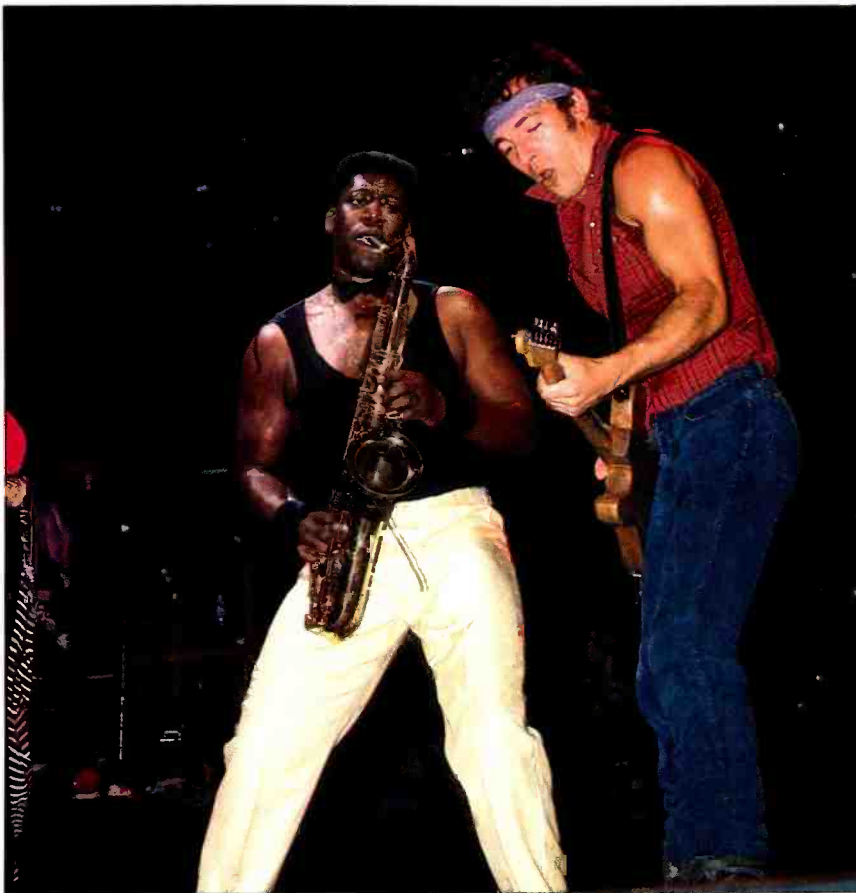
1 1/4-inch poles.

Though AR hasn't missed a trick in the design of the Powered Partners, I'm afraid they haven't thought of all the possible applications for these versatile audio associates. They mention using them with personal-portable cassette players but fail to mention what I think is a most important application, their use with portable CD players. They mention using the Partners to enhance TV and VCR audio performance but never mention how useful they can be in video surround-sound installations; many new surround-sound processors offer decoded rear-channel audio signals but require extra amplifiers and speakers for full implementa-

# ROCK/POP RECORDINGS

MICHAEL TEARSON  
JON & SALLY TIVEN

## BIG BRUCE BASH



**Live/1975-85:** Bruce Springsteen and The E Street Band  
**Columbia C5X 40558**, five-LP set.

Sound: B+      Performance: B+

The Emperor has clothes. He does not, however, have a complete wardrobe, and it's more than accessories that are missing.

Bruce Springsteen, the object of more bootleg concert albums than perhaps anyone else in rock 'n' roll, has finally released the authorized holy grail—a five-record live set. It is by any reasonable measure "a good album." Yet from an historical standpoint, *Live/1975-85* is more a testament to Springsteen's popularity than a complete overview of his music. It's a big package nonetheless: There are 10 sides, 40 songs, 3½ hours of music, plus a 36-page color booklet with photos, lyrics, and recording information. To the album's credit, the song list isn't a slave to chronology, but is divided into roughly similar themes and moods.

The sound quality is uniformly excellent—astonishing, considering that the album is culled from 16 concerts over the course of 10 years. Many of the specific performances here have previously appeared on bootlegs, and A/B comparisons reveal very little post-production sweetening aside from some clean-up and equalization.

