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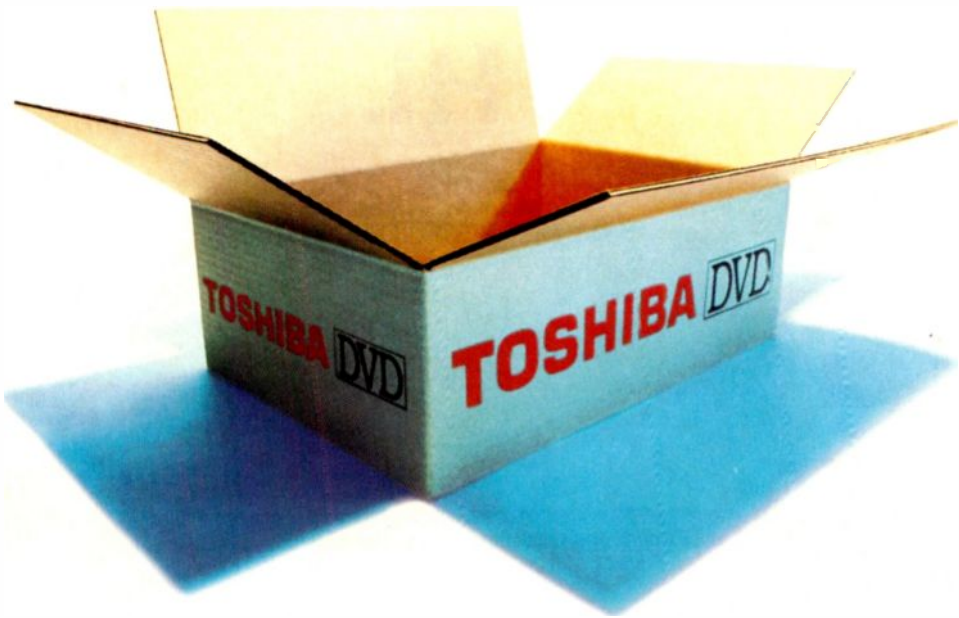

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CIRCLE NO. 18 ON READER SERVICE CARD

MARCH 1996 VOL. 80, NO. 3

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THE EQUIPMENT AUTHORITY

feature

equipment profiles

auricle

Lamm
Preamp,
page 96

departments

playback

recordings

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CIRCLE NO. 16 ON READER SERVICE CARD

FAST FORE-WORD

I have just returned from the Winter Consumer Electronics Show, loaded down with information on upcoming products. Not surprisingly, the big news was dominated by DVD and related topics (AC-3, for example, which is catching on in much the same pattern as Pro Logic did a few years ago). Almost all the major electronics manufacturers announced players for introduction by the end of the year, and I would be surprised if we didn't see some of them by early in the third quarter. It's definitely shaping up as the biggest new-format launch ever, including much better software support than CD had at the time of its introduction.

The DVD moniker originally came from "digital videodisc," but one of the things that came out of the agreement between the former SD and MMCD camps was adoption of DVD as the name for the unified high-density disc format. So officially now, DVD has no meaning other than identifying the new format. The computer version will be called DVD-ROM, for example, and presumably the video version will be called DVD-Video, redundant as that may seem. And then there's DVD-Audio.

Last month I talked about the opportunity that high-density DVD discs offer for audio-only use, particularly with respect to multichannel music recording. One of the most interesting presentations at CES was on precisely that subject, by Bob Stuart of Meridian. In this instance, however, he was representing an organization called Acoustic Renaissance for Audio, which he chairs. Founded by Hirokazu Negishi of Canon, the ARA is an association of individuals within the audio industry who are pressing for best possible implementation of DVD-Audio, with primary emphasis on multichannel sound for music. They have developed a comprehensive proposal for what they call the High Quality Audio Disc, or HQAD, which has been presented to the DVD audio standards committee in Japan. (A decision on how to proceed with DVD-Audio is expected in late March, so development is moving swiftly.)

There's no way to fit a detailed explanation in this space, but I will say that what the ARA has put together is extraordinarily thorough and intelligent; we can only hope the committee agrees. The key is flexibility, as the proposed system could accommodate everything from extremely long-play, 16-bit, 48-kHz two-channel stereo to 20-bit, 48-kHz eight-channel surround to 24-bit, 96-kHz two-channel stereo (for those who worship at the altar of big numbers). HQAD players would automatically configure themselves based on header information on the disc, while a conventional two-channel, standard-density pressing on the flip side of the disc would ensure compatibility with ordinary CD players, eliminating any need for dual inventories. The best way to get a fast look at the full proposal is to visit the ARA Home Page on the World Wide Web (http://www.meridian.co.uk/ara/). It deserves all the support we can muster.

Meanwhile, if you've been wondering why I seem so down on motherhood-and-apple-pie stuff like 24-bit recording and 96-kHz sampling rates, see D. W. Fostle's "19 Bits in a 16-Bit Sack" on page 32. The first of two articles on advanced digital recording systems, it's a real eye-opener. Among other things, Fostle illustrates how pointless 24-bit A/D conversion would be with existing (or foreseeable) technology. To make real progress, we have to attack the real problems, which seem mostly to be upstream of the point where the signals turn digital.

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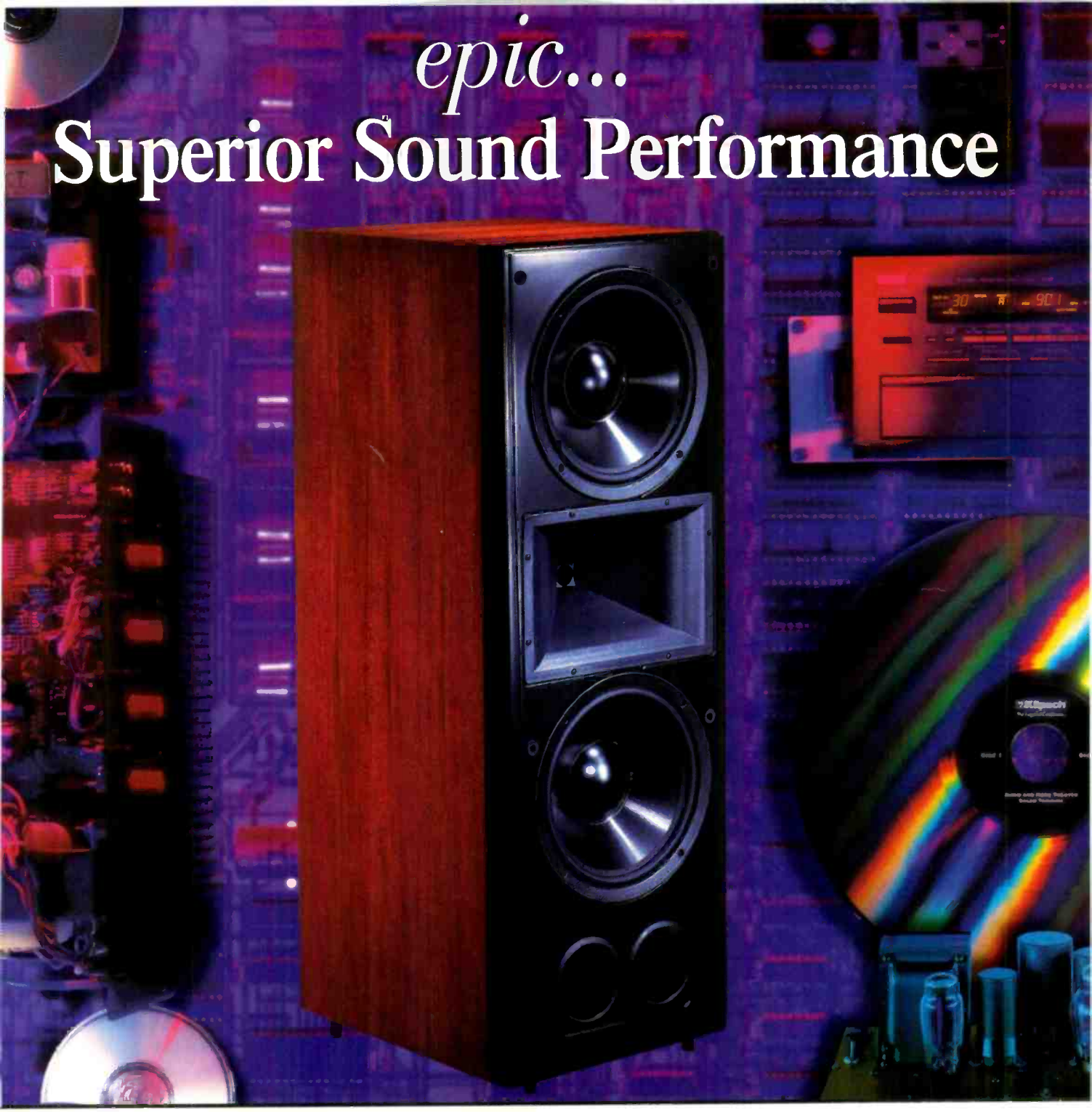

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LETTERS

Radio Story Makes Waves

Dear Editor:

I'd like to point out some errors concerning Nathan B. Stubblefield in B. Eric Rhoads' article "Who Really Invented Radio?" (December 1995).

The photo of Stubblefield and his wireless telephone on page 27 was taken in 1902, not 1892 as stated in the caption. The equipment shown is the 1902 Ground Conduction System, demonstrated May 30, 1902, in Philadelphia. His 1892 invention, the Induction Coil System, was a different animal.

The article also states that Stubblefield publicly demonstrated his wireless device in 1892. These demonstrations were private, as reported by Rainey Wells and Will Mason. Stubblefield did conduct a number of public demonstrations that were reported in several newspapers and in *Scientific American* in 1902. In the same paragraph, it says that the *St. Louis Post-Dispatch* reported Stubblefield's 1898 demonstration. Actually, the *Post-Dispatch* carried a story about the inventor in its January 12, 1902 edition, under the headline "Kentucky Farmer Invents Wireless Telephone." The newspaper ran an interview with Stubblefield and described a demonstration conducted at his farm near Murray, Kentucky, on January 10, 1902.

Also, regarding Patent No. 887,357, your article states that Stubblefield envisioned his device in motorcars. The patent shows illustrations of a steamboat, a railcar, and a horse-drawn coach. There's no mention of motorcars.

As for Stubblefield's apparatus being stolen (reportedly documented February 13, 1912), there's no reliable report of it. There was an article that mentioned a stolen trunk, but it contained enough factual errors as to render it unreliable. It would not have been necessary for someone to actually steal the equipment for either of Stubblefield's two wireless systems, anyway. All interests, secrets, and equipment for the 1902 Ground Conduction System were signed over and delivered to the Wireless Telephone Company of America in exchange for 500,000 shares of stock, so there was nothing of this invention left to steal. As for the 1892 Induction Coil System, which was patented in 1908, buying a copy of the patent would have been easier.

Finally, there is no statue of Stubblefield in Murray's town square. There is a monument across the street from the location of his home, which is now a parking lot on the campus of Murray State University.

Larry Albert, TV Engineer
Murray, Ky.

Dear Editor:

As a casual reader of *Audio* through the years, I have always found your publication to be detailed, professional, and reliable. So I was most surprised at the level of inaccuracy in the article by B. Eric Rhoads on the invention of radio.

Several years ago, Larry Albert and I built working replicas of Nathan B. Stubblefield's two wireless telephone systems, one based on electromagnetic induction and the other on earth conduction, and exhibited them at various venues in 1992, including the NAB Radio Show, to celebrate the centennial of Stubblefield's first verifiable transmission. Along the way, we found out more than the world probably wants to know about Stubblefield and many other American wireless inventors of the 19th century.

Since Larry has already covered Stubblefield, let me add a few more corrections to the text. Dr. Mahlon Loomis was a truly interesting character who probably created a crude tuned-antenna circuit. His kite experiment took place in Virginia, not West Virginia, and he never received the grant he sought from Congress. Had he, the invention of radio might have advanced a few decades.

The story of Nikola Tesla is equally fascinating. During lectures in Philadelphia and St. Louis in 1893, Tesla performed several experiments. In one of these, he excited a transmitter and turned on a light bulb on the other side of the stage. Although this was a wireless signal and the apparatus was capable of RF transmission, the plate voltage was 5 kilovolts and the distance 30 feet. As a Federal judge later pointed out, the phenomenon could also have been due to atmospheric conduction or electromagnetic induction. No one will ever know. As for Tesla's celebrated Supreme Court victory over Marconi, the decision plainly states that Marconi's original 1897 wireless patent stands unchallenged. Where Marconi erred, according to the Court, was in appropriating the work of others in his 1904 patent for improvements to his basic device. Tesla, in his 1900 patent, anticipated Marconi's work, but so did Oliver Lodge in 1898 and John S. Stone a month earlier than Tesla in 1900. The Tesla advocates conveniently leave out these other two electricians.

What are most interesting are not Rhoads' errors of commission but his ones of omission. We learned, for example, that Stubblefield found out about telephone, telegraph, and wireless inventions by reading *Scientific American*, so Larry and I did, too. The first wireless telephone we ran across was a device called the Photophone, patented by Alexander Graham Bell in 1880. It worked by using a voice signal to modulate a beam of light but was never more than a novelty exhibited at world's fairs. Of more significance was the wireless telephone patented in 1886 by Amos Emerson Dolbear, a physics professor, and demonstrated publicly in the United States, Canada, and Europe. It was actually an RF system that lacked a suitable detector. About the same time, John Trowbridge at Harvard was doing extensive experiments in both induction and earth- or water-conduction wireless apparatus. Thomas Edison, Granville Woods, Lucius Phelps, and others developed wireless telegraph/telephone systems to communicate with moving trains during the 1880s. In fact, Stubblefield's patent attorney pointed out in 1907 that Nathan's patent application duplicated that of Phelps from two decades earlier. Stubblefield replied that his was an improvement on the prior design and thus not original.

I do not mean to belittle the work of Murray's most famous native, but one must separate fact from folklore. I believe that when the truth is known, Stubblefield's work still stands on its own merits.

Bob Lochte
Director, MSU TV 11
Murray, Ky.

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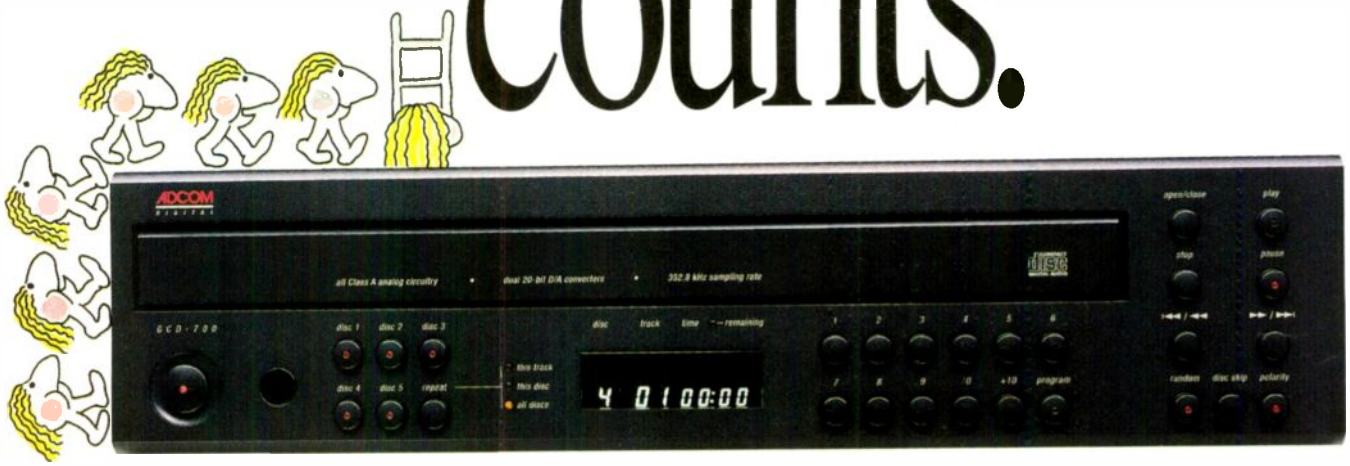

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For literature, circle No. 100

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For literature, circle No. 104

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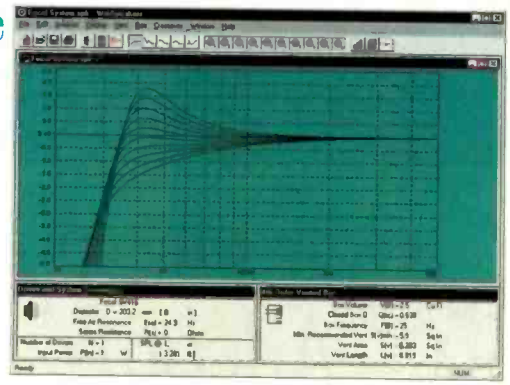

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18-3/96

WHAT'S NEW

Cerwin-Vega Home Theater Speakers

The Powered System 8, from Cerwin-Vega, comprises three matched front speakers, a powered subwoofer, and two surround satellites. Each HT-MDC front speaker has dual 5¼-inch midranges and a 1-inch tweeter, for a specified frequency response of 100 Hz to 20 kHz, ±3 dB. The HT-12PWR sub has a 12-inch driver, a 150-watt internal amp, and a wireless remote control. Its frequency range is 45 to 150 Hz, its polarity is switchable, and it has both line- and speaker-level inputs and a signal-sensing turn-on circuit. Each HT-S5 surround satellite has a 5-inch midrange and a 1-inch tweeter; response is 125 Hz to 20 kHz, ±3 dB. Prices: System, $1,935; HT-MDC, $235 each; HT-S5, $330 per pair; HT-12PWR, $900 each.
For literature, circle No.105

Digital Phase Bookshelf & Center Speakers

Complex Acousta-Reed enclosures may be the reason why the AP-.7 series speakers from Digital Phase are rated to go down to 20 Hz, despite having only two 4-inch woofers each. Those woofers, plus a titanium-dome tweeter, yield a claimed response of 35 Hz to 20 kHz, ±1.5 dB. The system shown includes four AP-.7 bookshelf speakers plus an AP-.7CC center-channel speaker. The latter is shielded, for positioning atop a TV, and has the same drivers as the bookshelf model. Prices: Set of five, $2,600; AP-.7, $1,000 per pair; AP-.7CC, $600 each.
For literature, circle No. 106

Sonance In-Wall Subwoofer

Sonance's PSWD8 passive subwoofer is designed for installation in walls using standard 2 x 4 construction. Built-in crossovers feed left and right bass signals (low-pass filtered at 125 Hz with 18-dB/octave rolloff) to the 8-inch driver's dual voice coils. Left and right satellite outputs are fed from 150-Hz, 6-dB/octave high-pass filters; with the signal split this way, a separate subwoofer amp is not required. Rated sensitivity is 88 dB for 1 watt at 1 meter, nominal impedance is 6 ohms, and power-handling capacity is 60 watts per channel. Either a cloth or a metal grille is offered, and mounting brackets are included. Price: $329 each.
For literature, circle No.107

KEF SPEAKER

Latest in KEF's New Reference series, the Model Four is a four-way speaker with six drivers. Two 6½-inch midrange units and a 6½-inch Uni-Q coaxial driver, with a 1-inch dome tweeter at its apex, are visible; inside are two vertically firing 10-inch woofers, coupled by a rod that ties their opposing motions together, cancelling a vibration source. The enclosure achieves a high-order alignment by venting the front and rear of each woofer. For added vibration resistance, the front-mounted drivers are mechanically isolated from the front panel, and the base plinth can be filled with sand or shot. Rated frequency response is 35 Hz to 20 kHz, ±3 dB, sensitivity is 92 dB, and impedance is 4 ohms. Price: $2,600 each in black ash.
For literature, circle No. 108

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Families are once again spending their vacations lumbering down the majestic highways of this amazing country by car. In order to keep everyone entertained long after you back out of the driveway and to thwart those boredom cries of "Are we there yet?", we suggest our car multimedia system. It includes a 6" color LCD TV that can be hooked up to any 12 volt VCR or video game player. So even when you're miles away from your cozy three position recliner you can still enjoy a ball game or your favorite show. That is, if your kids will let you watch it. Visit your nearest Clarion Dealer or call 1-800-GO-CLARION for more information.

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WHAT'S NEW

KENWOOD A/V TUNER/PREAMP

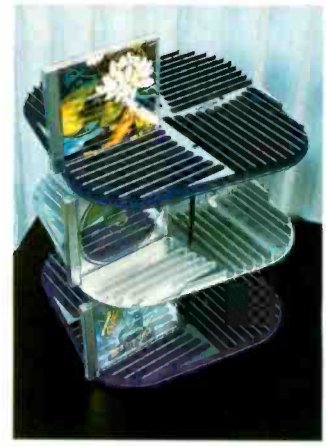
Using a removable touch panel in place of the usual front-panel controls and remote, the Kenwood KC-Z1 radically simplifies home theater setup and control. The first model in the company's projected Stage 3 series, the KC-Z1 includes Dolby Pro Logic and AC-3 decoding as well as a tuner and preamp. The touch panel displays a context-sensitive menu system comparable to that in computers, and it can accommodate all of the components of a home theater system. The touch panel communicates with the KC-Z1 via RF, so it is not limited to line-of-sight use.
Price: $2,800.
For literature, circle No. 109

Sauder Woodworking Equipment Cabinet

Shipped ready to assemble, the Sauder 2565 Entertainment Center holds TVs up to 32½ inches wide plus a variety of audio and video components. Part of the company's Coventry Collection, the cabinet has a washed-pine finish.
Price: $377.70.
For literature, circle No. 111

RPG Acoustic Conditioners

Classic Plus is one of three systems available from RPG Diffusor Systems for acoustic optimization of home listening spaces. (The others are AcousticTools and Acoustical Furnishings.) Several Classic Plus packages are available, including various combinations of Abffusors (which are broadband absorber/diffusors), Diffusors (phase gratings that also absorb below 500 Hz), and B.A.S.S. Traps. These wall-mounting components are built in multiples of 23⅝ inches wide x 47¼ inches high, to fit together neatly. The diffusor-element design is based on mathematical quadratic-residue theory.
Price: packages from $1,495 plus shipping.
For literature, circle No.110



EPIC CD RACK

DisCDisk is an appropriate name for this quasi-circular, stackable rack that holds CDs. A product of Epic Design Studios, the rack comes in a variety of models; the DD-44 shown can be stacked up to four layers high, using supplied stacking posts, and it has a revolving base. Each layer holds 44 CDs, including some double-disc albums. Black, silver, gold, and several other colors are available.
Prices: $70 per layer or $65 per layer in quantities of three or more.
For literature, circle No. 112

CONTINUUM AMP & PREAMP

The Audio Window preamp and Audio Stage amp, from Continuum Electronics, use no overall negative feedback. Both are remote-controlled and feature FET input circuitry as well as balanced and unbalanced inputs (and outputs, on the preamp). The Audio Stage is rated to deliver 200 watts/channel into 8 ohms, with peak current output of 50 amperes per channel; it operates in Class A at normal listening levels. Prices: Audio Stage, $1,750; Audio Window, $1,450.
For literature, circle No. 113

After developing a CD player with Legato Link Conversion S, twin D/A converters and a stable platter mechanism, we realized one thing was missing. The record button.

What lies before you is the most refined, most sophisticated and most uncompromising idea to be thought of in years, a CD player that records CDs, the Elite® PDR-99.

A CD recorder engineered not only to record CDs, but to play them back with the highest standards possible. A CD player that has Legato Link Conversion S, which effectively re-creates the music as it was originally conceived by the artist. The PDR-99 also has the extraordinary ability to record from any source.

The Stable Platter Mechanism—another astounding advancement—helps to suppress resonance and vibration of the disc. This ensures more accurate playback and recordability.

And yet, with all these advancements, the most important feature the Elite PDR-99 CD recorder offers is the ability to record your cherished music to the incredible, durable and long-lasting format of CD.

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Announcing Our National Sale On Ensemble

Audio magazine once said that our *Ensemble®* speaker system may be "the best value in the world." Since then, dozens of critics and thousands of customers have applauded our *Ensemble, Ensemble II, Ensemble III* and *Ensemble IV* speaker systems. Designed by Audio Hall of Fame member Henry Kloss (founder of AR, KLH and Advent), these systems have become best sellers by offering very high quality construction and accurate, wide-range music reproduction and precise stereo imaging – all at factory-direct prices.

And now, for a limited time, we're making the "best value in the world" even better. Save on all four models during the Great Ensemble Sale – now through March 31, 1996.

Save $50 On Ensemble

Ensemble is our very best speaker system. It involves no compromises in performance, no cost-saving shortcuts. We (and the critics) believe it competes head-on with audiophile tower speaker selling for well over $1,000 a pair. Yet its unique four-piece design literally disappears in your listening room. There is no other speaker like it.

The Original Ensemble

Ensemble consists of four speaker units. Two slim subwoofers reproduce the deep bass, while two smaller satellite units reproduce the rest of the range. By separating the low bass from the rest of the musical range, *Ensemble* is able to reproduce just the right amount of energy across the musical spectrum, without

turning your listening room into a stereo showroom.

You can place the subwoofers on the floor, up against a wall, or in a corner – all places that allow them to reproduce bass notes efficiently. The satellite speakers can then be placed out in the room, at ear level, positioned to create a realistic stereo image. Their small size makes them very unobtrusive.

"...crisp balanced sound...stereo imaging is phenomenally sharp—some of the best I've heard...some of the speakers I'm comparing it to cost $1,900 to $2,800."

High Performance Review
describing *Ensemble*

Ensemble's dual subwoofers give you unbeatable placement flexibility – the ultimate key to real-life performance for any speaker in any given room. They also deliver uniform bass throughout the room, and give you outstanding power handling and sound pressure level capability. This is particularly important when reproducing the demanding bass effects on modern movie soundtracks.

The satellite speakers are genuine two-way systems with separate 4" mid-bass/mid-range drivers and 1 3/4" tweeters with integral domes. Their cabinets are solidly constructed of resonance-resistant MDF for optimum performance. Each one is hand-finished in scratch-resistant Nextel or durable white paint.

The subwoofers feature an 8" long-throw woofer designed by Henry Kloss and manufactured by Cambridge SoundWorks. They use a unique integrated heat sink for increased power handling capacity.

But most importantly, *Ensemble* has been painstakingly "voiced" by Henry Kloss for proper octave-to-octave tonal balance. Because it does not give undue emphasis to any one octave of music, *Ensemble* has a rich, natural, accurate sound normally associated with the best (and most expensive) of conventional speakers under laboratory conditions. You can spend hundreds of dollars more for a speaker system that doesn't sound as good. Available in black or white. With vinyl-clad subwoofers, Reg. $599.99 – **Now $549.99.** With black laminate subwoofers, Reg. $649.99 – **Now $599.99.**

Save $40 On Ensemble II

Ensemble II is our best value in a high-performance speaker system. It uses the exact same satellite speakers as *Ensemble,* but with a more affordable, single-enclosure subwoofer. Because 90% of the music we hear is reproduced by the satellite speakers, these two systems have a very similar sound.

Ensemble II.

"Ensemble II performs so far beyond its price and size class that it can be compared only with much larger speakers at substantially higher prices."

Stereo Review

Ensemble and Ensemble II are now also available in white.

The Best Value In The World"?

n Sale!

ORDER BY SALE MARCH 31ST, 1996

Speakers - Now Through March 31, 1996.

The single subwoofer of *Ensemble II* has the same low bass extension as *Ensemble's* dual subwoofers. It simply doesn't have the room placement flexibility or power handling capacity of *Ensemble.* Compared to other three-piece speakers systems on the market, *Ensemble II's* subwoofer has more powerful deep bass – and its two-way satellite speakers easily outperform systems using dual "cube" satellites. Available in black or white. Reg. $499.99 – **Now $459.99.**

Save $20 On Ensemble III

With *Ensemble III* you can bring clear, balanced, wide-range sound into a small, crowded room. It consists of two small satellite speakers and a compact subwoofer. But don't be fooled by *Ensemble III's* small size and modest price. Its natural, balanced, wide-range sound rivals that of much larger, far more expensive speakers.

Most speakers in its price range use single-driver "cube" satellites. But *Ensemble III* uses true two-way satellites for improved dispersion, tonal balance and power handling. The satellite cabinets are constructed of a stiff, acoustically damped inner body surrounded by a high-grade ABS shell, finished in scratch-resistant Nextel.

"Ensemble III sounded very good...first rate in every respect...it sounds like a lot more speaker than its unassuming appearance and very attractive price would suggest."

Stereo Review

Ensemble III's subwoofer is constructed of resonance-resistant MDF composite trimmed in black vinyl. It encloses a single 6 1/2" dual voice coil woofer in an air-tight, acoustic suspension cavity. While it doesn't have the same low-end "reach" as our *Ensemble* and *Ensemble II* systems, it does have very impressive deep bass response – far better than other systems in its price range. Reg. $349.99 – **Now $329.99.**

Ensemble III

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Save $40 On Ensemble II*
Reg. $499.99–Sale Ends 3/31/96
YOU MUST MENTION COUPON CODE WHEN ORDERING
$459.99
Code: GES104

Save $50 On Ensemble*

Vinyl-Clad Subwoofers. Reg. $599.99	Laminate Subwoofers. Reg. $649.99
$549.99	$599.99
Code: GES104	Code: GES104

YOU MUST MENTION COUPON CODE WHEN ORDERING

*Sale price may not be combined with any other special offers.

Save $20 On Ensemble IV

Ensemble IV is the most compact, most affordable subwoofer/satellite speaker system ever designed by Henry Kloss. Its compact size and affordable price make it the perfect system for many situations – as a main speaker system for an apartment or college dorm, or as a second system for your office, kitchen or bedroom. *Ensemble IV* is also a great way to add high quality sound to a TV set, without cluttering up a room.

Ensemble IV's compact satellites (4"x4"x4") house a unique, wide-range, long-throw 3" driver capable of reproducing notes down to 150 Hz. Its shoebox-size subwoofer contains a remarkable long-throw 5 3/4" bass driver with dual voice coils. We don't know of any speaker near its price that sounds as good as *Ensemble IV.* Its best-selling competitor sells for almost twice its price. Reg. $249.99 – **Now $229.99.**

Ensemble IV

"Ensemble IV sounds so much better than the other sub/sat systems we've tried – at half the price of many – that it's a hands-down Hot Ticket."

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All Cambridge SoundWorks speakers are backed by a 30-Day Total Satisfaction Guarantee. So you can audition your speaker the right way – in your home, with no salesman hovering nearby. If within 30 days you're not happy, return your system for a full refund. We even reimburse original UPS ground shipping charges in the continental U.S.

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AUDIO CLINIC

JOSEPH GIOVANELLI

Checking Tape Deck Meters

Q *Why do my new recorder's meters register below 0 dB on playback of recordings that I made at +3 dB? I also notice that the left meter reads slightly lower than the right one; however, I think my receiver is to blame, because I have noticed this on various tape decks I have used with it. Should I compensate for this by using the balance control on the tape deck, or should I have my receiver looked at? The imbalance is too slight for me to hear.*—Mark D. Minna, Tustin, Cal.

A The fact that there's a difference between your deck's indications for record and playback level may mean you're not using the tape recommended for your recorder or that you have not adjusted bias for the tape you are using. Before anything else, follow the manufacturer's instructions, set the deck up for the tape you normally use, and then make another level check.

The simplest way to check out your deck's channel balance is to make a brief test recording (preferably with a mono source, so both channels get the same signal). Next, repeat the process but plug the cable to your tape deck's left input into your receiver's right tape output, and vice versa. If the channel that originally read high now reads low, the problem is in the receiver. If not, the problem's probably in the deck or perhaps simply in its meters. But just to be sure, swap the cables at the recorder end and try again; if the readings go back to what you had originally, the cables should be replaced.

Dubbing Through a Headphone Jack

Q *I want to dub my old open-reel tapes onto cassette, but my open-reel deck is built into a 25-year-old AM/FM/phono console. The console's only output is a headphone jack; can I safely feed signals from that jack to my receiver or cassette deck?*—George O'Neal, Leeburg, Ore.

A It's *probably* safe to do this. But before you try it, connect an AC voltmeter between the ground terminals of the headphone jack and your tape deck's or receiver's input jack, and make sure there's no appreciable voltage potential between them. The headphone jacks on some consoles (and many TVs) were grounded to the chassis of a transformerless amplifier circuit, and they could carry voltages that could damage your stereo equipment (or you, for that matter, if your body provides a path to earth ground for them).

