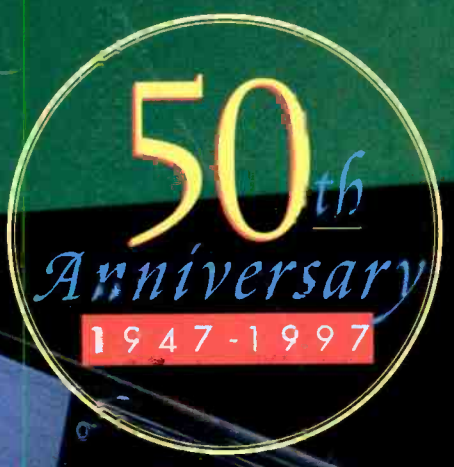


FIRST LOOK: RCA DVD PLAYER

AUDIO

THE EQUIPMENT AUTHORITY

MARCH 1997



TESTED

DENON DOES DOLBY DIGITAL

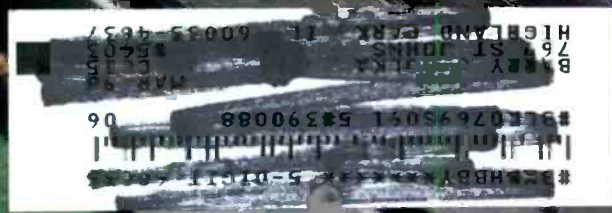
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CIRCLE NO. 15 ON READER SERVICE CARD

AUDIO

THE EQUIPMENT AUTHORITY



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California Audio Labs
CD Changer
and Denon
A/V Receiver

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CIRCLE NO. 22 ON READER SERVICE CARD

We've Got a Lot of Nerve

Dear Editor:

I read Corey Greenberg's "Front Row" column in the September 1996 issue ("Shut the Hell Up, Geeks!") with interest. My only gripe is that, in the December issue, you had the nerve to publish Kevin Tatterson's letter on the subject and not address the nonsense it contained.

Which is better? To improve existing technology, such as analog and digital sources, or to build crap that isn't functional and disappears into obsolescence a year later?

HDTV, DVD, laserdisc, Super Bit Mapping, digital signal processing, Dolby Digital—these all sound like technological advances to me. Where has this guy been for the last 10 years?

Jonathan Hiatt
Apple Valley, Minn.

Platinum Prices Plummet

Dear Editor:

Your Annual Equipment Directory is a great service to everyone interested in audio. That said, I would like to update the prices listed in the October 1996 issue for Platinum speakers. These price decreases, the result of efficiencies we have gained in our 2½ years of business, range from 11% to 42% (for our Duo model).

The new prices (per pair) are: Solo, \$1,695; Duo, \$2,195; Trio, \$2,995; Quattro, \$3,895; Studio I, \$995; Studio II, \$1,695; Reference I, \$3,995; and Reference II, \$6,500.

Dan Verreault
Chief Financial Officer
Platinum Audio
Bedford, N.H.

10cc Gets Shot in the Arm

Dear Editor:

In reference to Wayne Pflughaupt's letter regarding bad rock recordings and Daniel Levitin's response (January), I agree! From a recording standpoint, there is nothing better than listening to music when it's evident that the artists, producers, and engineers really care about what they're writing, playing, and recording. There's one name,

however, that I would like to add to your lists of excellent musician/producers: Eric Stewart. As one of the four original members of 10cc, Stewart has been co-songwriter, co-producer (with Graham Gouldman, Kevin Godley, and Lol Creme), engineer, and mix-down engineer for most of the group's recordings over the years. Listen to *The Original Soundtrack, How Dare You*, and *Deceptive Bends* (and the later work too). The musicianship, subtlety, and quality of 10cc's recordings are second to none. Even in the 1995 release, *Mirror Mirror*, where Stewart is at the mixing board, it's clear that he hasn't lost his touch. The surviving team of Stewart and Gouldman (with occasional input from Andrew Gold and others) is still creating and recording some wonderful music.

Walker Burns
via e-mail

Antiquarius Repairius

Dear Editor:

Ken Kessler's "Audiophilia Antiquarius" ("Mondo Audio," November 1996) left out one American manufacturer that has supported its product line with parts and service for 26 years, Audio Research Corporation. To this day, Audio Research makes a rigorous effort to stock components for every product we have ever manufactured since our first year of operation. Our Customer Service Department (612/939-0600) can repair and, in most cases, restore to original specification any product bearing our nameplate. It is part of our ongoing commitment to our customers, who have invested in products they can enjoy for a lifetime.

This long-term support for products already in service is, we believe, one of the distinguishing hallmarks of a quality manufacturer that is not often enough appreciated by audio reviewers and critics. Our thanks to Mr. Kessler for reminding your readers of its importance.

Terry Dorn
V.P., Marketing & Sales
Audio Research Corp.
Minnetonka, Minn.

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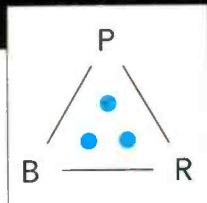
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WHAT'S NEW



TANNOY HOME THEATER SPEAKERS

The D50 left and right front speakers and D6C center-channel speaker use Tannoy's dual-concentric, point-source technology, wherein the tweeter is built into the apex of the woofer cone. Tannoy says this enables the high and low frequencies to leave the

drivers from the same point in time and space and thus arrive at your ears simultaneously. The system also includes the Model PS115 powered subwoofer and a pair of D5R surround speakers. Price: \$3,400. For literature, circle No. 100

LEGACY AUDIO SPEAKER

The 42-inch tall Classic has six drivers: a push/pull ribbon tweeter, a 1 1/4-inch linen dome for the lower treble, a 7-inch Kevlar-cone midrange, two dual-magnet 10-inch woofers with composite pulp cones in a sixth-order enclosure, and a defeatable rear-firing titanium-dome tweeter for added ambience. Four tone-contouring switches on the rear can be used to compensate for listening-room response aberrations, and dual sets of binding posts handle biamping and bi-wiring. Frequency response is specified as 22 Hz to 30 kHz, ± 2 dB, and rated impedance is 4 ohms. The 110-pound tower is available in oak, black, rosewood, or walnut finishes. Price: \$2,450 per pair, factory direct, shipping included. For literature, circle No. 101



Martin-Logan Speaker

The Aerius *i*, an upgraded version of the Aerius, has a thin, curved, transparent electrostatic film diaphragm that helps it achieve a 30° angle of dispersion. It also boasts an improved, higher-excursion 8-inch woofer that is claimed to handle more power (200 watts). A new crossover, with a lowered frequency of 450 Hz, is said to improve imaging, midrange clarity, and dynamics and to yield tighter bass. The 55-inch-tall Aerius *i* has a footprint of little more than 1 square foot. Price: \$1,995 per pair in black; light oak or bi-wiring, \$100 additional.

For literature, circle No. 102



Polk Audio Powered Subwoofer

The PSW150 has a 10-inch driver with a polymer composite cone that Polk says is virtually free of cone breakup. The 17 x 21 1/4 x 20-inch enclosure houses a built-in 150-watt power amp with auto on/off, a low-pass filter variable from 50 to 150 Hz, a volume control, and a polarity-reversal switch. The sub uses Polk's patented Power Port venting, which is said to inhibit

port noise and increase bass output often lost to port turbulence. Overall frequency response is specified as 20 to 200 Hz, with -3 dB limits at 30 and 150 Hz. Price: \$649. For literature, circle No. 103

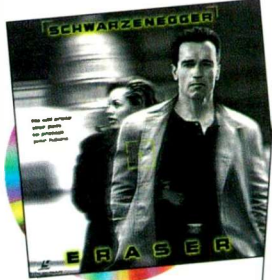


Heavy Metal	*1486901
Barb Wire (Director's Cut)	*1963305
The Birdcage	*1970409
All Dogs Go To Heaven 2	*1952209
The Craft	*2000800
Darkman III:	
Die, Darkman, Die	*1959006
The Quest	*1971209
Diabolique	*1956002
Down Periscope	*1948504
Dracula:	
Dead And Loving It	*1932201
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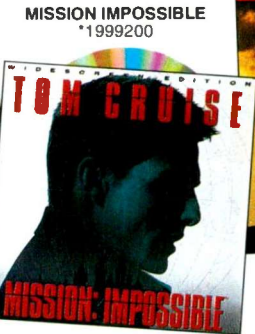
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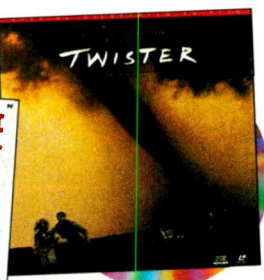
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Mulholland Falls	*1963503	A Clockwork Orange	*1356005
One False Move	*1959402	Strange Days	*1502608
Romeo And Juliet (Remastered)	*1987809	The Silence Of The Lambs	0805309
Screamers	1933001	Bridge On The River Kwai (Restored)	*1143809
Sudden Death	*1933407	Sabrina (1995)	*1923408
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Pink Floyd: The Wall	*1293802	Interview With The Vampire	*1364405
The Abyss	*0881102	2001: A Space Odyssey	*0844308
Batman Forever	*1432509	Leaving Las Vegas	*1501808
Bad Boys	*1451806	Virtuosity	*1483601
Get Shorty	*1502509	Jaws	*0844605
Money Train	*1923101	The Wizard Of Oz	0001404
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When Nature Calls	*1490309
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Under Siege 2:	
Dark Territory	*1483007
Close Encounters Of The Third Kind (Special Edition)	*1273002

NEW RELEASES

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The Great White Hype	*1991801
Mary Reilly	*1969203
Night Of The Living Dead (CLV)	2024602
Primal Fear	*1987601
The Truth About Cats And Dogs	*1980002
"10"	*2024800
Hello Dolly	*1943604
The Last Of The Mohicans (THX)	*1959303
Sgt. Bilko	*1963602
The Sound Of Music (THX)	*1946706
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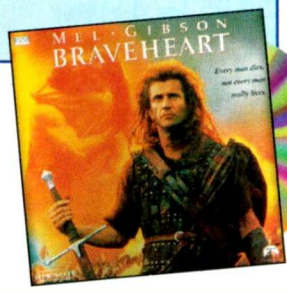


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Broken Arrow	*1941806
Jumanji	*1918002
Sense And Sensibility	*1936301
True Lies	*1327105
Forrest Gump	*1333202
Bladerunner: The Director's Cut	*1097906
Waterworld	*1472000
Star Trek Generations	*1382803
Assassins	*1491109



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WHAT'S NEW

LEXICON DOLBY DIGITAL RF DEMODULATOR



Lexicon says that its LDD-1 keeps the potentially degrading effects of RF interference at bay by isolating the RF demodulator for laserdisc Dolby Digital (AC-3) soundtracks in an outboard unit with its own power supply and grounding. The LDD-1 will switch automatically between S/P DIF digital and RF inputs and has proprietary processing to

minimize error rates from a wide variety of laserdisc players, thereby optimizing the integrity of the Dolby Digital bitstream. The unit has two S/P DIF inputs (one coaxial and one Toslink optical), one RF input, and one S/P DIF coaxial output for connection to an AC-3 surround processor, such as Lexicon's DC-1/Dolby Digital. Price: \$699. For literature, circle No. 104

NAD DIGITAL PREAMP



The Model 118 has four analog inputs, four digital inputs, a digital output, and 18-bit A/D and D/A converters (switchable to a 44.1- or 48-kHz sampling frequency). Digital signal processing can be applied to stereo signals for compression or expansion,

adjustment of stereo width and spread, as much as 12 dB of bass/midrange/treble cut or boost, polarity inversion, and volume and balance control. Each input circuit can store proprietary DSP settings and gain adjustments. Price: \$1,599. For literature, circle No. 105

STINGER INTERCONNECTS



Dream Series impedance-balanced interconnects are oxygen-free-copper twisted pairs with twin copper shielding and helically wrapped Mylar foil. The latter is claimed to resist RF interference, electromagnetic interference, and crosstalk. The interconnects are supplied with 24-karat gold-plated RCA plugs. Prices: \$25.95 for 1-meter pair, \$27.95 for 2-meter pair, \$32.95 for 4-meter pair, and \$36.95 for 5-meter pair. For literature, circle No. 106

Classé Audio Integrated Amp

The CAP-100 is intended to combine the key features and virtues of Classé Audio's separate amps and preamps. The amplifier section is said to produce 100 watts per channel into an 8-ohm load, with THD + N specified at 0.002% at 1 kHz. The preamp section has four single-ended inputs and one

balanced line-level input; a plug-in phono module (\$200) can be added any time. The supplied remote commands volume and muting, whereas tape monitoring, input selection, and amp/preamp separation are selectable via front-panel controls. Price: \$1,995. For literature, circle No. 107



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CIRCLE NO. 2 ON READER SERVICE CARD

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Ensemble

Ensemble®

Ensemble is our best subwoofer/satellite speaker system. We think it competes with audiophile speakers selling for over \$1,000 a pair. Yet its unique four-piece design literally disappears in your room.

Ensemble consists of two compact, two-way satellite speakers and two slim-line (4 1/2" thick) subwoofer cabinets enclosing 8" woofers. Because the bass produced by the

subwoofers is non-directional, you can put them in out-of-the-way places...even behind or under furniture. Then place the satellite speakers to create a realistic stereo image.

High Performance Review describes Ensemble by saying "...stereo imaging is phenomenally sharp...the dynamics are stunning...some of the speakers I'm comparing it to cost \$1900 to \$2800."

White or charcoal grey.

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SALE PRICE: \$499.99

Ensemble II

Ensemble II is our best value high-

performance speaker system. It uses the same satellites as Ensemble, but with a single subwoofer cabinet that holds two 6 1/2" woofers in an acoustic suspension enclosure. Because 90% of the music is reproduced by the satellites, Ensemble II sounds much like

Ensemble. Stereo Review says

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SALE PRICE: \$399.99

Ensemble III

Ensemble III was designed to bring big sound into smaller rooms. It has two small, two-way satellites and a subwoofer cabinet that encloses a single 6 1/2" woofer

Ensemble II



Reg. \$499.99
 Save \$100

Ensemble II is our best value in a high-performance speaker system. Its satellite speakers are identical to Ensemble's.
 Regular Price: \$499.99 **SALE PRICE: \$399.99**

with two voice coils. Ensemble III maintains the smooth, natural tonal balance of our more expensive systems, but without the same deep

Ensemble III brings high-performance sound into even very small rooms. It uses genuine two-way satellite speakers.

Regular Price: \$349.99
SALE PRICE: \$299.99



Reg. \$349.99
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Ensemble III



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CIRCLE NO. 7 ON READER SERVICE CARD

Stacking Components

Q *My equipment rack has limited space, and I need to squeeze a CD player into it. Is it safe to stack another component on top of a CD player? What is the heaviest weight that a CD player can support?*—Tim Anzalone, Streamwood, Ill.

A Some chassis are made of thin sheet metal and may not support the weight of other components. Check your CD player for the sturdiness of its housing before you place a heavier component on top of it.

I prefer to put components that run hot (amplifiers, for example) on top of those that run cool or cold (such as equalizers and CD players). By doing so, the hotter component can't heat up the one above it (excess heat exacerbates deterioration of electronic parts). Leave an inch or two of space above the hottest component to ensure proper airflow for cooling. (*Editor's Note:* My VCR is heavy and runs hot, so it's on top of my laserdisc player, which runs cool. And the VCR's broad round feet don't dent the laserdisc player's sturdy steel chassis.—A.L.)

If your cassette deck is very light, it could be stacked on a CD player. But don't put a tuner above or below a CD player because of the risk of radiated interference from the player's digital circuits. An amp or receiver should be kept away from other components because of hum fields emanating from the power supply's transformer. The hum fields could find their way into tape heads and other parts, producing audible noise. Stacking equipment on amps will also obstruct airflow and impair ventilation.

Loudspeaker Deterioration

Q *Do loudspeakers weaken incrementally or fail suddenly?*—Jason Paskowitz, Bayside, N.Y.

A Loudspeakers typically operate for many, many years. Their magnets remain strong, so there's little loss of magnetic flux. However, several factors can cause a speaker's performance to deteriorate gradually.

Some woofers may undergo a gradual reduction of free-air resonance. Depending on the design of the system, however, that might actually improve low-bass performance.

Many drivers have foam surrounds, which typically deteriorate after 8 to 10 years. Sound quality will remain substantially unaffected until the foam disintegrates. This will seriously degrade bass response and may also cause the voice coil to lose its centering between the magnet's pole pieces. The coil rubs against them, producing scraping sounds and audible distortion. The speaker's manufacturer or specialized firms can replace the surround. As long as the new surround material's compliance is similar to the original surround's, the speaker's performance will likely be as good as new.

Other drivers—those that have butyl rubber surrounds, for example—should last almost indefinitely, provided they are not damaged by constant clipping from too weak an amplifier or by being overdriven. Too much power fed into a speaker will, over time, cause the voice coil to warp from overheating or short out. The coil will then fail, just as a light bulb's filament does.

Biamping Balance

Q *I am biamping my speakers. The tweeter and midrange are driven by one amplifier, and the woofer is driven by another. How can I rig my system so that one volume control acts on both amps, thus maintaining the balance between the woofer and the midrange/tweeter? How can I set an initial balance? Most amps do not have input level controls.*—Enzo Ronquillo, Manila, the Philippines

A Biamping has been with us for years. Bass frequencies can sometimes intermodulate with the rest of the frequencies in the audio spectrum and add a small amount of distortion. Biamping eliminates this and ensures that bass overload won't cause distortion in the treble.

You will need an electronic crossover to divide up and distribute the high and low frequencies to separate amplifiers, as well as

to adjust the relative balance of each frequency band. Connect your preamp's outputs to the inputs of the electronic crossover, and then route the crossover's outputs to the separate amps for the bass and treble parts of the spectrum. The crossover has level controls to individually adjust the output, and hence the relative balance, of high and low frequencies. Overall level is varied by the volume control on the preamplifier.

You're right about many power amps: Few have input level controls. Set the crossover's level controls and the preamp's volume control to near mid-rotation, high enough to drive the power amps to significant output yet not so high as to make background noise from the preamp or crossover audible at loud listening levels. Also, be careful not to overload the electronic crossover's input circuits by setting the preamp's volume control too high. You must strike a happy medium between these adjustments.

Measuring Subwoofer Response

Q *How can I measure the frequency response of a subwoofer? Among other things, this will help me determine the crossover frequency to use between the subwoofer and the satellite speakers.*—Steve Merr, South Fallsburg, N.Y.

A If you don't have access to a PC-based FFT measurement system, the Liberty Audiosuite (reviewed in the February issue), or MLSSA, assessing the response of a subwoofer (or any speaker) can be a real pain, because the tests must then be done outdoors to avoid the corrupting influence of room acoustics and standing waves. Doing the tests in a remote location—the middle of a field, say—is advisable, because the noise of traffic, airplanes, air conditioners, and other ambient sounds can bias the readings.

The subwoofer should be on a high stand to reduce ground reflections. (In the past, some designers would suspend the speaker from a crane). Keep a distance of 10 feet or more between the stand and any building

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walls. (Now do you understand why I said this project is a pain?)

You'll need a calibrated microphone, a good AC voltmeter capable of reading down to 10 millivolts, a power amplifier that has flat frequency response (most modern solid-state amps meet this requirement), and an audio-frequency generator or test CD having a reasonably flat response over the range of frequencies that you want to measure. If the generator is not flat, you will need another AC voltmeter that must be monitored to maintain a constant voltage during the measurements.

Place the microphone directly in front of the subwoofer, about 3 feet away from it. Connect the mike leads to the input of the voltmeter—the "hot" lead to the positive meter terminal and the common lead to the ground side of the meter. Set the meter to its most sensitive range, and talk into the mike. The meter's pointer will vary, depending on how loud you talk.

Next, connect the power amplifier to the subwoofer and connect the output of the audio-frequency generator to a line-level input on the amp. Be sure the gain control on the generator is turned down. Set the frequency of the generator to something appropriate—say, 70 Hz. Turn on the generator and the power amplifier.

Gradually turn up the gain on the generator until you hear a sound from the subwoofer. Watch the meter, and advance the generator's volume until the meter reads about in the middle of the range. Vary the generator's frequency over the subwoofer's probable range while you note the readings on the meter. If your meter is calibrated in decibels, you can directly log the positive and negative variations in subwoofer output over its frequency range without having to convert voltage readings into dB.