The E Street Band, as usual, often lets its enthusiasm get the better of its craftsmanship—a good thing, too, as that's a tendency crucial to rock 'n' roll. The two lineups here abet The Boss with soaring, nook-filling but unmuddy (and, frankly, unvirtuoso) backing. We do get a couple of bits of Springsteen's patented between-song storytelling. And if his vocals are seldom chilling here, they're never, ever boring.

Yet something's missing, and not just the appropriate rawness that a slightly dirtier mix might have retained. For one thing, the song selection is immensely imbalanced: There are fully eight cuts from the most recent studio

album, *Born in the U.S.A.*, but only nine from the first *three* albums combined. Aside from the instrumental "Paradise by the 'C,'" none of Bruce's seminal unreleased songs appear. (And recordings of live versions *do* exist.) His cowritten song "Because the Night," a Patti Smith hit, is an interesting addition thanks to alternate lyrics, as is "Seeds," a new song not yet on a studio album.

But where are the roots of his creativity? Where is the proto version of "Thunder Road," where Mary was still Christine? Where is the exquisite "Frankie," from *Darkness on the Edge of Town*, which Bruce often performs live? Where are such historical touchstones as his first single ("Blinded by the Light") or his early, long-forgotten first attempt at a "Jungleland"-type epic ("Lost in the Flood")? How about a cut from his legendary Bottom Line shows of 1975? The unfortunate decision to concentrate so heavily on *Born in the U.S.A.* seems a sop to newer fans who, ironically, would probably have appreciated hearing the foundation music.

Of the four non-Springsteen compositions here, the band excels on Edwin Starr's 1970 hit "War." The Tom Waits song "Jersey Girl," which inexplicably closes the album, is the same sleepy version as appears on the 12-inch single for "Cover Me" (Columbia TA 4662). Springsteen's inclusion of Woody Guthrie's classic "This Land Is Your Land," however, raises a tough question for Bruce. Guthrie was devoutly against private ownership of property, and his last stanza makes clear that he meant the title literally. Why does Springsteen leave it out? Forgetfulness? Maybe. But this is typical of the emotional hollowness in a disturbing number of Springsteen's later performances, as he moved farther from the working-class oppression he once knew firsthand.

*Live/1975-85* is a musical and technical *tour de force*. Historically and emotionally, however, there is a scratch on the Teflon rock star.