Since both channels of a headphone jack share a common ground, you'll need a cable with a stereo ¼-inch plug at one end and two RCA connectors at the other (such as Radio Shack's No. 42-2474). If you get bad hum, it may be caused by a ground loop between the channels; try cutting the shield away from *one* of the RCA plugs and see if that helps.

Connect the signal from your console to one of your system's line inputs. Set the console's volume control to produce an output level high enough for good recording but not so high as to cause distortion or limit your recording-level adjustments to the lowest quarter of your level controls' range. See which settings of the console's tone controls produce the best-sounding signal.

Speaker Impedance and Receiver Safety

Q *What differences will I hear if I use 4-, 8, or 16-ohm speakers with my receiver? And am I likely to damage it with any of these loads?*—Peter Nguyen, San Jose, Cal.

A Changing the load impedance alone should not change the sound you hear significantly. (However, changing speakers to get a different impedance will change the sound because of other differences between the speakers.)

If your receiver's specifications include a power rating for 4-ohm loads, it can handle this load safely. If it has no such spec, ask the manufacturer; the receiver will probably be safe for 4-ohm loads. High impedances, such as 16 ohms, should be safe with any receiver, though it may deliver less than its rated power. There are, however, some receivers that cannot be used with 4-ohm speakers, and there may be a few that can't be used even with 6-ohm loads. If you use these loads, you risk damaging the receiver's output stages, especially at high power levels.

Receivers that have switches for two pairs of speakers often connect the pairs in parallel. This is no problem if you use one pair at a time. On the other hand, if you use both pairs at once, two sets of 8-ohm speakers will present a 4-ohm load and two 4-ohm pairs will yield a 2-ohm load, which many receivers cannot handle. To avoid this situation, some receivers connect multiple speaker pairs in series rather than in parallel, which increases the impedance when more than one set of speakers is played instead of reducing it. Unfortunately, this will also reduce power output and (unless the speakers in both sets are the same model) alter frequency response when more than one pair of speakers is played at the same time, degrading sound quality.

Subwoofer Wall Thickness

Q *After reading about designing a subwoofer in the July 1995 issue, I wonder whether enclosures made of ¾-inch, acoustical-grade particleboard are adequate for good performance and if 2-inch particleboard (which costs a lot more) would make a significant difference.*—Name withheld

A If I were to design a subwoofer, I surely would use the most massive enclosure I could. A cabinet of ¾-inch particleboard is likely to outperform a cabinet made from the same thickness of plywood, but I would still prefer to use particleboard that is even thicker.

The thinner the wall, the more likely it is to flex when the woofer cone's motions compress and decompress the air inside the box. (Even vented boxes have pressure variations, as venting is not quite instantaneous.) The resulting wall vibrations will generate sounds: If those sounds simply augmented the woofer's output, that would be fine, but cabinet sounds are colored by wall resonances, thus distorting the sound. As with most things, however, there will be some point past which further technical

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improvement will yield little or no practical benefits, so I am not sure how significant an increase in panel thickness beyond the specified ¾ inch would be audibly. But my feeling is that if you can afford the thicker enclosure, use it!

House Wiring for Home Theater

Q *I would like to know about prewiring my new home for an A/V system, mounting speakers in the wall, types of wire to use, and remote-control options.*—Steven Cross, Tofte, Minn.

A Mounting speakers in the walls makes it virtually impossible to move those speakers if your room arrangement changes. I'm also wary of how many such installations are capable of delivering really good bass. Some new in-wall speakers do have matching enclosures that fit between the wall studs (or floor joists, with some subwoofers), which should help. For good bass in such installations, your best bet probably is to route all signals below 100 Hz or so to a subwoofer.

While I approve of burying cables that carry signals between rooms, I personally prefer not to bury the cables from a room's amp to its speakers. Usually, your in-wall wiring will terminate at a wall plate with jacks or binding posts, into which you plug the cables to the speakers themselves. (Make sure the wall plates have heavy-duty connectors, and *never* use AC house-wiring sockets and plugs for this purpose!) But though the leads from the wall to the speakers let you move the speakers and amps a bit, the wall plates still limit your flexibility. I like to run my speaker wiring around the baseboard or under carpeting. This is essential when it comes to rear, or surround, loudspeakers; if their wiring is not tucked away somehow, people will trip over it. And since it's hard to upgrade buried cabling, be sure to use a heavy wire gauge—maybe AWG No. 12, if practical.

For remote control between rooms, the most common solution is to use infrared repeater systems. These systems read the output from a remote controller in the room where you're listening, while repeaters near your equipment retransmit the infrared pulses. Some of these transmitters will also fit inside a closed equipment cabinet. If you move your entertainment center to another spot in the room, you'll still need to run some additional wiring (probably outside the wall) for this; if you move the system to another room, more extensive work will be required. You might also consider using the LeapFrog wireless repeater system from Terk Technologies (65 East Bethpage Rd., Plainville, N.Y. 11803; 516/756-6000).

Many companies make in-wall speakers. Offhand, I know of three that offer a wide range of accessories for in-wall and multiroom use: Niles Audio (12331 S.W. 130th St., Miami, Fla. 33186; 800/289-4434); Sonance (961 Calle Negocio, San Clemente, Cal. 92672; 800/582-7777); and Xantech (12950 Bradley Ave., Sylmar, Cal. 91342; 800/843-5465).

Deep Bass and Pipe Organs

As an organ builder and audio enthusiast, I thought I'd add my 2¢ worth to the accurate information you gave Mario Penna in the September 1995 issue. You are right: Only two pipe organs in the world have true 64-foot stops. One is the 64-foot Trombone in the 1890 William Hill and Son organ at the Sydney Town Hall in Australia. The other is the 64-foot Diaphone Profunda in the Midmer-Losh organ of the Atlantic City Convention Hall.

There exist three recent recordings of the Sydney organ (available from The Organ Historical Society, P.O. Box 26811, Richmond, Va. 23261), which I have not heard. I believe the only commercial recording ever made on the Atlantic City organ was Bach on the Biggest *on Mercury Living Presence, which is long out of print and not reissued on CD yet. While fascinating, the recording is so swamped with reverberation that individual stops are not discernible; I don't hear the 64-foot stop.*

Many large organs that don't have 64-foot pipes do have stops marked to indicate 64-foot pitch. For example, the Gravissima "64-foot" stop is merely a "resultant" stop: It synthesizes the pitch by playing two pipes in the 32-foot octave a fifth apart, to produce a beat frequency in the 64-foot octave. There are also electronically produced 64-foot stops, often called Sub Bourdon or Untersatz.

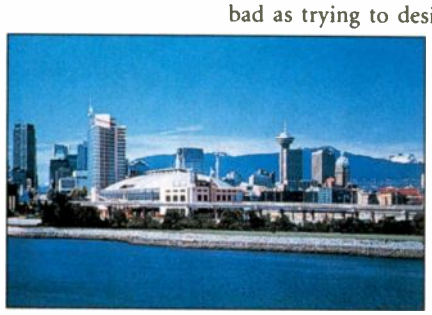
Thirty-two-foot stops, with fundamentals reaching down to approximately 16 Hz, are very common and very thrilling. My advice to bass-lovers like Penna is to ignore the 64-footers and concentrate an octave higher.—Chris Nagorka, Charleston, W. Va. A

IVAN BERGER

REMOVING THE BLINDFOLD

Raising the roof in Vancouver's new GM Place; below, an exterior view.

Ever wonder why so many buildings have bad acoustics? "Until now," says Kenneth Jacob, one of Bose Corporation's chief research engineers, "architects and clients have had to design every building without using their ears to judge its acoustics. It was as bad as trying to design a building's facade while blindfolded." However, now there's a system from Bose that makes it possible to hear how a building will sound before it's built. This system puts an acoustical sketchpad in the hands of architects, acousticians, and sound system designers. In the year since its introduction, this system has been used for about 100 projects, ranging from an upgrade of the Sistine Chapel's sound system to the acoustical design of a new arena, General Motors Place, in Vancouver, British Columbia.



Arenas pose a special challenge: "Sports teams don't want any sound absorption; they want spectator enthusiasm to raise the roof," says David Bell, manager of Bose's Professional Products division. "The audio people do want absorption, for clarity. We wound up with just enough—still clean and intelligible yet lively enough for sports." The extra absorption costs money, but the owner of GM Place, Arthur Griffiths, willingly paid it because he *heard* what that money would buy, a year before the arena opened.

HEARING HOW A BUILDING SOUNDS BEFORE IT'S BUILT CAN SAVE MILLIONS IN FIX-UP COSTS.

The demonstration system Griffiths heard his unbuilt arena's sound on has two parts. First comes Modeler, a program (only for Macintosh, so far) that computes acoustics based on a building's interior plans and the materials to be used. "Its job is to predict how sound emanates from sources, is treated by the room, and arrives at the listener's two ears," says Jacob.

Next comes Auditioner, a hardware system in two parts. The first is a digital signal processing computer that fits into a Macintosh expansion slot and processes "dry" (nonreverberant) audio signals to match the way Modeler predicts how a room will process equivalent sounds. "The sound recipe for a typical room is about 250,000 instructions long," says Jacob. And since Auditioner uses a 48-kHz sampling rate, "the DSP has to perform 250,000 x 48,000 calculations—12 billion operations—per second for each channel. Five years ago, when we started, nothing on the planet could do it. Then we found a math trick that would reduce those computations and a chip that just happens to do exactly this trick, very, very fast." Although the chip (originally developed for radar use) is no longer in production, Bose bought all the remaining stock and expects commercial equivalents to be available by the time its supply is exhausted.

The second half of the Auditioner demo system is the strange box in the photo on page 22, its playback module. Inside the box is a stereo amp and more DSP. ("We use DSP to remove aberrations from the speakers," says Jacob. "We get response that is flat within ±0.1 dB from 45 Hz to 10 kHz.") On the outside are two small speakers, mounted on fixed arms, and a chin rest to make sure the listener is in exactly the right position relative to them.

At a demonstration in Vancouver, Bose first took me to a meeting room, where its engineers played

THE BRYSTON ST SERIES AMPLIFIERS

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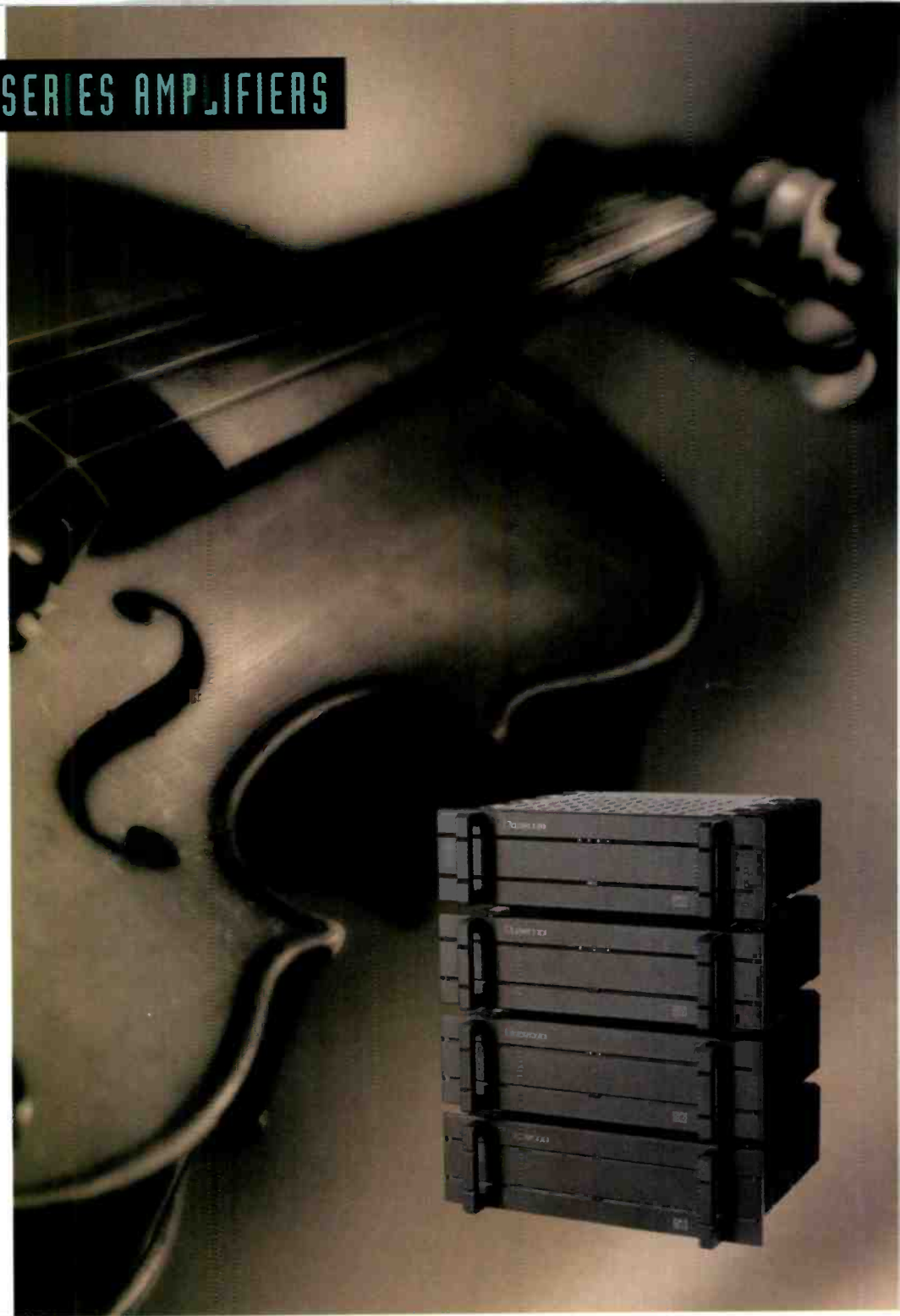
Once in a while an idea comes along which represents a significant step forward in advancing the current state-of-the-art. We feel our new ST Series amplifiers exemplify this unique distinction.

A new approach to low-noise, low distortion signal-path has produced a line of amplifiers which is actually quieter and more transparent than any source material currently available.



Bryston ST amplifiers, from the top: 8B ST 4 channel 120 wpc, 5B ST 3 channel 120 wpc, 4B ST 250 wpc stereo, 7B ST 500 watts mono. Not shown is the 3B ST 120 wpc stereo.

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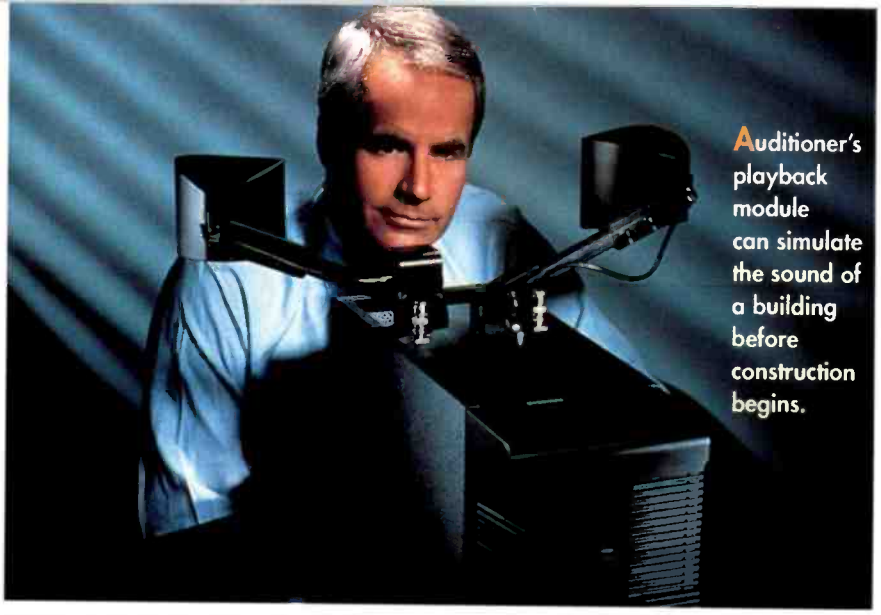

Auditioner's playback module can simulate the sound of a building before construction begins.

speech and music through Auditioner, processed to simulate the sound in each of 10 seats scattered through one quadrant of the arena. (This was the same computer file that Arthur Griffiths had listened to a year earlier, before actual sound work began.) What I heard through Auditioner in the meeting room was definitely the sound of an arena, but the multiple delayed sounds normal for such halls were low in volume and seemed to ring rather than slap. I could understand words easily. And voices from the simulated sound system seemed paradoxically close, considering the big-arena sound cues. (It was like attending a concert held in a tunnel, but sitting in the front row.) The sound was definitely clearer in the simulated upper tiers of seats than down by the basketball court, but it was adequate even down there.

What I heard in the empty, 20,000-seat arena, a few minutes later, was basically what I'd heard through Auditioner. Some boominess (which I had not noticed through Auditioner) muddied the bass voice of singer Richard Loney but not the alto of Kirsten Nash. That night, with the arena filled for a basketball game (Chicago Bulls 94, Vancouver Grizzlies 88), the sound seemed hardly different in the upper rows though it was definitely less intelligible at the bottom of the seating area.

Getting the acoustics right was apparently less troublesome than it might have been. "Our original analysis told us we had a pretty good room, acoustically," says Tom Anselmi, the arena's vice president for operations, "and Bose reacted to the room we handed them without demanding wholesale architectural changes." What changes were made were relatively inexpensive, because they were made early. The ceiling, for example, is of perforated metal backed with fiberglass, to provide absorption—more costly than a plain ceiling but cheaper by far than installing something else and then replacing it.

Getting the sound system right, however, took specialized speakers, Bose's Panaray LT (long-throw) series. These speakers have comparatively flat frequency response over very narrow angles and then cut off sharply. Controlling where the sound goes can reduce the amount of sound absorption needed. But the main impact is to ensure that spectators within the beam of one speaker won't be bothered by overlaps and interference from speakers adjacent to it, a major factor in sound clarity. "Just piling speakers in a large space gives you a loud but swirling soup of sound," says Cliff Henrickson, the speakers' designer, "because you hear all these speakers at different times. . . . But if you build up an array of speakers in which each delivers a very narrow slice of sound, that sound seems nearer and you don't hear so many speakers at once."

Could Modeler and Auditioner be used for designing (or redesigning) concert halls? "I think that would be marvelous," Jacob says, but he believes some system enhancements would be useful for concert-hall work, such as lowering Auditioner's bass response by at least an octave and enhancing Modeler's ability to model the action of diffusers. Bose might even give the Auditioner playback system rear speakers to simulate the sense of immersion you get in good concert halls. A

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JOHN EARGLE

DSS TODAY

By any measure, RCA's Digital Satellite System (DSS) has been one of the great commercial successes in consumer electronics of the last two decades. James Harper of Thomson Consumer Electronics (RCA's parent company) states that total DSS sales for 1995, for RCA and other makers, are estimated at about 1.5 million units, up from 600,000 during DSS's first year, 1994. Currently, DSS offers about 275 channels, including movies (many in duplicate with different starting times), sporting events, music, and the wide range of typical cable fare.

Last year also saw an evolutionary improvement in overall DSS performance, through the gradual phase-in of MPEG-2 video compression technology. This variable-data-rate algorithm has cleaned up the occasional "blocking" artifacts of MPEG-1, which, in the early days, plagued some of the "slower moving" channels (such as the Learning Channel and the Discovery Channel). Even before the implementation of MPEG-2, significant progress had been made in this respect by a technique known as statistical multiplexing, in which the data requirements of fast-moving, high-ticket programs, such as pay-per-view sporting events, could be spread out over additional channel space, thus producing top-quality video images.

WHAT YOU SEE ON DSS WILL SURELY LOOK VASTLY BETTER THAN THOSE SAME CHANNELS ON CABLE.

Having used an RCA DSS dish for a little over six months, I have a number of observations that may help *Audio*'s readers in deciding whether this new technology is for them. Before I get into those particulars, I'll briefly describe my evaluation setup.

I used a late-model Hitachi TV set (4:3 aspect ratio), located at a distance such that the horizontal dimension spanned a viewing arc of 10°. (As a rule of thumb, keep in mind that the width of your index finger, seen at arm's length, is about 1°.) This is the "target" condition at which the 4:3 aspect ratio of current television systems works best, in that it keeps the raster (horizontal scan) lines from being noticed as such while allowing the picture to be of reasonable size. The viewing space was moderately lit, as opposed to the dark surroundings that are more appropriate for cinema presentation. Overall picture brightness was adjusted against this background illumination so that it would seem neither overly bright nor dim.

An important recommendation: Do not install the system yourself, unless you are that rare handy type who feels entirely at home installing a rooftop rotating antenna system. As small as it is, the DSS dish demands firm anchorage, well out of reach of roaming hands, and it must be properly grounded for safe operation. Snaking coaxial cable through attic and walls requires special skills, and I doubt many people would want to try this. Plan to spend anywhere from $175 to $225 for a professional installation, depending on where you live.

The control unit is about the size of a VCR and conveniently sits on top of your TV set. You have a choice of two basic hookup modes. If your TV has the capability for composite, non-RF input, then that input should be used, for best picture quality. (Actually, if you have S-video connections, that will be slightly better still; DSS is one of the very few sources that provides a benefit with this type of hookup.) Older sets may need to be set for channel 3 or 4, whichever one is not used in your area, and the control unit set for that unused channel. Depending on your TV set's vintage,

Photograph: Courtesy of RCA

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it may be possible for the new DSS remote control to "learn" some of the functions from your TV's remote so you won't have to go back and forth from one remote to another as you operate the system. DSS supports two-channel stereo sound, which, with current movies, implies a Dolby Surround-encoded pair of tracks for use with a Pro Logic decoder to get surround sound.

A big question for most potential DSS buyers is the status of their existing cable/antenna service. Remember that DSS programming is generic for the entire continent and does not carry your locally originating programs. If you rely on cable for local service, you may have to think twice about continuing that cable service while you assume new monthly charges for DSS.

WITH DSS, YOUR ACCESS TO INDIVIDUAL PROGRAMS CAN BE TURNED ON OR OFF VIA SATELLITE.

Many users find that they can get better local reception than they ever thought possible with an antenna. But this may be impossible for an apartment-dweller in a big city. In any event, what you see on DSS will usually be a vast improvement over those same channels as they appear on cable.

The following is a typical evening in the life of a DSS watcher. After you turn on the system, you will probably want to browse the program guide. The display can be scrolled up or down, as fast or slow as you wish, and you simply press "Display" on the remote when a desired program is highlighted on the screen. If that channel is covered in your basic fee, the picture will come up immediately. If it's pay-per-view, you will see ordering information. You have two options here: If you spend a lot of time watching current movies, it is quickest (and cheapest) to have your control unit wired into a telephone line; if you don't watch that many current movies at home, you can simply phone in and ask that your set be "turned on" for the given show you want. DSS has direct satellite access to your control unit; via your personal DSS access cards, decoding of individual programs can

be turned on or off by a signal embedded in the data stream. This may take a few minutes, and some restrictions may apply.

Many of the satellite channels are the same as on your cable service, so your local newspaper listings will give you an idea of what is available from week to week. Other satellite channels will not appear in your local listings, and your only indication of programming will be the onscreen program guide. It is possible, via the main menu, to check the guide up to 54 hours ahead. When you do this, the control unit will take 10 or 12 seconds to access the future program information before displaying it.

If the pilot light on the control unit blinks slowly, there is something in your "mailbox." It might be a notice of a special event that may be of interest to you or, perhaps, billing information. Other main menu items you can choose include language options, scanning of specific program types, and diagnostic tests of your system. In this last category you can actually monitor the incoming digital signal's strength, which could indicate if there is a problem in the aiming of your dish.

Although I have not operated my dish during the heavy rains that come to Los Angeles during the winter months, I must say that heavy fog, which we have lots of, does not reduce the system's effectiveness. The rains, when they do come, may be another matter.

Presently, there are two providers of programming for DSS: USSB specializes in first-run movies, offering such channels as HBO and Showtime; DirecTV presents pay-per-view movies plus most normal cable services. Both USSB and DirecTV provide a wide range of music-only channels, said to be "CD quality." This statement is difficult to assess, since the material is presented pretty much in a continuous background music fashion, which does not invite critical listening.

The main reason for getting DSS in the first place is not music, but a superior picture—and this it does deliver. The quality level depends not on the delivery system but on the original source material. You can readily see these differences as you switch from channel to channel, comparing older video recording technology with new program material. Computer-generated video graphics are absolutely stunning, as are first-run films; both have excellent detail and contrast along with well-saturated color. Of course, what you are ultimately looking at here is NTSC (North American and Japanese standard) television, but without the noise, snow, ghosts, or moiré patterns often associated with terrestrially based RF transmission.

The DSS picture, with the best program input, rivals that of laserdisc and in many cases exceeds it. Specifically, the MPEG-2 signal, driven from a digital master tape at the programming point, will have none of the isolated dropouts (often showing up as tiny white spots against dark backgrounds) that routinely plague laserdiscs.

Recent DSS developments include the launching of a third satellite, with its promise of more channels, as well as viewing options for wider aspect ratios. When that day comes, we should all be lucky enough to use line doublers so that the picture width can be extended to 15° or 18°. Now that will a real motion picture experience at home! A

KEN KESSLER

CULTURAL BACKSLASH

While Bill Clinton's actions in the Country Formerly Known As Prince, er, Yugoslavia might have restored Americans' faith in the global image of their nation, he really didn't have to prove anything to the rest of the world. (I'd like to think that he was motivated by a love for peace.) Although his intervention reminded Europeans that Americans still pack the biggest punch and reminded Americans that the United States is still *the* supremo superpower, in cultural terms things haven't changed one bit since the turn of the century. As we move into the 21st century, it's clear that everyone from taxi drivers in mainland China to waiters in Budapest want their MTV, Levis, and Big Macs. And it's most amusing to note that even the French haven't been able to curb the Americanization of the planet, despite having made the use of American expressions a crime.

American dominance exists even when it's a case of the tail wagging the dog; the world of hi-fi is but one example. The United States has, after all, a smaller population than all of the countries that make up the European Economic Community put together, and it probably absorbs no more than 30% of the world's hi-fi. Indeed, one can name a dozen countries (including the odd American brand) that export better than 90% of their output just to the Hong Kong/Taiwan/Singapore triangle. (No, I won't embarrass them publicly, but I can also name a couple that export 100% of their output to this region.)

NEARLY ALL NON-AMERICAN BRANDS SEEM TO ASPIRE TO AMERICAN ACCEPTANCE.

Conversely, there are brands that do very nicely in Europe but don't even have (or want) U.S. distribution, arguing that the market is too diverse and dispersed, too xenophobic, too price-oriented, and too political. Oh, and all but devoid of worthy high-end retailers. But the world of hi-fi still marches to an American drumbeat, and nearly all non-American brands seem to aspire to American acceptance, even if they don't actually sell their wares in the United States.

So, should any unpatriotic types start telling you that American influence has lessened, tell them to think again: The home cinema and multiroom (or installation) markets have ensured that U.S. tastes and requirements still determine the final shape, size, and color. There's no better example of this slavish pandering to the United States than the decision of a certain misguided British loudspeaker manufacturer, which depends as much on its home market as it does on export, to produce a range of in-wall speakers that cannot be used in the majority of British homes. The British, you see, have not embraced cavity-wall house construction, so you need a jackhammer to cut into the brickwork to fit their flush-mounts.

For that matter, the British haven't embraced multiroom either, nor have many other nations. Multiroom is primarily an American phenomenon; one manufacturer told me, even more specifically, that it's a Southern Californian phenomenon. And yet there are companies around the world producing full remote-control systems, with wall-mounted keypads and camouflaged hardware, that appeal only to American consumers—except the Americans are buying the far less expensive homegrown equipment. Why pay over the odds for imported multiroom control systems when you can buy products from Audio Access, Crestron, Lexicon, or a few dozen other American makes at prices that seem shamelessly low compared to the imports?

Illustration: Courtney Granner

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Whatever you call the current parlous state of the world's economy—a recession or a depression or simply the end of the millennium—the construction industry has been hit hard, and new homes aren't being built with the fury that they were in the mid-'80s. As a result, fresh new apartment blocks are not there waiting to be prewired for a six-zone home entertainment system. And only the absurdly wealthy outside of the U.S. can consider high-end multiroom installations, because they're the only people who are redecorating their homes to an extent greater than new wallpaper or a lick of paint. The types of apartments in London, Paris, and Hong Kong that are being pre-wired for multiroom hi-fi are the luxury homes that will house oil magnates, top lawyers, show-biz types, and Grand Prix racers. Mere audiophiles (who don't want multiroom junk anyway) cannot afford $30,000-plus just for the wiring and the controllers and the carpentry.

YOU CAN AMELIORATE RESISTANCE TO HI-FI BY DISGUISING OR DECORATING IT.

And another thing that multiroom vendors tend to forget: Americans typically have larger homes, in terms of square footage and in the number of rooms. That's what has also allowed American consumers to embrace home cinema, because it's more likely that an American home has an extra room or a finished basement adaptable to the cause of home viewing. This is not to say that all Europeans and Asians live in shoeboxes, but it's not far off the mark, either. It will be amusing to see how successful the recently founded CEDIA-Europe is at educating both the public and the trade about the wonders of multiroom hi-fi.

What Europeans have learned from the Americans, and not a moment too soon, is that you can ameliorate resistance to hi-fi by disguising or decorating it, even if you don't go all the way with custom installations that hide the hardware like a mad uncle locked in the attic. And since speakers are the worst culprits when it comes to upsetting domestic harmony (unlike amps and CD players, they don't work behind the closed doors of a cabinet), one can only register surprise as to why it's taken so long for European speaker builders to progress beyond offering different wood finishes.

Both venerable and new American brands deserve the credit for this. The four-way Nobis, with removable lower baffle trim as a separate section, was launched last year by BNS Loudspeakers; it's available in various veneers and primary colors. This is such a logical and cost-effective solution for supplying a multitude of finishes, I can only wonder why nobody thought of it before. (I trust a reader with a long memory will remind us of any ancestor that might exist.) Best of all, for those with a near-fatal dread of upgrading or redecorating, future changes in the domestic environment can be addressed simply by purchasing new panels. And now a German company has followed the lead of BNS.

Heco is one of Germany's largest speaker firms, with more lines than I can keep straight, but the new Ascada series presents a novel alternative to the BNS method. The models in this new line, which comprises three floorstanders and a medium-sized two-way speaker, are offered with glossy all-black or all-white cabinets. What's interchangeable, though, are their top panels and the lower section of their front panels (roughly LP-sleeve-sized sections), which enable the owner to match speakers with room decor. The catalog shows, in addition to black and white panels to create monochromatic monoliths, a half-dozen veneers, including oak and cherry, and a half-dozen bold colors (turquoise, mauve, royal blue, and the like).

But you can now go even further. And again, there's an historical precedent from the U.S. Instead of offering replaceable bits, why not make it easy to refinish the entire enclosure? I may risk sounding sexist, but in truth most objections to the presence of hi-fi in a room do come from wives and girlfriends. So this alternative will enable the beleaguered, henpecked male to get the distaff component involved in overall color selection. Think of it as hi-fi's answer to the lipstick counter.

Partial color modifications have existed before in forms that didn't involve panel replacement or refinishing. A couple of

decades ago, JBL offered a choice of colored grilles for certain models; I seem to recall a selection for the original Century and Decade, especially a not-too-appetizing orange. Around the same time in the United Kingdom, KEF came up with cloth stockings that slipped over the entire speaker like a gigantic condom. But the true antecedent for Mordaunt-Short's new Decormatch is the option that used to be available to Acoustic Research customers in the 1960s. (Before the hate mail starts, I must gleefully admit to being just that bit too young to remember what hi-fi was available before my interest was aroused in 1967. So to any other manufacturers who were also offering what I'm about to describe, and I think that Klipsch was one of 'em, sorry for leaving you out.)

LIKE IT OR NOT, AUDIOPHILES ARE OUTNUMBERED BY CIVILIANS, 100,000 TO 1.

If you look through old AR catalogs and your now-yellowing annuals from *Audio* and *Stereo Review*, you'll discover that nearly all of AR's mid-'60s loudspeakers were available in raw, unfinished wood for the customer to paint, stain, varnish, or veneer. Unlike with kits versus built-ups, the possible savings probably weren't a motivating factor in buying ARs *au naturel*. Quite simply, this option allowed the handy-with-sandpaper customer to match his AR speakers to any decor. And for AR, it meant not having to offer (or keep stocks of) bizarre veneers in the hope that one day they'd have an order for a pair of zebrawood or ebony 2AXs.

Now the British company Mordaunt-Short has revived this 30-year-old idea, a boon for house-proud music lovers who don't want to cut holes in their walls to accommodate flush-mounted speakers. But the finish isn't raw wood, and you don't need to know about varnishes to benefit from the "freedom to decorate."