After this is accomplished, drag all of that equipment back into the house before it starts raining!

Using Two Different Amps

Q I have a 130-watt mono amp and a stereo amp whose output is 40 watts per channel, which I can bridge to yield 90 watts in mono. Can I use these two amplifiers to run my two front speakers? Will I have problems because these amps have different power outputs and different input sensitivities?—Ferdinand Mariano, via e-mail

A If you can live with 90 watts (the power of your weaker amplifier), you are probably all right. If the two power amplifiers have different input sensitivities, you will have to adjust your preamplifier's balance control to favor the amp having the lower sensitivity. This has nothing at all to do with which amplifier has the lower power output.

It is also possible that the two amplifiers will be out of phase with each other. If they are, you must reverse the connections to one of your speakers.

Replacing Old Electrolytic Capacitors

Q I have several old power amps and pre-amps, some dating back to the '50s. The amps, which have their original filter capacitors, still work (though I do hear a slight hum through the loudspeakers), but I suspect the capacitors should be replaced. However, they are rated at 500 volts, and the only ones I can find are rated at 450 volts. What should I do?—Donald Bisbee, Columbus, Ohio

A I would replace these capacitors immediately; they are unlikely to be functioning very well after 40 years or so of service. The fact that you hear some hum indicates that the filters' capacitance may have changed.

If you cannot obtain the proper capacitance values at 500 volts, you should obtain two capacitors, each having twice the capacitance that is required. It would be best if their operating voltage is 250 to 300 volts because it is desirable for electrolytic capacitors to operate near their rated working voltage (but you may have to settle for 450 volts). Wire them in series, with the positive terminal of the first capacitor connected to the negative terminal of the second. (Luckily, capacitors today are often smaller than they used to be.) Next, wire this series combination into the circuit as if it were a single capacitor. Connect a 100-kilohm, 2-watt resistor across the terminals of each capacitor. The resistors will equalize the voltage drops across by each capacitor's leakage current.

You can probably use tubular capacitors instead of the can types used in old amplifiers. If you do, and you want to preserve your amps' appearance or their value as collectors' items, don't remove the cans. Just disconnect them from the circuit and mount the replacement capacitors inside the chassis. A

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MERCEDES, BOSE, AND BUSES



focus and clarity. Listening to the S 320 sedan's Bose system (which I would definitely keep if I owned the car), I at first thought its treble was dull and its bass excessive. But the bass level proved just about right when I got on the road (where road noise masks bass), and the treble opened up when I hiked it to "+3"; with that, the sound grew much clearer, "not like electrostatics," said my notes, "but still quite good." I also had to boost the treble on the other cars; as I got used to things, I found myself cutting the bass down a notch or two on all the cars, even on the highway. I noted later that the systems in the S-class Mercedes cars have a 2-inch Twiddler driver (Bose-speak for a midrange/tweeter hybrid) behind the rear-view mirror, for center fill. Also, unlike many Bose systems (including those in the E-class Mercedes), they have tweeters on each side.

The sports cars, an SL 600 and the SLK 230, sounded okay with their tops up but seemed to have an upper-midrange resonance with them down. This was more noticeable (in fact, a bit obnoxious) on the SLK, perhaps because it was the smallest car or because its 100-watt sound

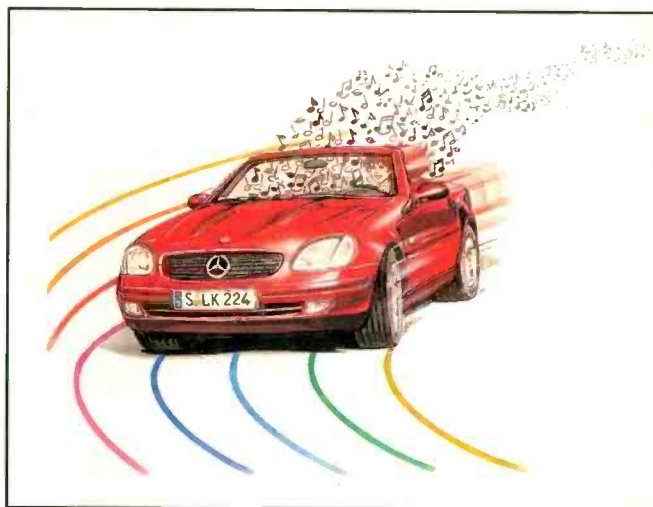
The Mercedes-Benz SLK 230 already swallows a Bose sound system. Will it someday swallow a bus?

When a Bose representative asked, "How would you like to drive a supercharged Mercedes through the Alps?" I gave the obvious answer: "Who do I have to kill?" And that is how I wound up in Austria last fall, driving and listening to a bunch of delightful cars—and talking with Brandon Westley, general manager of Bose's car stereo division, about a bus.

The bus we talked about doesn't quite exist yet. But the cars sure do. What Bose and Mercedes laid on in Salzburg was not just the new SLK 230 supercharged sports car but the entire Mercedes line, all with Bose sound systems. Together with other journalists from the United States, Japan, and Italy, I spent some time in

each model, half of it behind the wheel and half of it navigating and evaluating various Bose stereo systems from the passenger seat.

I've always felt that Bose's stereo systems for cars were aimed more at music lovers who want their time in the car to be made pleasant than at audiophiles who relish sonic nuances, and I think Bose would agree. Still, to my audiophile ears these systems have been improving, reducing their emphasis on immersing the listener in a warm bath of sound and adding



system was the simplest (two tweeters in the dash, two midranges in the doors, and 6½-inch woofers behind each seat, with 100 watts total power for all six speakers).

As it turns out, I hadn't accurately diagnosed the problem. "Lowering

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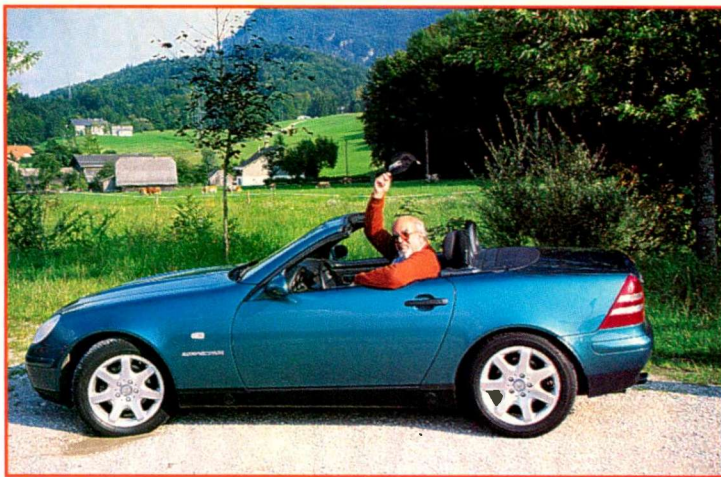
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the top,” Brandon Westley told me, “reduces the system’s acoustic output in the mid-bass and treble, while the upper midrange and low bass remain relatively unaffected. These acoustical properties of the open car may leave the listener with the impression that the upper midrange is being accentuated.” Bose tried to reach a compromise between top-up and top-down audio performance but in the end had to optimize it for one or the other. Sensibly, the company optimized it for top-up driving. That’s the more common use, at least for drivers in the age range that can afford the \$123,200 SL 600; the SLK 230 is a mere \$40,000 or so. Motoring



The author in the Austrian Alps (above). Somewhere east of Salzburg (right).



with the top up is also more conducive to critical listening; when I put the top down, I’m listening to the purr of the engine and the whish of the wind, not the music on the sound system.

One way to solve the problem, Westley said, would be to switch to different equalization curves as the top goes up or down. The SLK already has a sensor that registers the top’s position, which could make that switching automatic. But Bose systems currently use analog equalization, which leads to costly duplication of components and larger board sizes if dual curves are required. In the digital domain, it would be easier, a matter of changing software programs instead of hardware components: “We’d just instruct the device to behave differently,” said Westley. A digital EQ curve could also be tailored more precisely to the car’s acoustics. At the moment, however, the cost of making the transition to the digital domain would be prohibitive. Bose has a line on ways to reduce some of the cost but doesn’t want to talk about it yet.

Which brings us to the bus. Today’s cars use a spiderweb of wire pairs, each dedicated to a single purpose, to carry power and control signals to each electrical device. The next step is to multiplex power and control on a bus—a single pair of wires that snakes

around the car, connecting all its electrical devices. (The 1997 Jeep Wrangler already has one; more are soon to come.) This will cut costs by reducing assembly time, wiring errors, and the amount of expensive copper needed. With less copper to carry around, cars will be lighter and get better gas economy. Such a bus could also carry digital audio signals (but probably not analog, because of interference and other problems).

With a bus system, digital signal processing (DSP) could replace not only the custom equalizers made for each car but also tone controls and other audio processing circuits. DSP would facilitate more sophisticated audio processing, which would be too expensive in analog. Equalization, for example, could become more complex, compensating more precisely for the car’s acoustics. And, said Westley, “we also can add value through monitoring what the car is doing and modifying the audio system’s performance accordingly.” Such a system could compensate for actual road-noise conditions, rather than estimated average road noise, and for acoustic differences caused by changing passenger loads. It might even optimize imaging for a driver alone or for a driver and passengers.

A bus would also allow for distributed, modular audio systems. These could en-

hance performance while potentially reducing the cost of car assembly and making dashboard designs more flexible. For example, manufacturers could reduce radio interference by making the tuner a digitally controlled module, positioned right at the antenna base; the module’s output would either be converted to digital form for the bus to carry to the sound system or be fed in analog form via short lines to amps in the trunk. The CD transport, by contrast, could be in the dashboard or the armrest and feed the amplifier system digitally via the bus.

To car makers, the savings from the bus approach would more than cover the costs of adding A/D and D/A converters. And the ability to make sound systems that do more or perform better without costing much more would be attractive. The odds are that the next decade

will see all but the smallest manufacturers going over to a bus system (and companies like Bosch or Delco might make bus technology available even to the little guys). Mercedes, with its high-tech tradition and increasing cost pressures, will probably be among the first.

The bus design could, however, make it very hard for car owners to add new or upgraded audio systems or other accessories. The Consumer Electronics Manufacturers Association (CEMA) has therefore requested that car manufacturers adopt a dual-bus system, to accommodate aftermarket electronics. CEMA’s wish list includes provisions for aftermarket intelligent-transportation systems (such as navigation devices), 5.1-channel digital audio, and MPEG-compressed video. (The car makers’ own buses will accommodate the factory-installed versions of these gadgets.)

If aftermarket audio suppliers can connect their components to digital bus systems, they could offer enhancements that are currently found only in original-equipment audio systems like those made by Bose. The digital bus would make it practical and profitable for aftermarket companies to adopt DSP—which, in turn, would make it easier for installers to do factory-style custom equalization. It shouldn’t be

too hard to use a computerized system, such as the low-cost Liberty Audiosuite (see review in the February issue) to measure an audio system's response from several mike positions in a car. The installer's computer could use that data to generate EQ curves and delays that would help compensate for acoustical and speaker-positioning problems. It would then store those curves and delays as digital instructions on an EPROM chip, which would control the audio system's DSP chip.

But the CEMA proposal can't take effect until various car- and electronics-industry groups develop a common bus standard, as well as standards for gateways between the car's main bus and the aftermarket bus. Car owners should welcome the dual bus, because it will let them use any advanced aftermarket electronics they might want. Car manufacturers will probably resist it, because every piece of gear from an aftermarket company is one fewer piece sold by the car's own manufacturer. **A**

PUTTING THE HEAT ON SWAP MEETS

You may see fewer recordings on sale at swap meets and flea markets this year than in previous years. If so, it's probably because of last year's U.S. Court of Appeals decision in *Fonovisa v. Cherry Auction, et al.* The Court ruled that contributory liability can be imposed on a swap-meet owner who has reason to know that vendors at his meet are selling counterfeit recordings.

How would an owner know? I asked Frank Creighton, vice president in charge of anti-piracy at the Recording Industry Association of America (RIAA). "Most likely," he said, "vendors of legitimate recordings will tip the owner off, by complaining that the guy across the aisle has the latest hits for well below wholesale. If a vendor has the Top 10 hits, dirt cheap, something's wrong. Another tipoff is low-quality graphics—blurred or misaligned. And since the record labels don't all use the same tape boxes, a vendor whose products are identically boxed, regardless of the label, probably isn't selling the real thing. Typically, the legitimate dealers will help you spot the fakes.

"Counterfeit CDs are harder to spot, because you need good, high-tech equipment to make them in the first place. But we haven't seen nearly as many of them."

As word of this decision gets around, people who lease space to vendors will probably start weeding out the rascals, refusing space to those they know are crooked or whose stock looks bogus. That may just mean that crude copies

disappear (and I'm not sure all counterfeits are crude). But it probably won't mean that sellers of legitimate discs get kicked out, too, by extra-cautious market owners.

"By the time we get to the prosecution stage, owners have been educated, and they have been warned," said Creighton. Since the RIAA's members don't want to cut into sales of all recordings, just of the counterfeit ones, the RIAA educates market owners on how to recognize counterfeits, what state and federal statutes cover them, and what owners' potential liabilities are. "Owners also have an obligation to police their markets frequently," said Creighton. "A vendor whose merchandise is all legitimate this week might be selling counterfeits next Saturday."

While the *Fonovisa* ruling was directed at swap meets, it carried a broad implication: that anyone knowingly contributing to trademark violations by others is liable under law. That was made plain in March 1996, when a U.S. District Court in California ruled on *A & M Records, Inc. v. Mohammad Abdallah*. Abdallah's company, General Audio Video Cassettes, sold blank cassettes cut to specific lengths for mass duplication. Legitimate duplicators doubtless buy such cassettes, but Abdallah knew that many of his customers were not legit. He'd been timing legitimate cassettes provided by the counterfeiters, then cutting blanks to match. The Court socked him and his company with a \$7 million judgment.



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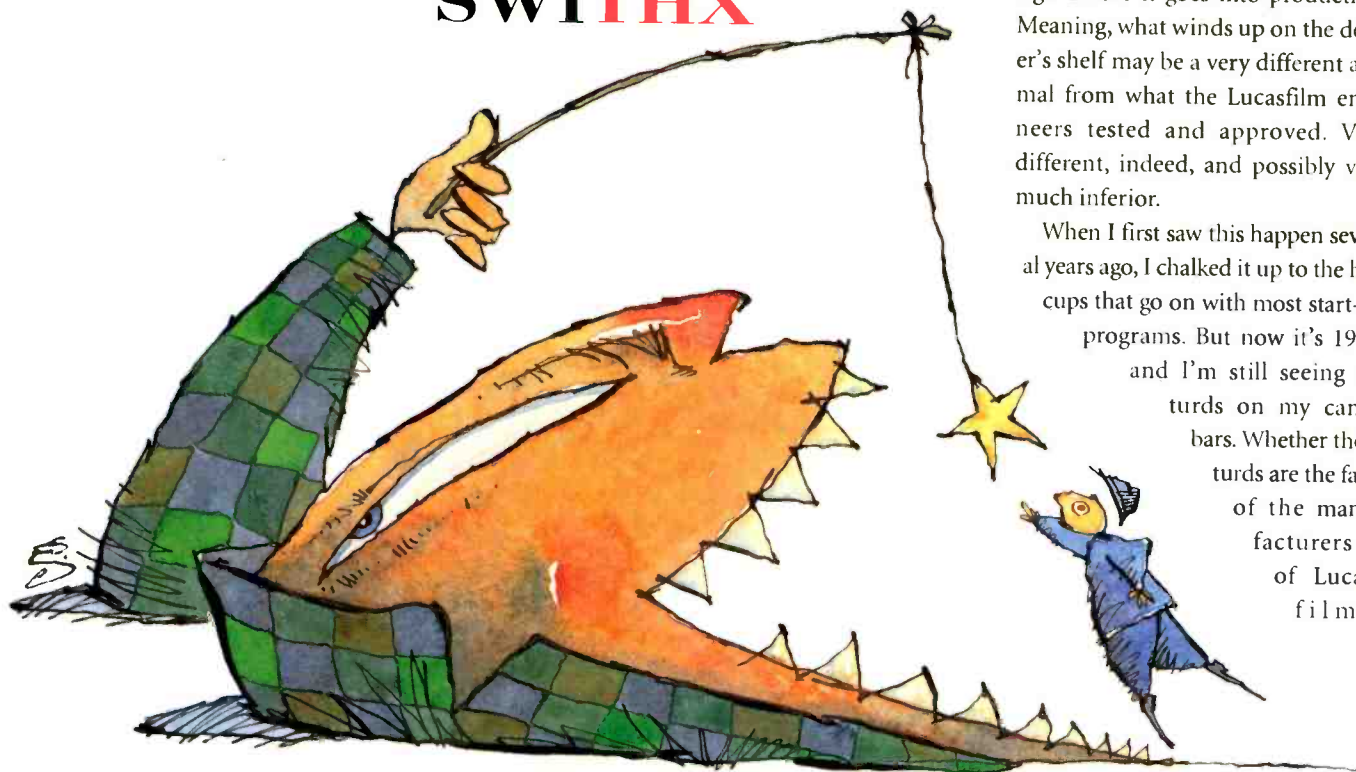
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THE OL' BAIT AND SWiTHX



Ahhh, the ol' Bait and Switch. Before it was outlawed years ago, innocent people felt the bitter sting of this classic scam in hi-fi huts everywhere. It went something like this: You'd see an ad in the paper advertising a great price for a popular piece of gear, the Bait, but when you went down to the store to buy it, the salesman told you he was out of stock on that particular model. *However*, there was this *other* model over there that was even *better* than the advertised item for the same price. . . And that was the Switch. Which, as if I have to tell you, was always pretty much a box of dung.

There's no telling how many people went to hi-fi huts lusting for that cool-man Dual turntable with the ultra-low-mass tonearm they saw in the ad, only to come home with a hollow plastic BIC turntable that howled like a mutt when the needle

hit the groove. I fell victim to this scam myself in college when I answered a store's ad for a no-brainer price on a pair of B&W speakers, only to be steered to—and eventually sold—a pair of big, gnarly Genesis towers (not Genesis Technologies, but a different company deservedly long out of business) that proceeded to blow drivers like Chicagoans blow their noses.

But even though we don't see *that* scam so much anymore, I see a new twist to the ol' Bait and Switch, and it's got to do with Lucasfilm's Home THX program for product testing and certification. I'm talking about the problem of manufacturers submitting prototypes of new products

to Lucasfilm for THX certification, winning the coveted stamp of approval and the right to carry the consumer-comforting THX logo on the product's front panel (as well as the manufacturer-comforting premium price tag), but then changing the design before it goes into production. Meaning, what winds up on the dealer's shelf may be a very different animal from what the Lucasfilm engineers tested and approved. Very different, indeed, and possibly very much inferior.

When I first saw this happen several years ago, I chalked it up to the hiccups that go on with most start-up programs. But now it's 1997, and I'm still seeing rat turds on my candy bars. Whether those turds are the fault of the manufacturers or of Lucasfilm's

WHAT'S ON
THE DEALER'S SHELF
MAY BE DIFFERENT
FROM WHAT LUCASFILM
TESTED AND APPROVED.

the product that bears it has passed Lucasfilm's tests and will deliver picture and sound "exactly as the director intended"—a THX line I've

never swallowed even when everything's jake, by the way—I think this new version of the ol' Bait and Switch threatens the future of the Home THX program.

The first time I encountered the Bait and SwiTHX scam was two years ago, in the process of reviewing a new Home THX controller. Both the first and then a second sample I

auditioned exhibited the same problems: an edgy, distorted sound on program peaks and a noticeably over-the-top surround decorrelation effect that made the surround-channel piano on the *Dick Tracy* laserdisc sound like a pair of out-of-tune uprights. Lucasfilm's Tony Grimani and Paul Matwiy tested both units back at Skywalker Ranch and confirmed what I'd heard: Not only was it easy for many laserdisc and CD players to overload the controller's non-level-adjustable A/D conversion stage, but the degree of pitch-shifting in the decorrelator circuit was much wider than the Home THX specs allowed.