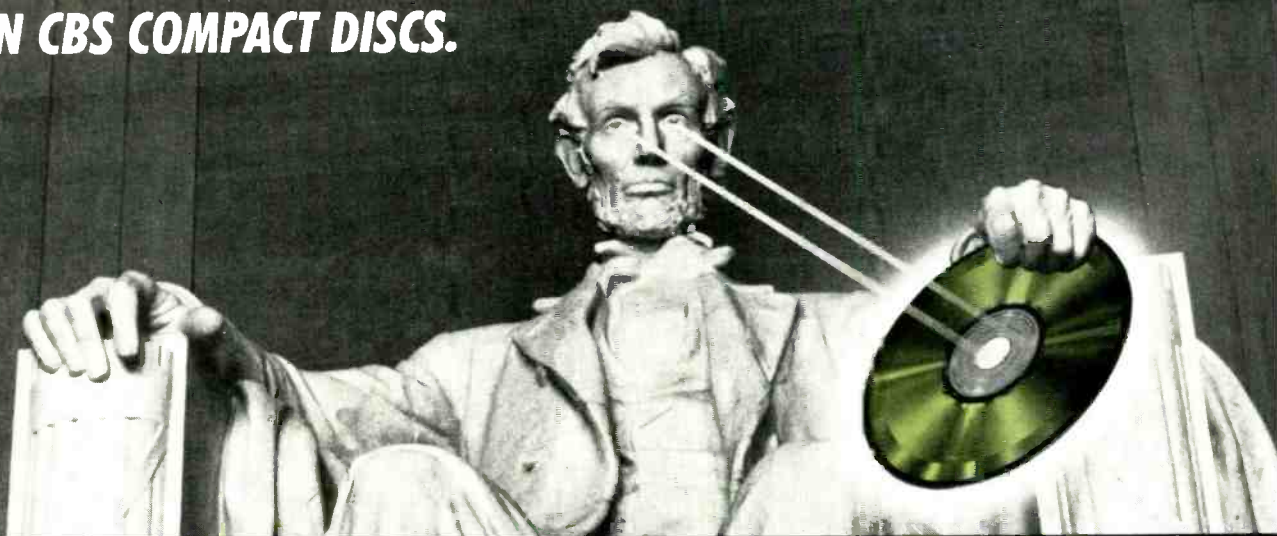
Frank Lovece

(Editor's Note: Now for another view, plus some comments about the CD.)

Bruce Springsteen and his band have always had a reputation, hard-earned at that, for being better live

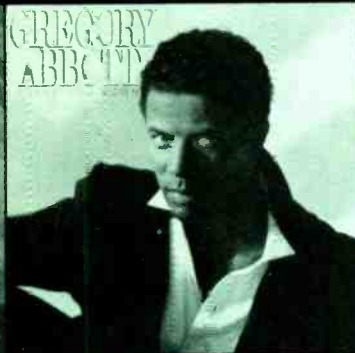
Photograph: ©1984, Ebet Roberts

**THIS MONTH'S BIG EVENTS  
ON CBS COMPACT DISCS.**



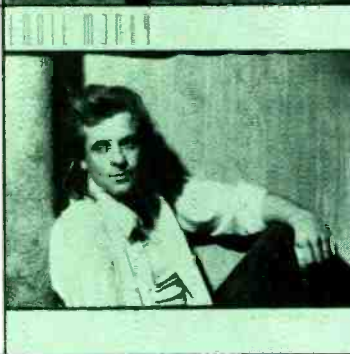
# FEBRUARY

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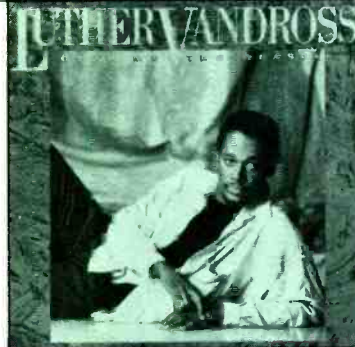
LOUIS ARMSTRONG  
DAVE BRUBECK  
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**SAMPLES VOLUME 1**

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BILLIE HOLIDAY  
BENNY GOODMAN

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CHICAGO "Greatest Hit... Volume II"  
BANGLE: "Eiffers-i Light"  
THE CLASH "London Calling"  
CHICAGO TRANSIT AUTHORITY  
'TIL TUESDAY "Welcome Home"  
MOZART Sonatas, K.301, 405, 403;  
Six Variations, K.304; Twelve Variations, K.354  
Jean-Pierre Rampal, John Sleele Fitter  
MOZART Requiem  
Alliot-Lugaz, Ysse, Hill, Reinhardt,  
Choeur Régional No d-Pas-de-Calais;  
La Grande Ecuile/Malgoire  
GIORDA VC: Follera  
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The sound of Springsteen's boxed set is uniformly excellent. Aside from some clean-up and equalization, there's been very little post-concert sweetening.

than in the studio, for giving sensational concerts that are almost as physically draining to watch as to perform. Their shows aspire to—and achieve—the level of religious catharsis.

It is hard not to be impressed with the Compact Disc edition of *Live/1975-85* (Columbia C3K 40558). It is as full an experience as being at a live show with your eyes shut—except you can hear the music much better on the recording. In every case, the performance selected is a strong one by both the band and the singer. Bruce likes to tell stories on stage to give more resonance to the songs or to tell where they came from. There is a generous amount of these included, and they add emotional depth to the album.

Technically the three-disc set is quite an accomplishment. The performances from '75, '78, '80, and '81 were recorded on multi-track analog and mixed down to a digital two-track, and the '84 to '85 performances were recorded on 24-track digital equipment.