Decormatch is the name of the polymer formulation used for the cabinet material, a surface that can be painted with vinyl matte or vinyl silk emulsions. Mordaunt-Short collaborated with Dulux, the U.K.'s largest paint manufacturer, in the design of the cabinetry, so the system is guaranteed to work with the widest range of paint colors imaginable. Leaving nothing to chance, M-S even ensured that the grille cloths can be colored to match or contrast with the enclosure, using a proprietary cold-water dye. Two coats of paint and the dyeing of the grilles are all that it takes to adapt the smallest Mordaunt-Shorts to even the most pastel of dwellings.

Decormatch will first appear on the company's CS-1 loudspeaker, a fully shielded, inexpensive little two-way system, rather than a costlier design. Not surprisingly, Mordaunt-Short also sells loads of CS-1s for home theater systems because, even in their standard state, they're relatively unobtrusive. While paying attention in this manner to the nonperformance-related matter of appearance might be anathema to purists such as us, it does address the real world. And, like it or not, audiophiles are outnumbered 100,000-to-1 by civilians. A

19 Bits in a 16-Bit

Noise shaping is today's hot CD mastering technology—so what is it, and does it really make a difference?

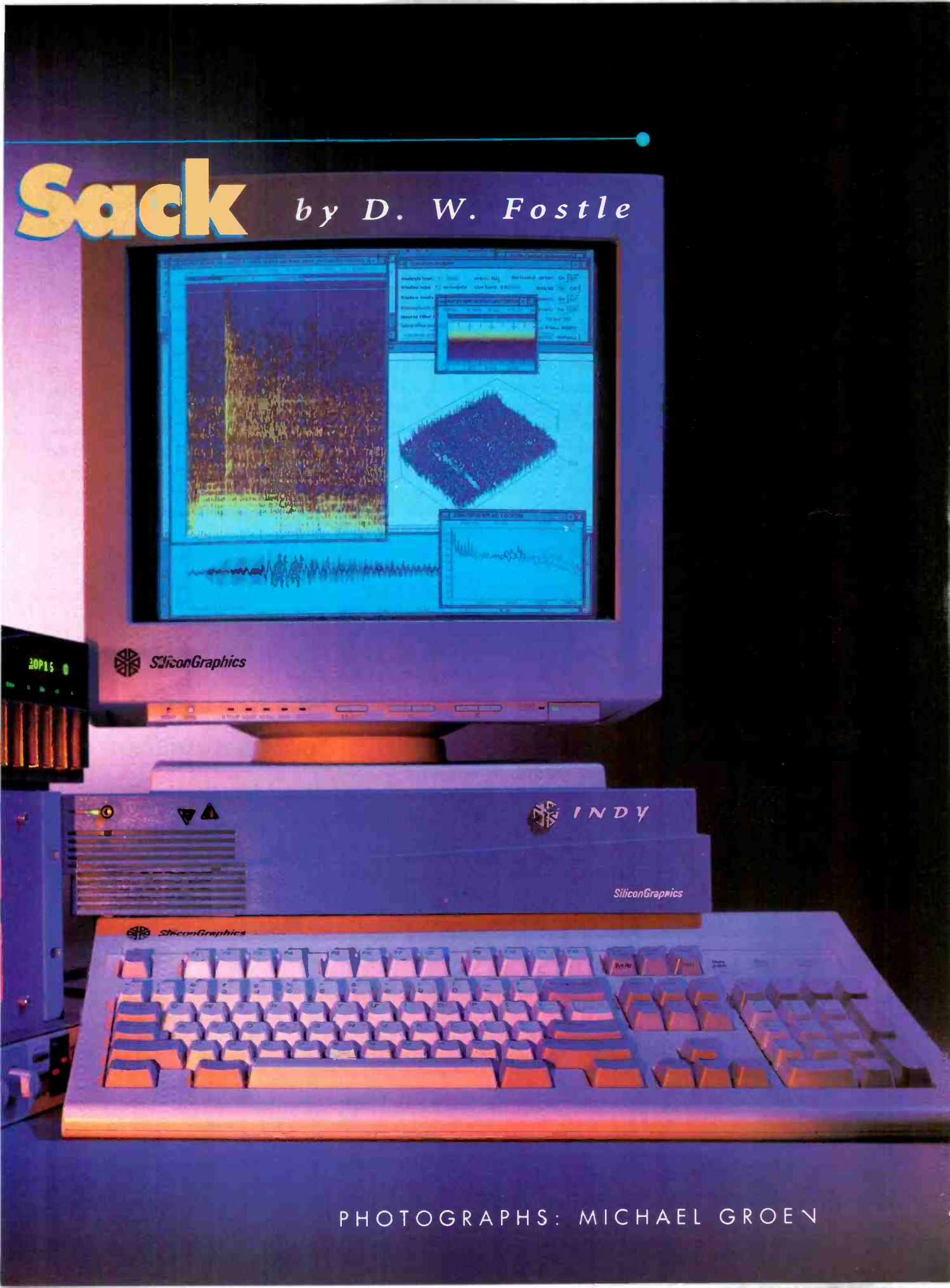
A formerly exotic engineering technique called noise shaping has entered the audio mainstream. Chances are you own CDs bearing the logos of some of the proprietary noise-shaping systems developed by major labels to transfer their 20-bit master tapes to the 16-bit CD format with minimum audible degradation. Sony's Super Bit Mapping (SBM) and Deutsche Grammophon's Authentic Bit Imaging (ABI) are among the digital procedures that promise greater transparency, improved resolution, and reduced noise in what some have called "19-bit-equivalent" recordings.

The practice of transferring old analog masters to 20-bit digital format and then noise-shaping the copies for rerelease on CD is also growing. Available now are the legendary Impulse "Blues and the Abstract Truth" sessions by Rudy Van Gelder and the renowned Everest "mag-film" classical recordings engineered by Bert Whyte. Sony has

D. W. Fostle is the author of The Steinway Saga *(Scribner, 1995), an account of the piano-making family and their instruments. His techniques for computer-based measurement of musical signals, developed in researching that book, form the basis of this article.* *The author wishes to thank Silicon Graphics and Entropic Research Laboratory for systems and software support.*

Sack

by D. W. Fostle



PHOTOGRAPHS: MICHAEL GROEN

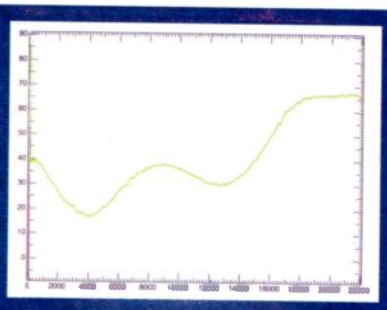


Fig. 1—*The Weiss SFC-1's noise-shaping spectrum. Note the pronounced dip in the noise floor around 4 kHz, where the ear is most sensitive, and the steep rise at very high frequencies, where it is least sensitive. Decibel scales here and on most following graphs show relative, not absolute, levels.*

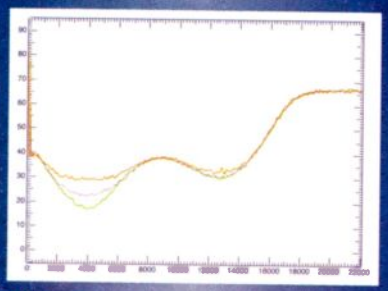


Fig. 2—*The Weiss SFC-1's shaped 16-bit output-noise spectrum with no input (green curve) and when fed by two popular 20-bit A/D converters, the Lexicon 20/20 (purple curve) and the Wadia Digital 4000 (red curve), with no audio input. The converters' noise partially fills in the dips in the SFC-1's noise floor.*

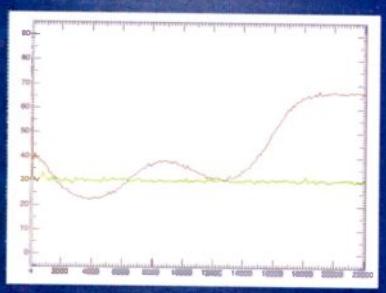


Fig. 3—*The Lexicon 20/20 A/D converter's noise floor (green curve) and the noise-shaped 16-bit output of the Weiss SFC-1 fed from the Lexicon with no input signal (purple curve).*

been a leader in rereleasing the works of some of the major names in pop and jazz: Boston, Dave Brubeck, Miles Davis, Bob Dylan, Robert Johnson, Pink Floyd, and Weather Report, among many others, are available in the company's premium Mastersound series, all with SBM processing.

There is also a considerable amount of stealth noise shaping on recordings that carry no identifying logo or label note. A recording by a famous "grunge" band shows treble lift in the noise floor for a few milliseconds before the onset of modulation; this is noise shaping's "smoking gun," but visible only by spectral analysis. Those whose CD collections are flannel-free zones and whose tastes incline to recondite programs on the audiophile labels may be surprised to learn that these types of recordings, too, are sometimes noise-shaped without notice.

Finding the Noise Floor

Noise shaping for CD mastering grew out of the appearance of so-called "20-bit" analog-to-digital (A/D) converters in the early 1990s. A method was needed to properly shorten the word length of the converters to the 16-bit format of the Compact Disc. As an alternative to simply chopping off, or truncating, the extra bits, as was sometimes done, or (better) rounding off and redithering, members of the Audio Research Group at Canada's Waterloo University proposed a means to retain some of the benefits of the theoretically lower noise levels on the 20-bit masters.

On paper, a full-scale 20-bit digital representation of an analog signal can resolve more than 1 million discrete levels (2^{20}, or 1,048,576, to be exact), whereas a 16-bit representation of the same signal has a potential resolution of just 65,536 levels (2^{16}). The difference between the actual level of a signal sample and the nearest discrete quantization level that it can be assigned by the A/D converter is known as the quantization error, which manifests itself during playback as noise and distortion. The longer the word length, the finer the level gradation available to the converter, which in turn reduces quantization error and, thereby, noise and distortion. For true 20-bit conversion, the theoretical level of quantization noise and distortion works out to –122 dB relative to full scale (maximum level, or 0 dB), as compared with –98 dB for a 16-bit converter.

These engineering measurements do not make intuitively sensible the magnitude of the quantities involved. A $10,000 stock-market investment that rose 98 dB would have a value of about $794 million. If that sum represented a "16-bit portfolio," a 20-bit portfolio would be worth $12.7 billion. Saying that one 3-foot pace represents the theoretical noise in a "20-bit full-scale walk" implies a hike of almost 722 miles; for a 16-bit walk, the distance shrinks to 45 miles.

So impressive ratios lurk inside the deceptively unprepossessing quanta designated by 16 or 20 bits. If a way could be found to preserve some of the information in the 20-bit representation, that presumably would be a good thing. After all, it seems undesirable to turn that $12.7 billion portfolio into one worth a mere $794 million.

Noise shaping for CD mastering reduced sensitivity at very high frequencies.

Enter noise shaping, which is nothing more than a particular type of digital filter applied to a signal in a particular way. The goal of the filtering operation is to save some of that $12 billion we are about to throw away while creating the illusion that we have saved much of it. The basis for this clever trick is the long-known nonlinearity of human hearing, which is most sensitive in the region of 4 kHz. If you remember when hi-fi gear was equipped with "loudness controls" (which purportedly compensated for our reduced sensitivity to bass at low sound pressure levels), then you already know something about the phenome-

non, which is based on our perception of equal loudness.

Curves of equal loudness versus frequency are determined empirically. Subjects are asked by experimenters to state when a tone or a narrow band of noise is equally loud in comparison to a reference tone or noise. By comparing the actual sound pressure levels that create the impression of equal loudness, you can plot the frequency response of the subject's hearing for a given reference level. As the level of the reference stimulus rises, these curves tend to flatten out (although they never come anywhere close to being completely even). At low levels, doubling the frequency of a 4-kHz tone that is just audible may require boosting it by roughly 20 dB to keep it audible at 8 kHz. At low frequencies the nonlinearities are much larger: Dropping the 4-kHz tone to 40 Hz might require a 40-dB increase in sound pressure to create the impression of equal loudness. Variations from person to person can be very large, however, and standard deviations of 3 to 10 dB are reported. A range of ±3 standard deviations conventionally encompasses 99.7% of a population, so we might well expect individual judgments of equal loudness to diverge as much as 60 dB in extreme cases, depending on frequency and level. An equal-loudness curve derived from averaged responses may therefore be an inconsistent predictor of individual responses.

takes advantage of the ear's

Noise shaping for CD mastering takes advantage of the treble portion of the ear's nonlinearity (loss of hearing sensitivity is actually more pronounced in the bass, but filters for the high-treble range require much less computing power). In the process of requantizing a (usually) 20-bit signal down to 16 bits, the shaping filter digs a depression in the 4-kHz region of the 16-bit noise floor, where we would be most likely to perceive it. The noise is not reduced in total; in fact, total noise power is increased. The noise energy excavated in the 4-kHz region is piled up, so to speak, where it will be harder to hear, principally above 13 kHz. The original work on noise shaping set the filter contour to match the 15-phon ISO equal-loudness curve (i.e., the curve of levels needed to make each frequency equal in perceived loudness to a 1-kHz tone at 15 dB SPL).

Noise shapers of the type used to convert 20-bit masters for 16-bit CDs work as follows: The bottom four bits are clipped from the 20-bit signal and fed back into the incoming signal through a filter that alters the spectral shape and adds dither. A delay is involved that is determined by the number of coefficients in the filter (digital filters work by multiplication of numbers). The University of Waterloo group proposed a filter shape based on the psychoacoustic data described above; it was not long, however, before claims were made that listening tests revealed other shapes to be sonically superior. Sony's SBM curve is one such alternative, and there are others.

Figure 1 shows the spectrum of a commercially available noise shaper, the Weiss Engineering SFC-1. Though not widely known among audiophiles, Weiss's superbly built equipment is used in hundreds of mastering rooms worldwide. The Weiss curve is shown here because it represents a "pure" implementation of the original concept of equal-loudness-based noise shaping. Ignoring the spike below 50 Hz, which results from low-frequency noise, you can see that the curve descends to its minimum at 4 kHz, then rises about 21 dB at 9 kHz, dips back 8.4 dB to mimic the increased sensitivity of the ear in the region of 12.5 kHz, and then continues its ascent to about 18 kHz, where it levels off. Trough to peak, roughly 50 dB of shaping is applied to the noise floor. It is a curve of this type that is the basis for the "19-bit-equivalent" claims. The quantization noise in a theoretical 19-bit channel is at –116 dB; in the region immediately around 4 kHz—and only that region—a noise shaper like the Weiss approximates that performance. At 2 and 6 kHz, for example, the noise is somewhat higher, roughly equal to that of a 17-bit channel. And, obviously, at very high fre-

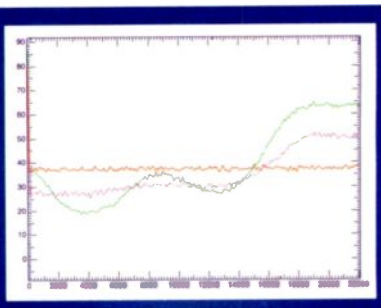


Fig. 4—*Noise floors of Weiss SFC-1 noise shaper (green curve) and Sony's Super Bit Mapping system (purple curve), fed by a Lexicon 20/20. The flat (red) curve is unshaped 16-bit TPD (white-noise) dither from a Meridian 618.*

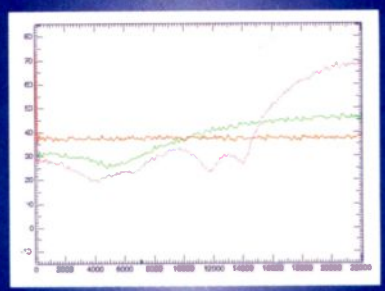


Fig. 5—*Output of Meridian 618 at its most and least aggressive noise-shaping settings (purple and green curves, respectively) and at its flat-dither setting (red curve).*

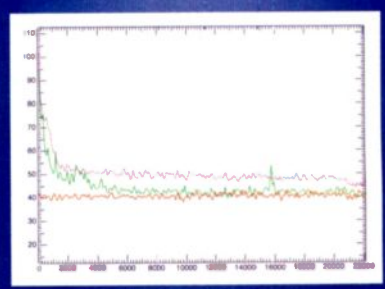


Fig. 6—*Noise floors of two digital recordings from audiophile labels (purple and green curves) and Gaussian noise at –96 dBFS for reference (red curve).*

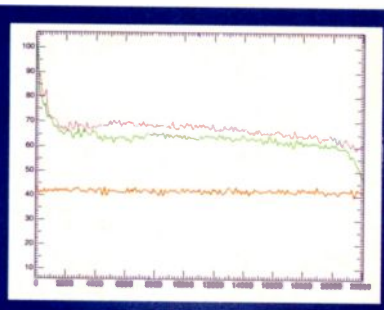


Fig. 7—*Noise floors of an Aretha Franklin track from the 1960s (purple curve) and of a cut from Cassandra Wilson's* Blue Light 'Til Dawn *CD of 1993 (green curve). The flat reference is Gaussian noise at –96 dBFS (red curve).*

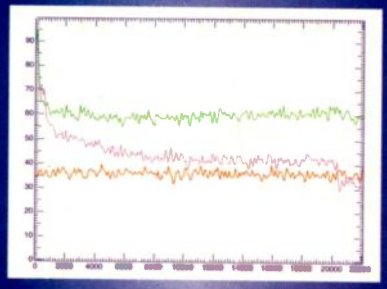


Fig. 8—*Noise floors of the original CD release (purple curve) and SBM-processed Mastersound CD release (green curve) of Miles Davis's* Kind of Blue. *The flat (red) curve is Gaussian noise at –96 dBFS, about the lower limit for a 16-bit medium without noise shaping.*

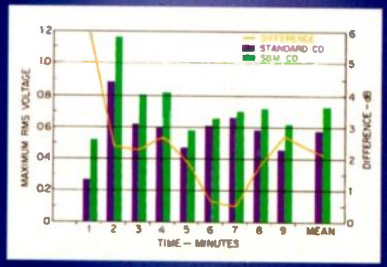


Fig. 9—*Maximum level differences, minute by minute, in "So What" on the original and SBM-processed Mastersound CD releases of* Kind of Blue.

quencies the noise is much greater than in a pure 16-bit system.

There are other caveats as well. The use of a specific equal-loudness contour also implies a specific sound pressure level for the music above the shaped noise floor. At any other level, the shaping will not be optimal (though it may be very close), and some degradation of perceived noise performance must occur. Perhaps some people do listen to Hootie and The Blowfish, the Tokyo String Quartet, John Coltrane, and the Chicago Symphony at the same levels; others almost certainly do not. Further, hearing either the noise floor itself or a substantial portion of the musical information that is supposed to be preserved by noise shaping implies playback at very high levels. If we expect to hear the alleged "19-bit resolution" (assuming no masking by ambient noise in the listening room and the availability of a playback system that does not degrade the signal-to-noise ratio), we must achieve peak levels nearing the threshold of pain. Systems capable of such performance are few and far between, so it is plausible that only a handful of people can benefit fully from 19-bit-equivalent noise levels—assuming they actually exist on some recordings.

If the noise floors produced by various shapers are digitally multiplied by 1,000—in effect, amplifying them by 60 dB—the sound that results is strange and markedly different by type. The sonic impression of the Weiss implementation might be described as a hollow hiss, while the gain-multiplied floor of the Sony SBM shaper, though less hissy, contains a distinct crackle reminiscent of frying eggs. The most aggressive noise-shaping curve of the ones I have examined, the Meridian 618's Curve D, gives the impression of a very sharp fizz that is almost pitch-distinct. It is probably a good thing that we do not hear these noise floors under normal listening conditions.

Hitting the Wall

In practice (meaning, in real recordings), 19-bit performance is not achieved at any frequency and probably cannot be, given the current state of the art. Consider the curves of Fig. 2, which compares the spectrum of the Weiss SFC-1 under three conditions. The first condition, and the lowest (quietest) curve, is the output of the SFC-1 with no input. The next curve shows the SFC-1 fed by a popular 20-bit A/D converter, in this case the Lexicon 20/20, which has a specified 112-dB dynamic range. You can see that the noise level increases by 5.8 dB, or nearly 1 bit, at 4 kHz. The uppermost curve shows the noise floor of the SFC-1 when combined with another, somewhat noisier 20-bit converter having a claimed dynamic range of 108 dB, a Wadia Digital 4000. Another 6.3-dB increase in the 4-kHz noise level can be seen.

Figure 3 compares the Weiss's shaped output to the noise spectrum of the Lexicon converter itself, without shaping. At 4 kHz, the shaped noise is about 7.3 dB lower than the unshaped noise, and some advantage is apparent between 1.6 and 6.4 kHz. Although a benefit is obtained, it is smaller than might be anticipated from the characteristics of the noise shaper alone. The original University of Waterloo research papers cautioned that the full benefits of noise shaping require very low-noise signals. In practical recording systems, such signals are rare, if they exist at all.

Some makers of professional A/D converters provide signal-to-noise specifications; others do not. When given, the noise ratings of 20-bit converters typically fall around –105 dB, only about 7 dB better than the theoretical noise floor for a full 16 bits. So while they can provide 20 bits of data from an audio input, true resolution is usually in the vicinity of 17 bits. To move the roughly 3 bits, or 18 dB, to full 20-bit performance implies a factor-of-eight re-

In practice, 19-bit performance achieved and probably can't given the current state of

duction of noise. That is no small task, and if sonic nirvana is a million-to-one signal-to-noise ratio, nobody is going to get there soon.

Accepting that we're not likely to get all that noise shaping promises, how do some of the systems in use today stack up? Figure 4 compares the noise floors of the Weiss SFC-1, with its "pure" psychoacoustic approach, and the most famous noise shaper of all, Sony's Super Bit Mapping system, both fed by the Lexicon 20/20 A/D converter with no input signal. Based on its own research, Sony seems to have abandoned any attempt to closely mimic an equal-loudness contour and opted for a broader, shallower depression in the noise floor. The SBM curve is roughly flat between 1 and 5 kHz. By 7 kHz it is up 2 to 3 dB, where it remains until about 13 kHz, rising from there to a plateau around 18 kHz. Trough to peak, the SBM curve measures about 26.5 dB, or 20 dB less than the Weiss SFC-1 under the same conditions.

The red curve in Fig. 4 is the spectrum of the Meridian 618 in its triangular-probability-distribution (TPD), or "flat," mode. This is an unshaped white-noise dither that represents the minimum practical noise floor achievable with low distortion and without shaping when converting from 20 to 16 bits. With respect to the TPD line, SBM is about 9 dB quieter at 4 kHz, whereas the SFC-1 achieves a 17-dB reduction at the same frequency. On the other hand, SBM excels below 2 kHz and from approximately 7 to 10 kHz, and it produces a smaller noise bulge at very high frequencies.

The Meridian is not limited to TPD dither, however. The user has a choice of

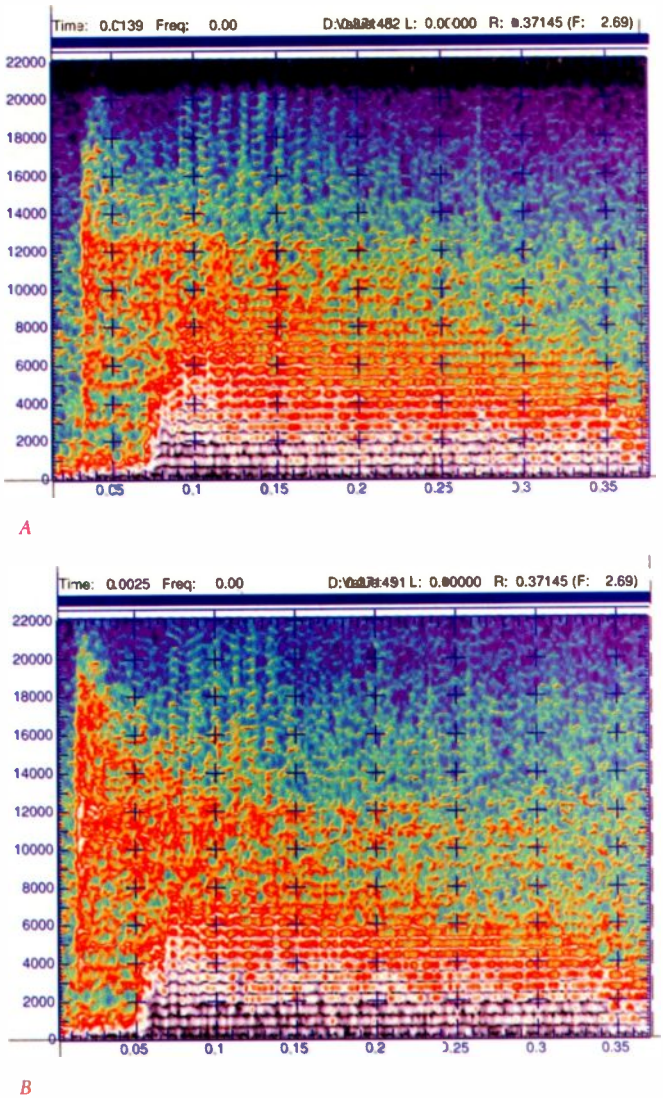
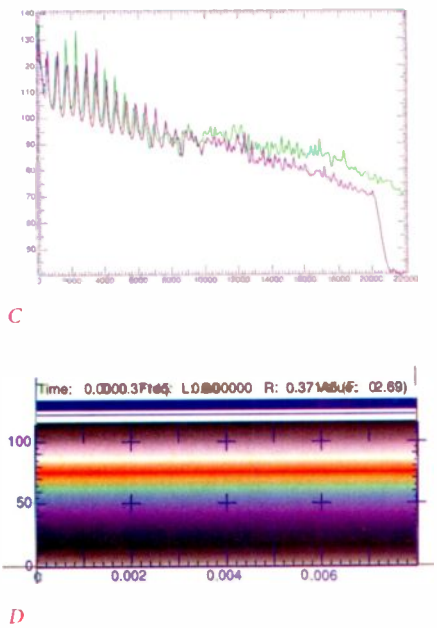


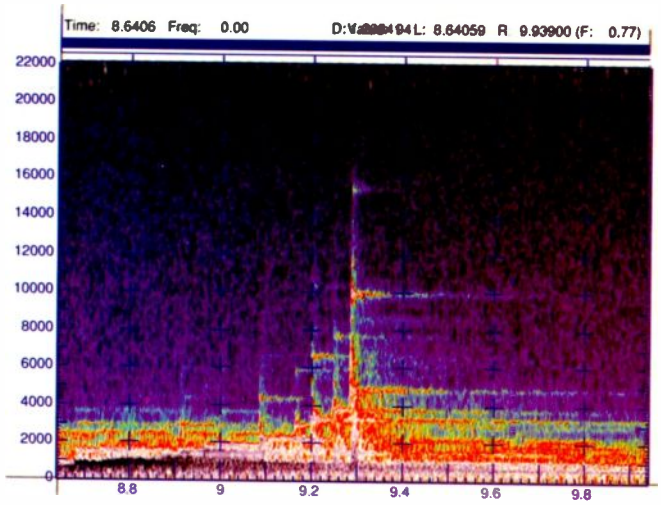
Fig. 10— *Spectrograms of approximately 400 milliseconds from the original CD release (A) and Mastersound CD release (B) of* Kind of Blue. *Time is shown horizontally in seconds, frequency vertically in hertz. Amplitude is indicated by color. Amplitude-versus-frequency plots (C) for the same interval show equalization and bandwidth differences between the original version (purple curve) and SBM-processed Mastersound version (green curve). Color key (D), shown at bottom, is for Figs. 10A, 10B, 11A, and 11B.*

is not be, the art.

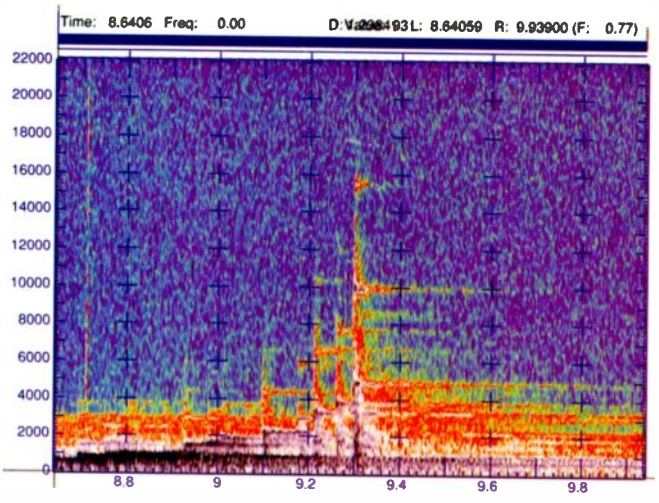
curves ranging from flat to the most aggressive noise shaping I've examined, along with recommendations from Meridian on their use. For example, Meridian provides separate curves for optimizing loudspeaker and headphone listening, as well as facilities for pre-emphasis and digital gain change. When connected to the same A/D converter as the Weiss and Sony noise shapers, the Meridian produced the curves shown in Fig. 5, achieving a maximum reduction from its own flat dither of 18.6 dB at 4.2 kHz and, for a much milder alternative shaper, 12.5 dB at 4.8 kHz. The Meridian's peak noise is about 30 dB above the flat dither. With its trough-to-peak range of 50 dB at its most aggressive setting, the Meridian displayed the greatest alteration of noise floor among the shapers tested when connected to an A/D converter.

So you can readily see that there are considerable differences among the various noise-shaping options available, even though all are said to be based on similar



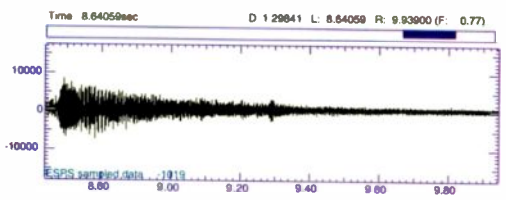


A

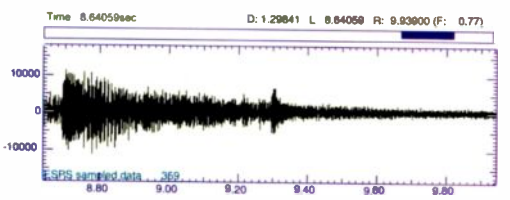


B

Fig. 11— *Spectrograms of about 1.3 seconds from a high piano arpeggio near the start of "Strange Meadow Lark" on the original (A) and Mastersound (B) CD releases of Dave Brubeck's* Time Out. *Equalization of the Mastersound version is even more evident here than on the Miles Davis. Amplitude-versus-time plots for the old (C) and new (D) versions show the EQ's dramatic effects on musical dynamics and phrasing.*



C



D

principles and directed to the same objective, a reduction in subjectively experienced noise. Moreover, each of the systems delivers less effect when connected to a real A/D converter than when operated alone. What was first shown in the case of the Weiss SFC-1 is true for the others as well: The noise from the converter "fills in" the lowest portions of the shaped noise floor in much the same way that the lowest part of a basement is the first to fill with water in a flood. This phenomenon makes the noise shapers somewhat less effective than theory or stand-alone performance tests would suggest.

Unfortunately, the converter is only part of the story. We have yet to consider performance spaces, microphones, preamplifiers, mixing consoles, and so forth, all of which add further noise. Before getting into that, however, let's take a look at the noise levels on some real recordings, beginning with Fig. 6, which shows the noise floors of two digital recordings from audiophile-label sampler CDs. For reference (red curve), I synthesized Gaussian noise at an rms level of 96 dB below digital full scale. (I chose that level because it represents excellent performance for more than 30 actual "purist" recordings that I examined.) The quieter of the two recordings comes within about 3 dB of the –96 dB curve, while the noisier is about 9 dB above it. The spike at 15.7 kHz in the quieter curve is a common artifact, leakage into the audio channel of signals from computer or video monitors at the NTSC horizontal-scan frequency. The noise levels of some analog audiophile recordings released on CD can be as much as 12 to 13 dB higher still. Such productions may have noise performance roughly equivalent to that of a digital recording with a resolution of 12 or 13 bits.