Now, any complex A/V component has its share of internal adjustments that can drift a bit with shipping and handling, just enough to subtly tilt that component's measured performance a bit in one di-

**LUCASFILM PUSHED
THE INDUSTRY
TO GET REAL ABOUT
HOME THEATER, AND
EVERYONE BENEFITED.**

rection or another. But Grimani told me that those two controllers had different circuitry from that of the preproduction unit originally sent to Lucasfilm for THX certification.

I encountered the same problem a little later with a THX home theater speaker system. The speakers sent me for review were treble-hot to the point of being unlistenable at theater levels, so I sent them to Lucasfilm. The engineers who examined the speakers found that the crossover circuit had been changed to raise the tweeter level by 3 dB—after the speakers had already gone through the THX certification process. Of course, the new version didn't meet Lucasfilm's frequency response specifications, and the manufacturer was forced to revert to the original, flatter-response crossover circuit so it could keep selling the speakers with the THX logo on them.

You don't have to look far for the latest Bait and SwiTHX. In *Audio's* December 1996 issue, Ed Foster's review of the Technics SA-TX50 Home THX A/V receiver revealed the rather startling news that a receiver can simultaneously wear the THX seal of approval and exhibit more than 2,000° of nonlinear phase shift between 20 Hz and 8 kHz. The test sample had other problems that would undoubtedly hinder

its obtaining THX certification, such as higher-than-usual levels of noise and distortion and a subwoofer crossover that actually rolled off the deepest bass slightly when a subwoofer was used. As I'm writing this, Lucasfilm has not tested the review sample sent to Foster to determine whether it differs from the unit originally approved. But either way, the situation is discouraging: Either Technics dumbed down the receiver's design after it got THX approval, or something that performs the way this thing did is capable of gliding through the THX certification process—even with Lucasfilm's "relaxed"

standards for A/V receivers. And if that's the case, then what kind of "quality assurance" does the THX logo really stand for?

I'm no fan of the THX trip, but even I have to give Lucas-

film credit for promoting home theater during its baby steps to market as well as for helping to steer it in the right direction by preaching the importance of things like properly executed subwoofer crossovers and the ability of a system to belt out movies at theater levels without audible distortion. By sticking to its guns and promoting a strict set of standards at a time when much of the gear being sold for home theater was just plain lousy, Lucasfilm pushed the industry to get real about home theater. Everyone—licensees, non-licensees, and consumers alike—benefited from better gear across the board and a whole new way of looking at what they used to just call their "stereos."

But the Bait and SwiTHX problem needs to be addressed, and in a hurry. Although I can certainly see how Lucasfilm's certification process could be so full of holes that the blame rests there, I'm more inclined to believe that it's the manufacturers who are slipping up, not Lucasfilm (although the company could certainly be a hell of a lot more vigilant about these things). The fact is, THX-certified products are hitting the market that don't meet THX specs. Until Lucasfilm or some of its licensees move to clean up this situation, the THX logo isn't worth the metal it's stamped from. A

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THE X-FACTOR



The little can that could: Musical Fidelity's X10-D tube buffer stage is hip and hot.

That bleary-eyed look you see on most hi-fi manufacturers' and retailers' faces is a result of sleep deprivation. Lately, far too many of them are lying awake at night, worrying about the future. No, make that the present. Hi-fi is just about holding its own, but only just.

Depending on whom you ask, the audio industry in the United States is recovering, and the United Kingdom's is just about stable. However, Hong Kong is a catastrophe, France is waiting for someone to inject the embalming fluid, Italy's a mess, Germany's paying the price of reunification, and Korea's overheated—ad nauseum. What's emerging, though, are leaner, fitter companies and, one hopes, fewer time-wasters or purveyors of (to be blunt) junk.

One has to be careful when criticizing the fringe companies that have the stability of leaky dynamite, because specialist hi-fi has its roots in bold, pioneering, cottage-industry-sized companies peopled by crazies. These firms go from one- or two-man operations to major players with alarming regularity, but there are also legions of sad bastards who'll never amount to anything more than space-wasting entries in CES catalogs or *Audio's* Annual Equipment Directory. The problem is that this industry seems to encourage the flaky types even more than it

MUSICAL FIDELITY HAS ENTERED A MARKET THAT BLURS THE LINE BETWEEN COMPONENTS AND ACCESSORIES.

rewards the innovators. The best thing that could happen to specialist hi-fi would be the disappearance of at least half the brands, leaving the rest with much healthier market shares. The problem is: Which ones deserve the lifeline and which should be given euthanasia?

As digital technology makes hi-fi increasingly the preserve of the Big Boys, it's fascinating to watch how the smaller companies deal with the current state of the market. Some have found solace in appealing to kit-builders, reviving that most adventurous form of audiophilia; there hasn't been so much activity in the do-it-yourself field since the days of Heathkit, Lafayette, and the old Dynaco. And specialist magazines the world over, both newsstand and subscription-only, have helped. It's good news for the self-sufficient enthusiast, but it doesn't do much for impoverished audiophiles who lack soldering skills.

"Impoverished" is the key word here. The '80s, those days of the yuppie with a BMW before his 23rd birthday, are over; conspicuous consumption has reverted to the traditionally wealthy. We're looking at full-scale downsizing, in prices as much as in dimensions. (Back in 1989, Jason Bloom of Apogee Acoustics warned me that the days of gigantic loudspeakers with Mercedes price tags were coming to an end.

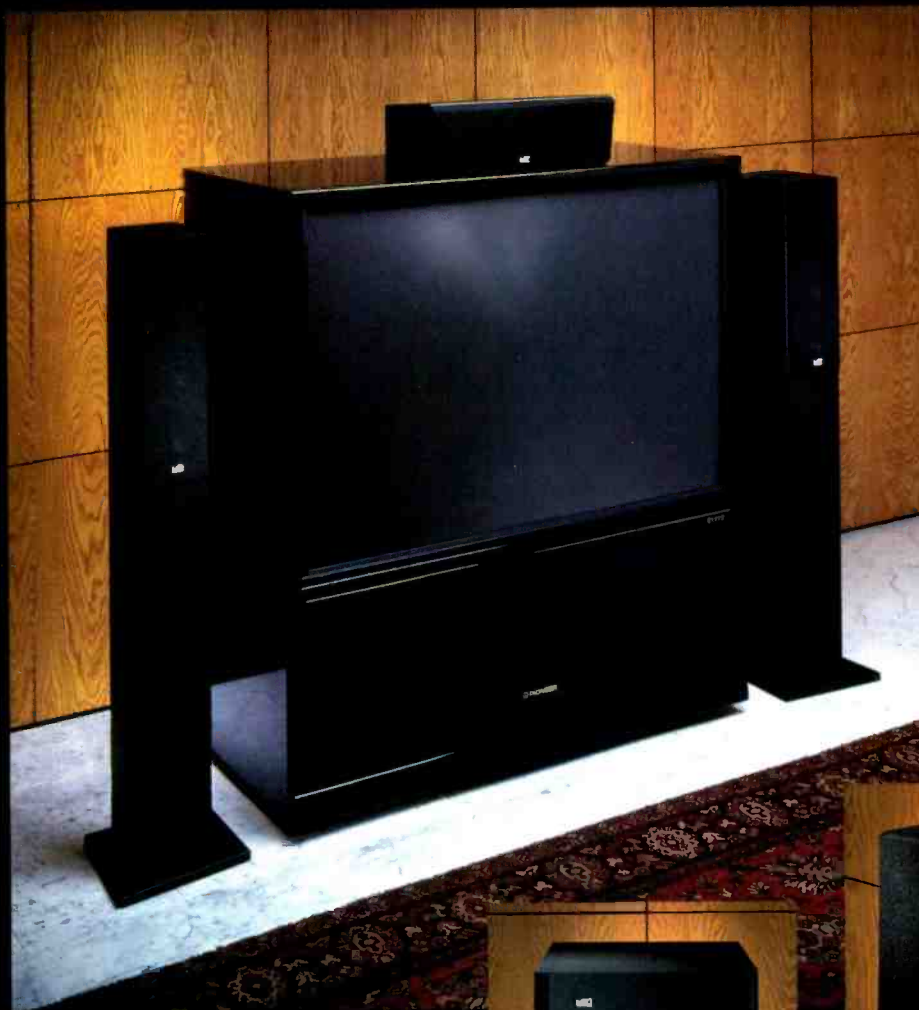
His company responded to the forthcoming global downsizing/downpricing by introducing the Centaurus models and, a bit later,

the even smaller and more cost-effective Ribbon Monitors.)

Look around if you don't believe me. One of the biggest success stories of 1996 was the launch of Krell's first integrated amplifier, in the same space that previously would have housed only a Krell preamp, and

S-125

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even then it probably would have had an outboard power supply. Classé Audio, GRAAF, and Audio Research followed suit with integrated amps of their own. Wilson Audio launched the CUB and the WITT, despite the phenomenal success of the 72-inch-tall SLAMM. Basis Audio finally unveiled a sub-\$3,000 turntable. Audio Note countered its stratospherically priced On-gaku integrated tube amp with the relatively affordable Conquest mono tube power amp. Jadis followed its Eurythmie horn speaker with a two-thirds-scale version. Theta Digital's hottest product is the high-value-for-money, ultra-compact Chroma D/A converter. Sonus Faber's latest speakers, the Concertino and Concerto, are mid-priced and compact. Martin-Logan's most appealing speaker designs are the Aerius *i* and reQuest. It goes on and on, and not a moment too soon.

Not that anyone wants to pander to peasants. (Even Microsoft now makes noise about no longer writing programs backward-compatible with 15-year-old 8086 snails.) But it's true that the consumers who grumble the most and the loudest are those who spend the least (whether or not they can afford to spend more), and many a manufacturer has failed by listening too closely to the malcontents. (If you want to see misery in action, latch onto any hi-fi forum on the Internet. Some of these

guys redefine "penny-pinching.") So I can only commend the bravery of a company that is dealing with the closing years of this century by offering products that probably give too much away.

"Whoa!" you're thinking. Aren't hi-fi magazines supposed to help you find bargains and squeeze the most out of each and every dollar? Yes, but only up to a point. And that point, a line that is crossed all too often, is the one between financial health (for the manufacturers, distributors, and retailers) and bankruptcy. I mean, why has

the real price of hi-fi plummeted over the past 20 years while every other mature market is, at the least, allowed to keep up with inflation? (Please, don't throw computers at me. This is a relatively new field that is still at the stage where it, almost alone, enjoys the continual trickle-down improvements and price cuts that come with improved manufacturing techniques.)

You don't believe me? Compare the cost of an entry-level system (a cheap CD player, an inexpensive receiver or amp, and a pair of small two-way speakers from established hi-fi brands) with similar products from 1980. Go on: I dare you to dig out your October 1980 issue of *Audio*. What's terrified (and terrorized) the British, in particular, is that prices haven't changed at all, despite wages and the prices of everything else having increased—what, tenfold? Fact: An NAD 302 integrated amp, a pair of budget KEF or Celestion speakers, and a Dual turntable with cartridge cost \$550 to \$600

in 1980. Today, you can still buy an equivalent entry-level system, substituting a CD player for the turntable, for \$600. Does any current car have the same price as its 1980 equivalent? A chocolate bar? A burger? A newspaper? No. So how are hi-fi manufacturers and retailers supposed to survive with prices stagnating? Maybe my dream of a great culling of the industry will come as a result

of hi-fi pricing itself out of existence, not because it's too expensive but because it's too cheap.

Everyone wants something for nothing, and this industry has been forced to cater to such madness. Ask a British speaker manufacturer what its biggest problem is, and the reply will be the need to make speakers that can retail for less than \$200 per pair. Charge any more, and competitors will suck up that market. If you ask the manufacturers why they don't simply agree to stop making loss-leaders, they'll all point to the illegality

of cartels. And yet the retailers, who stand to make the biggest margins, still insist on products that, in real terms, aren't worth selling if they want to make sensible profits.

What Musical Fidelity has decided to do is to create its own market niche, a commendable venture when you're smaller and less influential than, say, Sony. Here's a company that made its mark with "affordable audiophile wares," such as a Class-A integrated amplifier for under \$500, yet also offers what passes for British high-end equipment. But now Musical Fidelity has entered a market that blurs the line between separate components and accessories. And it's selling them in the U.S. through a mail-order company, Audio Advisor (4649 Danvers Dr., S.E., Kentwood, Mich. 49512; 800/942-0220). The word to remember here is "volume," and I don't mean maximum SPLs.

Before I get all sorts of hate mail from ex-Musical Fidelity distributors and retailers who have their own horror stories to recount, yeah, I know, it's a two-way street. Yes, I've heard Musical Fidelity's Anthony Michaelson foaming at the mouth about the incompetence of everyone but himself; still, there's no denying that the guy comes up with brilliant ideas. His latest? A line of unusually styled components priced between \$200 and \$600 that have high perceived value, great performance, and—surprise, surprise—a sense of humor. These products all come in cylinders turned on their sides, aluminum extrusions painted black and capped with nicely machined aluminum lids. You'll want to own a bunch just because they look so cool, like those cans of designer water from Japan.

Out first was the X10-D, a tube buffer stage designed to fit between a CD player's or D/A converter's analog outputs and a preamp's inputs. Said to create a better match between the two, it also happens to add tube "warmth" as a result of the valves inside. Wishful thinking? No way. Musical Fidelity is selling thousands of units per month, and every reviewer has praised the X10-D to the hilt, with only one proviso: The benefits diminish as you move up the system price scale. In other words, you don't need this \$200 miracle cure if you live in Levinson/Wadia/Threshold land.

From the outset, Michaelson envisioned a whole system using this 7½-inch-deep x



**YOU'LL WANT TO OWN
A BUNCH OF
MUSICAL FIDELITY
PRODUCTS JUST BECAUSE
THEY LOOK SO COOL.**

4-inch-diameter product. Next up is the X-DAC, a solid-state D/A converter with Burr-Brown chips and HDCD decoding. After that, look for the \$199 X-CANS, an all-tube (two ECC88s) Class-A headphone amplifier designed to work with Grado RS1s "because they're revealing and a tricky load, too." Alongside this, Musical Fidelity intends to introduce the X-LP, a solid-state head amp with moving-magnet and moving-coil inputs, followed by the X-TONE, a solid-state tone-control system that will have adjustable rollover frequencies. All of

**EVERYONE WANTS
SOMETHING FOR NOTHING,
AND THIS INDUSTRY
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CATER TO SUCH MADNESS.**

these are designed to complement the X-PRE, an all-tube line-level preamp with four inputs, set to sell for around \$300. Since all of these X modules will use black-lump, stuff-'em-in-a-wall-socket AC adaptors, purists with more than one X module will welcome the X-PSU power supply, which will be able to feed four modules. Then there'll be the X-ACT, a budget-priced D/A converter, which will drop HDCD from the X-DAC spec so it can sell for \$300. Later on, there'll be solid-state power amps (yet to be named), and the line will be completed by a CD transport dubbed X-RAY.

It goes on and on. There's probably going to be a rack called the Six-Pack that will hold a half-dozen modules in wine-rack fashion, plus interconnects and other accessories. And already Those Who Would Be Audio Alchemy are looking at Musical Fidelity and the X-Series with dread.

For some, the success of the X-Series will mean that the entry-level ticket for real hi-fi has been lowered even further. But for others, it will mean that people who simply can't afford mid- or high-end components will be able to acquire rather cheaply something a lot more interesting than whatever else passes for budget equipment in the late 1990s. And however much you might fear the former, you can't help but admire the X-Series for the latter. **A**

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Flying Blind

The case against long-term listening

W

we use our ears all day, every day, so listening doesn't seem difficult—until, that is, we are asked to judge the sound of audio equipment. Making observations that accurately describe

the sound of a speaker, and that are specific enough to help a designer improve the product, is never easy. Consistent, reliable data can be elusive. Yet many manufacturers use open, uncontrolled listening comparisons when they're designing hi-fi components, and practically all retailers rely heavily on such methods to sell products. Indeed, an attitude shared by many reviewers, professionals, and audiophiles is that experimental controls are both intrusive and unnecessary—that open, extended listening, over periods longer than one gets in any store or in any single listening session, is mandatory to uncover subtle aspects of sonic performance.

The opinions that flow from long-term listening tests are an important part of many product reviews and sales pitches, and they underlie the listening strategies often recommended. The standard advice calls for a listener to relax, put up his feet, open his mind, listen over an extended interval, and trust his ears. He is often warned that switching components or making direct comparisons of different audio gear during the session will interfere with his connection to the product,

thereby generating stress and reducing hearing sensitivity. None of this is news to experienced enthusiasts, and though it sounds rational enough to most people, this advice seems at odds with what we know about the human sensory system.

Humans, and nearly all other animals, are most sensitive to a stimulus when first exposed to it. We are consciously aware of the fan only when it is turned on or off; with continued exposure, its drone tends to disappear into the background. Further, common

sense tells us that we are most sensitive to a stimulus when we are at attention. How does your dog or cat react to the sound of a can opener or to a strange sound? He pricks up his ears, snaps to attention, and turns his head to localize and face the sound. Why? This response helps him gather the maximum amount of information, the most detail.

Let's take the example a little further. Have you noticed how acutely you respond during a moment of urgency, when you have just received a kick of adrenaline? Why does this happen? During an especially stressful or potentially dangerous situation you quite naturally reach a state of maximum alertness and heightened awareness; your

ability to assimilate new information is elevated. Did you ever get an adrenaline blast from closing your eyes and drifting off to Pachelbel's Canon in D Major? No, because your senses are at minimum sensitivity and your mind contributes more to the experience than the environment does.

Humans, and nearly
all other animals,
are most sensitive
to a stimulus when
first exposed to it.

by Tom Nousaine



PHOTOGRAPH: ROBERT LEWIS

We also tend to be most sensitive to differences on direct comparison. The differences between off-white paint chips, for instance, are most apparent when the chips are viewed side by side. However, if you put them in separate rooms, you may have trouble telling them apart. At the very least, any differences between them will seem diminished. Minor differences may ultimately prove to be inconsequential, but they will always be highlighted by a direct comparison.

On the other hand, it is clear that training and experience can increase listener sensitivity and reliability. For example, many people have to learn to hear stereo imaging, because they are not aware that recorded sound has a spatial character or that this might be an important aspect of audio system performance. In fact, it's highly desirable to use well-trained listeners in most research dealing with subjective evaluation of such things as data-reduction schemes like those used in Dolby Digital (AC-3) and MiniDisc (ATRAC). Some researchers have indicated that one well-trained, experienced listener may be worth as much to their studies as eight untrained subjects.

PREVIOUS RESEARCH

In the late 1980s, David L. Clark (of DLC Design) and Larry Greenhill conducted an experiment that compared the efficiency of long-term, single-unit listening to shorter-term, switched, side-by-side comparisons. In the single-unit experiment, they used identical-looking black boxes that contained either a simple straight-wire bypass or a circuit that introduced 2.5% distortion to the music signal fed through it. (The distortion circuit generated harmonic distortion that remained a fixed percentage of the output at all signal levels.) Each test subject was given one box, which could be either the bypass model or the distortion box.

Each subject connected the box in the tape loop of the preamplifier of his own audio system and took as long as he wanted to determine if the box he was given produced distortion or was clean. Listeners were encouraged to use any listening technique (except opening the box) to reach a decision. They didn't have to identify the type of distortion or make any determination except whether the box was "clean" or "dirty" (i.e., whether it produced clean or distorted sound). When the results were tabulated, it turned out that members of two different audiophile clubs had been unable to reliably identify whether they had been given the bypass box or the distortion box.

In a subsequent experiment, however, which included a 45-minute training session and switched double-blind comparisons, the subjects were able to reliably hear the distortion. During this test, subjects were first exposed to music with 13% distortion, a lev-

el that yields plainly garbled sound, like a bad AM radio. After the initial training period, the distortion was reduced to 4% and 2% with music and then 0.4% with a sine-wave test signal. Using an ABX double-blind switchbox, subjects were able to reliably identify all these levels of distortion. (With the ABX Comparator, a subject has unlimited, at-will access to two signals, "A" and "B," and to an "X" signal that's identical to either A or B. The ABX circuit randomly assigns A or B to the X position at the beginning of each trial and keeps track of which signal was used as X each time.)

In this experiment, switched direct comparisons proved to be more sensitive at revealing distortion than long-term open listening to a known (and relatively high) level of distortion. However, this was just one experiment, and the program material used in the at-home, long-term test was not controlled. Moreover, more than half a decade has elapsed since it was conducted. Many audio enthusiasts believe there have been significant advances in audio equipment since that time and that the debate over listening methods has never been settled. Clearly, it was time to repeat the experiment originally done by Clark and Greenhill.