There is remarkably little variation in the quality of the sound between early and late material. Along the way, you get an excellent feel for the live ambience of the location, and you can hear the changes as the band progressed from small rooms to arenas to huge, open-air venues. Bruce was always critically concerned with maintaining a real intimacy with his audience and only made the jumps in venue size after very serious deliberation. Remarkably, his shows never suffered and no intimacy was lost.

The mixing of the live performances is superb, better than I had any right to expect. However furiously the band is playing, you can always hear all of the pieces, even Clarence Clemons' tambourine when he isn't playing sax. All the voices are clear, from the growl and honk of the sax, to Danny Federici's glockenspiel, organ and accordion, to the big thump of mighty Max Weinberg's drum kit, to Roy Bittan's elegant piano, to Garry Tallent's bass,

to the bite of the guitars of Steve Van Zandt and, later, Nils Lofgren. Backing voices also come across quite well.

The sequencing has been arranged so that it flows like a real concert, one song setting up the next either musically or thematically, and often both. Each of the three Compact Discs is 69½ or more minutes in length, excellent use of the capacity of the format.

Let there be no question. *Live/1975-85* is a landmark, the live rock 'n' roll album that all the others are going to be measured against. True, some songs are conspicuously absent—"Jungleland," "Dancing in the Dark," and "Incident on 57th Street" spring to mind. But I disagree with my colleague Frank Lovece; I think this is as complete a portrait of the artist as anyone could hope for, given the limits of a three-disc set. The permanence of the Compact Disc combined with the stellar production effort that went into it make it a "must have" that I'm awfully glad I've got.

Michael Tearson



**Sony just extended the range of**



**Still Standing:**

Jason and The Scorchers  
**EMI America ST-17219.**

Sound: B                      Performance: B+

Narrow is the gate to rock 'n' roll greatness, and few are the musicians who enter. To one side of the gate lies the broad field of half-baked intellect, into which artists like Paul McCartney, Squeeze, and Sting have wandered; to the other lies the vast expanse of mindless thrashing, into which noisemakers like Motley Crüe, Bad Brains, and The Plasmatics have rushed headlong. But with this, their second LP, Jason and The Scorchers are well on their way to joining the likes of Jerry Lee Lewis, Neil Young, and The Rolling Stones in the Great-Balls-of-Fire wing of the rock 'n' roll hall of fame.

Seven of the album's nine tunes are examples of the felicitous meeting The Scorchers have engineered of heavy metal, C&W, punk, The Stones, and folk. But unlike many of the improbable



concoctions third-decade rockers have resorted to in the hope of re-inventing a genre. The Scorchers' invention kicks like a mule and flies like a lark. Their fusion works so well, it's a wonder it wasn't invented sooner.

But it took these four to do it. Lead vocalist Jason Ringenberg brings to the mix his sometimes plaintive, sometimes growling, country-accented vocals and melodies, and his witty, wistful, and optimistic lyrics. Guitarist Warner Hodges is a really fine rock musician, whose playing and arrang-

ing consistently outsmart and exceed conventions and expectations. For example, he uses heavy-metal guitar tones not only in the usual context—on crunching chords and lunatic licks—but on sweet country picking and Keith Richards rock, as well. In addition to figuring prominently in the songwriting credits, bassist Jeff Johnson and drummer Perry Baggs are two of the very few rhythmists who really know what it means to shake, rattle, and roll.

Producer Tom Werman has managed to translate the band's tremen-

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Sony UX tapes. Now when a musician really extends himself, so will your tape.

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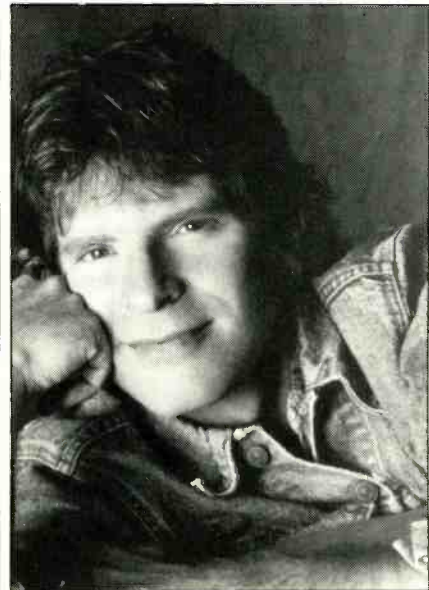
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Musically, John Fogerty has tentatively begun to explore new directions. Mostly, though, he sticks to punching hard with a bare-bones rock ensemble.