Those who believe that the passage of time must bring technical progress will be disappointed by Fig. 7. It compares an Aretha Franklin track from the 1960s to a cut from the critically acclaimed Cassandra Wilson *Blue Light 'Til Dawn* CD (Blue Note 81357) of 1993. Despite the lapse of roughly a quarter-century between the two sessions, the noise floors are similar. At 4 kHz, the passage of time brings a 1.6-dB improvement, largely the result of equalization that pushes down the noise between 3.7 and 7.5 kHz on the Wilson disc. The EQ imparts an "inky" quality to the tracks that, given the music, somehow seems apt. By 5 kHz, Cassandra bests Aretha by about 6 dB, but the noise is still almost 22 dB (12.6 times) higher than the –96 dB reference

Analog recordings may have roughly equivalent to that 12- or 13-bit digital.

curve. It is difficult to find enough silence on pop recordings to make this type of measurement, but two on which there is some, Nirvana's *In Utero* (Geffen DGCD 24607) and *Sons of Soul* by Tony! Toni! Toné! (Mercury Wing 514933), exhibit 4-kHz noise levels nearly 22 and 13 dB, respectively, above the –96 dB curve. From this it can be inferred that the Wilson noise levels are not unusual.

Perhaps the most important point is that typical listeners readily accept noise markedly higher than the theoretical 16-bit floor. This acceptance extends not only to popular recordings but also to some, probably most, analog audiophile recordings.

The Real World of Reissues

Easily the most amazing manifestation of noise tolerance, at least to me, is the pandemic critical approval of some releases in the Sony Mastersound series. Positioned as a demonstration of the sonic potential of "the revolutionary 20-bit Super Bit Mapping process," to quote from a brochure found in a record store, the rereleases in the Mastersound Legacy series are said to deliver "unprecedented clarity and accuracy."

Actual comparison of the near-silence in the first two seconds of "So What" from Miles Davis's seminal *Kind of Blue* in the standard (Columbia CK-40579) and Mastersound (CK-52861) releases can only be described as surprising. The initial probings of Paul Chambers' bass, almost tentative in the original, rumble forth in the Mastersound reissue. System noise, though perceptible in the original, assumes an aggressive and distinctly electronic character in

noise of

the later version. To minimize the "new" noise, there is a fade-in at the head of the track that is absent from the original.

Measurements in Fig. 8 confirm the subjective impression of both level change and increased noise. At 4 kHz the noise on the new mix is about 11 dB higher. Examining the recorded levels of the two CDs reveals that the maximum level of the Mastersound is (at this point in the recording) about 5 dB above the level of the original. This implies a net 6-dB increase in 4-kHz noise.

Note also that, whereas the noise spectrum of the original mix slopes downward, the remix noise actually rises slightly at high frequencies. At 10 kHz the noise energy is 17.3 dB above the original's, and at 20 kHz noise on the "new" Miles is 20.3 dB higher than on the old. With respect to the –96 dB Gaussian noise curve, noise on the "old" Miles is up 10.4 dB at 4 kHz and 6.9 dB at 10 kHz. The equivalent values for the new are +21.7 and +24.2 dB, respectively.

Based on the maximum recorded levels of the two releases, it might be suggested that one could reduce the intrusiveness of the noise on the Mastersound CD simply by turning down the volume 5 to 6 dB. That would be true if the level difference were stable, but it isn't. Figure 9 shows the maximum level difference in each minute of the two "So What" mixes. A maximum level difference of 6 dB (a doubling) in the first minute shrinks to 2.4 dB in the second minute, rises slightly, and then falls to about 0.5 dB in minutes 6 and 7 before rising again in the final two minutes. In remastering the recording, the overall dynamics of the performance were substantially altered from the original.

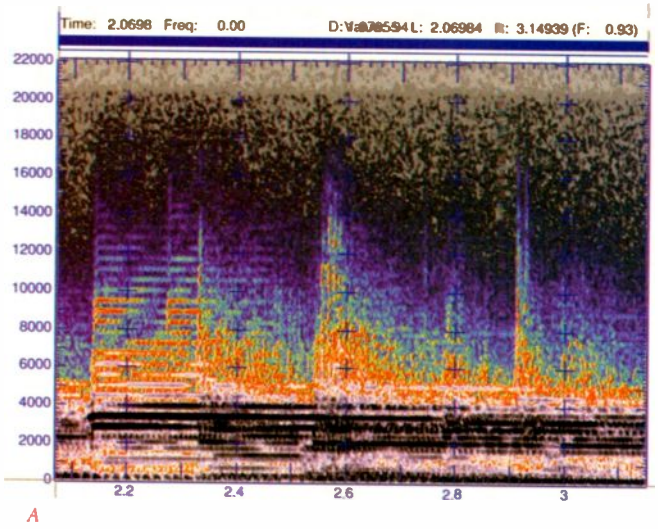
These changes have nothing to do with Super Bit Mapping. The greatly increased treble energy implies the use of equalization. If you take into account the level difference, it appears that perhaps 12 dB of lift was dialed in at 10 kHz, and possibly as much as 15 dB at 20 kHz. One effect of the EQ is to make much more prominent the cymbal work of Jimmy Cobb, often adding a "click" to cymbal attacks.

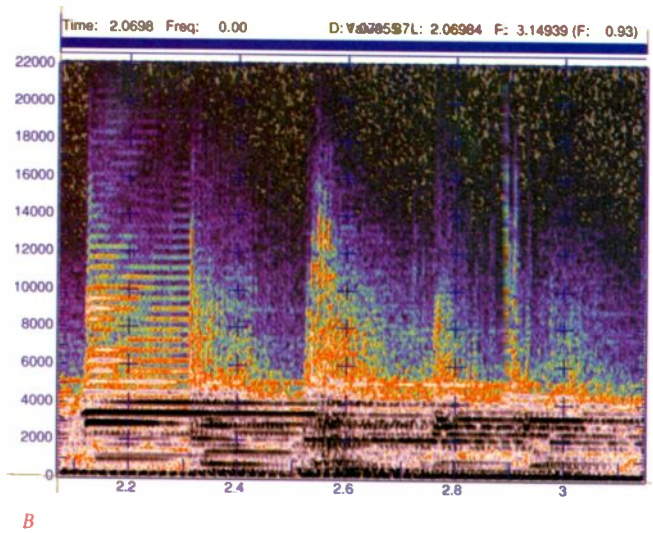
The horn tones of Coltrane, Adderly, and, most prominently, Davis himself are also altered. While the saxophones have a slightly "breathy" timbre on the new version, Davis's trumpet tone seems greatly changed. The color spectrograms of Fig. 10 make this point more clearly than words. A spectrogram reveals the amplitude and frequency variation of a signal over time. Figures 10A and 10B show one ride-cymbal strike as the first vertical event on the left. Note the greatly increased energy in the new cymbal (10B) versus the old (10A) and the way cymbal energy washes across the entire frame with much more of the orange color. Observe the well-formed partials (overtones) above 7 kHz in the old version and their absence in the new. The obliteration of the partials accounts for some of the difference in the sound of the trumpet, which is the second event. Close inspection reveals that the trumpet partials are much darker in the region from 1 to 2 kHz on the new than on the old. This is a further alteration of the trumpet timbre, and there is also a small, hard-to-see bass boost. The subjective result of the spectral differences is marked alteration in Davis's trumpet tone. The definitively "cool" Miles Davis sounds, momentarily at least, more like the brash Lee Morgan.

Figure 10C makes the equalization employed more obvious, with more conventional plots of amplitude versus frequency (the energy over the measurement period is integrated rather than broken out separately, as in the spectrograms). The use of a marked treble boost and some bass boost, though employed to varying degrees, was a characteristic of all three Mastersound releases I examined. The technique is particularly apparent on another rerelease of a jazz classic, Dave Brubeck's *Time Out* (Columbia CK-52860).

Although noise is much less intrusive on *Time Out*, the results of the equalization used are similar. Paul Desmond's alto saxophone tone is even wispier than in the original version (CK-40585), and Joe Morello's drumming has a new, spectrally induced prominence.

And once again, there is technically induced alteration of musical meaning. The introduction to "Strange Meadow Lark" contains a high-treble piano arpeggio, shown as a spectrogram in Figs. 11A and 11B (old and new). The reduced contrast between musical events in the new release is a result of the equalization used. While the overall maximum level in this segment is just a little more than 3 dB higher in the





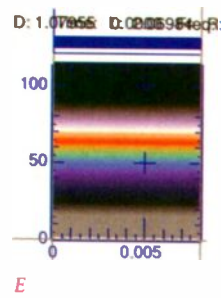
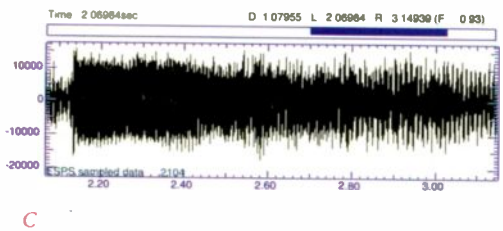
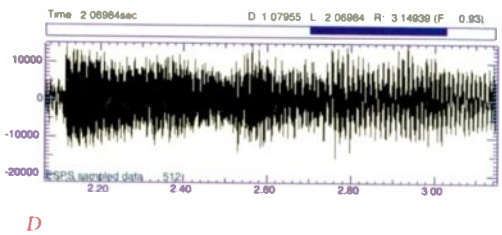


Fig. 12— *Spectrograms of a guitar lick in "Leopardskin Pillbox Hat" on the original (A) and Mastersound (B) CD releases of Bob Dylan's* Blonde on Blonde. *The most prominent differences appear to result from reduced signal compression on the new disc. Note the amplitude-versus-time plots in C and D and the much greater peak-to-average ratio in the new (D) versus the old (C). Color key (E) is for Figs. 12A and 12B.*





tling: The piano tone takes on a woody quality, more like a marimba. Further, Brubeck's phrasing is altered. The last note is now accented, whereas in the original mix it had a tentative, gentle quality. The amplitude difference, old to new, is +6.5 dB, or more than double for the last and highest note of the arpeggio compared to +3.2 dB for the entire musical figure. You can see the effect quite dramatically in the amplitude-versus-time reductions of the spectrograms, Figs. 11C and 11D (old and new).

Musical consequences are also evident in the Mastersound rerelease of Bob Dylan's *Blonde on Blonde* (Columbia CK53016). The spectra in Figs. 12A and 12B show an effect that results primarily from the *removal* of processing found in the original (CGK-00841). The spectrograms show a guitar lick from "Leopardskin Pillbox Hat." In the original (12A), note how the black spectral lines in the low-kilohertz range blur together to create a relatively continuous sound of a "smoking" rock guitar. On the Mastersound CD, the individual attacks are more apparent, both in the spectrogram and to the ear. The difference is even more obvious in the energy-versus-time plots of Figs. 12C (old) and 12D (new). The probable cause is that compression applied to the original guitar track was either reduced or entirely removed in the remix. Although the musical effect is not easily described, it might be called "impaired groove." Increased treble lift on this track also emphasizes the individual guitar attacks—to its detriment, as the guitar riff is less than masterfully executed.

Through aggressive remixing and equalization, plus other techniques, new Mastersound mix, the energy at 10 kHz is up 12 dB, and at 15 kHz it is up 17 dB. As in the case of "So What," the absence of a distinct band at the top of the new mix's spectrogram, above 20 kHz, indicates bandwidth that now extends fully to 22 kHz.

Individual spikes show the hammer transients on the piano. Observe that they are much more intense (wider) in the new mix than in the original and contain more energy. The subjective effect of this is star-

Technical during change

the Mastersound tracks examined appear to have as their primary objective what might be called an "aesthetic update." The now dated balances of old recordings are revised to the extent possi-

ble, often with massive equalization. The process brings to mind the colorization of black-and-white movies. New audiences are recruited, and even those familiar with the originals may discover details they missed in the old versions when examining the new. That the old and new are markedly different is clear, but the audible differences are completely unrelated to the underlying technology of 20-bit recording and noise shaping. On the CDs examined, the noise from the original recordings entirely swamped the SBM process and rendered its use technically undetectable.

Lest there be any misimpression that Super Bit Mapping itself does not work, Fig. 13 should banish it. Shown is the noise floor from a Sony Classical release of Emanuel Ax playing Liszt's Piano Sonata in B Minor (SK 48484). By 1 kHz the noise plunges beneath the –96 dB reference curve, there to remain until the SBM shaper pushes it back over at about 17 kHz. From 3 to 5 kHz the SBM curve is 7 to 9 dB below the reference. Allowing for the fact that the peak level on this recording is 4 dB below full scale and for the 2 dB needed to move from –96 to –98 dB, the theoretical 16-bit noise floor, we can conclude that the Ax recording does, in fact, exceed theoretical 16-bit performance by roughly 1 to 3 dB from 3 to 5 kHz and by a wider margin, about 5 dB, at higher frequencies up to 10 kHz. That is remarkable noise performance for a recording of a live instrument, in that it approaches 17-bit equivalence in the high-frequency portions of the spectrum.

alterations made remastering can also musical meanings.

While superbly quiet—no other recording examined achieved such low noise, although a Dorian release, *Memories of Bohemia* by Anton Kubalek (DOR 90185), came close—the Liszt/Ax disc has a rather intimate perspective. Sounds of the artist's breathing and sundry mechanical noises from the instrument can intrude at times and detract from the brooding Lisztian majesty that might otherwise prevail.

What It All Means

In the end, we learn that noise performance approaching the 16-bit theoretical level is rare on real-world recordings, even with noise shaping and a 20-bit recording medium. The use of multitrack recording or complex recording consoles and multiple microphones probably precludes dynamic range in excess of 15 bits (and that's being generous). This is not difficult to understand: In mixing down from 16 channels, for example, the simple addition of the uncorrelated noise sources has the potential to degrade performance by 12 dB. Conventional consoles contain amplifiers by the hundreds, each contributing noise. In most productions a signal passes through a console twice, once when it is recorded and again when it is mixed down. If very low noise is somehow deemed mandatory to listening pleasure, then the most likely place to find it (there are still no guarantees) is on recordings made with minimum equipment: two mikes, two preamplifiers, a state-of-the art A/D converter and digital recorder, and no more.

All this assumes that the noise level of the listener's system and its environment contribute less noise than the recording itself and that the system's dynamic range is sufficient to enable playback levels great enough to take advantage of the noise performance. In a technical paper, Sony suggests that a CD player with a signal-to-noise ratio of 114 dB is needed to extract the full benefit of SBM. Of the 171 outboard D/A converters listed in the 1995 *Audio* Annual Equipment Directory, only 10 models (about 6%) meet or beat this specification. And that may not tell the entire story, since most D/A converters mute during a conventional S/N test, so the measurement winds up being only of the noise from the analog output electronics.

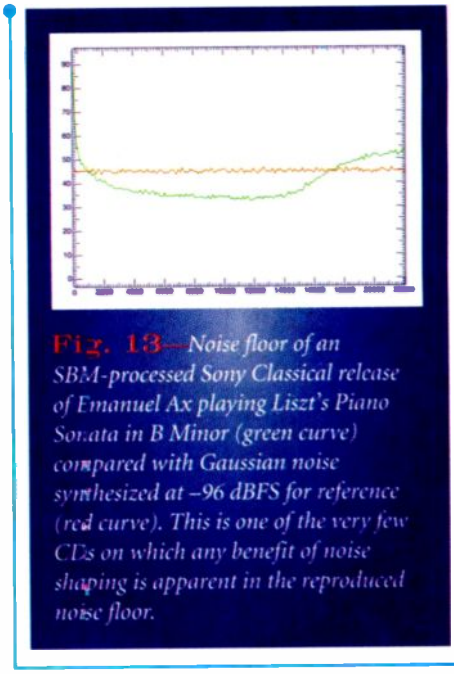


Fig. 13—*Noise floor of an SBM-processed Sony Classical release of Emanuel Ax playing Liszt's Piano Sonata in B Minor (green curve) compared with Gaussian noise synthesized at –96 dBFS for reference (red curve). This is one of the very few CDs on which any benefit of noise shaping is apparent in the reproduced noise floor.*

Should recordings that materially exceed 16-bit performance ever appear in substantial numbers, upgrades of many systems will be required to give listeners any shot at hearing the improvement—and those upgrades will extend beyond the CD player, for many line-stage preamplifiers and power amplifiers have noise floors well above the implied requirement.

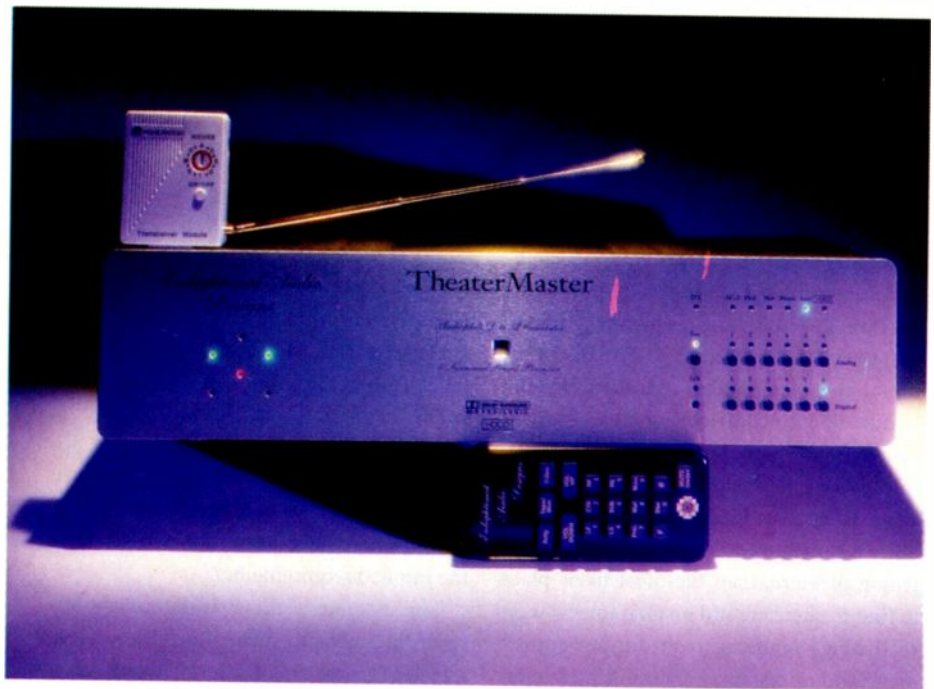
The essence is this: To date, very few recordings actually meet, much less exceed, a 16-bit theoretical noise level. If they did, it is likely that the full difference could not be heard on most systems. The existing noise shapers, though they perform largely as expected alone, are often defeated in practice by the devices and signals in the recording or mastering systems that feed them. Simply put, recording studios and listening rooms are still too noisy, both acoustically and electrically.

Although noise shapers have little or no effect on the perceived noise of most real recordings, they do have sonic influences that can be heard. I have explored these effects by passing the same 20-bit master recording of a Steinway grand through selected noise shapers and evaluating the result. That exploration, a look at Apogee Sound's entirely different approach to 20-to-16-bit conversion, and the results of the first independent comparison of Pacific Microsonics' HDCD process to conventional recordings will be reported next. Expect surprises. A

EQUIPMENT PROFILE

EDWARD J. FOSTER

EAD THEATERMASTER DOLBY AC-3 SURROUND PROCESSOR



If technological masterpieces intrigue you, look no further than the Enlightened Audio Designs TheaterMaster. The TheaterMaster is unique. (I rarely use that word, and never lightly.) But don't let this component's name fool you. The TheaterMaster is both more and less than a complete home theater front end. Although it's one of the first products to provide Dolby AC-3 5.1-channel surround decoding (as well as Dolby Pro Logic), it's less than complete in that it does not have video switching. (An external video switcher, controlled by the TheaterMaster, is due out about the time you read this.) On the "more than" side, the TheaterMaster features Pacific Microsonics' HDCD decoding, to derive optimum results from CDs released in that format, and a number of other high-end audio features.

EAD'S THEATERMASTER HAS D/A CONVERSION AND CAN DECODE HDCD, DOLBY AC-3, AND DOLBY PRO LOGIC.

Noteworthy among these is its Digital Flywheel reclocking. EAD claims that this achieves a tenfold reduction in bitstream jitter and realizes "the ultimate musical resolution and sound-stage focus possible through the HDCD process." AccuLinear analog circuitry is said to provide "superior reconstruction of the musical waveform" and to reduce "transient distortion in the critical current-to-voltage stage—a principal cause of harshness, glare, and stridency commonly associated with CD sound." The TheaterMaster's AccuLinear circuitry "incorporates discrete components within a single chip wafer to provide greater speed and accuracy than either discrete or conventional integrated designs. . . ."

Digital-to-analog conversion is handled by six hand-matched, dual-differential Burr-Brown PCM63 "Series-K" 20-bit DAC chips (one for each of the TheaterMaster's six analog outputs), and you can select four-times or eight-times oversampling. The TheaterMaster implements all functions digitally, including polarity inversion and internal crossover from each channel to the subwoofer or, optionally, to the front stereo speakers. So signals from its six analog inputs are internally digitized, processed, and then returned to the analog domain to drive the power amplifiers. (In the Signature Series version, which sells for $9,995, analog-to-digital conversion is handled by "state-of-the-art" 20-bit converters. The models in EAD's Signature Series also incorporate ultra-premium passive components, including Teflon circuit boards and 0.1% Vishay resistors.)

The TheaterMaster accepts six analog and six digital sources. The analog inputs and three of the digital inputs use RCA jacks; the remaining digital inputs use ST (glass) and Toslink optical connectors. For laserdisc, the AC-3 input is via an EAD SmartCable (supplied), which demodulates the RF signals from a player's AC-3 output.

The SmartCable, made for EAD by Music Interface Technologies, is powered by a "wall wart." One of the cable's two RCA plugs goes to the AC-3 laserdisc player, the other to any of the TheaterMaster's three RCA digital inputs. The player's digital outputs can be connected to one of the EAD's other digital inputs and the player's analog outputs to the correspondingly numbered analog input, to handle analog laserdisc soundtracks.

As required for 5.1-channel surround, the TheaterMaster has six outputs (five full-range, one subwoofer). All six are available through unbalanced RCA jacks, with additional balanced XLR outputs for the left and right front channels. The processor also

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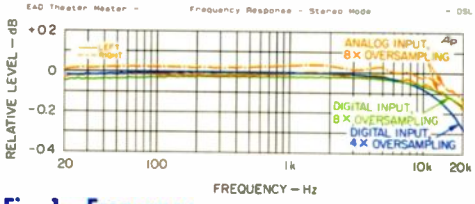


Fig. 1—Frequency responses, stereo mode.

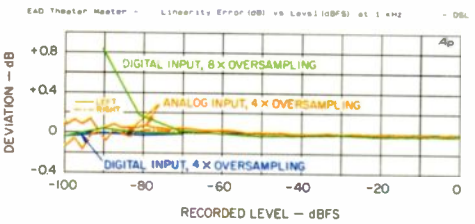


Fig. 2—Deviation from linearity.

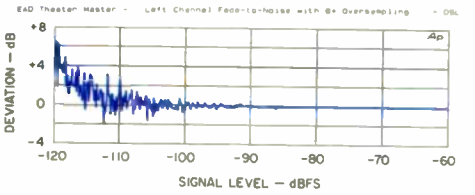


Fig. 3—Fade-to-noise test.

has two sets of fixed-level outputs (labeled "Thruputs") to feed recording equipment, an external equalizer, or a remote stereo system. One set of these outputs is driven by the main signal, the other by whatever source is chosen by the tape-monitor program selector. This makes it possible to record a program other than the one to which you're listening. To prevent feedback when a recorder or equalizer is used, the TheaterMaster can be "taught" not to accept the recorder or equalizer as an input. Both analog and digital "Thruput" jacks are provided, enabling you to use the TheaterMaster's internal A/D converter when making a digital recording from an analog source. All but the optical digital jacks are gold-plated.

The TheaterMaster enables you to direct bass information from any channel (or channels) to the subwoofer, with the option of simultaneously rolling off the bass content in the chosen channels to provide a true, complete crossover. Directing bass information from a channel to the subwoofer without rolling it off within the channel avoids phase shifts in the vicinity of the crossover frequency. However, the speakers in the channels being crossed over must then be capable of accepting deep bass without generating distortion, even if they can't reproduce it. If you don't use the rolloff, bass is fed both to the channels being crossed over *and* to the subwoofer, so you should pick a crossover frequency that matches the natural rolloff of the speakers in those channels. And your main front speakers must be able to accept full-bandwidth signals, because the TheaterMaster won't roll off bass to these speakers in stereo matrix modes (this is to ensure proper HDCD operation).

To help you balance the channels, the TheaterMaster comes with a microphone and an internal noise generator that has two modes of operation. (As usual, the subwoofer is adjusted by ear, using real program material.) When the microphone is plugged into the unlabeled front-panel jack and the automatic noise sequencer is activated, noise cycles between main front, center, and surround speakers while one row of lights on the panel displays sound pressure level. In this mode, left and right front channels and, separately, left and right surround channels are adjusted in pairs, to preserve side-to-side balance. Alternatively, you can choose a "static" mode that enables noise to be directed individually to any speaker and lets you adjust the gain of each channel independently. You can, if you choose, store the adjustments selected in either mode.

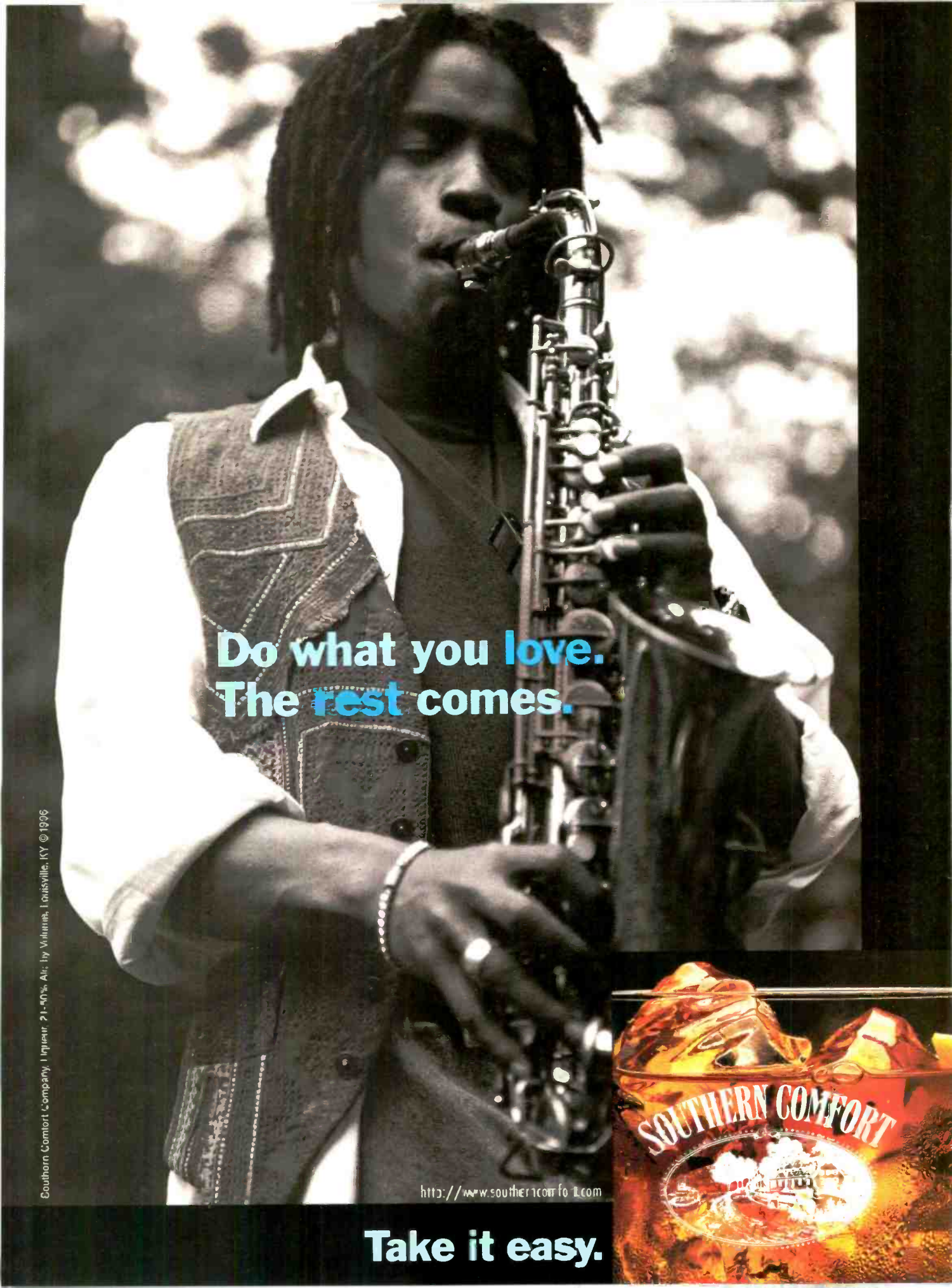
The volume level of any speaker can also be fine-tuned while the system is operating; the results can be used for the current listening session or stored for future use. Volume levels can be set by ear, using "VOL Up" and "VOL Down" pads, or by entering a numeric attenuation value, in dB. When you've reached maximum gain in any channel, that channel's panel light blinks slowly. You can still increase the gain of the other channels (or of all together), but the maxed-out channel will be unaffected by further gain increases.

Surround-channel delay relative to the arrival time of the sound from the front channels (15 milliseconds in Pro Logic operation, 0 for AC-3) can be adjusted by entering the distance from the center, left (or right) front, and left (or right) surround speakers to the listening position in tenths of a meter. Last August, however, EAD announced several software enhancements, one of which provides automatic level balancing and delay calibration by using a series of pink-noise bursts for level balancing and "ticks" for calculation of time of arrival. (If dipolar surround speakers are used, they must be temporarily reoriented for the time tests so that the listening position is not in the null of the radiation pattern.) This Auto Setup program issues a warning if it cannot complete the setup to its satisfaction, and you can always revert to one of the manual setup modes.

The TheaterMaster offers a choice of four operating modes from its remote control: "ProL" (Pro Logic), "MAT" (a Hafler-type matrix arrangement that uses the surround speakers to deliver L – R ambience information), "Mono" (which directs a mono signal to the center speaker and synthesized stereo to the left and right front speakers), and "STER" (normal stereo). If the source program has both AC-3 and Dolby matrix surround encoding (as AC-3 laserdiscs usually will, on their digital tracks), AC-3 decoding is automatically selected over Pro Logic. Similarly, HDCD decoding also activates automatically if the TheaterMaster detects an HDCD-encoded disc. Both conditions are indicated by front-panel lamps. If the AC-3 data stream is carrying programs other than 5.1-channel surround (as with some digital satellite broadcasts), then the TheaterMaster will indicate that fact on its signal lamps and will decode them properly.

The six analog and six digital inputs are selected with 12 front-panel buttons; pressing any source button brings the system to life. These, along with a polarity-inversion button ("INV"), are the only panel controls; all other controls are on the remote.

That remote has a telephone-type keypad with buttons that raise and lower volume, mute and unmute the system, or put it in standby mode (i.e., turn it off); the remote also has buttons marked "ANLG," "Tape/MON," and "Video." Digital sources are selected from the remote by pressing the appropriate number on the telephone pad;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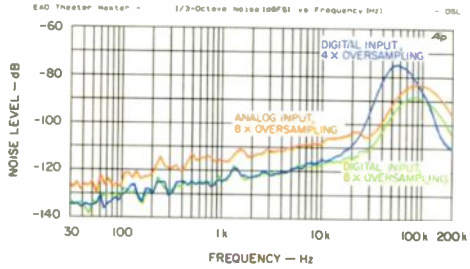

Fig. 4—Noise spectrum.

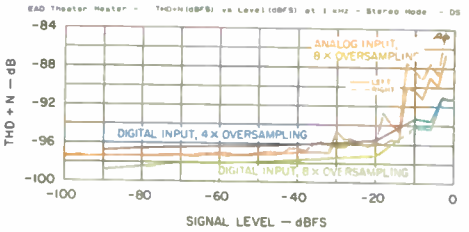

Fig. 5—THD + N vs. level.

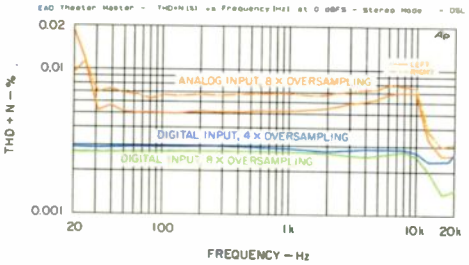

Fig. 6—THD + N vs. frequency.

analog inputs are selected by pressing the "ANLG" key before entering a number. You can toggle between the analog and digital inputs of a channel by pressing the "ANLG" key twice.

Tape-monitor inputs are selected by pressing either "Tape/MON" and a number (to select a digital input) or "Tape/MON" and "ANLG," followed by a number (to select an analog tape-monitor input). Buttons "7," "8," "9," and "0" choose Pro Logic, matrix, mono, and stereo operation, respectively, and legends to that effect are marked above the numbers on the buttons.