FIRST HEAT

For this experiment, I prepared CD-R versions of Joan Baez singing "Diamonds and Rust" that either contained 4% of the same distortion used in the prior experiment or were clean, bit-for-bit digital copies of the original CD (*The Best of Joan Baez*, A&M CD3234). The distorted versions were taken from a DAT recording of the track made from

the analog output of David Clark's Audio Chamber of Horrors box, a device that generates calibrated amounts of different types of distortion. I used what Clark calls "grunge" (the same distortion used in the earlier study) and transferred the distorted versions to CD-R. Clean samples were made via a direct digital transfer of the original CD from a Marantz CD-63 player to a Marantz CDR-610 CD recorder through a 1-meter AudioQuest Quartz cable. Each CD-R was labeled with a coded serial number written on the face of the disc with a water-based marker.

Sixteen audiophile subjects (see Table) from Illinois, California, and Canada were given discs and a score sheet. Five CD-Rs were used in all. Three had added grunge, and two were clean. The assignment of discs and subjects was determined by coin flips. Subjects were told that either a "certain level of harmonic distortion" was added to the disc or the disc was clean and free of any additional processing. They were asked to take as long as they needed to decide whether the disc was clean or dirty, mark the score sheet, and return the disc. The subjects were told they could use any listening methods they wished except a direct comparison to another CD of the song played on a second CD player. And they were forbidden to

Listening long term,
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discuss the results with other participants who had not completed the test. The initial five discs were assigned in May 1996, and the discs were reissued to other subjects as they were returned. The final subject finished the test on October 28, 1996.

The subjects were intensely interested in the results and wanted to know immediately after submitting their score sheets whether they had correctly identified their disc. One subject shouted "Yes," with a sharply raised fist, when told he had correctly identified his disc as clean. Respondents nearly always expressed surprise and disappointment with an incorrect answer. The longest any subject kept a disc was 13 weeks. One subject returned a disc after a single day, but the average participant took three weeks to complete the listening assignment.

After all scores were tabulated, only 10 of the 16 subjects had correctly identified their discs as clean or dirty. Five of seven subjects correctly identified a clean disc, and five of nine correctly identified a dirty one. (These results are not statistically significant at the 95% criterion level, using a one-tailed test of significance.)

Speaking in statistical terms, we do not reject the null hypothesis—that the results are attributable to chance alone and not to a systematic factor—because subjects were unable to prove they could hear the difference between the clean and dirty discs. Twelve of 16 correct answers are required to confirm that subjects were not just guessing. So, over the long term, subjects were not reliably able to tell when 4% distortion was added to a recording, even when they listened with their own audio systems and faced no time limits.

SECOND HEAT

For the following session, I asked one of the subjects, who had kept his CD-R for the longest time and who had incorrectly concluded that a dirty disc was clean, to participate in a sin-

gle-listener, double-blind, switched ABX comparison. For this experiment, a second CD-R of the same Joan Baez song ("Diamonds and Rust") was made in mono, this time with distortion added to the left channel while the right channel was kept clean. This facilitated comparisons of clean and dirty mono programs with a single CD-R loaded in the Marantz CD-63 player, enabling me to avoid timing discrepancies that sometimes occur between two simultaneously running CD players.

With cheap RCA Y adaptors, the distorted left channel was connected to the A (for Awful) inputs and the clean right channel to the B (for Beautiful) inputs of the ABX box. Thus, the signal at the selected switch position appeared in both earpieces of Etymotic Research ER-4S in-the-ear 'phones. The 'phones were driven directly from the ABX box's output jacks, and the volume was adjusted from the CD player's remote control.

The subject was first given a 10-minute trial run, with 13% distortion added to one channel. Next, he participated in a 16-trial ABX test that compared 4% distortion levels versus a clean signal. He could choose any switching protocol he wanted.

Running the disc straight through and switching in any fashion he desired, the subject identified clean and dirty signals correctly

only seven of 16 times, indicating he was unable to reliably identify the distortion. Next, I used the CD player's A-B repeat to define a 25-second interval on the disc. Listening only to this segment, the subject identified 12 out of 16 correctly—the first statistically significant positive result of the experiment. This confirmed that the subject was able to hear the difference between the clean and dirty signals, with only a 1-in-20 chance that he was guessing. When I shortened the A-B repeat interval to 6 seconds, the listener scored 16 out of 16 correct, leaving virtually no doubt that he could hear the distortion. (I should note that the total test sequence, including

HEAT 1—Long-term listening.

Listener	Auditioning Period, Weeks	Disc Condition	Listener Answer
1	1	Clean	Dirty
2	<1	Dirty	Dirty
3	3	Dirty	Dirty
4	2	Clean	Dirty
5	1	Clean	Clean
6	13	Clean	Clean
7	2	Dirty	Dirty
8	3	Dirty	Clean
9	3	Dirty	Clean
10	1	Dirty	Dirty
11	4	Dirty	Dirty
12	4	Dirty	Clean
13	3	Clean	Clean
14	3	Clean	Clean
15	3	Clean	Clean
16	13	Dirty	Clean

Dirty Discs: 9
 Clean Discs: 7
 Correct Responses: 10
 Incorrect Responses: 6

RESULTS BY AUDITIONING PERIOD

Duration	Correct Responses
1 Week	3 of 4
2 Weeks	1 of 2
3 Weeks	4 of 6
4 Weeks	1 of 2
13 Weeks	1 of 2

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the warm-up, took about an hour; the final two sessions consumed less than half that.)

SUMMARY

My results confirm my initial description of the human sensory system. Humans are most sensitive to a stimulus when first exposed to it and can more reliably discern differences in sound quality by immediate comparisons than through long-term exposure. As test signals, I used common program material (pop music)—clean, and with distortion added of a type and amount previously shown to be audible. The shorter the comparison interval, and the more rapid and direct the comparisons, the better the results were.

In other words, to highlight differences in the sound of audio components, direct A/B comparisons provide maximum listening acuity. Shorter and more similar comparative periods maximize sensitivity (praise be for the player's A-B repeat function). However, I would emphasize that direct comparisons seldom have the level of experimental control used in these listening sessions, in which blind ABX presentations and precise level matching played integral roles.

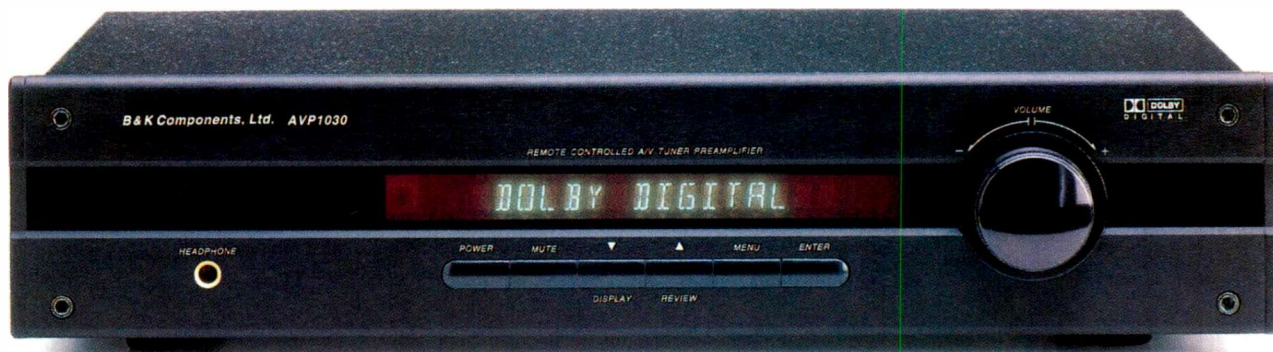
You might question whether the poor long-term listening results could be attributed to low-quality audio systems. But I chose subjects who were audio enthusiasts, people who were already familiar with the concept of distortion and who were interested in the ability to hear differences between hi-fi components. They tended to own above-average audio gear. At least four of the participants had what I would call exotic systems, and two were audio-store salesmen who had easy access to high-end equipment.

The evidence of these experiments, combined with a common-sense approach to human hearing, tells us that the most sensitive listener is the one who is alert, who is at attention, and who uses direct, side-by-side comparisons. The cat-and-can-opener model provides the best operating blueprint for a high-acuity listener. The only thing that would improve results would be to train the cat.

So listen with your ears and brain when assessing audio gear. And listen with your heart for enjoyment—after you've checked out the gear.

A

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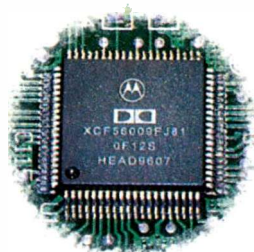
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BURIED TREASURE

SONY CLASSICAL'S MASTERWORKS HERITAGE REISSUE SERIES

About 80 miles north of New York City, deep in an underground vault, are stored 400,000 first-generation master tapes and lacquers, some dating back more than 50 years. On these are the ghostly voices and instrumental artistry of Columbia and CBS Masterworks recording artists. Sony Classical has begun to unearth and sonically refurbish this extraordinary musical legacy, using computerized noise-removal systems and Sony's own 20-bit technology and Super Bit Mapping process.

The Masterworks Heritage series encapsulates an almost-complete history of recording technology, beginning in 1900 with the acoustical years, when performers sang or played directly into a large acoustical horn connected to a diaphragm. (The latter was *mechanically* linked to the cutting stylus that engraved the grooves in the master disc.) The series also includes recordings from the mono electrical period, which began in 1925 when microphones, electrical amplifiers, and disc cutters replaced the acoustical horn. Recording technology then continued more or less unchanged up to the modern analog stereo era, which prevailed from 1957 to 1980.

The artist roster includes the famous (tenor Richard Tucker, soprano Eileen Farrell, and conductors Leopold Stokowski, Fritz Reiner, Eugene Ormandy, Leonard Bernstein, and George Szell) and the familiar, names that I recall my parents discussing when I was a child (such as violinists Eugène

Ysaÿe and Zino Francescatti and pianist Claudio Arrau). Moreover, there are once-celebrated artists (sopranos Bidú Sayão and Eleanor Steber and bass Alexander Kipnis) whose names and work, until now, have remained relatively unfamiliar to all but collectors, opera buffs, and musical historians.

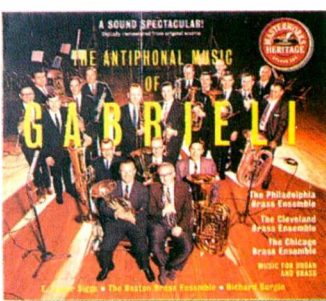
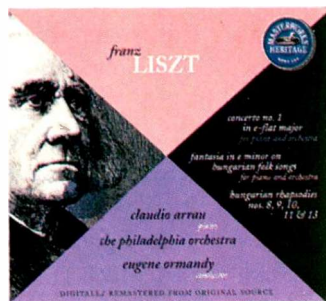
According to Sony Classical's Masterworks Heritage executive producer Thomas Frost and a series consultant, Dennis Rooney, the process of transferring discs and lacquers has evolved significantly over the past decade. Previously, they were transferred to tape, and then the ticks and pops were removed through individual tape edits, an expensive and time-consuming process. Now computerized digital systems, from such companies as Sonic Solutions and CEDAR Audio, enable the noise spectrum of the recording to be displayed and analyzed on-screen, and noise can be removed in the digital domain. Rooney cited another advantage of digitally processing historic reissues: preserving the master recording's dynamics. These dynamics, available to CD listeners for the first time, were previously unheard because of inherent limitations of 78-rpm disc technology. For example, in 1947 Columbia cut 33 $\frac{1}{3}$ -rpm master lacquers that embodied a wide dynamic range, which, regrettably, had to be compressed for transfer to 78-rpm discs because home playback equipment of the period simply couldn't handle the original dynamics without distortion.

"The difficulty with so much of this reissue work," Rooney told me, "is that it's incumbent

by Alan Lofft

AUDIO/MARCH 1997





on us to get the message across that this material is *not* the same old stuff that's been available for years—the 78-rpm discs and second-generation releases from 1939 to 1950. It's very much a departure from policy for us to go back to the first-generation stereo masters, such as the Leopold Stokowski and Eugene Ormandy recordings [*The Philadelphia Orchestra Plays Bach*, Sony Classical MH2K 62345].

"You see, Columbia was never an audiophile company like Mercury or London Decca. The releases were never treated the way Bob Fine handled his Mercury Living Presence series of recordings. And there was some awful analog disc mastering back then. Why, even the Shaded Dog Victors were wildly uneven; some of them were out of phase!

"Columbia's marketing philosophy at that time was for the releases to sound loud, to have 'presence'. The Leonard Bernstein/New York Philharmonic LPs, for example, were crude and crass-sounding, with no detail or subtlety. Yet when we listened to the original three-track, three-channel master tapes, the nuance, color, detail, and spaciousness were all there.

"For this Heritage series, all three channels were analyzed, track by track. Sonic Solutions NoNoise and CEDAR were used in tandem. They're excellent for removing small- and large-order crackles and ticks, but they're not perfect. We'd leave steady-state tape noise alone, out of respect for the material."

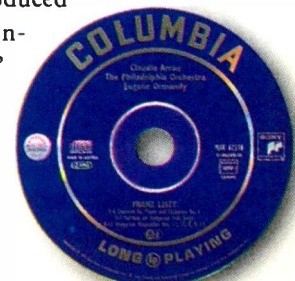
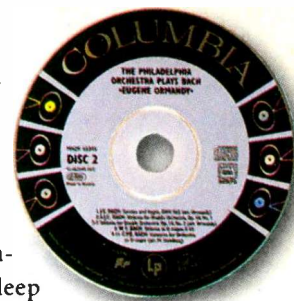
To reclaim very old recordings, such as *The 1903 Grand Opera Series* (MH2K 62334), Rooney and his team would sometimes play a negative metal matrix (a mirror image of the 78-rpm disc) with a special Stanton biradial stylus that rides on top of the "groove"—in fact, on a ridge. During such a transfer, the turntable must revolve backwards because the metal matrix is a mirror image of the final pressing. This technique was used to dub a 1903 recording of baritone Antonio Scotti singing the Prologue from *I Pagliacci* for *The 1903 Grand Opera Series*.

How successful have Sony Classical's efforts at sonic restoration been? An afternoon's listening to seven Masterworks Heritage releases revealed some stunning musical and audio treasures plus one or two that might charitably be described as being of historical, archival interest only. (*The Grand Opera Series* fits into this latter category.) The winners include the radiant and crystalline voice—new to me—of Brazilian soprano Bidú Sayão, on recordings done mostly from 1947 to 1950 (*Opera Arias and Brazilian Folk Songs*, MHK 62355); the beautiful sound and singing

of former New York Metropolitan Opera star Eleanor Steber, in works by Berlioz, Bach, Handel, and Mendelssohn (MHK 62356); the wonderful string sound, deep bass, and Severance Hall acoustics in superb, early stereo recordings of four Schumann symphonies from sessions done in 1958 and '60 with the Cleveland Orchestra under George Szell (MH2K 62349); and similarly lush string sound and low bass available on the aforementioned Stokowski/Ormandy Bach recording.

On the other hand, the slightly hard edge to the violin sound on Zino Francescatti's *Great Violin Concertos* (MH2K 62339) seemed exactly like that of the original '50s Columbia LP (I still own it), which I played many times on a mono tube audiophile system I built for my father in my early teens. By contrast, the smooth and spacious sounds of the Philadelphia, Cleveland, and Chicago brass ensembles have been finely preserved on *The Antiphonal Music of Gabrieli* (MHK 62353), as have the acoustics of the Romanesque Hall of the Busch-Reisinger Museum at Harvard University and of Town Hall in Philadelphia, where the sessions took place. However, the dreadful sound, shaky intonation, wobbly pitch, and curiously slow tempos (all of which may be a product of the primitive acoustical recording technology) evident on *Eugène Ysaÿe: The Complete Violin Recordings* (MHK 62337) did nothing to persuade me of the violinist's vaunted virtuosity.

The last disc aside, Sony Classical has accomplished wonders of audio restoration with its Masterworks Heritage releases, and there are many more to come. Incidentally, the art direction and packaging of the CDs are a knockout. Rugged cardboard binders are used in place of standard jewel cases. The beautiful color artwork of the original record jackets and all booklet notes have been printed on heavy paper. Even the original record labels have been perfectly silk-screened, in full color, on the Compact Discs. Buyers of the Cleveland Orchestra and George Szell's two-disc set, in particular, will reel with nostalgia when they see how perfectly Sony Classical has reproduced the original, black-on-gold Epic "Stereorama" label, under which the recordings were first released. A



EDWARD J. FOSTER

DENON AVR-5600 A/V RECEIVER



Denon's AVR-5600 comes as close to fulfilling my A/V receiver wish list as anything I've seen. First of all, it's a powerful beast, rated at 140 watts per channel into 8 ohms with all five of its channels driven. As with most A/V receivers, the five-channel rating is specified at 1 kHz (with 0.7% distortion), but the stereo rating (also 140 watts but from 20 Hz to 20 kHz with 0.05% THD) hints that real-world performance is likely to be better than claimed. Second, the AVR-5600 is equipped with a Dolby Digital Surround (AC-3) decoder and is Home THX-certified in both Dolby Pro Logic and Dolby Digital Surround, i.e., for both matrixed and discrete surround soundtracks. Its Dolby Digital section can accept an RF-modulated

AC-3 signal from today's laserdisc players without an external box, as well as direct AC-3 bitstreams from DVD players (and, in a year or two, HDTV receivers). What's more, the AVR-5600 can accept the Dolby Digital bitstream from any of its four digital inputs. (Of these, one is a coaxial connection; the other three are optical.)

In a novel twist that provides the AVR-5600 with unusual versatility, the receiver's setup menus enable you to allocate any digital input to any of seven program sources. However, only one digital input, "Optical-3," is accompanied by an output (also optical) to feed a digital recorder. Three sources ("Phono," "Tape-2," and the built-in tuner) cannot be assigned to digital inputs. When you select a source, the AVR-5600 uses the digital input, if one has been allocated; otherwise, it uses the analog input whose name corresponds to the source. For digital in-

puts, the Denon analyzes the input bitstream to determine whether it's standard PCM or needs to be fed through the AC-3 decoder. Thus, the AVR-5600 handles all current (or soon-to-exist) audio program sources—stereo or matrixed analog, stereo or matrixed digital, and discrete 5.1-channel digital (including RF-conveyed AC-3 from laserdiscs). Like most A/V receivers these days, this one can display menus, settings, and even a speaker-setup diagram on your TV screen.

The AVR-5600 has provisions for five audio/video and five audio-only sources (counting its tuner), including two VCRs and two audio recorders. The tuner features 40 presets in five banks of eight and automatic memorization of local stations (with manual override). It also incorporates the Radio Data System (RDS), which Denon has persistently championed for car and home FM. As more and more FM stations start broadcasting with RDS, this will enable you to search among the RDS stations in your area to find a particular type of program, get traffic reports, display transmitted text (such as song and album titles), and receive emergency alerts. (*Editor's Note:* About 12 RDS stations can be received in suburban New Jersey, where I live. All of them list their program types, but none transmits traffic reports or useful text yet.—I.B.)

The AVR-5600 has recording outputs to complement its audio tape and VCR inputs and, of course, an output for your TV monitor. Denon also provides stereo connections for an audio system and an additional TV in a second room. All connections are

Rated Power Output, All Channels Driven: Stereo mode, 140 watts per channel into 8 ohms, 20 Hz to 20 kHz, at 0.05% THD or 170 watts per channel into 8 ohms at 1 kHz and 0.7% THD; surround modes, 140 watts x 5 into 8 ohms at 1 kHz and 0.7% THD.
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Photos: Michael Groen

on the back, and all video signals (except that for the second TV) are carried in S-video and composite-video forms. All audio and composite-video RCA jacks are gold-plated, as is the front-panel headphone jack. There are preamp outputs for each of the five main channels and for a powered subwoofer but no input connections for the internal power amps. Since the AVR-5600's five power amps are identical, the omission is justified; there's little purpose in swapping identical power amps.