dous charisma into what might be called "disc presence." With the exception of a very few tips of the hat to the reverberant, distant sound of Sun and Nashville recordings, he opts for the warm, clear, and immediate. There is art behind the apparent artlessness of the production, but only once or

twice on the whole album is it made very obvious—as on "Promised Land," where one is struck by how comfortably and effortlessly Jason's unstrained, easy singing can be heard above Warner's full-tilt guitars.

If any band in rock deserves attention, this one does. *Susan Borey*



**Eye of the Zombie:** John Fogerty  
Warner Bros. 25449-1.

Sound: B

Performance: C

Like a modern Rip Van Winkle, John Fogerty expresses attitudes on *Eye of the Zombie* that almost seem to belong to someone who fell asleep in 1966 and woke up again 20 years later. In the mid-'80s, it's startling to hear anachronistic protests against weapons manufacturers, ambiguous ravings about news headlines, or tirades against yuppies striving for success. Even the instrumental jam in the middle of "Change in the Weather" sounds like '60s psychedelia.

Musically speaking, Fogerty has tentatively begun to explore new directions, as with the ethereal choir in the instrumental opener "Goin' Back Home," the funk of "Soda Pop," and the reggae lilt of "Sail Away." Mostly, however, this is idiosyncratic Fogerty. He punches hard with a bare-bones rock ensemble—gris-gris grundge guitar, bass, drums, and a little keyboard embellishment—that takes full advantage of cleanly produced, modern sound values.

*Eye of the Zombie* isn't as coherent as the timeless classic *Centerfield*, due in part to the strident topicality that seems out of step with contemporary pop culture. Only time will tell if Fogerty is behind or ahead of his time.

*Michael Wright*



### The Next Logical Step . . .

Meridian, the company which led the way in demonstrating the true sonic possibilities of the CD medium, continues to lead the industry with the introduction of their new model 207 Professional compact disc player.

The 207 is built on two chassis. The transport and all mechanical components are housed in a chassis which offers front loading convenience while carefully isolating both the disc drive and laser mechanism from external vibrations. A separate chassis containing the audio and control electronics is entirely free of the electromagnetic radiation of the transport motors and any microphonics that might be introduced by their operation. These factors contribute to the 207's ability to reproduce the more subtle nuances of a musical event.

The full function remote control capability of the 207 includes a recently designed circuit for controlling the output level. This revolutionary electronic gain control provides the highest audible quality ever available with a remote control, allowing the 207 to be conveniently used to directly drive active loudspeakers or a power amplifier without requiring a preamplifier.

In addition, the 207 provides an auxiliary high level input and a full tape loop, making this product essentially a CD player plus preamplifier. The 207's innovative design can simultaneously improve your sound quality and simplify your home entertainment by performing as the control center for your system.

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Linda Ronstadt moves beyond mere readings on this album of standards; she sets the pace and mood, and her phrasing is sure and daring.



her duet with James Taylor on the upbeat "Straighten Up and Fly Right," which feels out of place, nor with "When You Wish Upon a Star," a song that Ronstadt obviously loves but is so sappy that even Jiminy Cricket made me wince when he sang it in the movie *Pinocchio*.

Special credit must go to guitarist Bob Mann, whose versatility sparkles throughout the album, and to engineer George Massenburg, who's captured a warm and quite satisfactory sound.

Simultaneously with the release of *For Sentimental Reasons*, Asylum has issued all three of the Ronstadt/Riddle

## Revox has a 20-second solution to your tape selection problems.

**For Sentimental Reasons:** Linda Ronstadt with Nelson Riddle and His Orchestra  
**Asylum 60474-1 E.**

Sound: B Performance: B

*For Sentimental Reasons* is the final album of the trilogy of Tin Pan Alley standards that Linda Ronstadt recorded with the late Nelson Riddle and his charts.