On digital sources, a front-panel "LCK" light illuminates to confirm presence of an active source or blinks slowly if you've muted the system. With analog sources, an "O/L" lamp warns of potential or actual A/D converter overload. Should this occur, pressing "ANLG" and "VOL Down" reduces the analog input sensitivity by 6 dB and stores the change for that input. Gain can be restored by pressing "ANLG" and "VOL Up." If you have a preferred listening level and know how many dB of attenuation will produce it, you can enter it directly by pressing "F" (where the "*" key is on a normal telephone) followed by a two-digit number.

In general, the "F" key selects features, while the "#" key causes the TheaterMaster to enter its adjustment mode. For example, "F" followed by "ANLG" followed by "VOL Down" turns on a high-frequency equalization (shelving rolloff) in theater modes; "F-ANLG-VOL Up" restores the treble. Without going into specifics, the "F" key, followed by various other sequences, offers a choice of three dynamic-range compression ratios for late-night viewing and the means to deactivate or activate AC-3's dialog-normalization function (which maintains a constant subjective sound level during loud commercials and such). You can also swap left and right channels, invert the polarity of the signals, choose four- or eight-times oversampling for the D/A converter, and dim the panel lights with appropriate "F"-key sequences.

The TheaterMaster provides a 12-volt signal to raise and lower motorized projection screens with remote-control inputs. By entering appropriate codes, you can have the screen lower itself when specific sources are chosen or every time the TheaterMaster is powered up. There's also a switched AC outlet on the back that can be toggled on and off in various ways, depending on how you program the TheaterMaster, and an internal radio transmitter that controls up to two sets of lights or appliances. This transmitter activates an X-10 transceiver/controller supplied with the system. The controller receives the RF transmission and rebroadcasts the signal through the AC power mains to remote X-10 receivers, which you buy separately.

The TheaterMaster also has a special status mode, in which the front-panel lights show the active sampling frequency, whether a digital recording is an original or a copy and if it is copy-protected, whether or not the recording was pre-emphasized, if the Digital Flywheel is locked, and the nature and origin of digital errors flagged by the "O/L" light. Since the TheaterMaster is software-controlled, EAD can issue upgrades to further enhance operation.

Measurements

With all the permutations and combinations that this technological tour de force offers, I kept the TheaterMaster on my test bench for over a week, followed by several days of data interpretation. After all, I had to test its performance as a D/A converter, A/D converter, Dolby Pro Logic decoder, and AC-3 decoder. (The HDCD processor could not be bench-tested, for lack of a test standard.) The results in "Measured Data" are for the worst channel.

For my tests of the D/A converter and analog output circuitry, I used a stereo bitstream, decoding it with both four- and eight-times oversampling. Four-times oversampling produced slightly better results vis-à-vis low-level linearity with dithered recordings and also did a trifle better in the tests of A-weighted dynamic range and signal-to-noise ratio. However, eight-times oversampling seemed to provide better numbers overall.

To measure frequency response (Fig. 1), I used a digital input to exercise the D/A converter alone and an analog input to exercise both the A/D and D/A converters. I've greatly expanded the vertical scale to show

I DOUBT YOU'LL FIND ANYTHING ELSE THAT EXPLOITS AC-3'S POTENTIAL LIKE THIS UNIT DOES.

the differences, which are exceedingly small and wouldn't show up otherwise. You can see that the D/A's high-frequency response is slightly better with eight-times oversampling and that, except for the introduction of a very slight amount of ripple caused by the input anti-aliasing filter, the unit's response to analog signals is almost precisely the same as its response to computer-generated digital bitstreams. The response curves are so similar, in fact, that I had to show

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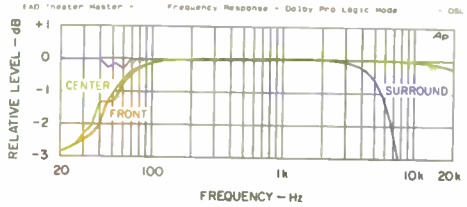

Fig. 7—Frequency responses, Pro Logic mode.

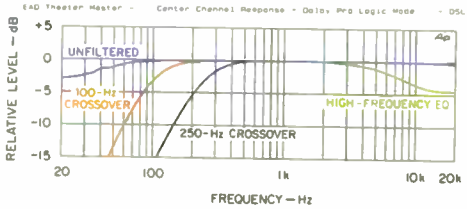

Fig. 8—Center-channel frequency response.

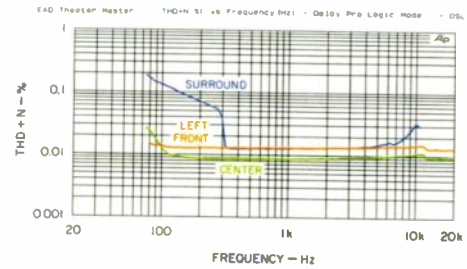

Fig. 9—THD + N vs. frequency, Pro Logic mode.

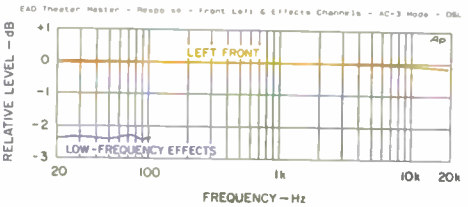

Fig. 10—Frequency response, AC-3 mode.

both channels for the analog-input curve so that the overlapping digital-input curves would not obscure the ripple. Obviously, EAD's A/D converter and input filter are excellent! (I checked response of all channels, using matrix surround. But since it was identical with stereo operation, I've not shown the curves or included the results in "Measured Data.")

Figure 2 shows converter linearity error. With undithered recordings, there's no difference between four- and eight-times oversampling from 0 to –90 dBFS, although performance at the –100 dBFS level is slightly better with four-times oversampling. But overall, the TheaterMaster's linearity at both sampling rates is so nearly perfect that there's no reason to choose one over the other on this account. Note, too, the excellent linearity when I used the processor's analog input.

Figure 3 is a fade-to-noise plot of a dithered digital signal, converted with eight-times oversampling. The two channels were virtually identical, and the oversampling rate had no consistent impact on these results.

You can see the effect of analog input-circuit noise in the results for A-weighted noise in "Measured Data"; you can also see it in Fig. 4, third-octave noise spectra for the analog and digital inputs. Over the audio band, the analog input curves have about 7 or 8 dB more noise than the digital input curves. Figure 4 also shows that the oversampling rate makes little difference in background noise out to 8 kHz but that eight-times oversampling lowers the noise in the 20-kHz region by about 5.5 dB. The ultrasonic noise also is much lower and at a higher frequency with eight-times oversampling. The combination of A-weighting and the 22-kHz low-pass filter used in the A-weighted measurement setup reduces the ultrasonic differences, which is why the S/N ratios in "Measured Data" look so similar.

I also ran spectrum analyses (not shown) of the output when the system was handling a 1-kHz digital tone at –60 dBFS. Interestingly, although the difference in ultrasonic levels was still apparent, the difference in 20-kHz noise between four- and eight-times oversampling was virtually nil.

Figure 5 shows total harmonic distortion plus noise (THD + N) versus level for a 1-kHz signal. Although there's little difference between four- and eight-times oversampling at 0 dBFS, eight-times oversampling generates several dB less noise and distortion over most of the dynamic range. The analog curves (shown about 2 dB below actual level) lie well above the digital curves from 0 to –10 dBFS; even so, THD + N via the analog inputs is equivalent to barely above 0.005% on the left channel (and is below 0.007% on the right channel), even at 0 dBFS. This further testifies to superb A/D conversion.

You also can see this in Fig. 6, which shows THD + N versus frequency at 0 dBFS, using the digital input at both sampling rates and the analog input with eight-times oversampling. Obviously, the analog input electronics and A/D converter introduce some noise and distortion that aren't present in the computer-generated digital bitstream, but it's mighty low. The EAD TheaterMaster has super converters at both ends of the box! I wouldn't be concerned about the apparent kickup in distortion at 20 Hz in the analog curves. The overload light was winking a warning at this point. I don't understand why the A/D converter's overload point should be frequency-sensitive—but it was, to a slight degree; the "O/L" LED came on at 1.91 volts at 1 kHz and at 1.74 volts at 20 Hz, but actual input clipping (which I define as 1% THD) didn't occur until the 2.72-volt level at 1 kHz.

Interchannel crosstalk (not shown) was, once again, better with a digital input than through the analog input electronics and A/D converter—but who can complain about a worst-case separation that's more than 82 dB? Quantization noise clocked in at an excellent –92.6 dBFS with eight-times oversampling, with either a digital or analog input, and was just a shade poorer with four-times oversampling. Dynamic range, both unweighted and A-weighted, also was the same for analog and digital signals with eight-times oversampling; it was a trifle worse, on an unweighted basis, with four-times oversampling but was a trifle better on an A-weighted basis. At the risk of being repetitious, I have to state again that EAD's converters are simply superb.

As the numbers in "Measured Data" show, output level is more than adequate to drive any power amp. The output impedance was very low (which should make interconnect cable capacitance a nonissue), and the channel balance was near perfect. The selectable analog-input gain settings

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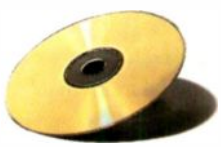

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MEASURED DATA

INPUT AND OUTPUT CHARACTERISTICS

Line Output Level: For 0 dBFS via digital input, 4.19 V; level at clipping with analog input, 4.31 V.

Channel Balance, Digital Input: ±0.01 dB.

Analog Input Impedance: 8.2 kilohms.

Analog Input Overload Level: 2.72 V.

Line Output Impedance: 50 ohms.

Gain via Analog Inputs: Maximum to main outputs, +4.05 or –2 dB; to recording outputs, –0.07 dB.

STEREO MODE

Frequency Response, Digital Input: With 8X oversampling, +0, –0.14 dB from 20 Hz to 20 kHz; with 4X oversampling, +0, –0.29 dB from 20 Hz to 20 kHz.

Frequency Response, Analog Input: With 8X oversampling, +0.01, –0.19 dB from 20 Hz to 20 kHz.

THD + N at 0 dBFS, Digital Input: With 8X oversampling, less than 0.0028% from 20 Hz to 20 kHz; with 4X oversampling, less than 0.0029% from 20 Hz to 20 kHz.

THD + N at 0 dBFS, Analog Input: With 8X oversampling, less than 0.021% from 20 Hz to 20 kHz and less than 0.008% from 30 Hz to 20 kHz.

THD + N at 1 kHz, Digital Input: With 8X oversampling, less than –91.4 dB from 0 to –90 dBFS and less than –97.5 dB from –30 to –90 dBFS; with 4X oversampling, less than –91.1 dB from 0 to –90 dBFS and less than –95.8 dB from –30 to –90 dBFS.

THD + N at 1 kHz, Analog Input: With 8X oversampling, less than –84 dB from 0 to –90 dBFS and less than –95.4 dB from –30 to –90 dBFS.

Maximum Linearity Error to –90 dBFS: For undithered recordings, 0.93 dB with 8X or 4X oversampling; for analog input with 8X oversampling, 0.08 dB.

Maximum Linearity Error to –100 dBFS: For dithered recordings, 0.13 dB with 8X oversampling and 0.09 dB with 4X oversampling; for analog input with 8X oversampling, 0.23 dB.

A-Weighted S/N for Infinity-Zero Signal: With 8X oversampling, 107.4 dB; with 4X oversampling, 107.7 dB; for analog input with 8X oversampling, 100.3 dB.

Quantization Noise: With 8X oversampling, –92.6 dBFS; with 4X oversampling, –92.0 dBFS; for analog input with 8X oversampling, –92.6 dBFS.

Dynamic Range: With 8X oversampling, 97.5 dB unweighted and 100.2 dB A-weighted; with 4X oversampling, 96.7 dB unweighted and 101.1 dB A-weighted; for analog input with 8X oversampling, 97.5 dB unweighted and 100.2 dB A-weighted.

Channel Separation: With digital input, greater than 108 dB from 125 Hz to 16 kHz; with analog input, greater than 82.1 dB from 100 Hz to 20 kHz.

DOLBY PRO LOGIC MODE

Frequency Response: Front channels, +0.0, –2.9 dB from 20 Hz to 20 kHz; surround, +0.0, –3.0 dB from 20 Hz to 7.6 kHz

THD + N: Front channels, less than 0.025% from 80 Hz to 20 kHz; surround, less than 0.140% from 100 Hz to 7 kHz.

A-Weighted S/N (re 0.5 V): Front channels, 88.3 dB; surround, 89.2 dB.

Channel Separation at 1 kHz: Surround to right front, 53.8 dB.

Maximum Output at 1 kHz: Main front, 2.4 V; center, 3.4 V; surround, 2.4 V.

DOLBY AC-3 MODE

Frequency Response: Main channels, +0, –0.15 dB from 20 Hz to 20 kHz; low-frequency effects (LFE) channel, ±0.06 dB from 20 Hz to above 100 Hz.

THD + N at 0 dBFS: Main channels, 0.0035% at 1 kHz; LFE channel, 0.0627% at 30 Hz.

Channel Separation at 1 kHz: 91.6 dB.

Balance, re Left Front: Main Channels, ±0.02 dB; LFE channel, –2.31 dB.

Maximum Output Level at 0 dBFS and 1 kHz: 4.01 V for left front channel.

differed by 6 dB, as claimed, and even at the higher gain setting the input overload point should be adequate. However, I wouldn't mind seeing an input impedance higher than 8.2 kilohms.

Let's turn now to the TheaterMaster's performance as a Dolby Pro Logic decoder. In this mode, it uses the DSP chip included for AC-3 decoding to perform digital-domain Pro Logic decoding. Figure 7 shows the frequency response of the front, center, and surround channels with all filters off. Figure 8 shows the response of just the center channel, with "crossover" (actually, just high-pass) settings of 100 and 250 Hz and, separately, with the high-frequency equalization (HFE) activated. I show just the center channel curves for clarity, and I used a vertical scale that would allow me to encompass a greater range.

With the crossover filters switched out, the three front channels have a modest bass rolloff, beginning at 100 Hz; the surround channels do not. Nonetheless, the front-channel rolloff is rather mild (response is down less than 3 dB at 20 Hz), and the response is essentially flat from 100 Hz to 20 kHz. The surround channel rolls off sharply above 7.6 kHz (the initial slope is about 18 dB/octave), as it should.

The crossover's –3 dB points are at precisely 100 and 250 Hz, and the filter characteristics approximate those of a second-order (12-dB/octave) Butterworth design. The HFE circuit shelves response above a few kilohertz, reaching an ultimate attenuation of about 4.7 dB at 20 kHz. Although EAD makes no claims in this regard, the curve is very similar to the THX re-equalization curve, albeit a trifle less aggressive.

Figure 9 shows THD + N versus frequency for the left front, center, and surround channels with Dolby Pro Logic. The results are exceedingly good, especially for surround-channel distortion from 300 Hz up; I've seen surround-channel distortion on some Pro Logic decoders that was orders of magnitude higher than this! The A-weighted S/N ratios also are unusually good for a Pro Logic processor. Note that the results in "Measured Data" are referenced to a 0.5-volt output and would be more than 12 dB higher if they were referenced to maximum output level.

Channel separation at 1 kHz in Dolby Pro Logic mode ranged from a minimum of 53.8 dB (from the surround to the right front) to a maximum of approximately 100 dB (between the main front channels). For the most part, separation exceeded 60 dB between any two channels, which, once again, is superb performance.

Last, but certainly not least, is the processor's handling of Dolby AC-3 5.1-channel surround. This is the newest and one of the most important new home theater audio technologies. However, the only available AC-3 test disc offers rather limited facilities. The frequency sweeps on the disc occur so

Continued on page 66

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EQUIPMENT PROFILE

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INFINITY COMPOSITIONS P-FR SPEAKER

The Compositions home theater speakers are the first Infinity products to reflect the input of Laurie Fincham, the company's new senior vice president of engineering. Mr. Fincham was formerly at KEF, where he pioneered computer-based speaker testing. In addition to the P-FR full-range system reviewed here (which I tested as standalone stereo speakers, not as part of a home theater setup), the Compositions Prelude series includes the P-CC center-channel and the P-QPS surround speakers. These will soon be joined by other series of Compositions speakers.

The P-FRs have a striking and distinctive shape: A column, 3 feet high and 8 inches deep, houses all but the woofer of this four-way system; that column sits atop a bass enclosure that's much deeper than the column but only 7⅝ inches wide. All drivers are magnetically shielded, so as not to affect nearby video screens.

The column, which has no amplifier of its own, houses seven drivers in a vertical array. At the center of the array is a 1-inch, soft-dome tweeter with a neodymium magnet. Its dome is surrounded by a molded-in elliptical waveguide, to smooth the response and control its directivity. Just above and below the tweeter are the two 4-inch upper-midrange drivers, which have polypropylene cones. They are driven in parallel and are mounted in small, individual sealed cavities. The four lower-midrange drivers are 5¼-inch long-throw

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units, wired in series-parallel, that use the internal volume of the column as their enclosure. That enclosure is vented by four small port tubes, 1 inch in diameter and 0.6 inch long, with flared ends; they tune the box to about 100 Hz, below which signals are handled by the woofer.

The column itself is heavily contoured, front and rear, to minimize diffraction and improve strength. It is made of metal, with a molded plastic front panel and a snap-on grille.

The base forms a small (⅔-cubic-foot) sealed enclosure for the beefy 12-inch woofer; it also houses the 350-volt-ampere power amplifier that drives the woofer. The P-FR's base is so narrow that the woofer's magnet actually protrudes through the opposite wall of the base and is covered by a metal magnetic shield. Though the woofer is mounted on only one side of the base, matching grilles are provided to cover both sides.

The woofer itself is a long-throw unit with a large magnet in a heavy cast frame. Its molded plastic cone has a foam surround, and the voice coil is 2 inches in diameter. The driver's impedance is a low

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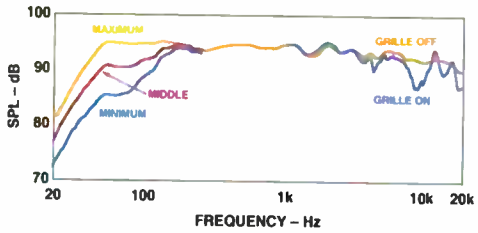

Fig. 1—One-meter, on-axis frequency response.

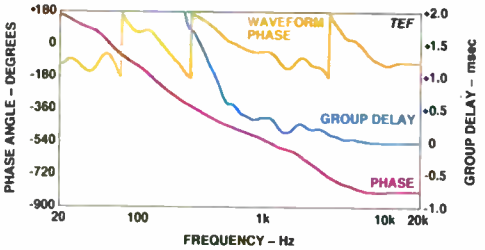

Fig. 2—On-axis phase response, group delay, and waveform phase.

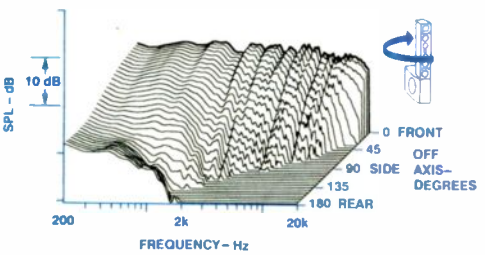

Fig. 3—Horizontal off-axis frequency responses.

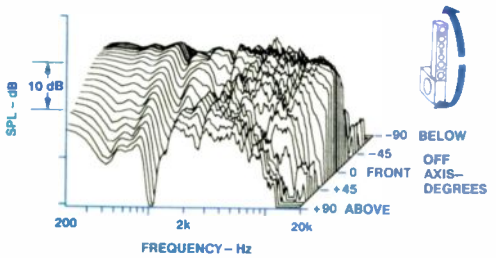

Fig. 4—Vertical off-axis frequency responses.

1.8 ohms, but the built-in amplifier is optimized for that impedance.

The woofer's small enclosure raises the driver's resonant frequency to a high 80 Hz. This causes a 12-dB/octave rolloff below that frequency, which is compensated by equalization in the power amplifier. In part because of the bass boost from this equalization, the system includes protection circuitry for the driver and amplifier. This circuitry makes the amp soft-clip before the woofer can exceed its maximum safe excursion level.

The amplifier is controlled by switches on the bottom of the base. By using these switches, you can turn the amplifier on or off, activate or defeat its auto-sensing (which puts the amp in standby when there is no signal), select one of three bass output levels, and adjust the grounding configuration. (You will need the grounding switch only if there's hum or noise from the bass amp.) The auto-sensing system turns the amp on just about instantaneously when signal is present and goes into the low-power standby mode after about 10 minutes without a signal. A two-color LED on the top front of the base turns red when the amp is in standby mode and green when it is operating.

OFF-AXIS RESPONSE IS VERY UNIFORM, BOTH VERTICALLY AND HORIZONTALLY.

A passive crossover network is mounted inside the column. The tweeter is driven by a second-order high-pass filter, the two upper midranges are driven by second-order high- and low-pass filters, and the four lower midranges are driven by second-order high- and low-pass filters. Impedance compensation is included for all drivers. The lower mids are connected with the same polarity as the woofer, whereas the tweeter and upper mids are reverse-connected.

Input connections go to two five-way binding posts, which are spaced to accept double-banana plugs and have large enough holes to accept cable up to 0.15 inch in diameter (AWG #8). These binding posts are mounted to a heavy-duty assembly on the rear of the base.

Measurements

Until now, my anechoic speaker measurements for *Audio* have been taken outdoors—not too pleasant or easy in the winter. From here on, though, I'll be using Electro-Voice's large anechoic chamber. That's because I recently rejoined Electro-Voice (after a 20-year hiatus) as a senior research engineer at the company's Mark IV Audio division. (E-V makes only professional audio products, so I will not have a conflict of interest.)

Figure 1 shows the P-FR's on-axis anechoic frequency response, for all three positions of the bass switch. With the switch set at maximum and the column's grille removed, the curve is flat and smooth, fitting a tight, 5.5-dB, window from 32 Hz to 20 kHz. Except for the slight droop above 10 kHz, the curve fits a commendable 3.5-dB window (–0.5, –3 dB) from 36 Hz to 10 kHz. Each successive switch position shelves the bass –5 dB below 70 Hz, with a hinge point at about 150 Hz. With the switch at "Max," you might

Drivers: 12-in. cone woofer, four 5¼-in. cone lower midranges, two 4-in. cone upper midranges, and 1-in. soft-dome tweeter.
Frequency Response: 35 Hz to 20 kHz, ±2 dB; +0, –6 dB at 25 Hz.
Sensitivity: 96 dB at 1 meter, 2.83 V rms applied.
Crossover Frequencies: 110 Hz, 350 Hz, and 3 kHz.
Impedance: 6 ohms, nominal.
Recommended Amplifier Power: 10 to 150 watts per channel, above 100 Hz.
Power of Built-In Woofer Amp: 350 volt-amperes.
Dimensions: 54⅛ in. H x 7⅝ in. W x 19⅝ in. D (137.5 cm x 19.4 cm x 49.9 cm).
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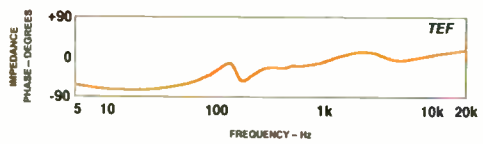

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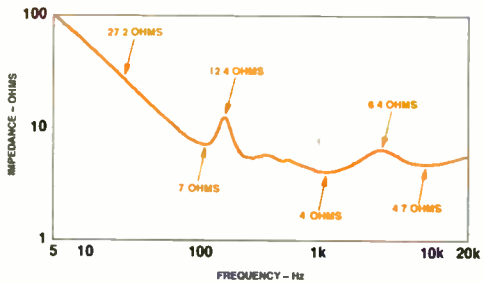


B

Fig. 5—Impedance phase (A) and magnitude (B).

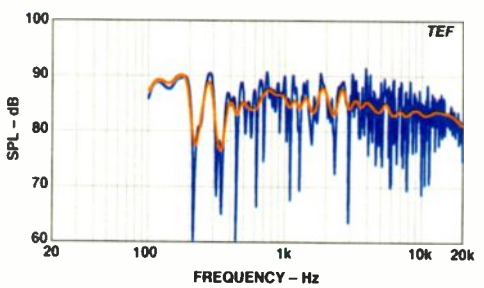


Fig. 6—Three-meter room response.

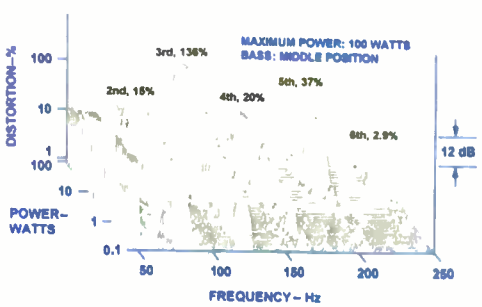


Fig. 7—Harmonic distortion for E_1 (41.2 Hz).

hear excessive bass when the P-FR is near a room's reflecting boundaries. The grille causes major response deviations above 7 kHz, with a significant dip at 9 kHz, a narrow peak at 12 kHz, and roughness at higher frequencies. Average sensitivity from 250 Hz to 4 kHz measured a very high 94.2 dB.

Figure 2 shows the P-FR's phase and group-delay responses referenced to the tweeter's arrival time. Also shown is waveform phase, which indicates whether waveshapes will be preserved in specific frequency ranges. The phase curve is well behaved but rotates 305° between 1 and 10 kHz. The group-delay curve, averaged from 700 Hz to 2 kHz, indicates an offset between drivers of about 0.25 milliseconds, the upper midrange delayed behind the tweeter. As is typical, the waveform phase curve indicates that waveshapes will not be preserved in any frequency range, because the phase values are not at or near 0° or ±180° over any frequency band.

Figure 3 shows the P-FR's response over a range of horizontal angles (the bold curve at the rear of the graph is the on-axis response). The uniformity from curve to curve is excellent, with only slight loss of high frequencies off axis above 10 kHz.

The P-FR's vertical off-axis response is shown in Fig. 4 (on-axis response is the bold curve in the center). Within ±10° of the axis, the curves are very uniform. Even at ±15°, there is a dip of only 5 dB (not clearly seen) in the uppermost crossover region. Though it's hard to see the curves behind the on-axis response (far below the axis), there is good up/down symmetry. At extreme angles, a sharp dip develops at 1.1 kHz.

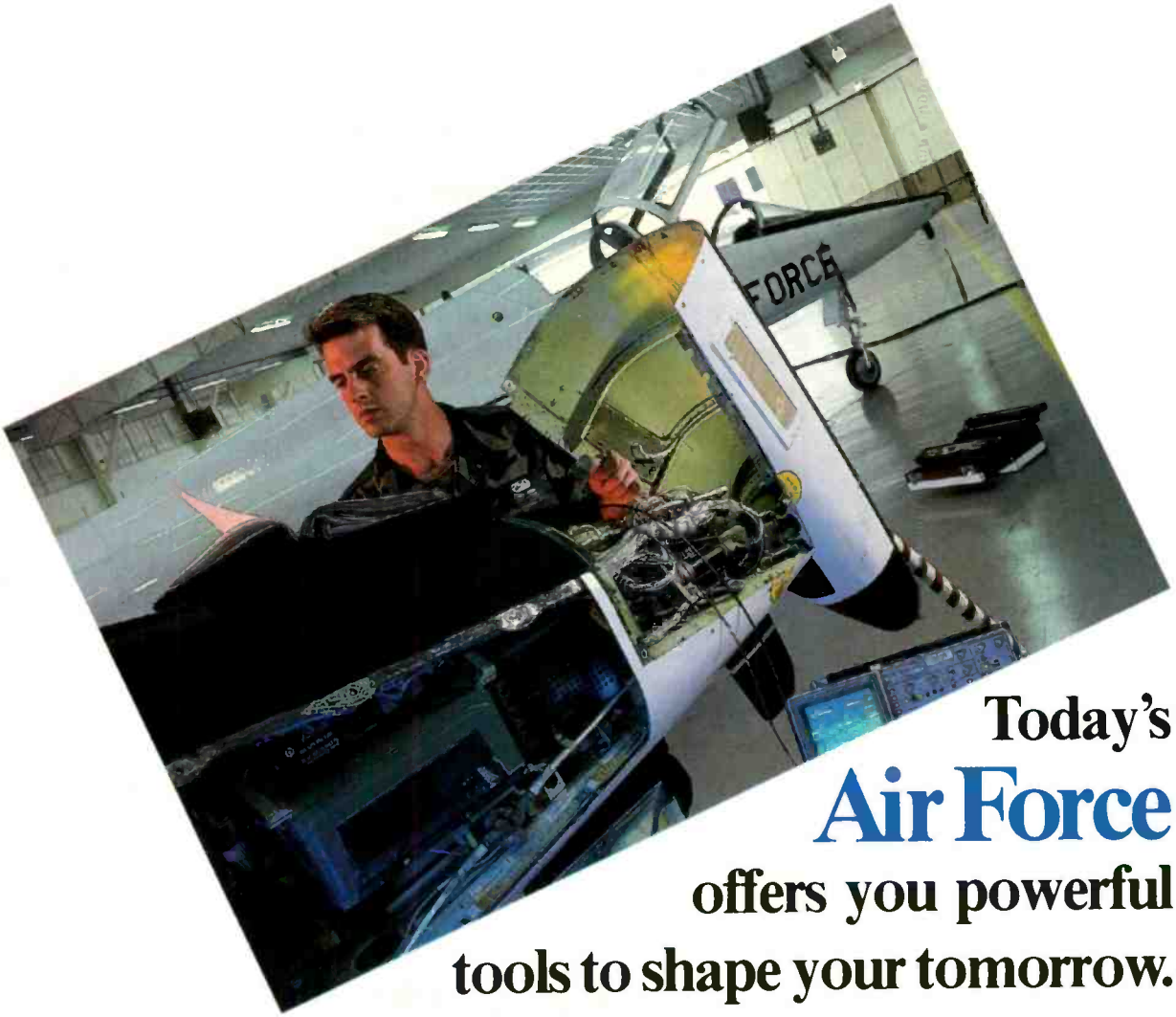
Figure 5 shows the phase and magnitude of the P-FR's impedance. Note that the phase (Fig. 5A) approaches –90° at low frequencies, which shows that the impedance is capacitive in nature. Within the woofer's range of operation, the impedance magnitude (Fig. 5B) shows a rapid upward slope as frequency drops, reaching 100 ohms at 5 Hz. This rise is due to the series capacitors in the high-pass filters in the column's crossover network; without the influence of that network, however, only the bass amp's even higher input impedance would be evident at these frequencies. Aside from that rise, the impedance's highest peak is 12.4 ohms (at 160 Hz), while its minimum is only 4 ohms (at 1.1 kHz). However, since the impedance is 27.2 ohms at 20 Hz, the max/min impedance variation between 20 Hz and 20 kHz is a fairly high 6.8 to 1 (27.2 divided by 4). To keep cable-drop effects from causing response peaks and dips greater than 0.1 dB, cable series resistance would have to be limited to a maximum of about 0.054 ohms. For a typical run of about 10 feet, that would mean using low-inductance cable of AWG #14 or larger. Yet because of its high impedance at low frequencies and its reasonable impedance minimums, the P-FR will be an easy load for most amplifiers. For amplifiers that have low damping factors, such as tube models, the capacitive impedance rise at low frequencies may lead to bass boost.

ON ROCK 'N' ROLL BASS, THE INFINITY P-FR MATCHED OR BETTERED ANY OTHER SPEAKER I'VE REVIEWED.

The cabinets were quite rigid. When the system was subjected to a high-level sine-wave sweep, side-wall resonances were minimal. When the Compositions P-FRs arrived, one of the woofers had a moderate "tick," caused by the rubbing of a misaligned voice coil. After I replaced that woofer with a new one from Infinity, I had no further problems.

Below the woofer system's closed-box resonance of 80 Hz, the driver's motion is controlled by stiffness, chiefly the stiffness of the small volume of air sealed into the enclosure. You can tell how stiff this is by trying to push the woofer's cone in. However, when the woofer is out of the enclosure and operated in free air, its diaphragm is quite easy to move.

I tested the amplifier's power-limiting threshold by noting the input voltage at the point where limiting occurred for several frequencies and settings of the bass switch. The higher the setting, the lower the limiting threshold. At the "Max" bass setting, the limiting thresholds at low frequencies oc-



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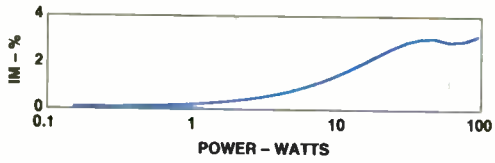

Fig. 8—IM distortion for A_4 (440 Hz) and E_1 (41.2 Hz).