The amplifier outputs are multiway binding posts that accept single or double banana plugs. Parallel-connected pairs of posts are provided for the three front speakers, to facilitate bi-wiring. Three switched convenience outlets, with a total power rating of 120 watts, are provided. The FM antenna connects to a 75-ohm F connector;

**DENON'S AVR-5600
COMES AS CLOSE
TO FULFILLING
MY A/V WISH LIST
AS ANYTHING I'VE SEEN.**

the AM loop connects to a pair of wire clamps. A grounding terminal is near the phono input, for easy connection to a tone-arm or a turntable frame.

The AVR-5600 may not win any beauty contests, but its front panel is inoffensive and, when the hinged door at the bottom is closed, rather simple. The "Power" button is on the left, "Master Volume" is on the right, and below the display are 11 small selectors: "AC-3 RF," "Phono," "CD," "Tuner," "VDP/DVD," "TV/DBS," "VCR-1," "VCR-2," "V.AUX," "DAT/Tape-1," and "Tape-2/Monitor" (with a nearby LED to indicate when that monitor is in use). I prefer individual program selectors like these to cyclic selectors, because they're faster and easier to use and eliminate an on-screen menu. (I also approve of Denon's use of relays rather than solid-state switches to route signals, because relays are less likely to inject noise and distortion.) Behind the hinged door are 16 buttons that control surround modes, input adjustments, tuner presets, and recording/multiroom program selection. These are flanked by a "Phones"

jack on the left and "Bass" and "Treble" knobs on the right.

Except for manipulating the tone controls, you can select anything from the remote that you can from the front panel, albeit sometimes in a different fashion. For example, selecting sound modes via the remote involves cycling through the modes, whereas the panel offers direct access to most of them.

These sound modes are "Direct" (which bypasses the tone controls when you're listening in stereo), "Stereo" (which activates the bass and treble controls), and six surround options. The surround modes are "Dolby Surround" (which automatically chooses Dolby Digital over Pro Logic if the receiver is fed an AC-3 program), "Home THX Cinema" (which adds Home THX enhancement to whatever Dolby Surround mode is used), "Mono," "Wide Screen" (DSP-enhanced Dolby Surround), "5CH Stereo" (which redistributes a stereo source among all speakers), and "DSP Simulation." The last chooses, in cyclic fashion, among five simulated surround modes ("Super Stadium," "Rock Arena," "Jazz Club," "Classic Concert," and "Matrix"). Both "Home THX Cinema" enhancement and the various simulation modes are implemented in a Motorola 56004 DSP chip.

Three buttons behind the hinged panel control the audio input settings for each source and, once adjusted, remain associated with that source unless you reset it. The first two raise or lower input level, and the third toggles "Analog/Digital" input connections. (In retrospect, it strikes me that this third switch probably lets you use four more program sources than appear on the front panel: Just connect whatever sources you wish to the analog inputs that correspond to the four source positions you allocated digital inputs to, and then use the toggle to select either input set.)

Next come three tuning buttons ("Shift," "Down," and "Up"). With the last two buttons on the bottom row, you set the pro-

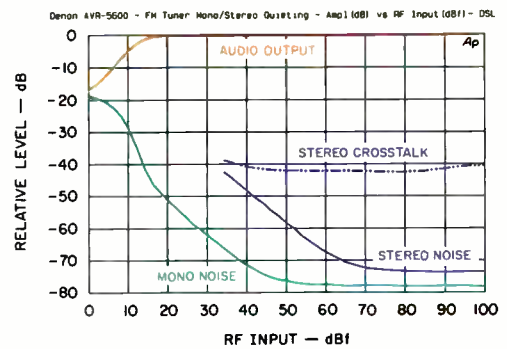


Fig. 1—Quieting characteristics and separation, FM tuner section.

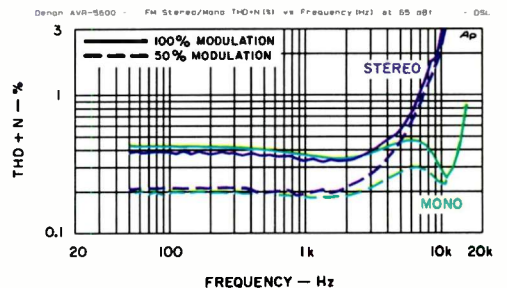


Fig. 2—THD + N vs. frequency, FM tuner.

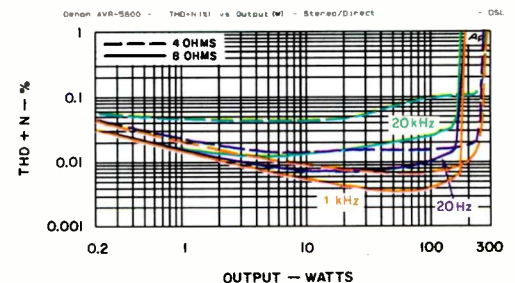


Fig. 3—THD + N vs. power output.

gram source to be fed to a second room and to the recording outputs. The "REC/Multi Source" button cycles through the 10 possible sources or, in its 11th position ("Source"), uses whatever source is set by the main program selector. The other button, "REC/Multi Mode," assigns the selected source to the recording outputs or to the multiroom jacks.

The AVR-5600's display is in three sections. On the right is a two-digit master volume LED that's always active. On the left are 10 small LEDs. Six of them indicate the presence of a Dolby Digital AC-3 signal and how many channels it contains. (AC-3 is just a compression system and can be used to carry stereo or mono audio as well as 5.1-channel surround.) The other LEDs indi-

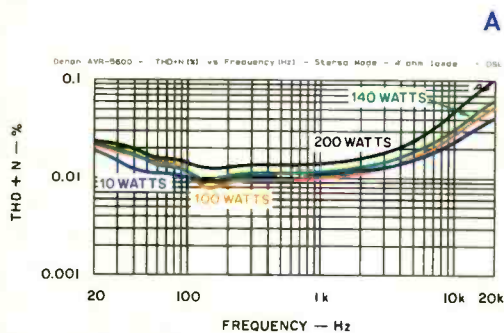
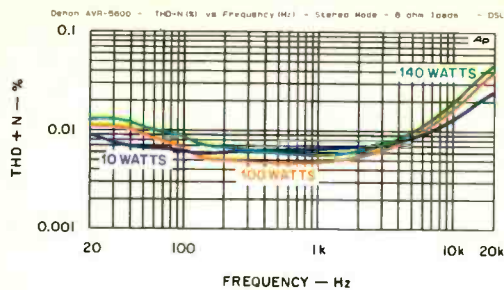


Fig. 4—Amplifier THD + N vs. frequency, 8-ohm load (A) and 4-ohm load (B).

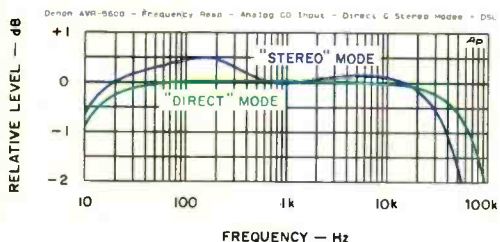


Fig. 5—Frequency response from CD analog input.

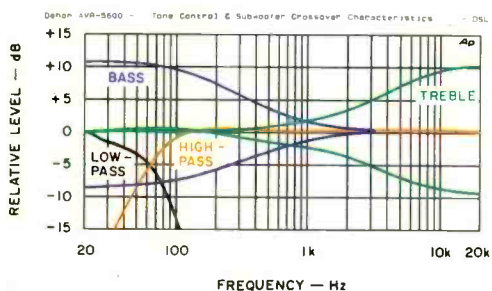


Fig. 6—Tone-control range and response of subwoofer crossover.

cate when a digital (rather than analog) input is in use, when Dolby Surround decoding is on, whether there are signals in the low-frequency effects (LFE) channel, and when circuits (presumably the inputs) overload. Unfortunately, the LEDs' labels are essentially unreadable, which makes the array virtually useless except as decoration. The display's center section is a fluorescent

panel whose brightness can be set to three different levels or turned off by the remote's "Dimmer" button. If you turn the display off, it comes back to life briefly when you change the program source or other settings.

The remote can control three audio and three audio/video sources. It's a universal remote, preprogrammed with the control codes of equipment from several major companies and capable of learning the codes of other makers' equipment. The remote has 59 buttons and two switches. The buttons don't illuminate, but they are color-coded, clustered in groups, and shaped differently to give a tactile indication of use. Twenty-one "infrequently used" buttons are covered by a hinged panel, which keeps them out of the way. Strangely, the major tuner controls ("Tuning" up/down, "Band," "Mode," "Memory," "RDS," and the buttons that activate RDS program search and text display) are among those that are hidden.

The setup buttons are also behind the remote's hinged panel. "Enter" brings up the main on-screen menu ("Surround Parameters," "System Setup," and "Menu Off"). The on-screen display indicates the active selection by a pointing finger, with upward- and downward-pointing arrows marking the selections above and below. The indicator is moved by up/down "Cursor" buttons; "Enter" activates your selection.

The main menu's "Surround Parameters" option is used for toggling the Denon receiver's "Cinema EQ" circuit on and off and for adjusting "Room Size" and "Effect" levels when you are using DSP-based enhancement.

The "System Setup Menu" offers eight submenus. These are used for matching the AVR-5600's individual-channel frequency responses, delays, and levels to your speaker setup; controlling a peak limiter for the subwoofer; allocating the digital inputs; toggling the AC-3 decoder's dialog normal-

ization on and off; setting tuner presets automatically; and controlling the on-screen display. Several of the submenus are self-explanatory, but four of them deserve a bit of explanation.

In the "Speaker Configuration" submenu, you inform the AVR-5600 whether you have center or surround speakers and whether each speaker, except a subwoofer, is small or large. (More and more microprocessor-controlled surround decoders use this setup method, which is clearer and more to the point than choosing "Center, Wide" for a large center speaker and "Center, Normal" for a small one.) If you indicate you have small main speakers, you're offered a choice of only "Small" or "None" for the center and surrounds, and the AVR-5600 redirects bass energy accordingly.

To set "Delay Time," you enter the distances between the listening position and each speaker, in feet or meters, rather than

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having to calculate and enter delay times per se. The left and right front speakers are assumed to be equidistant from the viewing position, so one entry serves both.

For "Channel Level" adjustments, you can press buttons to move test tones from speaker to speaker or have these tones cycle around the array automatically. Once you've activated "Test Tone Start," an array of speaker icons and five channel-level adjustment bars appear on-screen to guide you through the procedure.

The "Subwoofer Peak Limit LEV." submenu enables you to activate or deactivate a peak limiter on the subwoofer channel. It also helps you determine what peak limiter level will give you maximum bass from your sub without excessive distortion.

Measurements

The AVR-5600 has a number of things going for it. Its FM tuner is a good bit more competent than those I've seen in other recent receivers, and its power amps are clean

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MEASURED DATA

FM TUNER SECTION

Sensitivity: IHF usable, 15.6 dBf in mono; 50-dB quieting, 18.6 dBf in mono and 41.1 dBf in stereo.

S/N Ratio, 65-dBf Signal Input: Mono, 78.1 dB; stereo, 71.7 dB.

Frequency Response, Stereo: 20 Hz to 15 kHz, +0.32, -0.44 dB.

Channel Balance: ± 0.00 dB.

Channel Separation, 100 Hz to 10 kHz: Greater than 42.2 dB.

THD + N at 65 dBf, 100% Modulation: Mono, 0.42% at 100 Hz, 0.36% at 1 kHz, and 0.46% at 6 kHz; stereo, 0.38% at 100 Hz, 0.33% at 1 kHz, and 0.74% at 6 kHz.

Capture Ratio at 45 dBf: 1.4 dB.

Selectivity: Adjacent-channel, 4.6 dB; alternate-channel, 59.5 dB.

Image Rejection: 53 dB.

AM Rejection: 62 dB.

Stereo Pilot Rejection: 34 dB.

Stereo Subcarrier Rejection: 50.2 dB.

AMP SECTION, STEREO MODE

Output Power at Clipping (1% THD at 1 kHz): 8-ohm loads, 185 watts/channel (22.7 dBW); 4-ohm loads, 290 watts/channel (24.6 dBW).

Dynamic Output Power: 8-ohm loads, 195 watts/channel (22.9 dBW); 4-ohm loads, 310 watts/channel (24.9 dBW); 2-ohm loads, 500 watts/channel (27 dBW).

Dynamic Headroom re 8-Ohm Rating: 1.4 dB.

THD + N, 20 Hz to 20 kHz: 8-ohm loads, less than 0.045% at rated output and less than 0.025% at 10 watts/channel; 4-ohm loads, less than 0.103% at 200 watts/channel, less than 0.066% at 145 watts/channel, and less than 0.041% at 10 watts/channel.

Damping Factor re 8-Ohm Loads: 215.

Output Impedance: 39 milliohms at 1 kHz, 63 milliohms at 5 kHz, 107 milliohms at 10 kHz, and 165 milliohms at 20 kHz.

Frequency Response: "Direct" mode, 20

Hz to 20 kHz, +0, -0.32 dB (-3 dB below 10 Hz and at 117.6 kHz); "Stereo" mode, 20 Hz to 20 kHz, +0.54, -0.12 dB (-3 dB below 10 Hz and at 70 kHz).

Tone-Control Range: Bass, +9.4, -7.6 dB at 100 Hz; treble, +9.3, -8.7 dB at 10 kHz.

Subwoofer Crossover: High-pass, -3 dB at 78 Hz and -6 dB at 60 Hz, 12 dB/octave; low-pass, -3 dB at 45 Hz and -6 dB at 68 Hz, 24 dB/octave.

RIAA Equalization Error, 20 Hz to 20 kHz: "Direct" mode, +0.34, -0.57 dB; "Stereo" mode, ± 0.5 dB.

Sensitivity for 0-dBW (1-Watt) Output: CD input, 9.8 to 77.4 mV (15.6 mV with input attenuator at 0 dB); MM phono input, 0.127 to 1.13 mV (0.246 mV with input attenuator at 0 dB).

A-Weighted Noise: CD input, -83.5 dBW in "Direct" mode and -80.9 dBW in "Stereo" mode; MM phono input, -78.3 dBW in "Direct" mode and -77.7 dBW in "Stereo" mode.

Input Impedance: CD input, 54 kilohms; MM phono input, 46 kilohms + 200 pF.

Input Overload (1% THD at 1 kHz): CD input, 3.2 to more than 10 V (6.4 V with input attenuator at 0 dB); MM phono input, 54 to 168 mV (105 mV with input attenuator at 0 dB).

Channel Separation, 100 Hz to 10 kHz: Greater than 61.4 dB.

Channel Balance: "Direct" mode, ± 0.015 dB; "Stereo" mode, ± 0.05 dB.

Recording Output Level: 470 mV for 500-mV signal at CD input; 270 mV for 5-mV, 1-kHz signal at phono input; 650 mV for 100%-modulated FM signal at 1 kHz.

Recording Output Impedance: 700 ohms.

AMP SECTION,

DOLBY PRO LOGIC MODE

Output Power at Clipping, 8-Ohm Loads: Main channels, 185 watts/channel (22.7 dBW); center channel, 200 watts (23.0 dBW); surround channels, 180 watts/channel (22.6 dBW).

THD + N at Rated Output, 8-Ohm Loads: Main, less than 0.038%, 65 Hz to 20 kHz; center, less than 0.041%, 100 Hz to 20 kHz; surround, less than 0.168%, 100 Hz to 10 kHz.

Frequency Response: Main, 20 Hz to 20 kHz, +0.57, -0.29 dB (-3 dB below 10 Hz and at 23.3 kHz); "Center, Wide" mode, 20 Hz to 20 kHz, +0.56, -2.64 dB (-3 dB at 19 Hz and 23.3 kHz); "Center, Normal" mode, 76.2 Hz to 23.3 kHz, +0.37, -3 dB; surround, 80.5 Hz to 7 kHz, +0, -3 dB.

A-Weighted Noise: Main, -80.4 dBW; "Center, Wide" mode, -75.8 dBW; surround, -75.8 dBW.

Channel Separation at 1 kHz: 57.9 dB or greater.

DOLBY DIGITAL (AC-3) MODE

Channel Balance: 1.03 dB or better.

Frequency Response: Main channels, 20 Hz to 19.1 kHz, +0.57, -0.09 dB; center channel, 20 Hz to 19 kHz, +0.57, -0.12 dB; surround channels, 20 Hz to 19.1 kHz, +0.03, -0.35 dB.

THD + N at 1 kHz for 0-dBFS Signal: Main, 0.011%; center, 0.056%; surround, 0.058%.

Channel Separation at 1 kHz: 45.3 dB or greater (see text).

D/A CONVERTER SECTION

Frequency Response: 20 Hz to 20 kHz, +0.01, -0.32 dB.

THD + N at 0 dBFS: Less than 0.089%, 20 Hz to 20 kHz.

THD + N at 1 kHz: Below -77.9 dBFS from 0 to -90 dBFS and below -83.3 dBFS from -30 to -90 dBFS.

Maximum Linearity Error: Undithered signal, 4.73 dB to -90 dBFS; dithered signal, 5.2 dB to -100 dBFS.

A-Weighted S/N: 93.6 dB re 0 dBFS for infinity-zero signal.

Quantization Noise: -85.5 dBFS.

Dynamic Range: Unweighted, 89.1 dB; A-weighted, 91.9 dB.

Channel Separation: Greater than 44.5 dB, 125 Hz to 16 kHz.

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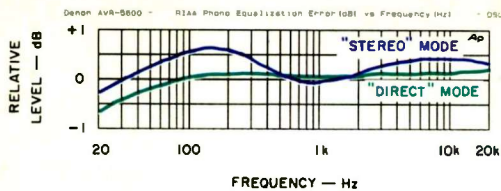


Fig. 7—RIAA phono equalization accuracy.

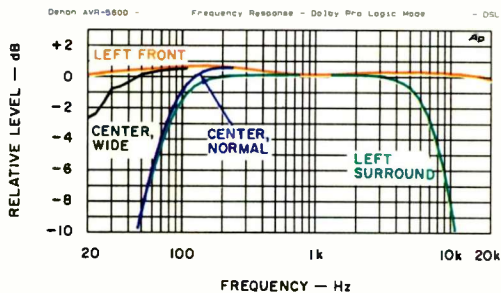


Fig. 8—Frequency response, Dolby Pro Logic mode.

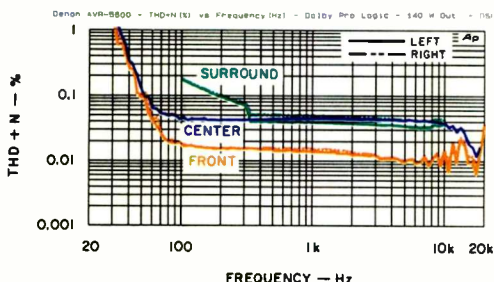


Fig. 9—THD + N vs. frequency, Dolby Pro Logic mode.

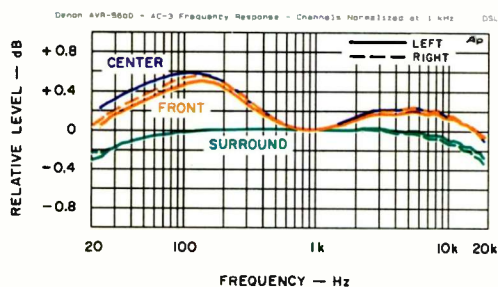


Fig. 10—Frequency response, Dolby Digital mode.

and potent. The analog preamp portion is fine too; so, in most respects, are the surround decoders. The major weakness I find lies in its D/A converters, which is odd, as Denon has established a rather good reputation in this area. But let's start with the AVR-5600's strengths.

As you can see in Fig. 1, the FM tuner snaps to attention quickly. The benchmark

50-dB-quieting point is reached with an RF input of 18.6 dBf in mono and 41.1 dBf in stereo, both very respectable. Band-limited (but unweighted) signal-to-noise ratio is greater than 78 dB in mono and almost 72 dB in stereo at 65 dBf, improving by another 2 dB or more with stronger stereo signals—impressive! Channel balance was perfect. Channel separation was remarkably uniform over the full audio band and was, at 42 dB or better, above average over the most important audio region.

Evaluating a receiver this elaborate requires a huge number of tests, with far more graphs than there's room for in this review. Mostly, I've omitted those that are easy to describe. For example, FM frequency response was almost ruler flat over most of the band, drooping slightly in the bass (-0.44 dB at 20 Hz) and rising a trifle in the treble (+0.32 dB at 15 kHz).