If Ronstadt sounded tentative on the first one, *What's New*, she gained assurance and confidence on the sequel, *Lush Life*, as she began to grow into the material. The third time around, Ronstadt is applying the lessons she has learned, and she turns in some excellent performances. Going beyond mere readings, she has begun to be an interpreter. She sets the pace and mood instead of letting the orchestra do it for her, and her phrasing is surer and more daring. Riddle's charts, too, are less "standard" as they veer into fresh combinations of sounds—often darker ones.

There are so many elements that make this quite a satisfying effort: The intimacy of the trio at the beginning of "You Go to My Head," the different ways Ronstadt sings the word "bothered" in "Bewitched, Bothered and Bewildered," the string-quartet-plus-guitar settings for "My Funny Valentine," the sepulchral string feel in "Round Midnight," and much more. I liked Ronstadt's poutiness in "Little Girl Blue" and her giddy sassiness in "Am I Blue." But I'm not quite as happy with

No matter how good your cassette deck and your tape, you cannot achieve peak performance unless your deck is calibrated for the tape you're using. Solution: the Revox B215.

*The Incomplete Calibration Compromise*—Most home recordists realize you should adjust the bias when changing from one tape formulation to another. And most better cassette decks have facilities for this one adjustment.

But, as any recording professional would tell you, simply adjusting the bias is—at best—an "ilfy" compromise. For optimum performance in magnetic recording, three interdependent parameters must be precisely calibrated for each tape formulation: bias, record sensitivity, and equalization. In the studio, this is done by a maintenance engineer who records a series of test tones, "tweaks" the adjustment pots, and checks the results.

*The Microchip Engineer*—With its powerful microprocessor and proprietary software, the B215 performs this calibration automatically in a mere 20 seconds. You simply press the red "align" button. The B215 records test tones (400 Hz, 4 kHz, 17 kHz), makes required adjustments through digital attenuator networks, and checks again. All



three parameters—bias, record sensitivity, and equalization—are optimized for peak performance.

*20 Seconds Too Long?*—Once the procedure is complete, calibration data can be stored in non-volatile digital memory. Up to six different tape formulations can be stored for instant pushbutton recall.

### Level Setting Option

—The B215 also offers a unique automatic level setting feature. Simply play a loud passage of the music to be recorded while holding down the "level set" button. The B215 samples the incoming signal and sets the record level for the best overall performance. For unusual recording situations, manual level setting is also available.

*The Best from the Best*—The Revox B215 also provides Dolby B/C<sup>™</sup> noise reduction and Dolby HX Pro<sup>™</sup> headroom extension. Put it

all together and you have everything you need for making the best possible recordings from today's best tape formulations—all of them, without compromise.



Philips microchip is programmed to test, analyze, and calibrate.

Naturally you will find that cassettes recorded on the B215 will sound best when played back on the B215. But a better-sounding cassette will also enhance your listening pleasure on just about any reproduction system. You will likely note a distinct improvement if you have a quality automotive system, and even better portable players can benefit from the superior quality of tapes produced by the Revox B215.

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Aretha Franklin is as great a contemporary singer as you will find. The only shame is how conservative she's gone with the smooth pop of *Aretha*.

albums in a boxed set under the name *'Round Midnight*. In one sense, the singer's growth through three albums is what the boxed set is all about. In the bigger picture, it's about how Linda Ronstadt has introduced these classic examples of American pop to a whole new generation. *Michael Tearson*

**Aretha:** Aretha Franklin  
**Arista AL-9442.**

Sound: B Performance: B

If you are a big fan of the Narada Michael Walden sound—which is basically updated Motown grooves—this album won't disappoint. Aretha is ca-

pable of singing these songs into submission and puts more emotion per note into the material than any of her peers. As on her last album, she is matched up with a couple of rock and pop foils; instead of Annie Lennox and Peter Wolf, we have Keith Richards ("Jumpin' Jack Flash") and George Michael ("I Knew You Were Waiting for Me") for the two best tracks. And Aretha's original composition/production, "He'll Come Along," is actually one of the stronger tracks, rather than filler.