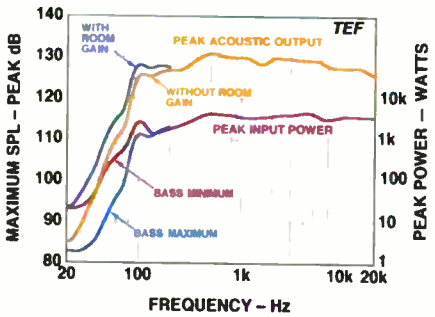

Fig. 9—Maximum peak input power and sound output.

curred at quite low input levels, in the range of only 3 to 4 volts rms. At inputs above this threshold, distortion increased rapidly because of the amplifier's clipping and the driver's reaching its displacement limit. This limit was only about 0.33 inch, peak to peak, at frequencies below 80 Hz and high input levels above threshold. (The woofer did not exhibit dynamic offset distortion at any frequency or level.)

Interestingly, without its enclosure, the woofer could be driven to maximum excursion of about 1.1 inch, peak to peak—the largest excursion capability I've yet measured. In other words, the power limitations of the bass amplifier and the stiffness imposed by the small enclosure limited the woofer's throw to about one-third its natural excursion capability!

Figure 6 shows the 3-meter room response of the P-FR, with both raw and sixth-octave-smoothed data. The system was in the right-hand stereo position, with its bass switch in the "Max" position (as it came from the factory), and aimed directly ahead, as per Infinity's recommendations. The measurement microphone was at ear height (36 inches), at the listener's position on the sofa. Between 380 Hz and 17.5 kHz, the averaged curve is very well behaved and fits a very tight, 5-dB, window. There are room-effect dips at 210 and 320 Hz and a bass elevation between 100 and 200 Hz. Slight treble rolloff is evident above 17.5 kHz. For another test of room response (not shown), made with the speaker canted in and aimed toward the test microphone, the results were essentially the same as those when the P-FR was aimed straight ahead.

Figure 7 shows E_1 (41.2-Hz) bass harmonic distortion with the bass switch in its middle position. At this frequency, power is actually being supplied by the woofer's internal amplifier; Fig. 7's indications of apparent power are calculated from my test amplifier's output voltage and the speaker's rated nominal impedance of 6 ohms. My test amp was actually delivering much less power than this.

The second harmonic reaches 15% at full power, after rising to an intermediate peak of 25% at about 12 watts. The third harmonic rises to a very high level, actually 2.7 dB above the fundamental, for a calculated distortion of 136%! The fourth harmonic reaches a level of about 20% at full power, while the fifth rises to an even higher 37%. The high third- and fifth-harmonic distortion values indicate that the woofer's displacement was limited symmetrically in both directions. Subjectively, the distortion rose quite rapidly above 10 watts and then leveled out at about 25 watts, with neither the fundamental nor the distortion getting any louder at higher input power levels.

SWITCHING TO A LOUDSPEAKER THIS SENSITIVE IS LIKE MULTIPLYING YOUR AMP'S POWER BY SIX.

It was quite clear that the bass amplifier was being worked very hard in this test, because the rear of the base unit (where the bass amplifier is mounted) was quite hot to the touch, and the system exhibited a moderate "hot electronics" odor. The Infinity did not sound as bad as these high distortion readings would suggest. In fact, it sounded rather mellow at these levels, which indicates low levels of high-order harmonics. At apparent input power levels above 25 watts, it was clear that the internal amplifier was simply self-limiting at its designed protection point.

At A_2 (110 Hz), bass harmonic distortion at full power (not shown) rose only to 3.0% second harmonic and 1.4% third; higher harmonics were below the floor of my test gear. The A_4 (440-Hz) harmonic distortion (also not shown) was quite low, reaching only 0.4% second harmonic and 1.1% third at full power.

Figure 8 shows IM versus power for 440-Hz (A_4) and 41.2-Hz (E_1) tones of equal level. After reaching 2% at about 16 watts, the distortion levels off at about 3% above 30 watts. At 100 watts, you can see that the IM rises only to 3%.

Figure 9 shows the short-term peak-power input and output capabilities of the P-FR as a function of frequency, with the bass switch in its "Min" and "Max" positions. (Peak input power was calculated by assuming that the measured peak voltage was applied across the rated 6-ohm impedance. Because of the system's high impedance at low frequencies, actual input powers levels were much smaller at low frequencies than calculated.) The measured peak power levels were for moderately clean-sounding acoustic outputs.

Note that the peak input level in the bass range depends on the gain setting of the bass amplifier. Maximum low-frequency power handling is achieved with the bass switch in its minimum position, and vice versa. With the bass switch in the "Max" position, the input power starts very low, only 2 watts at 20 Hz and 5 watts at 40 Hz. But the input power rises very rapidly thereafter, leveling out at a high 4,000 watts above 400 Hz.

With room gain, the maximum peak output SPL of the P-FR starts at a usable 93 dB at 20 Hz, rises very rapidly (reaching 100 dB at 32 Hz, 110 dB at 48 Hz, and 120 dB at 78 Hz), and then rises to the very high range of 127 to 130 dB SPL at all frequencies above 93 Hz. Note that the maximum peak acoustic output doesn't depend on the position of the amp's bass switch.

The P-FR's maximum acoustic output in the upper bass, midrange, and treble is very

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high, in the top 15% of all speakers I have tested. Its maximum low-bass output, however, falls only about in the middle of the speakers I have tested. On the other hand, its maximum output from 40 Hz up—very important in this speaker's home theater target market—has few equals.

Use and Listening Tests

The Compositions P-FR speakers come in quite large boxes with relatively complicated internal packing. Detailed unpacking instructions are included in the owner's manual. Before the systems can be removed from the cartons, four adjustable-height glides must be threaded into two bracket assemblies on the bottom of the speakers (supplied spikes can be substituted for the glides). Each of my test samples, however, had one improperly threaded bracket, which made it quite difficult to attach two of the glides to each system. The front glide bracket protrudes about 2½ inches beyond the sides of the woofer cabinet, but an attractive molded plastic cover hides it.

VOICES WERE VERY WELL REPRODUCED AND FIRMLY CENTERED, JUST WHAT'S REQUIRED FOR HOME THEATER.

The P-FRs are quite good-looking, even in their basic charcoal gray (the color of many TV sets) and present a striking narrow and tall appearance when set up—definitely not your usual column-style systems. Infinity has paid a great deal of attention to design, including such details as the appearance of the molded plastic front panel and the individual drivers, which are visible when the grille is removed.

The 16-page owner's manual is very comprehensive, with an emphasis on home theater and multimedia setups. Much useful information is included on operation and setup of the woofer and its controls.

The speakers were quite easy to hook up. I listened to them with gear that included Onkyo and Rotel CD players, a Krell KRC preamp and KSA250 power amp, Transparent Audio MusicLink Reference interconnects, and MusicWave Reference speaker cables. I also used B & W 801 Matrix Series 3 speakers for comparison.

The P-FRs were set up in my usual speaker locations, about 8 feet apart and far from the rear and side walls. Listening was done from the sofa, about 10 feet away, both with the speakers facing straight ahead (Infinity's recommendation) and with them angled in toward the listening position. I slightly preferred the sound with the Infinities angled in. All listening was done with grilles removed.

For my initial listening, I used *African Variations*, a promotional sampler disc of African music (Rykodisc RCD-PRO-AFR), which emphasizes percussion, rhythms, and drums. On this material, the P-FRs exhibited a very dynamic, clean, and wide-range sound. They were very smooth and could actually play louder and cleaner than the B & W 801 speakers.

Most listening was done with the bass level control set to its middle position. With the switch set to "Max," the bass was somewhat emphasized as compared to the 801s. In the middle position, the bass level was slightly less than the 801s'. The Infinities are among the very few systems I have evaluated whose maximum bass output can match that of the B & Ws. The P-FRs also kept up very well with the 801s in bass cleanliness, level, and smoothness. Only on material that had high levels of very low bass did the P-FRs come up short. There was no room-shaking bass from 20 to 30 Hz; the presence of such bass in the signal was sometimes accompanied by a sudden change of bass tonality when the level was turned up beyond a certain point. On loud rock 'n' roll bass and kick drum (which is mostly 35 Hz and up), the P-FR's bass quality and quantity matched or bettered that of any other speaker I have reviewed.

The P-FR's dynamic range capability was very impressive. This speaker could be played very loudly and cleanly on live sound effects, rock 'n' roll, and full symphonic music with percussion. I had to attenuate the signal a full 8 dB to match the Infinity P-FR's sensitivity to that of the B & W 801! Switching from speakers of average sensitivity to the extremely sensitive P-FRs is like multiplying your amplifiers' power by about six.

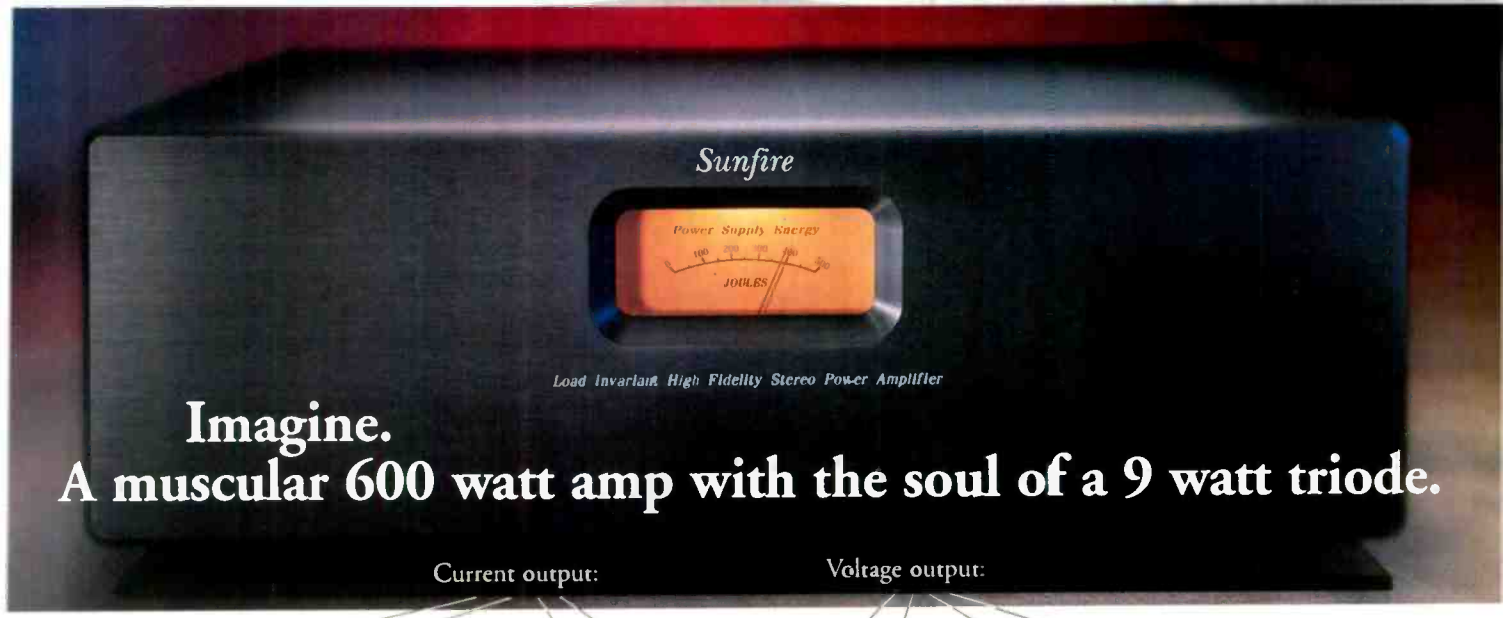
On my old favorite, *Ein Straussfest* (Telarc CD-80098), the P-FRs turned in one of the best performances I have heard; the rifle and percussive sound effects were recreated with extreme realism. The synthesizer sequence on track 1, "Ascent," of Don Dorsey's *Time Warp* (Telarc CD-80106) was quite impressive. This disc also demonstrated the Infinity's impressive capabilities on "movie-style" material, such as the main theme from *Star Trek*.

With pink noise, the P-FRs did quite well on the stand-up/sit-down test. They did exhibit a significant change in sound when I stood up, but the change was mostly a balanced reduction in level of mids and highs rather than the change in tonal character through the midrange that some other systems exhibit. When I sat, the Infinity P-FRs were just as smooth as the B & W 801s, with a very similar tonal balance. On most program material, it was hard to tell the difference between the P-FRs and the 801s in casual listening.

On band-limited pink noise, the Compositions P-FRs generated no usable bass output in the 20- and 25-Hz third-octave bands but produced some usable output at 32 Hz and had strong and powerful output in all bands from 40 Hz up. In the three lowest bands (20, 25, and 32 Hz), the P-FRs overloaded, suddenly sounding very distorted when a specific threshold was reached. Fortunately, the upper-bass and lower-midrange content of normal, wide-range program material effectively masks the woofer's distortion.

The P-FRs could handle a wide range of material—from symphonic music to male and female voice and from live jazz to loud dance music—with equal ease. In general, the P-FRs consistently presented a crisper, more up-front sound, with less room effect, than the 801s. Presumably this occurred because of the P-FR's restricted vertical coverage pattern. Speaking voices were particularly well reproduced, with a quite vivid center image. These latter traits are exactly what's required in a good home theater speaker.

The Infinity Compositions P-FRs' sound and appearance are competitive with those of the best home theater and stand-alone stereo speakers available. They should be very seriously considered by anyone who needs a speaker system that performs very well in both applications. A



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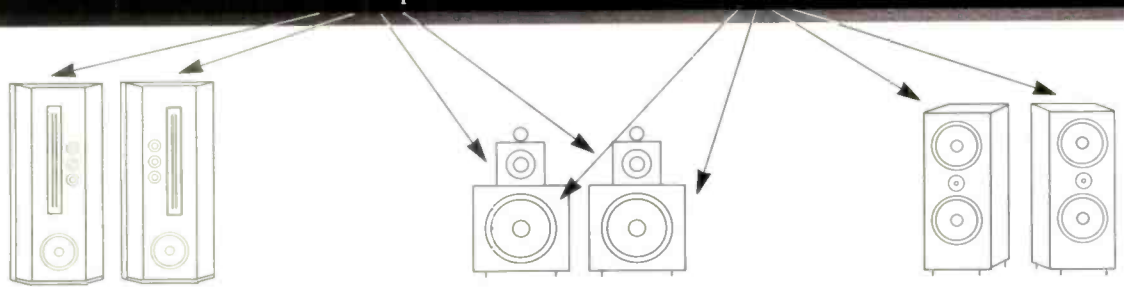

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SONY CDP-XA7ES CD PLAYER

Crowning Sony's "ES" series of CD systems is the CDP-XA7ES, a single-disc player obviously aimed at the high-end market. The CDP-XA7ES costs considerably more than other Sony ES players, but, in the esoteric league in which it plays, it's downright economical. The CDP-XA7ES features digital servo control and improved chassis construction. But what sets this player apart from its siblings is a "super-rigid vibration-reducing frame" (weighing more than 30 pounds), "the latest refinements in digital filtering, twin round-core power transformers, and a class-A output stage." That said, the two things I find most intriguing about the XA7ES are its fixed-pickup laser-tracking assembly (said to improve stability and reduce digital error rate) and its use of a disc-stabilizing weight, a technique long in vogue among manufacturers of esoteric top-loading players but seldom used by those who cater to a wider audience.

Unlike a top-loader (which demands topmost position for access in an equipment rack), the CDP-XA7ES loads conveniently from the front. The CD is placed, label side up, on a conical pillar and rests on a disc just slightly larger than the CD's center hole. The conical pillar centers the disc, while an elastomeric ring on the small supporting platter provides traction. A stabilizing block (which weighs about 4 ounces and must be in place for the system to operate) slips over the spindle and holds the CD against the ring. Felt on the underside of the weight helps protect the disc.

As the drawer accepts the disc (which occurs with remarkable silence and seeming precision), the spindle can be seen to advance the disc further inward to locate it above the laser head. Although you can't see the spindle while the disc is playing, it presumably continues to move the disc with respect to the laser head rather than spinning it in a fixed position and moving the laser to achieve tracking, as conventional CD players do.

The CDP-XA7ES has both balanced and unbalanced analog outputs, the former via base-metal XLR connectors, the latter via gold-plated RCA pin jacks. Two sets of unbalanced outputs are provided, one at fixed level and the other controlled by a front-panel knob that also adjusts headphone level. The line outputs are on the back; a gold-plated headphone jack is up front, near the "Line Out/Phone Level" control. The balanced outputs can be switched off by a back-panel slide switch. Optical (Toslink) and coaxial (gold-plated RCA) digital outputs on the back are energized by a front-panel button; an LED indicates when they're in use.

The CDP-XA7ES has the features you'd expect in a Sony player (and often won't find on esoteric models), including shuffle (random) play, program play, delete play (an alternate version of program play that enables you to delete tracks you don't want to hear), and custom index play (playback between two user-set index points). "Shuffle," "Program," and "C. Index" play are invoked from the front panel by pressing "Play Mode" multiple times; from the remote, they're accessible directly.

Delete play can be combined with shuffle play to randomize all tracks not deleted. Repeat play can continuously repeat the disc, a track, the contents of the program memory, or the custom-marked section as well as continually randomize playback of the disc with or without "track deletions." There's also music scan to play the beginning of each track in sequence; the scan duration defaults to 10 seconds but can be increased to 20 or 30 seconds if desired.

Sony has also simplified recording from the CDP-XA7ES (although its lesser siblings in the ES line are even more flexible in this regard). With the XA7, you can create a program of up to 24 tracks, check the tim-

Dimensions: 17 in. W x 5 in. H x 14⅞ in. D (43 cm x 12.5 cm x 37.5 cm).
Weight: 33.1 lbs. (15 kg).
Price: $3,000.
Company Address: Sony Dr., Park Ridge, N.J. 07656; 201/930-1000.
For literature, circle No. 92

Photos: Michael Groen

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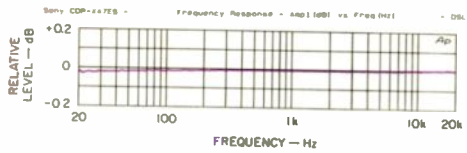

Fig. 1—Frequency response.

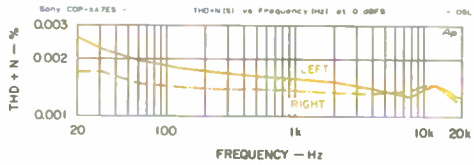

Fig. 2—THD + N vs. frequency.

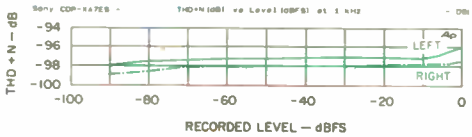

Fig. 3—THD + N vs. level.

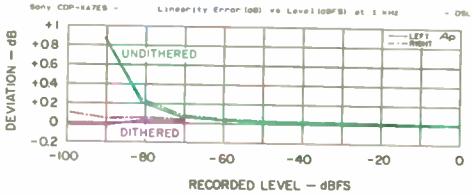

Fig. 4—Deviation from linearity.

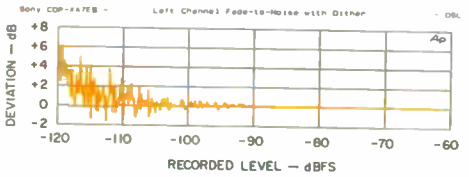

Fig. 5—Fade-to-noise test.

ing, and, if needed, divide the program in two for recording both sides of a cassette. (The pause that's inserted at the dividing point counts as a track.) "Auto Space" inserts 3 seconds of silence between programs, while "Peak Search" locates the highest level among the tracks to be recorded and repeats that portion of the program to facilitate setting the recording level. When recording from the analog outputs, you can manually fade in and out and adjust the fade time from 2 to 10 seconds (the default is 5 seconds long).

The CDP-XA7ES can store as many as 224 "Custom Files." These can be of two types: a "Custom Index" (which can contain up to eight marking points for a disc of 32 or fewer tracks and up to five marking points for discs with more than 32 tracks) and a "Delete Bank" (which stores instructions to omit the playing of specific tracks). If both types of files are used for a disc, they're stored separately and count as two "files." You can check the number of custom files retained by the player at will and erase the files for a disc if that disc is loaded. All custom files are erased if you don't use the player for a month.

The CDP-XA7ES has the normal transport controls on its front panel, including skip forward and back, "Check" and "Clear" for programming, and 12 keys for direct access to the first 12 tracks (plus a ">12" key to cue the remaining ones). The remote has enhanced versions of some of these functions, such as direct access to the first 20 tracks (plus a ">20" button) and both slow and fast music search. The remote also has some features not on the panel. For example, it has keys for cueing to prerecorded index points. It also enables you to adjust the level at the variable output jacks and to institute fades. It is the only means of initiating a peak search or music scan, activating and clearing the repeat function, marking portions of the disc for repeat A-B play, toggling the display through its three time modes, and activating or defeating the "Music Calendar" track display. The remote is the more convenient way to cancel random play, as it has a "Continue" key that immediately restores normal operation. From the front panel, cancelling shuffle play requires that you tap the "Play Mode" button four times.

THE CDP-XA7ES IS THE FINEST-SOUNDING PLAYER I'VE HEARD *AND* THE FINEST I'VE MEASURED.

Measurements

Wow! What a wonderful player! It simply sailed through my test sequence. Rarely do I find a product that doesn't make my eyebrows rise quizzically on one test or another, but the CDP-XA7ES was flawless.

We often speak of "ruler-flat" frequency response, but what does that mean? If you make the scale crude enough, you can make the response of any product look ruler flat. This one's is ruler flat with the most expanded (sensitive) scale I have ever used (Fig. 1)! There is nary a ripple, sag, dip, or peak. The channels are balanced within the limits of measurement accuracy. So is response. Incredible!

Now look at the plot of the Sony player's total harmonic distortion plus noise (THD + N) versus frequency (Fig. 2). The test is made at 0 dBFS, that is, at maximum recorded level. Check the vertical scale; it's much tighter than I've ever used before. Normally, THD + N rises at frequencies above a few kilohertz, often reaching several tenths of a percent (sometimes higher than that!) between 8 and 16 kHz. This curve stays well below 0.002% across almost the entire frequency spectrum!

Shift now to THD + N versus level at 1 kHz (Fig. 3). I have retained my "normal" scale here (although the CDP-XA7ES uses little of it!) just to make a point. I've never tested a CD player or D/A converter whose THD + N remained below –96 dB at all signal levels. Usually, THD increases toward 0 dBFS as the analog electronics get into trouble. Hence, and to account for the curve discontinuities common with "scaling" DACS (which use gain-compensated bit-shifting), I've been giving two results for

THD + N at 1 kHz in "Measured Data." One gives the maximum reading over the full dynamic range (0 to –90 dBFS); the other gives the worst reading over the lower operating range (–30 to –90 dBFS). The two numbers for the CDP-XA7ES are very close, which demonstrates that it works extraordinarily well at all recorded levels.

I've also used my tightest scale for the curves of linearity error versus level (Fig. 4). Whether a dithered or undithered recording is played, Sony's converter matches the best stand-alone D/A converters I've measured, vis-à-vis linearity, and is far superior to what you typically find in CD players. The fade-to-noise plot (Fig. 5) tells the same story: *far* better than run-of-the-mill and a match for the best.

Figure 6 shows spectrum analyses taken on the left channel when the CDP-XA7ES was reproducing the "infinity-zero" track of the CBS CD-1 test disc and when reproducing a 1-kHz signal recorded at –60 dBFS. Once again, I've had to adjust my scale range, this time downward by 10 dB to show the residual noise. Note the absence of power-line "hum" components in the noise plot. This testifies to excellent power-supply filtering and superior circuit layout. Overall, the noise plot lies 5 dB or more below what is typical of a good player, and the 1-kHz, –60 dBFS plot shows negligible odd-order distortion.

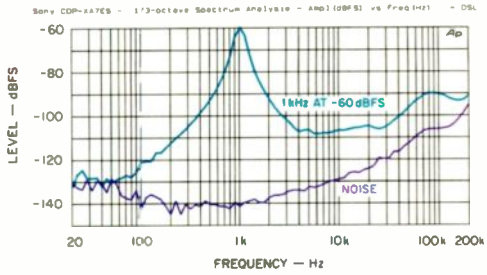

Fig. 6—Spectrum analysis of 1-kHz and "infinity-zero" tracks.

The absence of analog circuit noise also is apparent in the A-weighted S/N listed in "Measured Data" (data is shown only for the "worse" channel). The left channel came in at 126.1 dB, which, if memory serves me right, is a new record! The noise in the right channel was so low that I could not get consistent readings. The data for quantization noise reflects granularity in the conversion process. Once again, Sony has established a new benchmark.

Ditto when it comes to dynamic range, also listed in "Measured Data." I've never before seen A-weighted dynamic range figures greater than 100 dB, much less unweighted ones that, worst case, approach 99 dB. Channel separation also was stellar. I'm not sure who needs channel separation that exceeds 130 dB (worst case) over the meaningful frequency range, but, if nothing else, it sure is testimony to excellent circuit layout.

I took most of the data I've discussed using the fixed-level unbalanced outputs, which is probably the way most readers will use the CDP-XA7ES. I did rerun the frequency response sweeps through the variable-level unbalanced outputs as well as the balanced outputs. Except for the differences in output level in "Measured Data," the results were identical, and channel balance was equally good. In general, output levels are 1.5 to 2.5 dB higher than the quasi-standard 2 volts. Should this present an overload problem to a downstream processor (it shouldn't with a well-designed system), you can always use the variable output and turn the level down slightly. Source impedance from each output is low, and the player can even drive 50-ohm loads to full level without difficulty. Preamp input impedance and interconnect cable capacitance clearly are nonissues with this player.

MEASURED DATA

Line Output Voltage for 0-dBFS Recorded Level: Fixed-level unbalanced output, 2.57 V; variable-level unbalanced output, 2.42 V maximum; balanced output, 2.65 V; headphone output, 3.86 V.

Channel Balance: ±0.005 dB.

Line Output Impedance: Fixed-level unbalanced output, 100 ohms; variable-level unbalanced output, 200 ohms; balanced output, 300 ohms; headphone output, 105 ohms.

Frequency Response: +0.01, –0.02 dB from 20 Hz to 20 kHz.

THD + N at 0 dBFS: Less than 0.0027% from 20 Hz to 20 kHz.

THD + N at 1 kHz: –96.2 dB from 0 to –90 dBFS and –97.2 dB from –30 to –90 dBFS.

Maximum Linearity Error: To –90 dBFS with undithered recording, 0.87 dB; to –100 dBFS with dithered recording, 0.11 dB.

A-Weighted S/N for Infinity-Zero Signal: 126.1 dB.

Quantization Noise: –97.6 dBFS.

Dynamic Range: Unweighted, 98.8 dB; A-weighted, 101.1 dB.

Channel Separation: Greater than 118.5 dB from 125 Hz to 16 kHz.

Use and Listening Tests

What wonderful sound! No CD player I had in house at the time held a candle to the Sony CDP-XA7ES. Its sound was utterly transparent, amazingly detailed, and remarkably clean. The XA7ES added so few artifacts of its own that, for better or worse, I heard every wart in every recording: the almost subliminal ambient noise of the Troy Savings Bank Music Hall in Colin Tilney's recording of Bach's *The Seven Toccatas for Harpsichord* (Dorian DOR-90115); the slight shift in pitch that can occur when a piano's una corda pedal is held and the damper released, as on Schumann's "Carnaval" and "Kreisleriana," with Mitsuko Uchida on piano (Philips 442 777-2); and the breath sounds that accompany the low-level flute passages in the final movement of Mahler's Symphony No. 2, "Resurrection," with the St. Louis Symphony Orchestra under Leonard Slatkin (Telarc CD-80081/82). These "warts," if one may call them that, are unavoidable when real people play real instruments in a real acoustic environment. They should be reproduced; they are part of the sonic experience. But, even more remarkable—and much more enjoyable—were the musical accuracy and presence that this player delivered at all levels.

Mahler's "Resurrection," cited above, is an old CD (recorded in 1982) but is remarkably clean and underwent absolutely no dynamic-range compression at any step in the production chain. As a result, the disc has unusual dynamic range; quiet passages are really quiet, to allow room for the tremendous climax at the conclusion of the symphony. If you turn the level up in the quiet sections, you can often hear the low-

level granularity that CD players are wont to introduce. But not with the CDP-XA7ES. Low-level woodwinds, like flute and clarinet, retained their character at all levels. Furthermore, the bass line was extremely tight, solid but not flabby, and Kathleen Battle's voice sounded simply sublime. Maureen Forrester sounded, well, like Maureen Forrester of that time, experienced but showing some age. I also was impressed by the absence of intermodulation between brass and strings and by the cleanliness of the choral sections. Imaging was as good as I've ever heard from this two-disc set.

The Sony player's ability to reveal subtle differences in tonal character also was apparent in Itzhak Perlman's recording of Bach's Sonatas and Partitas (EMI Classics ZDCB 49483-2). I could hear the difference between the two violins he used for this two-disc set. What's more, the tiny instrument noises that even a violinist of Perlman's stature creates were clearly resolved.

To assess smoothness, I listened to how the CDP-XA7ES handled Mozart's "Eine Kleine Nachtmusik" with the Academy of Ancient Music under Christopher Hogwood (L'Oiseau-Lyre 411720). The sound on this disc, rather bright to begin with, is made even more shrill by the lack of vibrato. Yet the Sony player made the music sound "right," whereas lesser players can get downright harsh. The CDP-XA7ES clears away the veil between the listener and the music. I heard subtleties and detail on this disc that I had never heard before; I had neither been aware that the bass line was quite so tight and solid as the Sony displayed it to be nor that the imaging was quite so good as it really was. I could cite other examples of this player's remarkable smoothness and musicality, but I think I've made my point.

The Sony CDP-XA7ES is the finest-sounding CD player that's entered my listening room; it's also the finest CD player to have crossed my test bench. I consider it truly world-class and a reference against which others are to be compared. Among run-of-the-mill CD players from the Far East, the CDP-XA7ES is expensive. Compared with many esoteric players, it's a flaming bargain. For as long as I can keep it or until another replaces it at the pinnacle of perfection, the Sony CDP-XA7ES will be my reference CD player. A

EAD, *continued from page 50*

rapidly that my Audio Precision test equipment had difficulty keeping up. Thus, the response curve in Fig. 10 ends slightly before 20 kHz, although the sweep supposedly extends to that frequency. I've shown the front left response in Fig. 10; the responses of the front right, center, and both surround channels were identical. All main channels were balanced within a very tight tolerance, ±0.02 dB, although the low-frequency effects (LFE) channel was 2.31 dB lower in level. Its response, also shown in Fig. 10, is flat within ±0.06 dB from below 20 Hz to above 100 Hz.

I could not measure THD + N versus frequency with the Dolby AC-3 test disc because its sweeps are too fast for my distortion analyzer to track. The disc does contain 0-dBFS recordings at 1 kHz in the main channels and at 30 Hz in the LFE channel, so I could test THD + N at those frequencies and levels. The results, listed in "Measured Data," are excellent in all cases. Once again, it was impossible to measure channel separation as a function of frequency with the Dolby disc's sweeps, but I could use the static recordings to measure it at 1 kHz. In most cases, channel separation exceeded 100 dB; worst-case figures were 91.6 dB, between the two main front channels and between the two surround channels.

Use and Listening Tests

No point in mincing words: Enlightened Audio Designs' TheaterMaster is one of the most remarkable—dare I say *the most* remarkable—audio product to have entered my lab, my listening room, or my viewing room. But it's also one of the most user-unfriendly products I've encountered. Thank the powers that be that its Quick Reference Guide is laminated; anything less would be dogeared in no time.

I assume that one would eventually master the intricate control codes. Those that are used most frequently would, of course, quickly become second nature, but the more outlying codes would call for the Quick Reference Guide. It's not easy to find things in the manual (which is virtually devoid of drawings and doesn't even tell you which end of the SmartCable is which—the cable ain't marked either!).

My problem with the ergonomics of this device extends beyond multistroke commands. You simply can't tell what you've done after you've done it. Other than a handful of lights, there are no indicators on the processor whatsoever. You don't know whether you're using four- or eight-times oversampling unless you reenter the control sequence. If the TheaterMaster beeps at you (and if you can hear it beep, which is problematic), you've changed the setting (so reason tells you that you must have been using the other one). If it doesn't beep, you haven't changed the setting. So what you just asked for is what you were using, or maybe the TheaterMaster didn't pick up the code—better try the other one to be sure. Give me a break!