I measured the FM tuner section's total harmonic distortion plus noise (THD + N) using an RF input signal of 65 dBf. Usually, I present the data taken at 100% modulation because that's what the standard calls for; in Fig. 2, I've added curves made at 50% modulation, which is probably more typical of average broadcasts. (The results in "Measured Data" are for only the worse case, 100% modulation.) At 50% modulation, THD + N remains less than 0.25% to 4 kHz in mono (2.7 kHz in stereo) and less than 0.3% across the entire band in mono and out to 4 kHz in stereo. This is pretty good performance, especially in light of the tuner section's reasonably high adjacent-channel selectivity of 4.6 dB and its alternate-channel selectivity of nearly 60 dB.

Image rejection didn't set any record, but very few people live in places where this should be of any concern. For the rest of us, the AVR-5600's combination of relatively low capture ratio and high AM rejection bodes well for handling multipath. Stereo pilot and subcarrier rejections weren't bad

but could stand improving; if you intend to record cassettes with Dolby noise reduction, be sure to use the deck's MPX filter.

Figures 3 and 4 show the distortion characteristics of the AVR-5600's power amplifiers when driving 8- and 4-ohm loads. The data was taken by driving the analog CD input and using the "Direct" mode in order to bypass the tone controls and all processing circuits. As the curves in Fig. 3 indicate, the AVR-5600 can deliver 185 watts per channel continuously into 8-ohm loads (290 watts into 4-ohm loads) at clipping (1% THD) with a 1-kHz signal. A trifle less power is available at 20 Hz and 20 kHz.

To assess THD + N versus frequency into 8 ohms (Fig. 4A), I used output levels from 1 watt/channel up to rated output (140 watts/channel). However, distortion was so low at 1 watt/channel that the curve showed only noise, so I omitted it. Denon doesn't specify power for 4-ohm loads, so in Fig. 4B I added a curve at 200 watts/channel, safely below the maximum output power capability indicated by Fig. 3. (I also assigned that output level as my 4-ohm power rating for "Measured Data.")

As you can see from Figs. 4A and 4B, distortion is pretty constant and remains quite low from 100 Hz to 3 kHz or above. It turns up ever so slightly in the bass and more sharply in the treble. The curves show performance of the right channel, the poorer of the two on my sample. But because that channel cleared Denon's 0.05% 8-ohm full-power specification, there's no reason for complaint.

The AVR-5600 delivered just a trifle more power into 8- and 4-ohm loads with the IHF tone-burst signal than with a continuous signal. This suggests that the clipping point is determined primarily by the power supply's voltage rather than by its available current and that performance is unlikely to degrade substantially when more than two channels are driven simultaneously. With 2-ohm loads, the AVR-5600 delivered a whopping 500 watts/channel on tone bursts. The damping factor clocked in at more than 200, but output impedance slightly more than quadrupled when the signal frequency increased from 1 kHz (39 milliohms) to 20 kHz (165 milliohms).

I measured frequency response (Fig. 5) from the AVR-5600's analog CD input to its speaker outputs, using 8-ohm loads. (Only

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the left channel's response is plotted; the right channel's was essentially identical.) Response is flatter in the "Direct" mode, which bypasses the tone controls. In "Stereo" mode, the tone controls are in the circuit; even though I set them to their center detents, the curve for that mode is somewhat swaybacked. The response in "Direct" mode is admirable, but the "Stereo" curve is more the one to study because, as we will see, its behavior carries through across the board—oddly, even in Dolby Digital Surround! The -3 dB points in "Stereo" mode are okay, but I'm less sanguine about the broad rise in bass response ($+0.54$ dB at 150 Hz) and the smaller rise in treble response ($+0.2$ dB around 5 kHz). I presume that these anomalies came from the tone-control circuitry, but I can't be certain.

Tone-control characteristics are shown in Fig. 6. Both controls' curves shelf, the bass below 100 Hz and the treble above 10 kHz. As indicated in "Measured Data," each control provides a bit more boost than cut at the benchmark test frequencies of 100 Hz and 10 kHz.

Figure 6 also shows the subwoofer crossover's characteristics. The high-pass section's performance is typical for Home THX: -3 dB at just about 80 Hz and -6 dB at 60 Hz, with a 12-dB/octave slope. The low-pass section is peculiar in two ways. Although its slope ultimately reaches a nominal 24 dB/octave, it starts off rather gradually. And its response is never really flat except between 15 and 20 Hz (not seen in the graph).

Phono response (Fig. 7) has a swaybacked shape in "Stereo" mode, similar to what I measured from the analog CD input. In "Direct," it's flatter, though with a relatively minor bass rolloff.

For "Measured Data," I tested input sensitivity and input overload over the full range of input attenuator settings; all other tests were made with the input attenuator at 0 dB. (The input attenuator does not function in "Direct" mode.) With the attenuator at 0, the sensitivity data was typical of receivers in general, and the levels and source impedance of the recording outputs seemed fine to me. It's possible to overload the analog CD input on the test bench, but it's highly unlikely to occur in practice, especially if you use the input attenuator. The phono input's overload point should be ad-

equated for moving-magnet (MM) cartridges, though here, too, you might need to use the input attenuator. Phono input impedance was classic, in that it could be modeled by a parallel combination of a resistor and a capacitor, and the results were right on the mark; analog CD input impedance was also fine.

Channel separation and channel balance from the line (CD) input were good. However, as is increasingly common, the AVR-5600 doesn't have a conventional balance control; if a source is unbalanced you must correct matters with the speaker calibration controls.

On my sample, A-weighted noise was 0.6 to 0.7 dB higher in the right channel than in the left, so the right channel's results are reported in "Measured Data." The "Direct" mode was several decibels quieter from the line-level (CD) input, as you might expect. But on the phono input, preamp noise predominated, leaving little difference between "Direct" and "Stereo." Noise spectrum analyses revealed small but discernible power-line-related components at 60 Hz and at each harmonic through the fifth (300 Hz).

I evaluated Dolby Pro Logic operation by driving an analog input with simulated Pro Logic test signals and monitoring the speaker outputs of each channel. To save space, Fig. 8 presents frequency response only for standard Dolby Pro Logic (although I checked the Home THX enhancements and Denon's Cinema EQ system with the same test signals). The front channels have the same mid-bass response peak that appears in the "Stereo" curves in Figs. 5 and 7. On the other hand, surround-channel response is dead flat until it exhibits the "normal" bass rolloff. I admit to being somewhat surprised by this rolloff, since I had set the receiver up for large main and

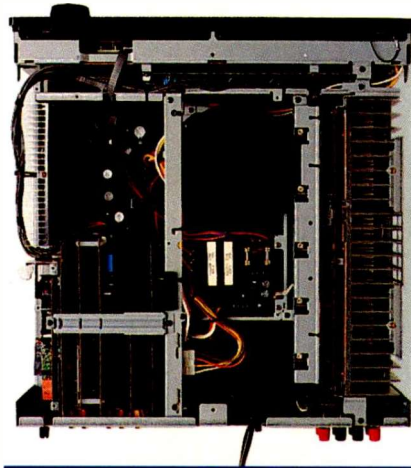
surround speakers. (The curve marked "Center, Wide" was taken using the setting for a large center speaker; the "Center, Normal" curve was taken with the setting for a small center speaker. Both were taken with the AVR-5600 programmed to assume that a subwoofer was in the system.) In each front channel, treble response was limited to 23.3 kHz by the anti-aliasing filter at the input of the A/D converter that feeds the processing circuitry from analog signals. As usual, the surround channel rolls off sharply above 7 kHz, as called for by the Dolby Pro Logic standard.

The curves I took with Home THX essentially reflected the Dolby Pro Logic responses, modified by THX re-equalization and timbre matching. Response was down 3 dB at 8.5 kHz (-6 dB at about 15 kHz) in the three front channels (THX re-equalization); surround-channel response showed signs of comb filtering and timbre matching.

The Cinema EQ curves were rather different. With this mode engaged, bass response in all three

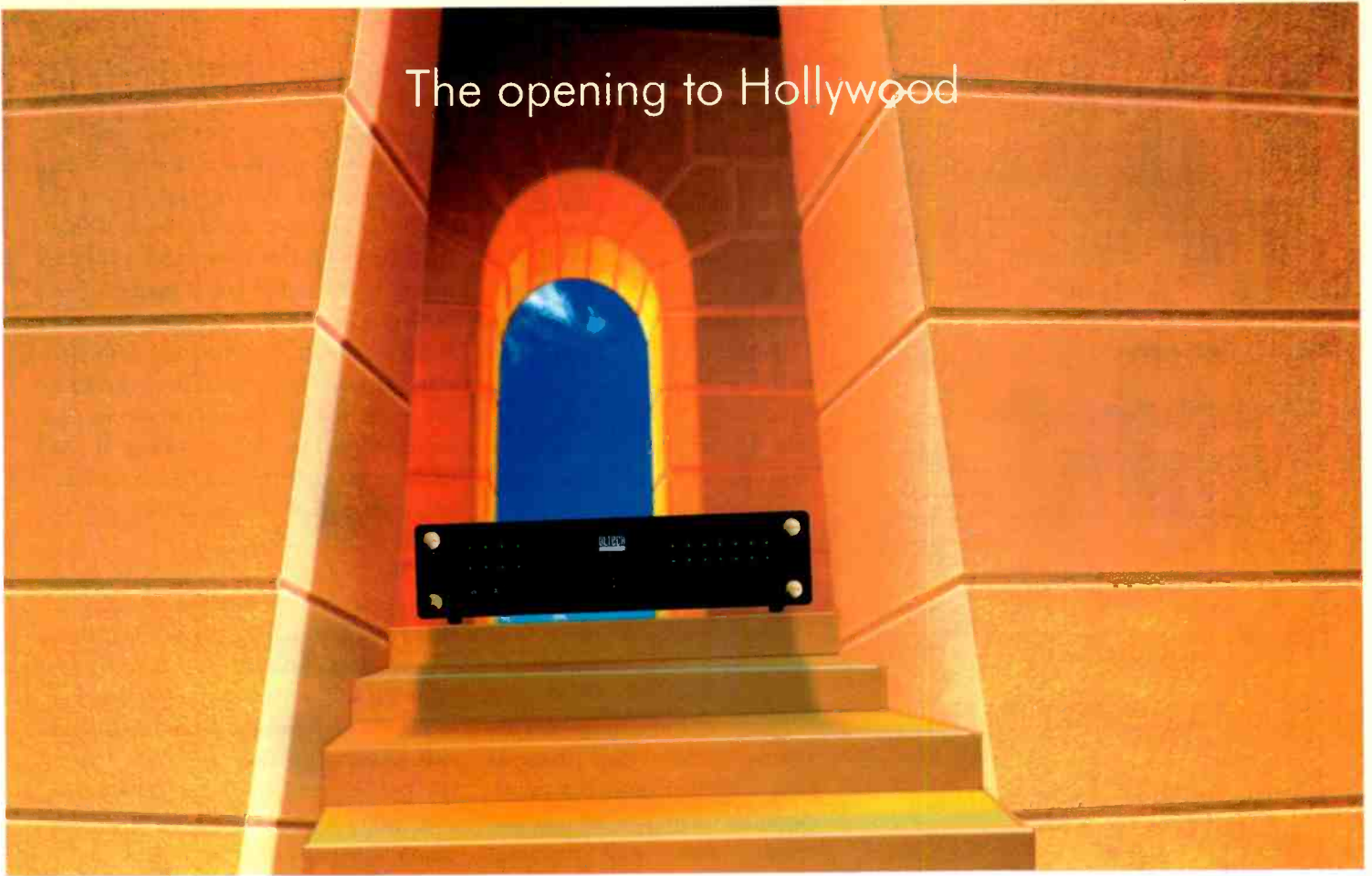
front channels rolled off sharply below 73 Hz (the -3 dB point), whether the AVR-5600 was set up for large or small center and main speakers. There was some additional mid-bass boost (about 0.76 dB at 210 Hz) and a gradual treble rolloff (-1 dB at 2.2 kHz, -3 dB at 5.8 kHz, and -4.7 dB at 20 kHz). Surround-channel response was the same as in Dolby Pro Logic mode.

Figure 9 shows THD + N versus frequency at rated output (140 watts into 8 ohms) in all five channels, using Dolby Pro Logic decoding. I used a 22-kHz low-pass filter here, to remove the ultrasonic garbage generated in the digital converters. Distortion in the three front channels remains at or below 0.04% from 100 Hz to 20 kHz. Surround-channel distortion is higher but still very good.



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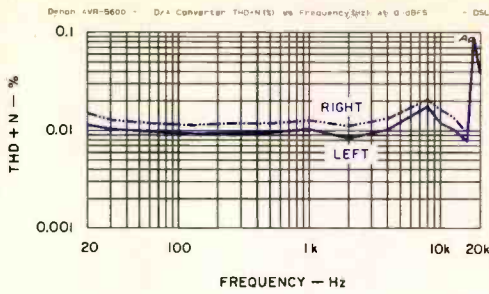


Fig. 11—THD + N vs. frequency, D/A converter section.

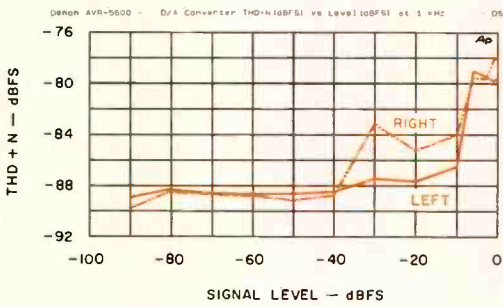


Fig. 12—THD + N vs. signal level, D/A converter section.

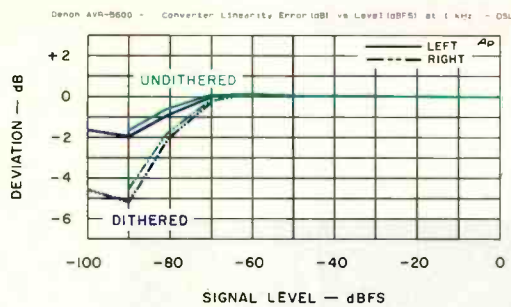


Fig. 13—Linearity error, D/A converter section.

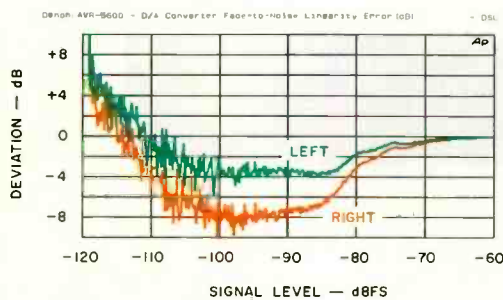


Fig. 14—Fade-to-noise test, D/A converter section.

In Dolby Pro Logic, the 1-kHz clipping point for each channel occurred at pretty much the same output level as in stereo. Steady-state channel separation at 1 kHz ranged from a low of 57.9 dB (surround to right front) to a high of almost 105 dB (surround to left front). On average, separation

was well into the 60-dB range, which is very good. The A-weighted noise was good in the main channels and fairly good in the others.

Strangely, channel separation in Dolby Pro Logic was better than in Dolby Digital. This can be somewhat misleading, however, as Pro Logic will achieve such separation only for strongly steered signals, whereas Dolby Digital will maintain it under all conditions. The worst separation in Dolby Digital was between the left front channel and the center, between the left and right front, and between the left front and right surround; each was just over 45 dB. Most of the other results were safely over 70 dB, although a few were in the 50s.

Figure 10 shows frequency response of the various channels with a Dolby Digital test signal. Again, we see the 0.57-dB mid-bass response hump in all three front channels but essentially flat response in the surrounds. Distortion at 1 kHz (0 dBFS) was a low 0.011% in the main channels and about 0.056% in the center and surrounds. Channel balance was within ± 0.75 dB.

Lately I've taken to exploring behavior of the D/A converters in products like this, since I've unearthed surprising and disquieting results from some of them. The frequency response of the AVR-5600's converter was unexceptional in the good sense; except for a slight rolloff at both ends and a treble ripple so small as to be hardly noticeable, it was flat. The curves for THD + N versus frequency (Fig. 11) are relatively unremarkable, too. Except for a peak at 16 kHz (which better converters would not produce these days), distortion is less than 0.02% on the right channel, the poorer of the two.

More worrisome characteristics appear in the curves that relate to D/A converter linearity. Those plots are for THD + N versus level at 1 kHz, linearity error versus level, and the fade-to-noise test.

The AVR-5600's THD + N at signal levels from 0 to -6 dBFS was higher than I usually see, so I had to adjust the vertical scale of Fig. 12 to accommodate it. Sometimes an audio component has elevated THD + N near 0 dBFS because of problems in its analog circuitry, but that doesn't seem to be the case here. The right-channel curve flattens between -3 and -6 dB, suggesting that converter nonlinearity, not output amplifier compression, is the cause of this behavior. I can accept the left channel's performance, more or less, but note the kickup at -30 dBFS on the right channel. These converters are simply not as linear as I would have hoped.

In Fig. 13, I again had to adjust the vertical scale to accommodate the level of error that I found. And the poorer channel's fade-to-noise curve (Fig. 14) occupies almost ± 10 dB, which is unusual. Neither channel's performance is comparable to that of today's better converters. If you check "Measured Data," you'll find that the AVR-5600's A-weighted S/N ratio, quantization noise, and dynamic range also are less than stellar; channel separation was actually worse with the digital input than with the analog CD input.

Use and Listening Tests

So what's going on? I've not seen a really bad DAC in a CD player in some time, and I had assumed I could count on basically decent DACs in processors and A/V receivers. I have felt that my time would be better spent exploring output power, high-level distortion, surround sound characteristics, and the like. But it takes six DACs to implement Dolby Digital, and I guess that's put pressure on the manufacturers to cut corners. Denon is not the only one to have done so, but I'm still surprised to find it here, especially since the company claims to use 18-bit DACs in the AVR-5600.

Could the right-channel DAC be a fluke of my particular sample? Perhaps, but the left-channel converter, while decent, isn't outstanding either. There are four more DACs in this receiver; unfortunately, they're not easily accessible for measurement. I have to assume that what I can measure is representative of what exists.

Could I hear the problems I measured? Can't say I did on Dolby Pro Logic or Dolby

Continued on page 57

Introducing The Tower™ Series By Henry Kloss.

Cambridge SoundWorks' new Tower series speakers combine musical accuracy, very natural tonal balance, precise stereo imaging and an incredibly dynamic presence – all without reinventing the laws of physics.



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Our new Tower series of speakers was designed by Audio Hall of Fame member Henry Kloss (founder of AR, KLH & Advent). They have the wide range, precise stereo imaging and natural tonal balance of our acclaimed Ensemble® series – and add improvements in efficiency, dynamic range and “presence.”

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Tower III is a two-way design using a wide-dispersion tweeter and a single 8" woofer. It combines high sensitivity and outstanding dynamic range with the natural, wide-range sound (including terrific bass) of a generously-proportioned cabinet. It has been carefully “voiced” by Henry Kloss for superb tonal balance and precise stereo imaging. These benefits come at a much lower cost than superficially similar models through a combination of Henry Kloss' design expertise, plus Cambridge SoundWorks' highly efficient direct-to-the-consumer sales policy. Tower III is the most affordable high-performance floor-standing speaker we know of.

Like other models in the series, Tower III is magnetically shielded and features removable black grilles, fully-finished cabinets (front and rear) and gold-plated binding posts. Finished in black ash vinyl. **Factory-direct price: \$599 pr.**

Tower II by Henry Kloss™

Tower II is a three-way system substantially larger than Tower III. It has two 8" woofers, a 5 1/4"

midrange, and a 1" soft-dome tweeter.

The large cone area of Tower II's drivers contributes to an effortless sound quality, giving music a strong feeling of “presence.” That presence, along with Tower II's smooth, musical octave-to-octave tonal balance and precise stereo imaging, produce what we think is the finest speaker system ever offered under \$1,000.

Tower II is finished in vinyl that simulates black ash or Vermont walnut. Bi-wire/bi-amp capable. **Factory-direct price: \$999 pr.**

“Tower II can generate the gut-wrenching bass and do justice to a first-rate music system. To top it off, the price is right!”

Stereo Review

Tower by Henry Kloss™

The flagship of the series is the three-way, bipolar Tower by Henry Kloss. Bipolar dispersion helps eliminate the “point source” effect of direct-radiator speakers, and ensures a proper stereo effect in many listening positions.