Aretha Franklin is as great a singer as you'll find in contemporary music, and the only shame is that she's gone as conservative a route as she has here. It would be nice to hear an entire LP in more of a Stax/Volt groove, and less of the smooth pop of *Aretha*. The record sounds too pristine, in places, and a little mystery could have made all of it more interesting.

*Jon & Sally Tiven*

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### While the City Sleeps:

George Benson

**Warner Bros. 25475-1.**

Sound: B+ Performance: B

Smooth and suave are words no doubt invented just so they could be applied to George Benson's art on *While the City Sleeps*. Moving away from the rather sweetened approach of *20/20*, Benson achieves a leaner, more slickly produced sound with a synth-based ensemble that closely hugs his soulful vocals (and his occasional guitar) which are at the center of the audio space.

There are still brief flashes of Benson's jazz roots evident as he breaks into his classic pseudo-scat, doubling a taut guitar lead on the danceable tunes "Shiver" and "Teaser" and on the ballad "Too Many Times." But overall, the emphasis is more on tight arrangements than on cutting loose. The tasty but slightly restrained jazz/blues lick providing counterpoint to "Love Is Here Tonight" is about as crazy as he gets.

Just a little more jamming would have been welcome, but nevertheless, *While the City Sleeps* presents a mature Benson playing polished pop that gracefully glides across the senses, with ease.