Similarly, it's pretty sexy to have this processor go through automatic level and delay calibration. But when it's finished, can you really trust that it did it right? You don't know what the settings are, so you can neither judge whether they make sense nor tell how they would have changed had the microphone been positioned differently. Using noise for setup helps reduce sensitivity to microphone position but does not eliminate it.

Putting aside these frustrations, you can revel in the sheer technology wrapped up in this product, and, when it is properly set up, you can experience some fantastically good sound. The vastly improved realism that Dolby AC-3 offers compared with Dolby Pro Logic can't be attributed entirely to the EAD TheaterMaster. But I doubt you'll find an AC-3 decoder that exploits the potential of 5.1-channel surround sound more fully than this one does. It's not simply a matter of channel separation—although that, too, is clearly evident when comparing AC-3 and Pro Logic soundtracks. Dolby AC-3 sounds flat-out cleaner and has more impact and vastly wider bandwidth than Pro Logic. That comes through loud and clear with the EAD TheaterMaster.

Then, too, the TheaterMaster is more than a great home theater device; it's a great audio controller (read: preamp) for reproducing and recording digital material. Its converters rank among the best I've tested or heard, and its analog electronics are superb. So I give the TheaterMaster a resounding A– for technology, an A– for upgrade potential (all done in software), and an A– for sound, but, sad to say, it's an F for friendliness. A

cloud ten

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Q I've got a hifi VCR hooked up to my stereo TV with the TV's audio outputs connected to my ProLogic receiver. But when I play a Dolby surround movie, I don't get much output from my rear channel speakers, even when I crank them all the way up. Why?

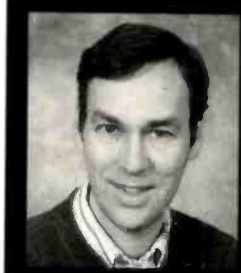
A There are two possible reasons. First, if you've connected the VCR to the TV via the antenna (RF) connectors, the stereo sound from your tape is not being sent to your TV. The RF output on a stereo VCR only passes MTS encoded signals from stereo TV broadcasts. From tapes, however, your TV receives a mono signal, and there is nothing for your ProLogic receiver to decode. Secondly, the output from your TV's audio jack may not have enough stereo separation to trigger the ProLogic decoding function. Try this, connect the audio output jacks from the VCR, directly to your receiver. Connect the video output jack of the VCR to a video input on your TV (if it has one-if it doesn't, use the RF connection and turn your TV sound all the way down.) Sounds a lot better doesn't it?

—Steven Firszt
Good Vibes Sound, Inc.
Champaign, Illinois

Good Vibes

Q I have a Laserdisc player without AC-3. Should I have it modified for AC-3 or buy a new one?

A I would recommend neither. To modify an existing player costs over $300 and replacing it costs at least $500. The problem is, nobody knows just how many laser discs will be AC-3 encoded. The emphasis of the movie studios will likely be on the new Digital Video Disc, and chances are they will never go back and remaster the thousands of existing LD titles for AC-3. What I would recommend doing is hooking up the optical digital output of your LD player (if it has one) to an outboard D/A converter. You will be amazed how much additional surround information you will hear on ALL LD's (even AC-3 ones!), not to mention clearer dialogue and more extended bass. The superior phase and time domain characteristics of outboard DAC's give your Dolby Pro Logic processor far better information to work with. Decent DAC's can be purchased starting at $300, and can also be hooked up to your CD player (if it has digital output), to give you twice the benefit.



—Richard Weaver
Evergreen Audio
Silverdale, Washington

EVERGREEN AUDIO

Each month, Audio Magazine's newest feature "See a Specialist", will showcase some of the finest audio/video dealers from across the country. The dealers, chosen as a result of recommendations from equipment manufacturers, Audio Magazine staff and industry organizations, will exemplify the best audio/video dealers from New York to California. The chosen dealers will offer solutions to problems that can best be handled by a specialty audio/video retailer.

If you would like to submit questions to dealers in your area please write to :
See a Specialist, c/o Audio Magazine, 1633 Broadway, NY, NY 10019

Q I already have full range loudspeakers, do I really need to add another subwoofer?

A Absolutely. There are three good reasons why a properly executed subwoofer addition will improve every system. One, even a theoretically ideal loudspeaker will exhibit uneven low frequency response once placed in a real room. Bass output at different locations can vary by a factor of 100! A separate subwoofer allows us to properly adjust the lower octaves, which in turn defines the overall tonal balance. Two, Digital software (CDs, Laserdiscs, etc.) and film soundtracks have much greater low frequency capabilities than we were used to with analog LPs and cassettes. There's a lot down there and once you've experienced realistic bottom end, there's no living without it. And three, the main reason that big speakers are big is to get more bass output and efficiency. With a sub, we can use smaller mains that can be placed more correctly, have better imaging, take up less space and are definitely more lifestyle friendly.

—Tom Altobelli
Woodbridge Stereo/Video
Woodbridge, New Jersey

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Q Should I buy a rear projection TV or a large tube TV?

A When speaking of any large screen format, bigger is better. Rear projection televisions have taken quantum leaps in picture quality. All of the areas that would cause one not to choose a projection TV years ago, such as viewing angles, light output, sharpness or noisy pictures have charged. In combination, today's technologies such as satellite, laserdisc, cable TV and the leaps in projection TV pictures, give stunning images. Many customers wish they would have bought a TV one size larger than they originally purchases, so don't be afraid to think big!

—Jim Kuhlmeyer
Goedecker's Super Store
St. Louis, Missouri

GOEDEKER'S SUPER STORE

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EQUIPMENT PROFILE

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JOLIDA SJ 302A INTEGRATED AMP

Who says tube amplifiers have to be expensive? In the growing market of comparatively affordable tube amplifiers, here's one from JoLida, the SJ 302A, that delivers 50 watts per channel. This unit has integrated-amp features yet sells for just $849.

JoLida, which was formed in 1983, deals primarily in industrial electronics, such as transformers, microwave tubes, and telecommunications equipment. It is also a major supplier of tubes and other component parts to the guitar-amplifier and high-end audio markets. JoLida does make five amplifiers, however, that range in power from 20 to 70 watts per channel and in price from $550 to $1,400 (with the SJ 302A right in the middle).

Rated Power Output: 50 watts into 8 ohms, 19 Hz to 100 kHz.
Dimensions: 17 in. W x 7½ in. H x 15 in. D (43.2 cm x 19.1 cm x 38.1 cm).
Weight: 39 lbs. (17.7 kg).
Price: $849.
Company Address: 10820 Guilford Rd., Suite 209, Annapolis Junction, Md. 20701; 301/953-2041.
For literature, circle No. 93

The front panel of the SJ 302A carries a selector switch with positions for four high-level sources, an on/off switch, and controls for balance and volume. On the rear panel are signal input jacks, five-way output binding posts (for each channel's ground, 4-ohm, and 8-ohm speaker connections), and an AC fuse and IEC line-cord jack.

Standing up from the attractive, welded-steel chassis are eight tubes: two 12AX7s for the input stage, two 12AT7 drivers, and two pairs of EL34 output tubes. Power and output transformers are mounted directly to the chassis top plate; the tubes and remaining components are on subplates or p.c. boards just underneath. The overall quality of parts and construction is good—better, in fact, than one might expect for a product in this price class.

Circuit Highlights

The SJ 302A's circuit topology is quite conventional except for its input stage. This stage uses a 12AX7 twin triode whose two sections are connected in series—similar to, but not the same as, the popular (and relatively new) mu-follower design. In the input circuit, the plate of the lower triode section is connected to the cathode of the upper tube through a cathode resistor; the plate also directly feeds the upper triode's grid. In addition, signal input is applied to the lower tube's grid. The concept behind this configuration is to present a semiconstant current load to the lower triode so that its voltage gain will approach its mu (amplification factor). Relatively low output impedance is maintained by taking output to the next stage from the cathode of the upper triode. The output of this first stage is directly coupled into a long-tailed phase inverter that uses a 12AT7 dual triode. The phase inverter's output is capacitor-coupled into the output stage, which uses an Ultra-Linear configuration with fixed bias.

Individual bias adjustments for each output tube permit matching their plate currents. A five-pin in-line socket on the chassis has contacts for ground and each tube's cathode voltage, which can then be checked with any DC voltmeter able to measure 40 millivolts with decent resolution. Overall negative feedback of some 5 dB is taken from the 8-ohm tap on the secondary of the output transformer back to the cathode of the first stage's lower triode section. The overall gain is said to be about 32 dB, about 6 dB higher than usual for a power amplifier, to accommodate low-output line-level signal sources.

The output of the four-position source selector feeds the volume control, which in turn feeds the input stage. The ends of the balance pot are connected to the wipers of the volume-control sections, and the balance pot's center tap is grounded. Because of this design, keeping the volume fully up and the balance control all the way to one side (an unlikely, but possible, scenario) will short out one channel of the signal source. This would not be particularly kind

Photo: Michael Groen

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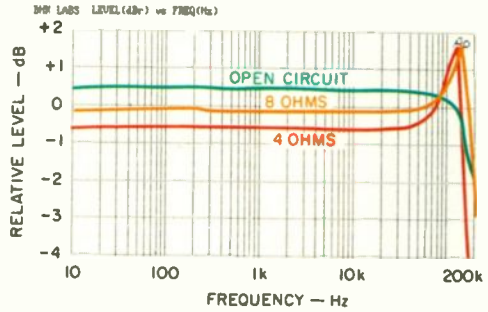

Fig. 1—Frequency response.

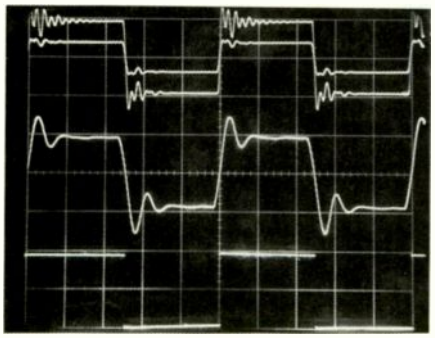

Fig. 2—Square-wave response for 10 kHz into 8 ohms (top), 10 kHz into 8 ohms paralleled by 2 microfarads (middle), and 40 Hz into 8 ohms (bottom).

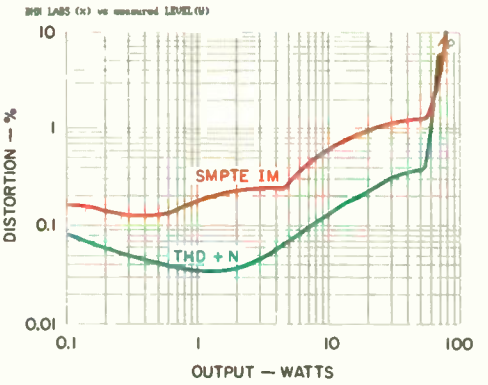

Fig. 3—THD + N and SMPTE-IM distortion.

to signal sources. However, in this age of predominantly high-level signal sources, making an integrated amplifier out of a power amplifier simply by adding input selection, volume, and balance (but no extra gain stages) is very sensible.

Measurements

Because performance of the SJ 302A's two channels matched very closely, data is shown for the right channel alone unless otherwise noted.

Voltage gain was 34.2 dB on the 8-ohm taps with 8-ohm loading. Although I didn't measure it, the gain with 4-ohm loads on the 4-ohm taps should be about 3 dB less. The SJ 302A's gain should be enough for most modern high-level program sources.

Frequency response on the 8-ohm tap for open-circuit, 8-ohm, and 4-ohm loading is plotted in Fig. 1. The SJ 302A has a somewhat greater bandwidth than most tube power amplifiers, albeit with some high-frequency peaking and consequent ringing. Oddly, it's the responses without 4- and 8-ohm loading, not the response with the open circuit (no load), that has a peak at the high-frequency end of the amplifier's bandwidth! I don't recall seeing any other amp do this. When I used the 4-ohm tap, the bandwidth was similar, but the peak (with 4- and 2-ohm loads) was essentially gone. Rise and fall times were each 1.2 microseconds with volume fully clockwise, output at ±5 volts, and 8-ohm loading on the 8-ohm tap. With the volume set for 6-dB lower output, rise and fall times increased to about 1.6 microseconds; that's still pretty fast, especially for a tube amplifier.

Square-wave response is shown in Fig. 2. The top traces are for 10 kHz into an 8-ohm load on the 8-ohm tap. The larger trace is with the volume control at maximum, and the smaller trace, at half amplitude, is with the volume down approximately 6 dB. Ringing is reduced when the volume is at the –6 dB point because the lower volume setting slows the rise time. (This is a common phenomenon: The amplifier's input capacitance and the equivalent resistance of the volume- and balance-control circuit form a first-order low-pass filter.) Note also that the ringing is different for each half cycle. This is usually caused by coupling differences between each primary half of the push-pull circuit's output transformer and its secondary windings. In the middle trace, the 8-ohm load is paralleled by a 2-microfarad capacitor; the ringing characteristic seen here is typical of most power amplifiers. The 40-Hz trace (bottom) exhibits admirably little low-frequency tilt, verifying that the response extends below 20 Hz.

Both total harmonic distortion plus noise (THD + N) and SMPTE-IM distortion are shown in Fig. 3 as functions of power output for 8-ohm loading on the 8-ohm tap. With 4-ohm loading, 44 watts was attainable at the 8-ohm tap; with a 16-ohm load, power at this tap was 33 watts. Figure 4 shows THD + N versus frequency; the rising THD + N below about 1 kHz at the low power levels is due to signal modulation from the power supply's ripple frequency of 120 Hz. At higher power levels, the rise in distortion at low frequencies is due to the output transformer's increasingly nonlinear magnetic characteristics. A spectrum of the 1-kHz harmonic-distortion residue at 10 watts into 8 ohms on the 8-ohm tap (not shown) revealed admirably low high-order components. The third was the dominant harmonic, as it should be in a well balanced push-pull amplifier. All in all, the SJ 302A's distortion was typical for a well-designed tube power amp.

DESPITE ITS FAIRLY MODEST COST, THE LITTLE SJ 302A TUBE AMP SOUNDED REMARKABLY GOOD.

Interchannel crosstalk was almost identical in the two measurement directions. With volume fully clockwise, the crosstalk level was about –77 dB up to a frequency of 500 Hz, increasing to –70 dB at 2.2 kHz and to –55 dB at 20 kHz. With volume set to about –20 dB of attenuation, crosstalk was some 15 to 20 dB higher.

Output impedance on the 8-ohm taps was about 0.4 ohm. Damping factor, the ratio of the tap impedance to the output impedance at that tap, is plotted for both channels in Fig. 5. What is unusual here is the increase in damping at the upper end of the audio range, a phenomenon I have no ready explanation for. Input impedance measured about 32 kilohms.

Output noise as a function of measurement bandwidth was 1 millivolt wideband,

740 microvolts from 22 Hz to 22 kHz, 200 microvolts from 400 Hz to 22 kHz, and 170 microvolts A-weighted. The EIA S/N was 84.5 dB, with the left channel about 2 dB quieter than the right.

Dynamic power was 68 watts at the beginning of the EIA tone-burst signal and 64 watts at its end; with the 68-watt measurement, that means dynamic headroom was 1.3 dB. Steady-state power at the visual onset of clipping was 60 watts. The AC line-current draw was 0.7 ampere at turn-on, before plate current started to flow. It was 1.5 amperes at idle and 3 amperes at 60 watts per channel.

Use and Listening Tests

I found the SJ 302A amp worked flawlessly, and its gain was entirely adequate for all of my signal sources. I got the distinct impression, from its stable performance and solid build quality, that this amplifier would be reliable in the long run. One thing that may be troublesome, however, is the outside diameter of the RCA input jacks, which seems to be smaller than standard; I would advise gently squeezing the outer contacts of any signal cables before plugging them in.

My intial listening impressions of the SJ 302A were favorable. (These early impressions are often pretty much in line with my impressions after more extended listening; sure enough, I concluded that this was an amp I could live with.) Space and dimension were quite good, and there was little irritation. Tonal balance was essentially neutral; the bass was just a bit "tubey," or underdamped, but otherwise musically consonant, and the amp had an amazing amount of impact and "whack." Pushing the SJ 302A hard produced a more than adequate and satisfying sound level, and it overloaded gracefully. I got very musically satisfying sound with all my signal sources. This little amp sounded remarkably good, despite its relatively modest cost. I liked the JoLida quite a bit; anyone wanting to experience tube amplifier sound without paying a fortune should check it out. A

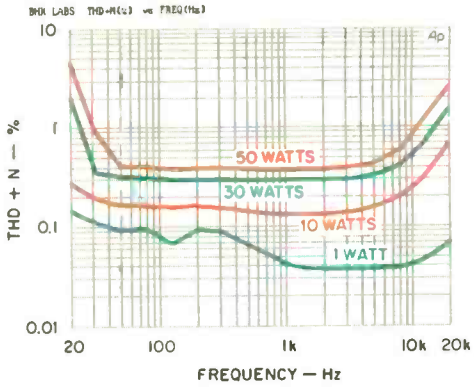

Fig. 4—THD + N vs. frequency.

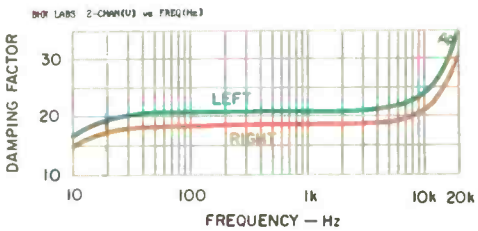

Fig. 5—Damping factor.

AURICLE

ANTHONY H. CORDESMAN

CONRAD-JOHNSON MF2300-A AMPLIFIER

Few would dispute that conrad-johnson has made some of the finest tube electronics in the world for nearly two decades. The new MF2300-A stereo power amplifier, however, is part of the company's growing line of solid-state electronics.

The $2,995 MF2300-A, the most expensive solid-state conrad-johnson amplifier, is rated to deliver 240 watts per channel into 8 ohms with less than 1% THD or IM from 20 Hz to 20 kHz. Its other specifications include frequency response of +0, –4 dB from 20 Hz to 20 kHz, hum and noise –98 dB below maximum output, sensitivity of 2.05 volts for rated power, and input impedance of 100 kilohms. The amp does not invert polarity.

Company Address: 2733 Merrilee Dr., Fairfax, Va. 22031; 703/698-8581.
For literature, circle No. 94

The MF2300-A's simple gold front panel has a power switch, an LED that shows the unit is turned on, and LEDs that warn if the left or right channel is being driven to maximum power. The rear panel carries left and right RCA inputs and speaker connectors. The MF2300-A does not have balanced inputs, which is a bit unusual at this price.

THE MORE I LISTENED, THE MORE I WAS STRUCK BY THIS AMP'S ABILITY TO GET THE BEST FROM LIVE RECORDINGS.

Separate, regulated power supplies are provided for the voltage and driver stages, to isolate them from the output stage's demands for current. This is a design feature that conrad-johnson also utilizes in its tube amplifiers.

The MF2300-A uses very little negative feedback—about 12-dB worth, where more conventional designs use 60 dB, according to conrad-johnson. To allow this, the company says, it designed each stage of amplification to be highly linear, with wide bandwidth and (since little gain is lost through the use of negative feedback) relatively low gain. Transistors designed for video applications are used in a particularly critical part of the circuit, to achieve the desired open-loop bandwidth. The company feels that lowering feedback provides better sound than minimizing measured distortions and notes that the MF2300-A still has less distortion than its best tube amplifiers. To ensure that the amplifier's distortion products are largely second-order and almost exclusively even-order (a distortion characteristic similar to that of a tube amplifier), and to improve its musicality, a J-FET input stage is used.

The MF2300-A was designed to present a relatively high load impedance to each stage. This is achieved in part by combining the J-FET input with a MOS-FET output. This use of higher input impedances (again typical of tube circuits) enables conrad-johnson to specify polystyrene and polypropylene capacitors, which it feels sound much better than the usual electrolytics, throughout the audio circuits. (Higher impedances allow using proportionately lower capacitances without changing low-frequency response, making the use of such expensive capacitors more practical.)

Photo: Michael Groen

The MF2300-A also uses laser-trimmed Vishay resistors in the critical input stage and feedback loop.

Low output impedance is also achieved by the use of MOS-FETs—four pairs of them—as output devices. This gives the MF2300-A a much higher damping factor than tube amplifiers.

The MF2300-A is definitely a music lover's amplifier, designed to capture the fine details of a performance rather than exciting musical dynamics or the deepest possible bass; it is the kind of amplifier you appreciate best by listening to natural recordings. Amplifiers that sound more striking at first, particularly with heavily processed music that depends on sheer power for its impact, are likely to sound less satisfying when you listen seriously and want music rather than drama.

FEW AMPLIFIERS IN THIS PRICE RANGE COMMUNICATE OVERTONES AND DETAIL SO WELL.

The overall timbre is slightly soft, compared to some solid-state units, and is similar to that of conrad-johnson's tube amplifiers. The MF2300-A's highs do not sound rolled off, yet they are smooth and sweet, matching very well the extended highs and flat response of the Thiel CS7s I use as one of my reference loudspeakers and allowing me to use the flat setting on my Apogee Studio Grand ribbon speakers. The MF2300-A produced a softer treble from B & W 801s, which have less overall upper-octave energy than the Thiel and Apogee speakers.

The MF2300-A has good deep bass, but without the sheer power and extension of the Krell KSA-300s and Classé Audio CA-400s that I sometimes use for comparison. Its deep bass is closer to that of the Pass Laboratories Aleph 1.0, with more emphasis on control and information rather than dynamic excitement.

Mid-bass and lower midrange are also good, without the leanness of many solid-state amps. As a result, the MF2300-A does an excellent job of reproducing the cello, grand piano, and deep male voice. This

amp gives music its natural richness, although without quite the warmth I remember from conrad-johnson's tube designs.

Mid-bass dynamics are good, and the MF2300-A reproduces percussion transients well. Its reproduction of mid-bass to lower-midrange dynamics is, however, more natural than exciting. This amplifier is better suited to classical, jazz, and other acoustic music than to electronically enhanced music.

The MF2300-A shares the exceptionally musical midrange performance of conrad-johnson's tube products. The more I listened, the more I was struck by its ability to get the best from live recordings and others that emphasize natural balance. It was unusually easy to distinguish one type of violin, guitar, or piano from another. This midrange performance also helped minimize the small sonic anomalies that can make music sound a bit electronic.

The upper octaves are slightly sweet and have a bit more warmth than detail, although brass, woodwinds, and percussion still sound very natural. The MF2300-A is not the ultimate in terms of upper-octave transient detail, bite, and excitement. Fortunately, that's a blessing with most studio and close-miked recordings, and the sweetness does not prevent this amp from reproducing musically natural "air" and harmonics.

The fact that the MF2300-A's dynamics are more natural than exciting scarcely means that it is reticent or overly polite. The MF2300-A reproduces very well the natural concert-hall dynamics required of 19th-century symphonic warhorses, big-band music, or the kind of rock that relies on musical skill rather than overblown synthesizers and sudden outbursts of sheer noise. However, this amp does seem to sacrifice just a bit of its transparency at the very lowest levels, perhaps reflecting conrad-johnson's heritage of tube design. At the same time, its transparency at other levels is excellent, much like top tube amplifiers. The harmonic structures and overtones of musical instruments and voice are very natural. Few amplifiers in this price range communicate so well the overtones in solo violin, guitar, and harpsichord music or the detail in upper-octave percussion and woodwind instruments.

The MF2300-A has excellent depth and a very good three-dimensional soundstage. Depending on the rest of your setup, it can reproduce as much depth and soundstage width as the recording justifies. Unlike some older conrad-johnson equipment, it does not slightly exaggerate depth at the expense of soundstage width. The MF2300-A is very good at reproducing the imaging of both live and naturally miked recordings, with no "hole in the middle" or clustering effects.

I was not happy to see that conrad-johnson didn't specify power into 4- and 2-ohm loads or specify current capacity. Such specifications are essential in helping the audiophile determine an amplifier's compatibility with a wide range of speakers. The MF2300-A did, however, work very well with difficult dynamic speaker loads, electrostatics, and ribbons, though it was not ideal in driving an older ribbon speaker of very low impedance.

All in all, the conrad-johnson MF2300-A suits me just fine. It makes the high end a path to the music rather than making the music a path to the high end. A

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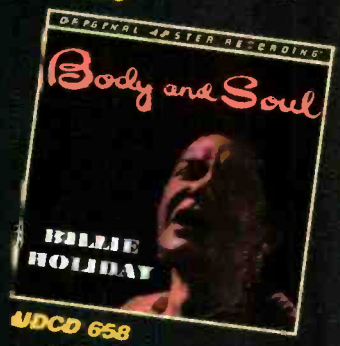

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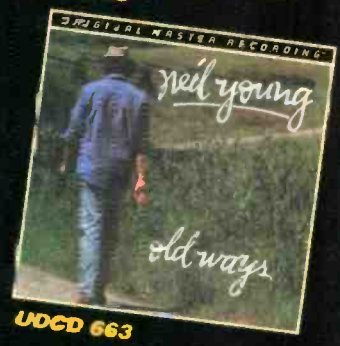

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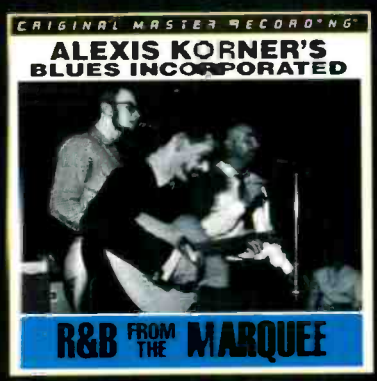

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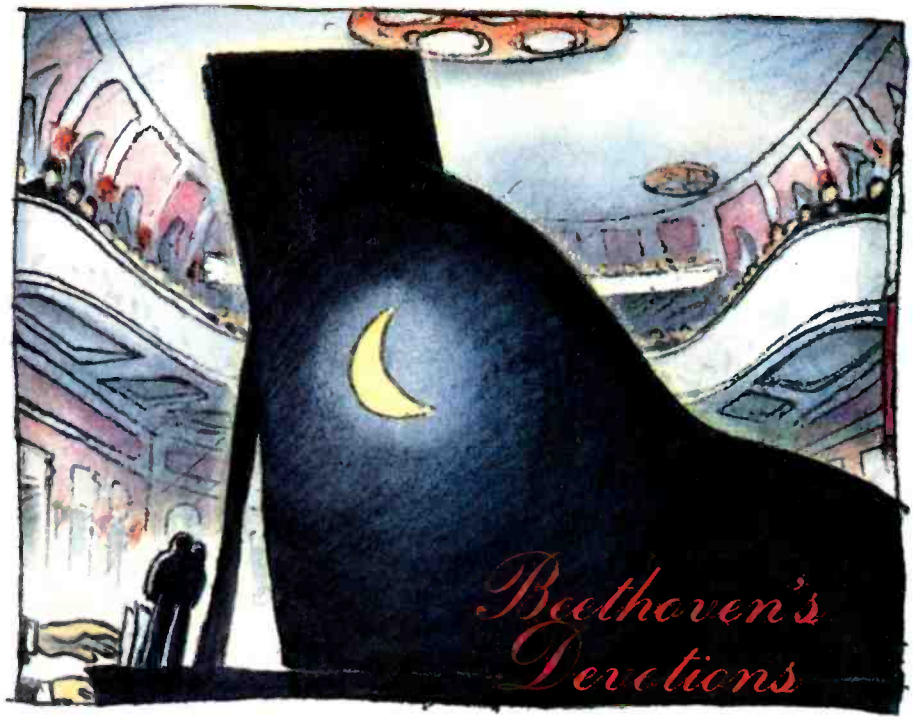


Illustration: Philippe Lechien

Entangled Devotions (Beethoven's Piano Concerto No. 5 and Piano Sonata No. 14)
Naum Starkman, piano; Russian Symphony Orchestra, Mark Gorenstein
POPE MUSIC PM-1004
CD; DDD; 56:39
Sound: A, Performance: A

These are fine performances of the "Emperor" Concerto and the "Moonlight" Sonata, played by one of those Russian master pianists who travailed in obscurity under Communist rule. I don't mean to put down the performances with so brief a mention, but fine recordings of both works abound, and the sound on this effort interests me far more than the repertory.

This recording was made last year in the Great Hall of the Moscow Conservatory by Gene Pope III, using a Nagra "D" tape deck and electronics supplied by Cello Music & Film. The hall is a rectangular space resembling Boston's Symphony Hall or Vienna's Musikverein in its proportions as well as in its decor, though it's bolder in detail. I was much impressed by the sound when Vladimir Ashkenazy recorded his triumphant "return" concert there (an MCA disc I reviewed in the February 1991 issue). Later, Ed Canby reviewed a different recording made in the same hall (Rubinstein piano concertos on Russian Disc, July 1995), commenting that a "reverb oscillation" blurred the orchestral sound. Is it a difficult hall over which Ashkenazy's engineers triumphed or a great one that was carelessly handled by Russian Disc?

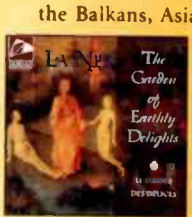
There is little evidence of any reverberation problem in the present recording, but it was made very close-to. The effect through my system is that of being suspended in the air a good 15 feet above the floor and perhaps 10 feet behind the conductor. The sound is top-notch if you can dispense with the impression that you are attending a normal concert, the only reservation that prevented an A+ rating. The Ashkenazy sounded utterly different. Looking at a photograph of the hall, I suspect that his microphones may have been placed at the front of the balcony. His sound wallows in the space—gloriously but, admittedly, with much less clarity than Pope has achieved.

My guess: The hall's exceptionally long reverb time does pose problems that can be overcome only through exceptional miking. In some halls (Carnegie Hall, at least before reconstruction, and the "new" Metropolitan Opera come immediately to mind), the sound can be remarkably clearer at the front of a balcony than in certain other, much pricier seats. Perhaps that is true here. If so, Pope's solution is totally valid. You can hear the long reverb time in the background, particularly on piano solos, but it is prevented from intruding on the body of the sound.

Oh, yes, the album title. *Entangled Devotions* evidently has something to do with Beethoven's feelings for Giulietta Guicciardi. Beyond that, I'm clueless. *Robert Long*

The Garden of Earthly Delights

La Nef
DORIAN DISCOVERY DIS-80135
CD; DDD; 64:04
Sound: A–, Performance: A



Objective criteria are even more elusive than usual in determining the above ratings, because this music—and therefore its sound—is sui generis. Its inspiration was the famous painting by Hieronymus Bosch, circa 1500. La Nef is a group of Quebecois musicians, all of whom have backgrounds in "old music." Beyond that, anything goes, and some of the material comes from the Balkans, Asia Minor, Spain, and points beyond. The result is an eclectic musical morality pastiche in medieval style. If you'd like an alternative to Hildegard von Bingen, give this a listen. The recording is generally crisp, and the performances are assured. *Robert Long*

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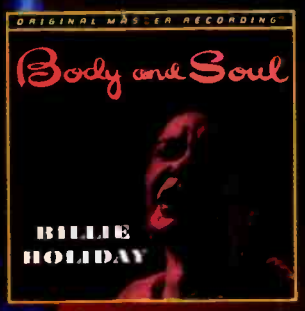

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Liszt: Piano Transcriptions of Beethoven's Nine Symphonies

Jean-Louis Haguenauer, Georges Pludermacher, Alain Planes, Paul Badura-Skoda, Michel Dalberto, and Jean-Claude Pennetier, pianists
HARMONIA MUNDI FRANCE
HMX 2901192.98
Seven CDs; DDD; 6:40:46
Sound A–, Performance A–

While other recordings exist of the amazing Liszt transcriptions of Beethoven's symphonies, this is the first to bring together all nine in one package—and at a budget price, to boot.

Liszt illuminates the contrasts of tone and color in the originals, almost creating new works that nevertheless capture Beethoven's volatile moods and emotions. The six pianists

give their all in negotiating the fearsome technical difficulties (including the most spectacular work, the Ninth, which calls for two pianos). Though we can hear the intended symphonic versions anytime and anywhere today, the transcriptions give a different picture of Beethoven's genius and his musical architecture. Occasionally, only the studs and rafters appear, as in extremely quiet sections or at major climaxes that tax the capability of 88 keys and 10 fingers. In general, though, I found the results breathtaking and think that this collection should generate a new appreciation for the orchestral versions. The sound is unforced and natural. *John Sunier*

Bach: Four Overtures; Two Sinfonias

La Stravaganza Köln, Andrew Manze
DENON CO-78965-66
Two CDs; DDD; 1:50:34
Sound: A, Performance: A+

Bach titled the four main works "overtures" instead of "suites," which they are generally known as now, even though each is a suite of dance movements preceded by a long overture in the French style. These orchestral suites have been recorded so often that one might ask why another could be needed. Yet this new version is performed by La Stravaganza Köln with such impeccable style that I recommend it even to those who have several other versions in their collection.