Tower features two forward-facing 8" woofers; a forward-facing 5 1/4" midrange driver; a 1" soft-dome tweeter; and separate rearward-facing midrange and tweeter units identical to those used in front.

Because it has even more cone area, Tower's feeling of “presence” is, if anything, stronger than that of Tower II. That presence, when combined with the three-dimensional sound of Tower's bipolar design, results in sound that is nothing short of incredible. Available in lacquered walnut or black ash veneers, Tower is one of the finest speakers ever offered. Bi-wire/bi-amp capable. **Factory-direct price: \$1,499 pr.**

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You can create a complete home theater sound system using CenterStage and any of our Tower speakers combined with our dipole radiator speaker, The Surround. Black or white. **Factory-direct price: \$399 pr.**

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CIRCLE NO. 8 ON READER SERVICE CARD

D. B. KEELE, JR.

BIC AMERICA VENTURI V-604 SPEAKER



If you were old enough in the mid- to late '70s to be interested in hi-fi, you probably remember BIC's heavy promotion of its Venturi speakers. These systems were based on a discovery by Italian physicist Giovanni Battista Venturi (1746-1822), who first observed that when air (or any other fluid) is forced through a constriction, its velocity increases and its pressure decreases. The Venturis' enclosures appeared to be conventional vented boxes, but their ports were strongly flared both inside and out and frequently

turned a 90° bend inside the box. The manufacturer proudly pointed out the output from the Venturi port had higher pressure and lower distortion than the output of the cone driver itself. These properties are common to most vented boxes, not just BIC's; what BIC accomplished was the design and manufacture of a well-engineered vented-box speaker with a low-turbulence vent, which was not very common in those days.

The name BIC originally stood for British Industries Corporation, an American company that imported components

from England and Japan to the United States. In the 1960s BIC handled such well-known brands as Wharfedale, Garrard, and Luxman. In the 1970s it began producing components and speakers under its own name, including the first belt-driven record changer, a two-speed cassette deck, and speakers using the patented Venturi design.

Unfortunately, the company folded in 1982. New owners revived it as BIC America in 1988, and it is doing very well as a loudspeaker manufacturer. BIC has 14 free-standing speakers in its home lineup as well as in-wall speakers and multispeaker packages for home theater. The free-standing speakers range in price from \$159 per pair for the Adatto A-1 up to \$1,200 per pair for the Reálta, a floor-standing speaker suitable for stereo and home theater.

The V-604 is the larger of two bipolar floor-standing tower speakers that have

**THE REAR-FIRING DRIVERS
ADDED AN ENVELOPING
SPACIOUSNESS
AND DEPTH.**

Venturi vents. Both are two-way designs with front and rear drivers that operate in phase with each other. The V-604 has 6-inch woofers and ¾-inch dome tweeters, one each on the front and on the rear, with the tweeters located above the woofers.

The V-604 has two ports, each 3 inches in diameter and 8½ inches long, mounted one

Rated Frequency Range: 34 Hz to 20 kHz; -6 dB at 30 Hz.

Rated Sensitivity: 90 dB at 1 meter, 2.83 V rms applied.

Rated Impedance: 6 ohms nominal, 4 ohms minimum.

Recommended Amplifier Power: 20 to 300 watts.

Dimensions: 38 in. H x 8⅞ in. W x 15 in. D (96.5 cm x 22.5 cm x 38.1 cm).

Weight: 38 lbs. (17.2 kg) each.

Price: \$699 per pair; available in oak or black.

Company Address: 458 Second Ave., Tiffin, Ohio 44883; 800/348-6492.

For literature, circle No. 91

above the other at the bottom of the rear panel. The Venturi effect is supplied by two 2¼-inch-long molded-plastic inserts that fit into the port tubes. These inserts smoothly constrict the airflow in the port by providing a bulge that reduces each port's cross-section by about one-third; they also serve as decorative bezels that improve the ports' appearance.

The enclosure's tuning can be changed by removing a foam plastic plug, half an inch thick, from the top port, which raises the tuning frequency by about one-half octave. Changing the tuning of a vented enclosure also changes its bass frequency response, power handling, and distortion. The V-604 comes with the plug in place, which makes its bass response flatter and more extended and improves the speaker's ability to reproduce pipe organ and other instruments that deliver high levels of low bass. With the plug removed, the V-604 has a slightly peaked bass response that may be preferred for music dominated by higher-frequency bass, such as pop and rock.

The V-604's enclosure is constructed of vinyl-wrapped, ¾-inch medium-density fiberboard. It is cross-braced internally with two ⅝-inch shelves (made of the same material), which divide the cabinet into three equal sections. Holes in the shelves allow the free flow of acoustic energy within the cabinet. The front of the enclosure is beveled to minimize edge diffraction. Front and rear grilles, made of foam and molded plastic, attach by pegs. Rather than lying flat

forced plastic cones, butyl-rubber surrounds, and ceramic magnets that are relatively large (3½ inches in diameter and ⅝ inch thick).

The terminal cup, at the center of the rear panel, holds a single pair of five-way binding posts on standard (¾-inch) centers; bi-wiring is not supported. The posts can accept cable up to 0.16 inch in diameter (AWG No. 8 or smaller).

The V-604's crossover is wired on a 3¼ x 2½-inch p.c. board attached to the terminal cup. The section driving the woofer is a second-order low-pass filter composed of a series inductor and capacitor to ground. The tweeter is connected to a second-order high-pass filter consisting of a series capacitor with an inductor to ground, followed by a resistor and a small inductor (0.075 mH) in series with the tweeter. That small inductance is apparently intended to reduce the tweeter's high-frequency response slightly, and the series resistor reduces its overall output level to match the woofer's sensitivity.

Measurements

The BIC V-604's frequency response, measured in a large anechoic chamber, is shown in Fig. 1. The measurements were taken at the height recommended by BIC, halfway between the woofer and tweeter.

The curve taken from the front of the V-604, even with the grille off, is not terribly smooth. Note the significant dips at 320 and 900 Hz and the rise between 4 and 16 kHz. The 320-Hz dip and the accompanying depression between 150 and 500 Hz are caused by interference between the outputs of the front and rear woofers, an effect common to bipolar speaker systems. Low frequencies from the rear drivers wrap around the cabinet to mingle with those from the front; these waves will be out of phase—and will cancel—in the range around the frequency whose wavelength is twice the path length from the front to the

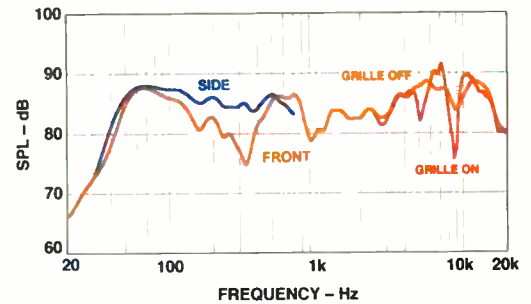


Fig. 1—On-axis frequency response.

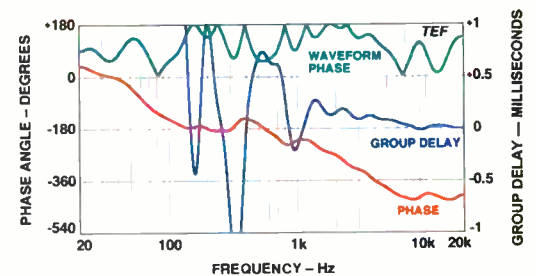


Fig. 2—On-axis phase response, group delay, and waveform phase.

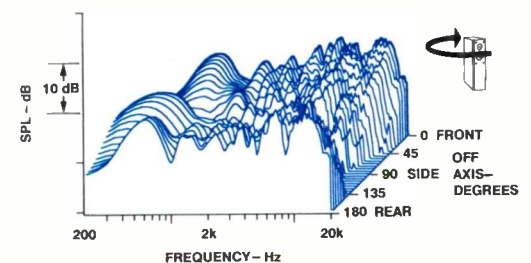


Fig. 3—Horizontal off-axis frequency responses.

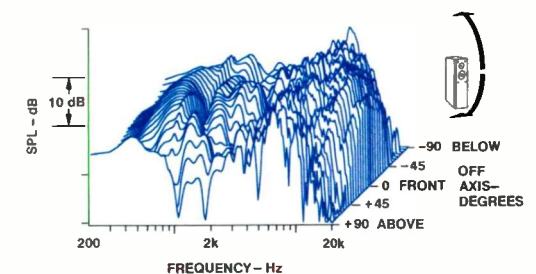


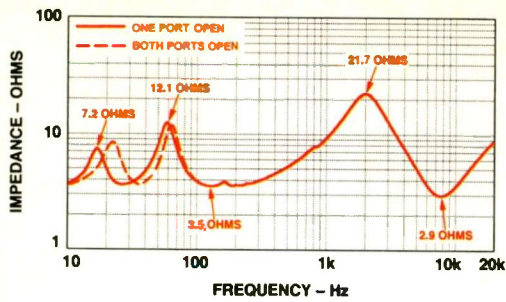
Fig. 4—Vertical off-axis frequency responses.

rear. Below that frequency the path length is a small fraction of the wavelength, and the rear output reinforces the front output. The front and rear radiation will also be out of phase at some higher frequencies, but cancellation is less of a problem above the bass range: The drivers become more directional

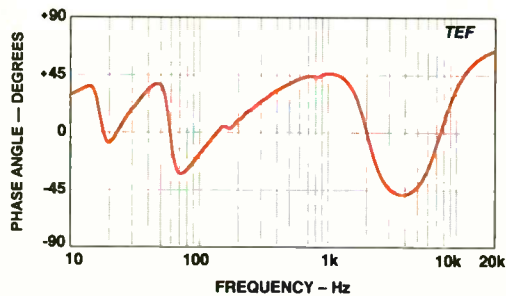
THE ABILITY TO CHANGE BASS TUNING BY UNBLOCKING OR BLOCKING ONE PORT IS VALUABLE.

against the panel, each grille rests about ¼ inch out from it. The speaker is available in either black or oak vinyl, with all four sides finished.

The V-604's tweeters are ferrofluid-cooled and have domes made from polyamide and Mylar. The domes are only ¾ inch in diameter, which improves the BIC's high-frequency coverage. The 6-inch woofers have stamped metal frames, rein-



A



B

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

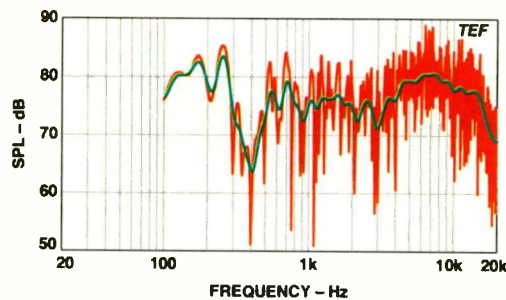


Fig. 6—Three-meter room response.

as frequency rises, and less and less of the rear output wraps around to the front.

In the response curve taken at the side of the V-604's cabinet, equidistant from the front and rear drivers and from the rear ports, the cancellation evident in the front response is completely gone. In this frequency range, the V-604 is radiating as an in-phase dipole but with its main radiation going to the sides rather than the front and rear!

The responses in Fig. 1 were taken with both of the V-604's ports open. Closing one port made little difference in response as measured from the front but made a more significant change in the side response. In each case, closing one port flattened the curve, reduced output slightly around 75 Hz, and increased output below 32 Hz.

Measured from the side (which is a more accurate reflection of what you would hear in a normal listening environment instead of my anechoic chamber), the port-closed response was flatter from 50 to about 150 Hz and about 2 dB lower at 80 Hz. The increase in deep bass output with one port closed ranged from 0.5 dB at 32 Hz to 3 dB at 20 Hz.

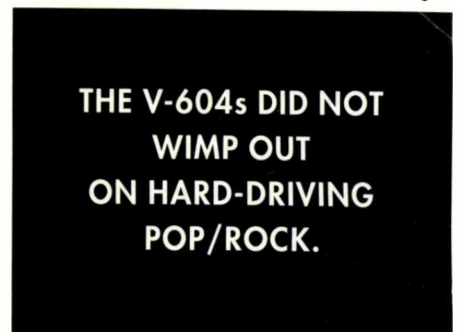
The V-604's grille causes significant response aberrations above 4 kHz: several large peaks and dips, including a particularly big dip of about 9 dB at 8.6 kHz. Averaged from 250 Hz to 4 kHz (giving equal emphasis to each third-octave frequency band), sensitivity measured 82.5 dB, significantly below BIC's 90-dB rating. The depressed response between 150 and 500 Hz and between 800 Hz and 3.5 kHz contributed to the low sensitivity reading. Even with these regions filled in, the sensitivity would rise only to 86 or 87 dB.

I had four samples of the V-604 to work with. Three of these samples matched quite closely, their responses fitting a 1-dB envelope from 200 Hz to 20 kHz. However, the fourth sample was not so well matched, at least above 9 kHz; its response was 2 dB higher than the others' at 10 kHz, 5 dB at 12.5 kHz, and 9 dB at 20 kHz.

Figure 2 shows the V-604's phase and group-delay responses, referenced to the tweeter's arrival time. The phase curve's decrease with rising frequency is not linear, as a well-behaved speaker's phase curve would be, but undulates in the range from 150 Hz to 1.5 kHz. The phase undulations correspond to the irregularities in the on-axis frequency response and would be reduced if the axial response were smoother. Between 1 and 10 kHz, the phase decreases by about 200°. When averaged from 1 to 4 kHz, the group-delay curve indicates a relatively low offset of about 0.14 millisecond, with the woofer delayed behind the tweeter. The waveform phase (actually, the absolute value of the wrapped waveform phase) undulates strongly between 0° and 180°, indicating that waveshapes won't be preserved in any

frequency range. For waveshapes to be preserved (either upright or inverted), the waveform phase must stay near 0° or 180° over significant frequency ranges, but no conventionally designed speaker achieves that.

The horizontal on- and off-axis responses of the V-604 are shown in Fig. 3. (The bold 0° curve at the rear of the graph is on-axis response; the 180° curve in the front is the response taken on the rear drivers' axis.) Even though the response is a bit rough,



the curve-to-curve uniformity demonstrates even horizontal coverage. High-frequency coverage is very good, with only minimal narrowing above 10 kHz. As you'd expect from a bipole, the rear and front responses are essentially the same, and output between 150 and 500 Hz is greater at the sides than at the front or rear (not clearly seen). At higher frequencies, however, output to the side is considerably lower because of the speaker's directivity.

The V-604's vertical on- and off-axis response is shown in Fig. 4. (The bold curve in the middle of the graph is on axis.) In the ±15° main vertical listening window, the curves are quite uniform except in the range from 1.5 to 7 kHz, which includes the 3-kHz crossover. In this range, there are broad dips at angles below the axis and a sharp, narrow dip 15° above the axis, although response through this range is quite uniform on axis and up to 10° above it. However, most details of the above-axis responses are obscured by features in the front of the graph.

Figure 5A shows the impedance magnitude of the V-604 from 10 Hz to 20 kHz, with both ports open and with one port open. The vented-box characteristic of two peaks straddling a dip is evident below 100 Hz. This dip indicates the approximate location of the vented-box tuning frequency (26 Hz with one port open and 36 Hz with both ports open). The maximum impedance is 21.7 ohms, which occurs at

2 kHz, just below crossover. The minimum is a low 2.9 ohms, at 8 kHz. A slight impedance anomaly is visible between 160 and 200 Hz.

The V-604's overall impedance variation is a moderately high 7.5 to 1 (21.7 divided by 2.9). Cable series resistance would therefore have to be limited to a maximum of about 0.039 ohm to keep cable-drop effects from causing response peaks and dips greater than 0.1 dB. For a typical run of about 10 feet, that would imply 10-gauge (or larger), low-inductance cable.

The cabinet is fairly solid: A high-level sine-wave sweep caused minimal vibration except in two frequency bands. There was significant vibration of the front, sides, and back in the band from 160 to 220 Hz, which coincides with the anomalies seen in the impedance magnitude curve (Fig. 5A). Some lesser vibrations of the sides and front occurred around 325 Hz.

The V-604's woofers overloaded quite gracefully when overdriven. Maximum excursion of the woofers was about 0.5 inch, peak to peak, and I noted no dynamic offset. Woofer excursion was, as it should be, considerably reduced at the vented-box resonant frequency, which was about 26 Hz with one port open and about 36 Hz with both ports open. There was little chuffing from the ports. I was impressed with the V-604's



Back view of BIC V-604 shows the rear-mounted woofer and tweeter, two ports (one plugged), and the terminal cup.

clean bass output in both of the port configurations.

The V-604's 3-meter room response, both raw and smoothed, is shown in Fig. 6. The speaker was in the right-hand stereo position; the test microphone was at ear height (36 inches), at the listener's position on the sofa. Between 480 Hz and 18 kHz, the averaged curve fits a fairly tight, 9-dB, window. Above 15 kHz, the averaged curve rolls off, until it's about 7 dB lower at 20 kHz than at 1 kHz. The maximum deviation is a dip of about 12 dB at 400 Hz; this coincides approximately with the bipolar cancellation region mentioned earlier and also with the region where floor-bounce cancellation causes dips in many speakers' response.

Figure 7 shows the V-604's E_1 (41.2-Hz) harmonic distortion with one port plugged. The second harmonic rises to a moderate 13.5%, while the third rises to nearly 21%; higher harmonics are below 2%. With both ports open, the E_1 distortion (not shown) was significantly lower, at only 10.8% second harmonic, 5.4% third, 1.1% fourth, and 0.9% fifth. This reduction occurs because opening the port raises the vented-box tuning point (where distortion is always low) to 36 Hz, which is closer to the 41.2-Hz test frequency. At 1 meter in free space and with a 70-watt input, the BIC V-604 generated a quite usable 102 dB SPL at 41.2 Hz.

Figure 8 shows the IM distortion versus power, created by 440-Hz (A_4) and 41.2-Hz (E_1) tones of equal power. With one port open, the distortion rises smoothly with power, reaching a significant 15% at 70 watts. With both ports open, the distortion is significantly lower, reaching only 5% at full power. On this test, the V-604 sounded significantly cleaner with both ports open.

The V-604's short-term peak power input and output are shown in Fig. 9. With one port closed, peak input power starts high, at 60 watts, then rises quickly to a plateau of 270 watts at 26 Hz. After a fall-back to 150 watts at 62 Hz, the input power rises smoothly (to 3.3 kilowatts at about

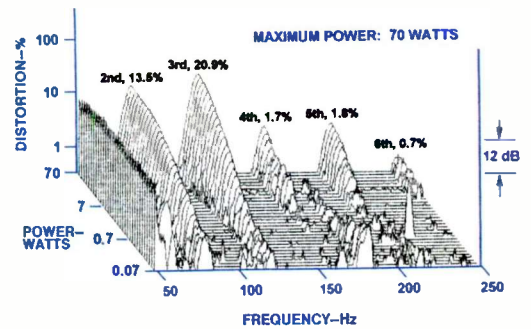


Fig. 7—Harmonic distortion for E_1 (41.2 Hz).

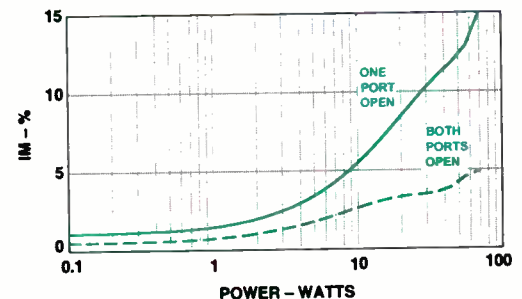


Fig. 8—IM distortion for A_4 (440 Hz) and E_1 (41.2 Hz).

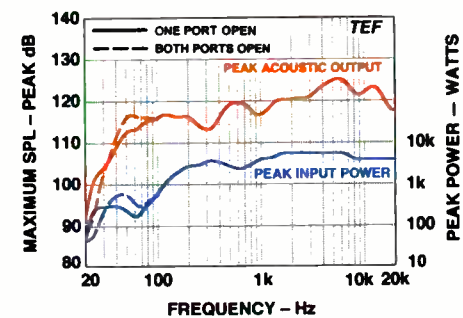


Fig. 9—Peak input power and sound output.