*Michael Wright*

AU2873

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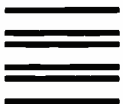
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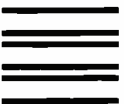
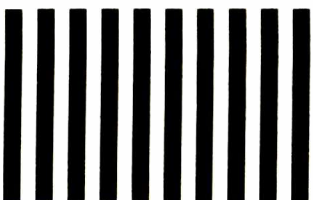
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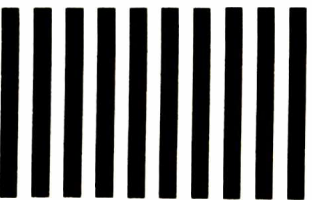
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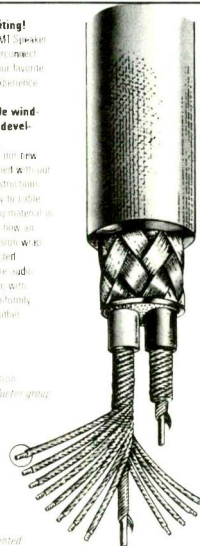
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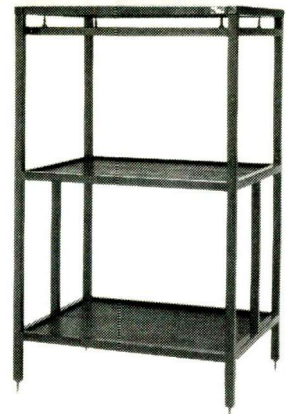
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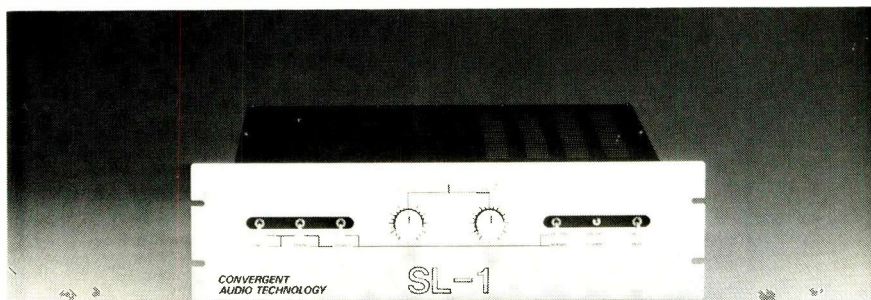
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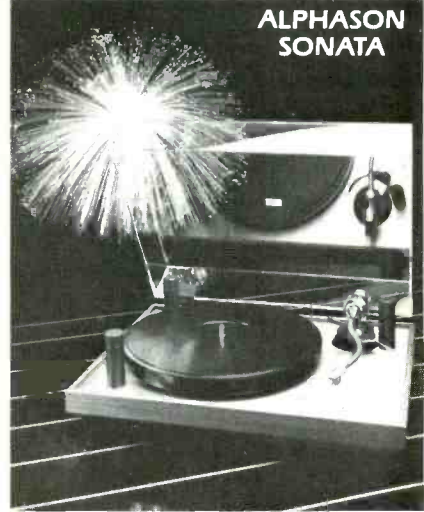
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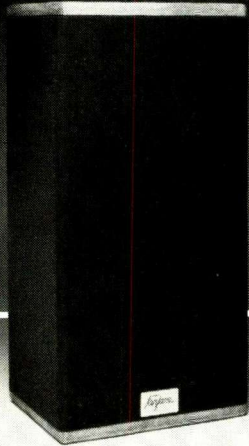
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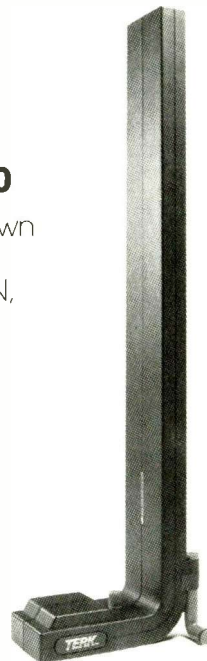
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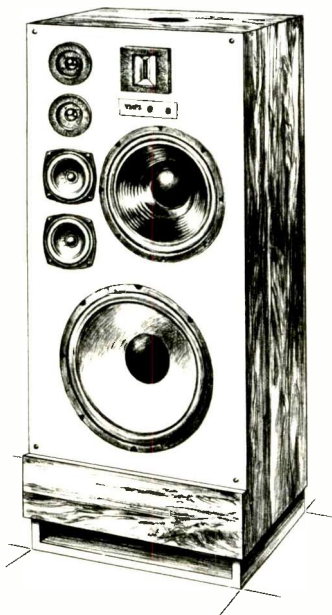
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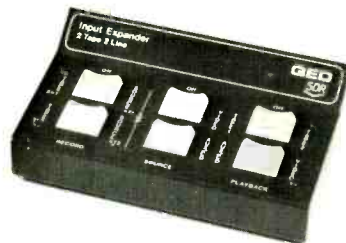
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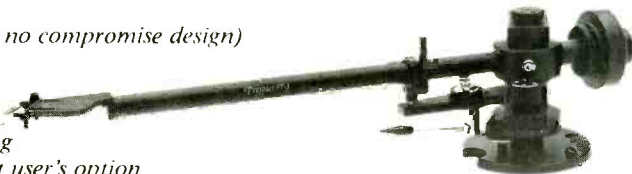
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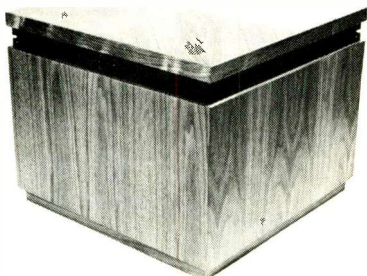
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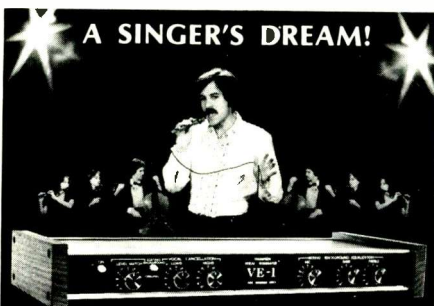
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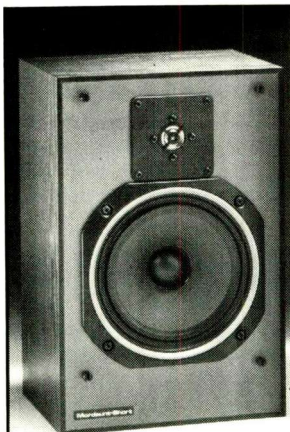
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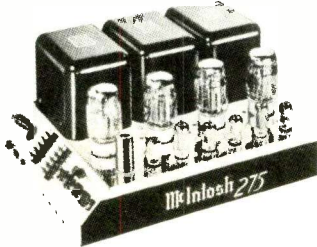
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