Although the four suites are based on similar patterns of dance movements, each is uniquely orchestrated. Suite No. 1 in C Major (BWV 1066) is scored for two oboes and strings, while Suite No. 2 in B Minor (BWV 1067) is essentially a concerto for flute. Suite No. 3 in D Major (BWV 1068), the most famous of the suites, adds trumpets and tympani to the ensemble—although the strings alone play the celebrated Air.

The final work, No. 4 in D Major (BWV 1069), is scored similarly to the Third Suite, but in this recording the trumpets and tympani are removed. Director Andrew Manze explains his argument that this Fourth Suite, "as it now survives, may have been a rearrangement of the original for a ceremonial function in Leipzig. If the original was composed in Cöthen," earlier in Bach's career, as many scholars now believe it was composed, "there could not have been any trumpets." Whether one accepts his musicological argument or not, the effect of this rescoring is remarkable, uncovering the antiphonal effect between the strings and the oboes.

This CD was made using a small group of period instruments, with relatively little ornamentation but without the cerebral coldness that is too often found in baroque interpretations. Instead, the musicians play with great enthusiasm coupled with meticulous accuracy. Masahiro Arita, one of the preeminent authorities of the flauto traverso, exemplifies this spirit with his exquisite solo performance in the Second Suite.

The recording quality is particularly excellent in the two sinfonias (BWV 29 and 146), which were recorded in Cologne's Emmanuelkirche. Although the orchestral suites were recorded in a studio, the ensemble nevertheless employs some interesting innovations—such as placing the trumpets behind the orchestra in the apex of a triangle for the Third Suite. While some listeners may object to such acoustical experimentation, the overall result is a freshness that easily corresponds to Bach's compositions.

The term "La Stravaganza" is usually associated with the composer Antonio Vivaldi, who used it as the title of a cycle of a dozen violin concertos. Its present use by these talented musicians based in Cologne is quite appropriate, since this group is more and more being recognized as one of Europe's finest interpreters of baroque music. The precision, intensity, and originality of this album place it in the distinctive elite of essential Bach recordings. *Patrick Kavanaugh*

CHARLES IVES & PAUL CRESTON

Ives: Symphony No. 2; Creston: Symphony No. 2

Detroit Symphony Orchestra, Neeme Järvi
CHANDOS CHAN 9390
CD; DDD; 56:37
Sound: A, Performance: A

Charles Ives' Second is the work that began the Ives revival in the 1960s, because of its exciting 1958 recording by Leonard Bernstein and the New York Philharmonic (available on Sony Classical). Hymns, barn dance tunes, country fiddlers, marching bands, and familiar classical snippets—a crazy-quilt of musical Americana is reflected in this rollicking score. But as infectious and historic as the Bernstein Edition is, its somewhat dated sound is obvious next to this smashing performance by Neeme Järvi's Detroit forces. For a specific comparison, try the giant orchestral raspberry with which the symphony concludes. Ives' wild and woolly instrumental cutups demand the best sonics, and Ralph Couzens (producer and consulting engineer) and his people deliver them.

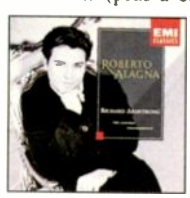
Paul Creston is another highly individualistic, do-it-yourself American composer. Only recently has the recording industry (notably the Delos label) begun to give his music the attention it deserves. Spontaneity, strong melodies, and rich harmonies are found in his music. Creston's Second Symphony has only two movements and was conceived as an apotheosis of song and dance.

The Second Symphonies of Ives and Creston are an appropriate and welcome coupling here, Volume 8 of the British label's "American Series." *John Sunier*

Roberto Alagna (Operatic Recital)

Roberto Alagna, tenor; The London Philharmonic, Richard Armstrong
EMI CLASSICS 5 55477, CD; DDD; 61:17
Sound: A, Performance: B

This disc is a blatant showcase to promote a rising star. The alternating Italian and French chestnuts (plus a couple of rarities) make it



plain that the music is not the principal concern here. Roberto Alagna, a tenor in the mold of, say, Mario del Monaco, sounds as though he has all of del Monaco's ego and panache, if not all his vocal velvet. With any luck at all, Alagna should become a major operatic force. The London Philharmonic is deliciously recorded (at Abbey Road) for a disc of this type. *Robert Long*

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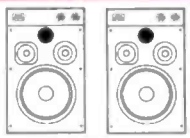

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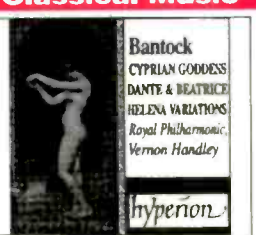

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ROCK~POP RECORDINGS

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The Cult of Ray

Frank Black
AMERICAN 2-43070-A, 38:37
Sound: B+, Performance: B

The "Ray" referred to in this album's title is science fiction writer Ray Bradbury, indicating that Frank Black's fascination with things otherworldly continues unabated. Three albums into his solo career, the former Pixies leader also continues to explore post-modern guitar rock, fronting a four-piece combo and deftly self-producing a slew of live-in-the-studio recordings. *The Cult of Ray* was originally conceived as a double album, but Black whittled away the surplus material to come up with the 13 songs included here. The results are solid, if not quite out of this world.

On the plus side, Black's knack for penning jarringly hooky rockers, in evidence since he first emerged as Black Francis with The Pixies in the mid-'80s, surfaces in new tunes like "You Ain't Me," "I Don't Want To Hurt You (Every Single Time)," and "The Last Stand of Shazab Andleeb" (the last, one surmises, is a kind of alien abduction "Knocking on Heaven's Door"). The album's high points are, indeed, celestial. Meanwhile, the three sidemen he's brought aboard put in stellar performances, with lead guitarist Lyle Workman, in particular, taking advantage of room to maneuver with his imaginative playing. On the downside, the album features too many chugging rockers like "Men in Black," "Jesus Was Right," and "Mosh, Don't Pass the Guy" (the last one of two instrumentals) that merge into an indistinct body.

The Cult of Ray will please those who've been fascinated with Black's cryptic lyrics and passionate (though now toned-down) vocals. Yet it may not appeal much beyond the cult of Frank Black. *Steve Stolder*

BLUE INCANTATION

Sanjay Mishra
with special guest Jerry Garcia
RAINDOG RECORDS RDR 098, 47:05
Sound: A, Performance: B+

On *Blue Incantation*, guitarist Sanjay Mishra's compositions reveal an intriguing and ingratiating raga influence, underscored by Samir Chatterjee's tablas throughout most of the album. Their combined sound during "Bach in Time" (based on J. S. Bach's Gavotte and Rondeau from Lute Suite No. 3) is fascinating and quite enchanting. Elsewhere, pungent Spanish strains appear. Elegant and meditative, Mishra's compositions are gently exploratory, with a comforting sense of melody.

Blue Incantation's attraction for many will be three tracks that feature Jerry Garcia on electric guitar. His session with Mishra in December 1994 was one of his last as a sideman and are the first recordings to be released posthumously. Garcia's barb-like electric fills dart around Mishra's acoustic guitar lines to achieve a nice rapport. However, despite the fire Garcia undisputedly adds, to me Mishra is most charming and effective—a bit more pure—when he is the only guitarist.

The sonic quality of this 24-track, Dolby SR recording is a star in its own right, and Dick Glasser's superb mastering really lets all the instruments shine, particularly the bubbling and exquisite sound of the tablas. Also, the MIDI-triggered voice on two songs is a fascinating and unexpected sound.

Traditionally, ragas tend to be oriented to specific times of day, as does Mishra's music. It sounds best to me midday and in the afternoon; I seem to do my housework rapidly and efficiently—and with a smile. (Available from Raindog Records, P.O. Box 7256, Silver Spring, Md. 20907.) *Michael Tearson*

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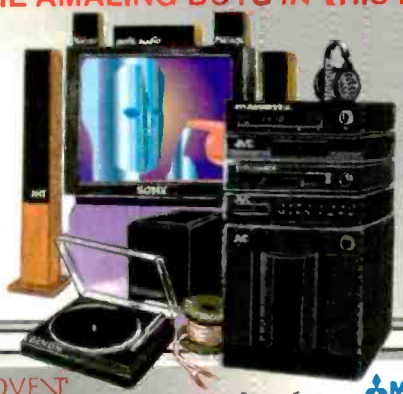

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Brian Jones Presents the Pipes of Pan at Jajouka

The Master Musicians of Jajouka
POINT MUSIC 446 487, 46:03
Recording: B–, Performance: A–

Long before Afro-pop washed up on Western shores and before Peter Gabriel discovered the world (so to speak), a young guitarist named Brian Jones journeyed to Morocco to record The Master Musicians of Jajouka. By 1968, when his artist friend Brion Gysin took him there, Jones was already a megastar: lead guitarist and resident eclectic of The Rolling Stones. He sought a transcendental musical experience and the music associated with the celebration of Pan, a mysterious, white-haired goat-god. As Gysin recounts in this reissue's extensive liner notes, Jones was somewhat of a mythical figure to the Jajoukans: "There was quite a commotion because they thought Brian Jones was very funny and not really of this world, with his long blond hair and furry hippie togs."

Thus, *Brian Jones Presents the Pipes of Pan at Jajouka* is an important document in the chronology of what we call "World Music"; in the years since this recording was made, artists like Ornette Coleman, Don Cherry, and Bill Laswell have been drawn to the powerful drums and the compelling call of the double-reed ghaitas. This well-packaged reissue also helps to frame an understanding of Jones, one of the most misunderstood figures of rock.

As for the music, it's fascinating if listened to closely. The syncopation of drums and handclaps mesmerizes, and the fluctuating tonalities of horns and pipes is, well, trippy. Yet this is ritual music, and as performed out-of-ritual in these excerpts, its effect is somewhat diminished. Also, several tracks bear the mark of studio gimmickry (phase shifting and the like), a detail not mentioned in the otherwise wonderful notes. As Master Musician Bachir Attar writes: "[Brian Jones] is dancing wildly with his headphones on and everybody loving him. When I see this big musician from the highest band of the world—he make me think to get our music out into the world." They have. *Larry Blumenfeld*

Different Class

Pulp
ISLAND 314 524 165-2, 52:03
Sound: B+, Performance B+

Remember that sinking feeling you had the first day of your freshman year in high school, when you timidly surveyed those imposing new surroundings? It was sorta like walking into the Minotaur's maze, wasn't it? For Jarvis Cocker—the delicate, fey frontman for the U.K.'s Pulp—those awkward times never ended, and he spends another shivery album trying to make sense of it all. It's a pastel, Little Lord Fauntleroy sort of world he lives in, where girls tease but never commit (the breathy "Pencil Skirt"), childhood chums stay friends forever ("Disco 2000," which owes a '70s guitar nod to Elton John's "Saturday Night's Alright for Fighting"), and puberty is one of life's enduring enigmas (the orchestral "Something Changed").

Thanks to keyboardist Candida Doyle's arsenal of kitschy instruments—a Minimoog synthesizer, a Farfisa organ, and a Fender-Rhodes electric piano—Cocker's ruminations maintain a dreamlike, almost carnival quality. Sometimes you want to slug him (the over-emoted "Underwear," for instance); at other times you want to hug him, like when he skewers the slumming rich on the New Wavey "Common People." When an art school girl says, "I wanna sleep with common people just like you," he acquiesces with, "Well, what else could I do?" Later, she even romanticizes cockroaches crawling down the walls. Cocker's vocals, which are usually postured, are especially cunning on this cut, full of asides and subtly wry wit.

No matter how far it strays, *Different Class* always returns to the teen theme of the acne-riddled underdog finally outfoxing the class bullies. In "Mis-Shapes," which rises to a crashing Top 40 crescendo, Cocker and cohorts would "like to go to town but we can't risk it. . .you could end up with a smack in the mouth/Just for standing out." Perhaps that's why the adult artist has become one of the showiest, most foppishly attired performers on the British rock scene. Call it Cocker's revenge: All those lunkheads who pushed him around during his teens now have to look up to him in the Pulp pulpit. And he isn't preaching forgiveness. *Tom Lanham*

Mood Elevator

Jack Logan, featuring Liquor Cabinet
MEDIUM COOL/RESTLESS 89290, 48:00
Sound: B, Performance: B+

Try to imagine, as the '70s were winding down, Elvis Costello as an amateur songwriter/car mechanic living in Georgia and The Attractions as some backwater galoots who'd join him on the weekends to swill beer and cut songs on cheap recording gear. Now try to imagine Costello as too self-deprecating to presume that anyone would actually want to hear the first 600 songs he'd recorded over the course of 14 years. But, as in a fairy tale, someone comes along and selects 42 of them for a two-disc introduction to the world.

Substitute Jack Logan for Costello and Liquor Cabinet (a loose configuration that's abetted Logan since 1979) for The Attractions, and you pretty much have the story behind *Bulk*, a 1994 underground magnum opus that inspired widespread acclaim in the pop press. The two-hour-plus *Bulk* is a tough album to top, and, indeed, *Mood Elevator* doesn't have the sweep of its predecessor. But then again, *Bulk* was an expansive aberration from an artist who specializes in terse, finely detailed lyrics framed by basic bar-band rock. For a point of reference, think of the late, lamented American Music Club, whose Mark Eitzel is a vocal and visceral dead-ringer for Logan.

Although *Bulk* was recorded in various settings using different supporting casts, the 17 songs on *Mood Elevator* were selected from

CHILDREN OF THE BONG

Sirius Sounds
Children of the Bong
MAMMOTH MR0131-2, 73:46
Sound: A–, Performance: B–

There's no guessing where Children of the Bong's heads are at; this is floor-ripping, acid-peeling techno. Daniel Goganian and Rob Henry, who are COTB, traffic in an analog synthesizer sound distilled through dub mixing and techno beats. Like their mentor, Toby Marks of Banco de Gaia, they've learned the art of techno drama. On "Interface Reality," for example, they drop beats in and out of the mix, creating tension through space before catapulting you out of your seat with a neck-snapping dance groove. COTB's dub bass lines on "The Veil" and the Kraftwerk-ian sequencer are all part of techno's vernacular template. But they also unleash a naive spontaneity and fractured sense of melody that make most of *Sirius Sounds* come to life, avoiding the monotony of techno's pneumatic vise-grip. *John Diliberto*

36 cuts recorded in Indiana. As in his earlier songs, Logan is fixated with the little horrors that put souls to the test. "Ladies and Gentlemen" is set in a crowd of people prepared for bad news. "What Was Burned" kicks through the ashes of a blazed home. Logan's vaguely foreboding side, which cropped up in several *Bulk* songs, returns in "Estranged," where a jilted lover muses: "The very sound of her voice is a blow to my head/I don't want her alive, and I don't want her dead."

Bulk was an unself-conscious snapshot of a crew of music-lovers at play; *Mood Elevator* is a more posed portrait of professional musicians at work. Let's just say this album provides all the evidence Logan needs to give up his day job. On the other hand, given what his labor has inspired, maybe he should keep punching the clock. *Steve Stolder*

The Way Out Is the Way In

Audio Active and Laraaji
GYROSCOPE GYR 6615-2, 55:17
Sound: A–, Performance: A

Pack your bags: Audio Active and Laraaji are about to take you on a joyful, mind-expanding sonic trip. The music here would not have been out of place in Haight-Ashbury during the Summer of Love; today it could be the perfect antidote to the Gingrichian '90s. *The Way Out Is the Way In* unites Audio Active, one of Japan's hottest "ambient dub" groups, and New York-based Laraaji, who is best known for his 1980 collaboration with Brian Eno, the transcendent *Day of Radiance*. Is this new collaboration World Music? No, it's more like Trans-Global, successfully combining Eastern and Western sensibilities in a very palatable stew.

Laraaji is a musical mystic, a serious musician who believes in the healing power of meditation. It was this interest in meditation that led to his work with Eno and their mutual fascination with ambient music. Laraaji's voice could be described as part '50s hipster Lord Buckley ("The Nazz") fused with a zonked-out Robin Williams-like speed rap. He

is a happy soul who went on to develop a "meditation-through-laughter" technique (don't laugh at this idea; on the other hand, laugh), which is where Audio Active enters the picture. *The Way Out Is the Way In* is a showcase for Audio Active's treatment of Laraaji's recordings: they slice and dice, mix, process, and add instruments, creating an album that's much greater than the sum of its parts. It's dense, yet Laraaji's voice floats over, under, and around, inviting you to "think cosmically, act locally." *Steve Guttenberg*

FAST TRACKS

The Memory of Trees: *Enya* (Reprise 46106-2, 43:53). A very satisfying album. If you've become an Enya devotee through her two previous releases, you'll thoroughly enjoy this new one. Nothing especially startling or different, but a healthy dose of her soothing, quality music. **M.T.**

Invocation: *Anuna* (Celtic Heartbeat/Atlantic 82855-2, 50:18). Anuna, a 12- to 20-voice choir that makes an astonishing sound, sings an array of Irish traditional songs and poetry with sparse accompaniment. Beautifully recorded, their sound is timeless, a rich tapestry of melody and voice. **M.T.**

The Long Voyage Home: *Joe Cocker* (A&M 31454 02362 2, four CDs; 4:52:54). If anybody figured to be a likely rock 'n' roll casualty, it was Joe Cocker. This triumphant, slipcased retrospective celebrating 30 years of recording marks the man as a survivor. All eras are fairly represented. Some dandy rarities and live shots brighten the proceedings. **M.T.**

JAZZ-BLUES RECORDINGS

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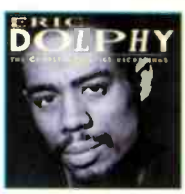

The Complete Prestige Recordings
Eric Dolphy
PRESTIGE 9PRCD-4418-2
Nine CDs; 11:19:42
Sound: A, Performance: A+

This definitive nine-CD boxed set contains all of Eric Dolphy's sides as a leader from 1960 to 1961, the brief but prodigious period when he recorded exclusively for Prestige and its New Jazz subsidiary. Stunning photographs and depictions of the original album artwork, along with Zan Stewart's comprehensive liner notes in the 40-page booklet, complete this portrait of a true jazz revolutionary who was misunderstood by the great majority and revered by only a hip few.

Consider the disparate views held by jazz figures of the day, cited by Stewart in the liner notes: Fellow saxophonist Sonny Stitt reviled Dolphy's sound, saying "That ain't pleasant to my ears, man!" while bassist Richard Davis referred to Dolphy's music as the "angelic passion for life itself."

The first disc quickly establishes Dolphy's astonishing talent on alto sax with material from *Outward Bound*, his 1960 debut as a leader. His supercharged playing on two takes of "G.W." (named for Gerald Wilson) and a burning "Les" clearly comes from the Charlie Parker school, though Dolphy's provocative choice of notes was a radical departure from standard bop vocabulary. A multi-reedman, he stakes out equally daring territory on bass clarinet with an original reading of "On Green Dolphin Street" and a swinging "Miss Toni." His flute playing on Rodgers and Hart's "Glad To Be Unhappy" showcases the same unorthodox genius at work. These tracks also contain superb performances by such stellar sidemen as trumpeter Freddie Hubbard, pianist Jaki Byard, and drummer Roy Haynes.

Dolphy continues to push the envelope with *Out There*, another Prestige landmark, with the intriguing sideman combination of George Duvivier on bass, Roy Haynes on drums, and Ron Carter on cello. Also represented in this chronological collection is *Eric Dolphy at the Five Spot*, featuring the trumpet virtuosity of Booker Little with the great rhythm tandem of bassist Richard Davis and drummer Ed Blackwell.

Included in this uncompromising collection are Dolphy's performances as a sideman on Prestige sessions for Oliver Nelson (*Screamin' the Blues*), Ken McIntyre (*Looking Ahead*), Eddie "Lockjaw" Davis (*Trane Whistle*), Mal Waldron (*The Quest*), and Ron Carter (*Where?*). Particularly breathtaking is an unaccompanied alto sax performance of "Tenderly" (from *Far Cry*) and an unaccompanied bass clarinet reading of "God Bless the Child." Less extraordinary are his performances with the Latin Jazz Quintet (originally issued as *Caribé*).

Hearing Dolphy's singular genius makes it hard to reconcile his tragic end—disillusionment over the relative apathy to his music in the States, poverty from a dearth of gigs, and ultimately death at age 36 due to complications from diabetes. But he left behind a rich legacy; the honest, emotional content of his music throughout an astonishing career assures people will be listening to Dolphy for some time to come. *Bill Milkowski*

Bing Bing Bing!

Charlie Hunter Trio
BLUE NOTE 8 31809 2 9, 56:19
Sound: B+, Performance: A

In the past several years, the Charlie Hunter Trio has been playing alternative rock clubs and even made a few select appearances on the Lollapalooza tour. Both of these facts are amazing, considering that, as an instrumentalist, Hunter has more in common with Joe Pass and Wes Montgomery than Primus and Green Day. The Lollapalooza gigs, in particular, probably exposed more than a few virgin ears to jazz for the very first time. For Hunter, it's the perfect tightrope walk; he gets to play what he wants (including a cover of Nirvana's "Come As You Are," done in 6/8 time) without compromising his art in any way. All he's gotta do is throw an occasional acid-jazz groove underneath, as on "Greasy Granny" or "Fistful of Haggis," and his music gets over with the kids.

Hunter and his San Francisco colleagues, drummer Jay Lane and tenor saxophonist Dave Ellis, are definitely in the jazz tradition. One need only hear 12 bars of "Come As You Are," the Eddie Harris-flavored "Wornell's Yorkies," or the smoking "Elbo Room" to understand that. But they are also extending the legacy with some oddball twists and little "ear cookies" (like a nasty wah-wah guitar or some Middle Eastern licks) that tap into the lucrative alternative rock market.

On a purely technical level, Hunter is astonishing. Playing a custom-made eight-string guitar in a finger-style manner, he simultaneously covers bass lines, chords, and single-note lines: Sort of like a Hammond B-3 organ player covering bass lines with his feet while comping with the left hand and blowing single-note lines with the right. He has a flawless sense of time, walking authoritative bass lines while comping up a syncopated storm on the up-tempo burner "Elbo Room." And his solos are marked by daring intervallic leaps and fluid, fleet-fingered, single-note runs that deftly avoid guitaristic clichés. Together, the three get a full quartet sound, which is augmented on a few tracks by special guests David Phillips on pedal-steel guitar, Ben Goldberg on clarinet, and Jeff Cressman on trombone.

This is one hip, groovy little jazz trio . . . coming to an alternative rock club near you, perhaps. *Bill Milkowski*

McCOY TYNER

Prelude and Sonata

MILESTONE MCD-9244-2, 63:48
Sound: B, Performance: C+

This recording could have been a summit meeting between generations. Instead, *Prelude and Sonata*, like a lot of contemporary acoustic jazz albums, settles for being an easygoing affair. Legendary pianist McCoy Tyner takes young saxophonists Joshua Redman and Antonio Hart, drummer Marvin "Smitty" Smith, and bassist Christian McBride through standards and works by Beethoven and Chopin (and even a tune from *Modern Times* by Charlie Chaplin) with professional ease and grace.

Tyner gives a hint of his old modal glory on his own "Contemplation," providing Redman and Hart the chance to work an improvisation of trade-offs and reharmonization. But despite the pleasant flight, they don't quite get there the way Joe Henderson did some 30 years ago.

Tyner seems to shake off the chains only in a trio version of Michel Legrand's "I Will Wait for You." He probes and prods the playful melody in one of the few instances where he's actually fired up by his sidemen, McBride and Smith. *Prelude and Sonata* aspires to be a grand meeting, but unfortunately it's just another serviceable jazz album, a gathering of generations on very safe ground. *John Diliberto*

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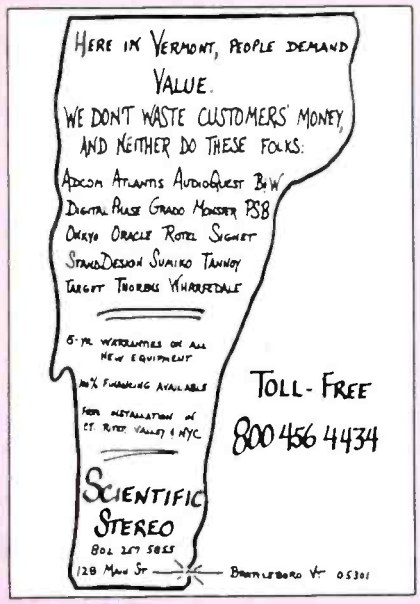

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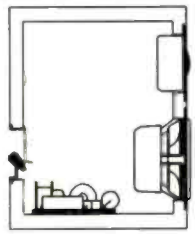

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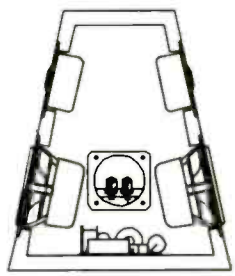

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Tom Nousaine, *Sound & Image*, February/March 1995

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PlayBack

Tekna Sonic C-5 and C-10

Vibration Absorbers

Owners of moderate-priced and upmarket loudspeakers may find Tekna Sonic's vibration absorbers effective in reducing box coloration caused by cabinet-wall resonances. Made of multiple polymer plates, the absorbers are said to dissipate the mechanical energy caused by resonances in rigid enclosure walls. (These absorbers are not recommended for use on low-priced speakers because of their flexible walls.) The absorbers are attached to enclosures' rear panels by removable sticky-backed magnetic pads. Tekna recommends its Model C-5 (at right in photo), at $80 per pair, for use with two-way speakers; the C-10 ($100 per pair) is meant for use with larger systems. A model for subwoofers, the C-12, has recently been introduced. The effects of the absorbers varied on the several pairs of box speakers I tried them with. Some recordings sounded generally improved, while others evinced no audible effects. With the absorbers attached to famous-name, $1,000/pair speakers, I heard a discernible tightening in the bass on some

GRADE: B

music, combined with an overall tonal realignment that made the sound seem to emanate from enclosures with thicker cabinet walls. Since results vary with the speakers used, there's no way to tell in advance what the absorbers will do for you. But they're sold with a 30-day satisfaction guarantee, so you can find out for yourself.

John C. Hallenborg

For literature, circle No. 120

Esoteric Sound Aten Turntable

Based on a turntable for disc jockeys that's been modified to include additional speeds, the Esoteric Sound Aten turntable ($530) is designed for those who play or archive old 78s or the 16-inch transcription discs once used to store old radio programs. This well-built, belt-driven turntable can play discs at speeds of 33.33, 45, 71.29, 76.59, 78.26, and 80 rpm. It comes with an S-shaped arm and a Sanyo cartridge (with styli for both LPs and 78s). Its features include pitch control, a platter strobe disc for 33s and 45s (plus an add-on cardboard strobe to use with 78s), a cartridge-alignment gauge (also cardboard), a dust cover, and an adaptor for 45-rpm records. There is no anti-skating or cueing control; the omission of the latter lowered the grade that I have given. Numerous options are available, including a vertical/lateral switch and the ability to play records either backward or forward.

GRADE: B

Cartridge setup was easy. With some of my 45s, LPs, and 78s—and with a 33-rpm transcription disc sent with the turntable—the cartridge and arm tracked well. However, the 16-inch transcription had a bend in its edge that rubbed the overly large on/off knob, even with the extra, anti-slip platter mat; putting a 78 under the mat fixed the problem.

John Gatski

For literature, circle No. 121

Lamm Audio Laboratory L1 Preamp

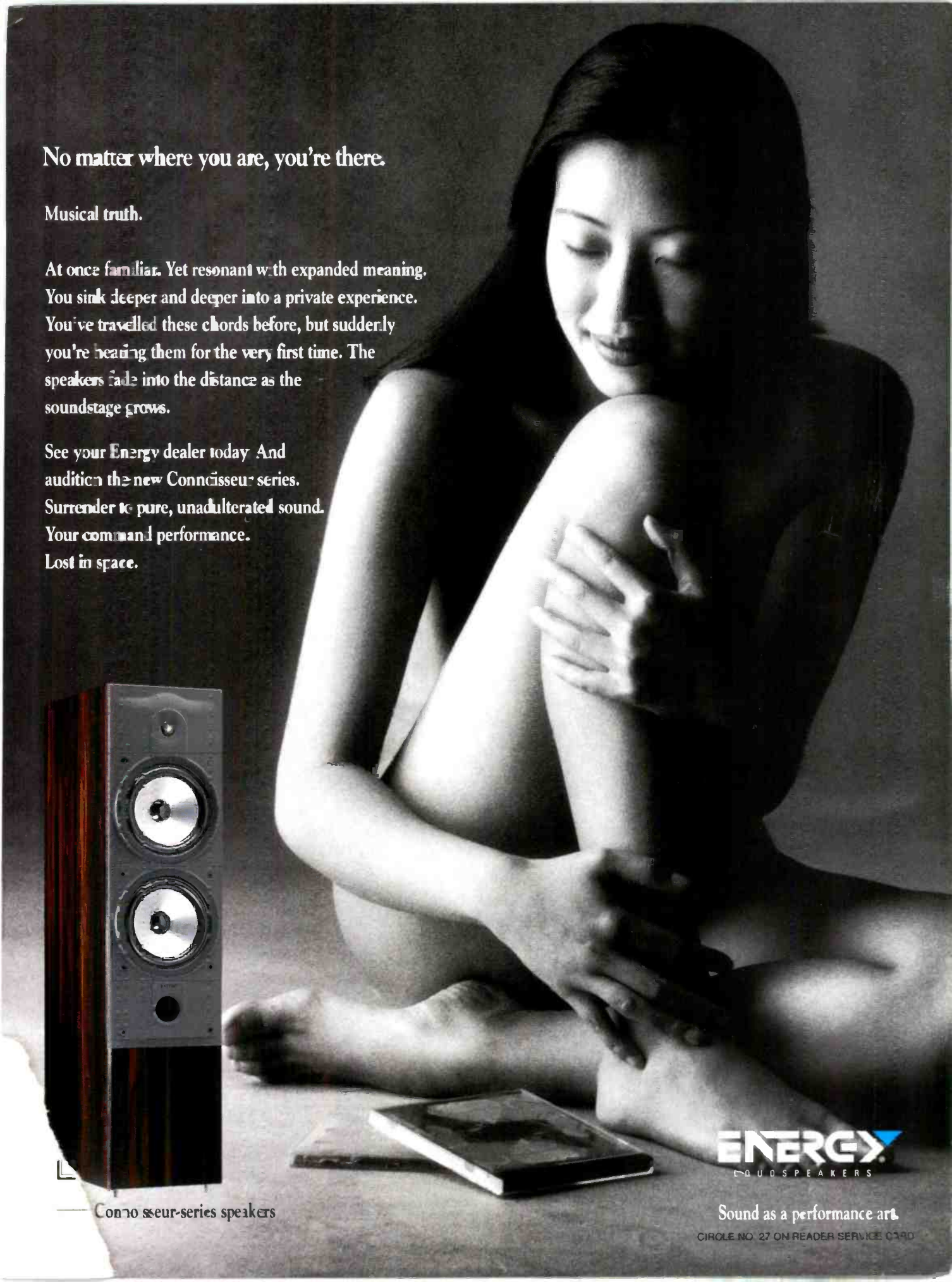
Paying nearly $6,000 for a hi-fi preamplifier does not necessarily get you four times better sound than from a preamp costing $1,500, though you may get subtle improvements. Some of the cost difference could be attributed to other factors, such as expensive internal components, advanced technology, and the exclusivity of a product sold in limited numbers.

Lamm Audio Laboratory's L1 preamp ($5,990) gives you all these things, including excellent sound. A well-engineered, hybrid (MOS-FET and 12AX7-tube) design that is said to use no overall feedback, this unit is well equipped: It has a polarity switch, volume and input-sensitivity controls, stereo reverse, rack handles, and plenty of connection capacity (including two tape loops). The preamp's modest looks belie its price, but there were some subtly perceptible sonic differences between the L1 and my $1,100 hybrid preamp—mainly, slightly tighter bass and a bit more space around musical instruments in the mid-range and treble. The L1's violin reproduction, in particular, was impressive.

GRADE: B+

John Gatski

For literature, circle No. 12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