350 Hz), falls slightly (to 2.2 kilowatts at 600 Hz), and then rises to its maximum, 5.5 kW, between 1.6 and 6 kHz. At higher frequencies, the maximum input power drops somewhat, to about 3.5 kW. Opening both ports affects peak input power only in the bass, below 80 Hz; below 32 Hz, power handling is reduced, but it rises above that point, increasing at 50 Hz by a significant 3.3 dB, from 220 to 470 watts.

The peak acoustic output shown in Fig. 9 includes room gain. With one port open, the peak output starts strong, at 91 dB at 20 Hz, and then rises rapidly: It passes 100 dB at 24 Hz and 110 dB at 44 Hz, reaching a peak of 116 dB at 125 Hz. After a hesitation at 300 Hz, the peak output rises into the high range of 118 to 125 dB SPL. With both

ports open, the maximum output drops dramatically below 33 Hz and increases correspondingly above that frequency, reaching a gain of nearly 5 dB at 55 Hz. The bass output of the V-604 is solidly in the middle range of all the speakers I have tested for *Audio*.

The ability to change the V-604's tuning by blocking and unblocking one port is a valuable feature. With one port closed, the V-604 is better able to reproduce program material with high-level bass below 32 Hz. With both ports open, the system is optimized to play material with higher-frequency bass energy, such as movie sound effects and pop/rock.

Use and Listening Tests

Compared to some large and heavy floor-standing systems I have reviewed recently, the BIC V-604s were a welcome relief. At only 38 pounds each, they are quite easy to lift, move around, and set up. My review speakers were finished in oak vinyl and looked quite good. The beveled front edges of the cabinet and the floating black grille add a distinctive look.

Small push-in spikes are supplied; I listened with the spikes in place and without them. When I put the V-604s on my listening room's thick carpet without using the spikes, the speakers were somewhat unstable laterally and would not quite stand upright. With the spikes piercing the carpet to make solid contact with the floor, these problems disappeared.

The Venturi tower owner's manual, though short, is filled with useful information on the spikes, hookup and cabling, power handling, listening room acoustics and construction, and listener and speaker positioning. I listened with the V-604s placed 2½ feet from the side walls and 4 feet from the wall behind them, within BIC's recommendations. My room's front wall is mostly hard-surfaced and reflective, quite well suited for listening to bipolar systems. I listened from a sofa about 8 feet away, mostly with the grilles removed from the speakers. For comparisons, I used a pair of B&W 801 Matrix Series 3 speakers; for A/B comparisons, I had to attenuate the V-604s by 1 or 2 dB to match their level to the 801s'. My other equipment included a Krell KRC preamp and KSA-250 power amp and Straight Wire Maestro cabling.

My initial listening to the V-604s revealed a bright and dynamic sound, an open and spacious soundstage, and extended, powerful bass. The first CD I listened to was a very clean Dorian Discovery disc of medieval chamber music with vocals, *Saint Francis and the Minstrels of God* (DIS-80143). The V-604s reproduced this disc very well, offering a clean, open, and spacious presentation but with a significantly brighter high end than the B&Ws. This brightness emphasized vocal sibilants and higher instrument harmonics but made the B&Ws' slightly rolled-off treble sound somewhat dull by comparison. The BICs' elevated high-frequency response was a plus on

**THE V-604 IS ONE
OF THE FEW SPEAKERS
WITH USABLE RESPONSE
IN THE 20-Hz BAND.**

most tracks of this CD. The Romanesque harp solo on track 3 was rendered quite strikingly and with much presence, and each individual string pluck sounded quite distinct.

On more lively classical orchestral material, such as *Telemann for Trumpet* (Dorian Discovery DIS-80132), the V-604s re-created the trumpet sound with clarity, cleanliness, good air, and presence. The rear-firing drivers helped significantly here by adding an enveloping spaciousness to orchestral passages and hall reverberance that was not present with the B&Ws. Instrument placement and soundstaging were quite accurate but had an added depth that I found quite pleasing. Overall, the BIC speakers made the music sound more distant, while the B&Ws were more up-front and dry-sounding. I also noticed tonal differences between the V-604s and the 801s that changed the effective stage depth of certain instruments.

On pink noise, the V-604s' response definitely tilted more toward the high mids and treble than the B&Ws', sounded less smooth through the midrange, and exhibited moderate tonality. (Any tonality in pink noise indicates that some frequency bands are being favored over others; a truly flat,

smooth speaker would exhibit no tonality.) When I stood up during the pink-noise tests, I heard low to moderate midrange tonal changes from the V-604s, mainly a roughening of the response, but it was restricted to the upper midrange.

With the supplied foam plug blocking one port, the V-604 delivered usable response in the lowest, 20-Hz, third-octave pink-noise band; few of the speakers I have tested can manage this. In the higher bass bands, the V-604's output was quite robust, competing well with the B&Ws'. At the lowest frequencies, the V-604s produced significantly less port air-turbulence noise than the B&Ws when both systems were playing at the same level. The V-604's woofers overloaded gracefully when overdriven. With the port plug removed, the BIC had no usable output at 20 Hz, some usable output at 25 Hz, and plenty of clean output at all higher bass frequencies. In the 40-, 50-, and 63-Hz bands, it could play noticeably louder than it could with the port plugged.

The V-604s did not wimp out with hard-driving pop/rock recordings. They played loud and clean, with a level of bass befitting a larger system. It was only on heavy metal rock, played at near-concert levels, that the V-604s compressed, rendering the kick drum without the wallop and gut-thump of the B&Ws. Removing the port plugs helped the V-604s compete better with the B&Ws on this music.

On classical recordings with high levels of low bass, such as pipe organ pedal notes, the V-604s performed very well, occasionally rattling knickknacks on the wall. On this music, the speakers performed better with the port plugs in.

One very positive trait of the V-604s is not evident unless you get up and walk around while listening. As you approach and walk between the BICs, their overall sound and high-frequency output changes very little. This is a characteristic of all bipolar systems that have a set of wide-range drivers on the rear of the cabinet as well as on the front.

In summary, the BIC V-604s performed very well in most of my measurements and listening tests. At only \$699 per pair, they are solid entry-level speakers for a listener who wants to go bipolar. The V-604s' extended bass response and good looks add to their appeal and value. **A**

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DANIEL KUMIN

CALIFORNIA AUDIO LABS CL-5 CD CHANGER



For many serious audiophiles, the term “high-end CD changer” might as well take its place alongside “British cuisine,” “political integrity,” and “teetotaling audio writer” in the pantheon of timeless oxymorons. However, the

popularity of multi-CD playback is such that even esoteric hi-fi manufacturers are starting to combine audiophile-oriented technologies with the inarguable convenience of CD changer mechanisms.

California Audio Labs, one of the first American companies to produce its own high-end CD models (nearly a decade ago), now has become one of the first to offer premium multidisc playback. The firm’s

\$1,195 CL-5 Multidisc Server, despite its high-falutin’ name, is a classic five-disc carousel. Over the past decade, this compact layout has proven the most popular multidisc format by far, thanks to its combination of a single-disc player’s load ’n’ play convenience and a changer’s ability to play for hours.

The CL-5 is constructed along generally standard five-disc lines, with a full-width, motor-driven tray that extends (in response to a command from either the supplied remote control or the front panel) to reveal five wells set into a plastic rotary tray. Each well is ridged to locate a standard CD, with a concentric indentation to center a 3-inch CD,

**CALIFORNIA AUDIO LABS
IS AMONG
THE FIRST TO OFFER
A PREMIUM
MULTIDISC PLAYER.**

in case you still have a few that aren’t being used as coasters.

The front panel carries the fundamental transport controls (including five disc-select keys and “Disc Skip”), the on/off switch, and a button to open and close the disc drawer. It also carries some less essential controls, for random and repeat play and to turn off the LCD screen’s backlighting. You’ll have to hunt up the remote for the track-change and two-speed “Search” buttons, the programming controls (which include a 10-key pad), and a few less common functions that I’ll describe later.

The remote’s layout inspired mixed reviews from my fingers. For starters, its 32 keys are rather closely packed, and their small, gray-on-gray lettering is ridiculously hard to read, even in moderate light—forget about a darkened room. On the upside, its buttons are of four different shapes, grouped against backgrounds of different colors and, for the most part, grouped logically. The location of the track-skip and search keys, segregated as far as they could be from the other transport keys (which are in the top rows), struck me as illogical and quite awkward.

When opened, the CL-5’s disc tray extends only about halfway, uncovering two adjacent cutouts for loading or unloading. A two-speed motorized mechanism slows the drawer down as it approaches its fully open or closed position—pretty slick. However, key-press is always required to close the drawer: The CL-5 does not whirl into action when you nudge its tray, as most CD players do; I rather missed that, because it frees you from having to hunt up the open/close button twice. While the drawer is opened, keying “Disc Skip” from either the remote or the front panel rotates the carousel by two discs for loading or swapping multiple discs.

As with many carousel changers, you can load or exchange as many as four CDs while a fifth continues playing. (A U-shaped slot

Dimensions: 17 in. W x 5 in. H x 15¼ in. D (43.2 cm x 12.7 cm x 38.7 cm).

Weight: 18 lbs. (8.2 kg).

Price: \$1,195.

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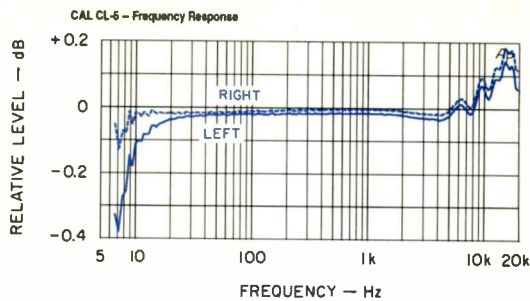


Fig. 1—Frequency response.

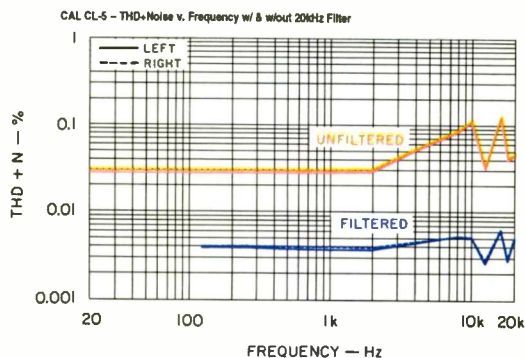


Fig. 2—THD + N vs. frequency.

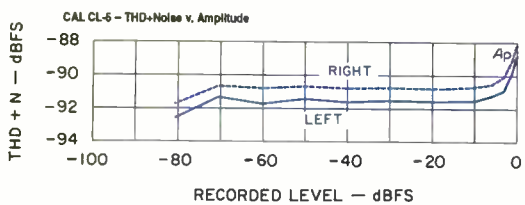


Fig. 3—THD + N vs. level.

in each disc well lets the tray withdraw from the mechanical-clamping drive spindle, which slightly lifts the disc that is playing. An ovoid icon on the salmon-colored display indicates which disc wells are filled and which disc is playing. Whenever the drawer is closed, the carousel spins once to check which discs are present; this speeds up the CL-5's response to "Disc Skip" or "Random" commands, by enabling it to pass directly over the vacant slots without pausing. Disc-skip cycles required from about 7 to about 11 seconds, depending on pickup position—about average, in my experience of carousel changers. (We reviewers tend to make a fuss about a few seconds one way or the other, but I suspect that such differences don't loom very large in real life.)

You can program the CL-5 to play up to 32 tracks from all discs loaded into it. Even more useful, in my book, this changer has

delete programming, enabling you to program out the tracks you'd rather skip. You can also select random play, track by track on any or all discs.

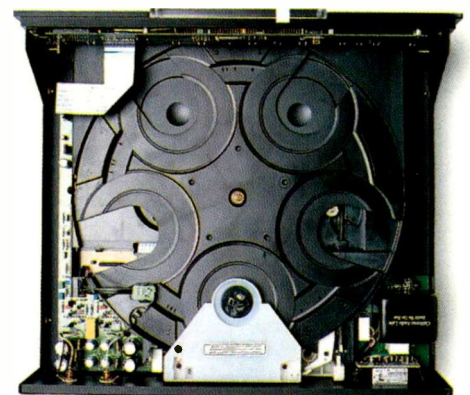
And then there's "Spin": Invoke this, and the CL-5 plays each loaded disc's first track in sequence, then each CD's second track, then each disc's third track, and so on, until it reaches the end of the disc that has the most tracks. I've racked my brain unsuccessfully for a scenario in which I would want to do this; "Spin" gets my vote for the year's silliest feature. (Where do these things come from? I imagine engineers sitting around the lab: "Dammit, Gumby! That microprocessor's got three more memory registers. If we don't use them for *something*, we're not getting our money's worth!")

Rather more utilitarian is "Scan," which helps you find the track you want by playing the first dynamic peak of each track, skipping over long silences or less recognizable low-volume intros. And if you tape from your CDs, you should love "Auto Cue"; it automatically searches for a track's first actual sonic event (which can occur a few seconds past the track ID) and then pauses, ready for nearly instant play. The "Time" button lets you select display of elapsed or remaining time on the current disc or track.

California Audio Labs assembles the changer on a much heavier steel sheet-metal pan than mass-market designs use, with a similarly heavy-gauge top cover. The thick aluminum front panel is handsomely machined, with a matching, sculpted piece forming the front of the disc drawer. Otherwise, however, mechanical construction appears quite conventional. The plastic disc-changing and transport assembly, sourced from Matsushita to California Audio Labs' specs, is solidly screwed to the pan, as are two compact p.c. boards of high-quality fiberglass. The power supply sits at the left rear. To the right is the main circuit board; this compact board carries all the D/A and analog audio goodies as well as the power supply's regulators and filter capacitors.

The CL-5's D/A converter section is a 1-bit MASH type, again from Matsushita, which runs at 32 times the sampling frequency (about 1.4 MHz). The player's analog output stages are clearly custom designed, however, and are assembled of high-quality, high-precision discrete components. (California Audio Labs says that the CL-5 does contain two op-amp pairs but only in the servo circuit that limits output DC.)

Around back are a pair of heavy-duty, gold-plated, all-metal, panel-mount output phono jacks and a removable IEC power cord—period. There is no digital output whatsoever, which I find strange on a \$1,200 player. (There's no headphone jack, either.) This is perhaps explained by the fact that California Audio Labs also offers a costlier five-disc changer, the CL-10 (\$1,795), which includes these amenities as well as an RS-232 serial port for software



THE CL-5'S CONSTRUCTION IS MUCH STURDIER THAN THAT OF MASS-MARKET DESIGNS.

updates and computer control; the company will upgrade a CL-5 to a CL-10 at any time for the retail price difference.

Measurements

The California Audio Labs CL-5 measured quite well and in general matched its manufacturer's specs quite closely. For the tests involving low-signal levels, such as the distortion and noise checks, I had to insert a 20-kHz brick-wall filter into the test loop

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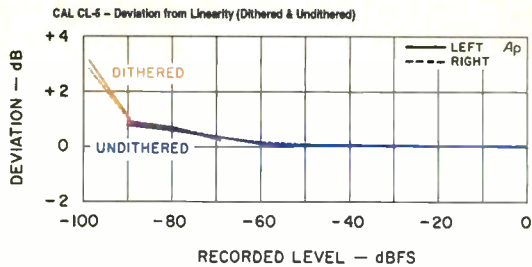


Fig. 4—Deviation from linearity.

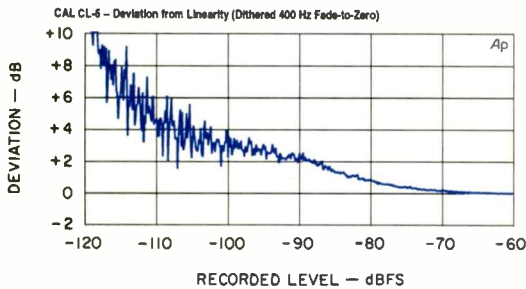


Fig. 5—Fade-to-noise test.

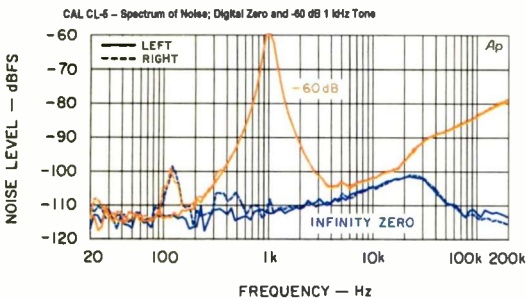


Fig. 6—Noise spectra.

because the CL-5's MASH 1-bit D/A converter generated relatively high levels of ultrasonic noise. This is entirely typical of today's high-speed, low-bit converters—whether MASH, Bitstream (Philips), or other types. As long as the audio system downstream is linear at several hundred kilohertz, there is little, if any, chance of audible impact.

Figure 1 shows the CL-5's frequency response at 0 dBFS.

(Note the *greatly* expanded vertical scale.) The CL-5 is perfectly flat through 10 kHz, where analog filter ripple begins to cause some very minor errors that are probably inaudible. Channel balance is dead-solid-

CHANNEL BALANCE WAS DEAD PERFECT, WHICH I SUSPECT IMPROVES IMAGING.

analog stages is negligible, as THD + N rises only very slightly at 0 dBFS.

Figure 4 illustrates digital-to-analog linearity with low signal levels: From 0 to -80 dBFS, the test signal is an undithered 1-kHz tone; overlying this from -70 to -100 dBFS is a curve for a dithered tone. Accuracy is very good to -90 dBFS, and error at -100 dBFS is only about +3 dB, still quite respectable; I've found such performance common in 1-bit systems. Figure 5 takes another slant on linearity: the classic fade-to-noise test, where a 500-Hz dithered tone ramps down in level from -60 dBFS to infinity zero. (Only the left channel's be-

havior is shown, as the right's was essentially identical.) For the recorded levels covered by both Figs. 4 and 5, we see pretty much the same error; below -110 dBFS, deviation from linearity rises rapidly. (I've noticed that 1-bit converters typically deviate only upward, perhaps an effect of their high ultrasonic noise.) This is respectable performance in an area whose sonic significance audiophiles still debate, but I have seen clearly superior linearity from several other \$1,000 CD changers and players.

Residual-noise spectra are presented in Fig. 6. When the CL-5 plays an infinity-zero track, its D/A converter apparently turns off, which is the case for most CD players. The noise spectrum made while the CL-5

Output level was precisely 2 volts, and output impedance was very low (about 60 ohms), which should help keep interconnect cables from becoming an audible variable. Channel separation was about 80 dB in either direction up to 10 kHz, falling to about 65 dB at 20 kHz.

In Fig. 2 I've plotted total harmonic distortion plus noise (THD + N) versus frequency at 0 dBFS, with and without the brick-wall filter in the circuit. Without the filter, THD + N goes up by more than an order of magnitude, making the noise contribution of the MASH system's noise shaping clearly evident. But because the shapes of the two curves are virtually identical, we can infer that actual distortion is very low indeed—in effect, below 0.005% throughout—and that the player's analog filters and output stages are all clean, fast, and wideband.

Figure 3 shows distortion another way, as output THD + N versus level at 1 kHz. Over most of the range, the distortion and (mostly) noise are suppressed by approximately -92 dB. And here, too, we see that the THD from the CL-5's

analog stages is negligible, as THD + N rises only very slightly at 0 dBFS.

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MEASURED DATA

Line Output Voltage from 0-dBFS Track (1 kHz): 2.04 V.
Line Output Impedance: 60 ohms.
Channel Balance: 0.01 dB.
Frequency Response, 20 Hz to 20 kHz: Left channel, +0.2, -0 dB; right channel, ±0.1 dB.
THD + N at 0 dBFS: Less than 0.006%, 20 Hz to 20 kHz, and 0.004% at 1 kHz; see text.
Deviation from Linearity: With undithered signal, +0.9 dB at -90 dBFS; with dithered signal, +3 dB at -100 dBFS.
S/N, A-Weighted: Left channel, 96.2 dB; right channel, 95.8 dB.
Quantization Noise: Left channel, -91.9 dBFS; right channel, -90.9 dBFS.
Dynamic Range, A-Weighted: Left channel, 94.7 dB; right channel, 94.5 dB.
Channel Separation: Greater than 80 dB, 125 Hz to 10 kHz.

reproduced an undithered, -60 dBFS, 1-kHz tone reveals nothing that could reliably be called a harmonic. It does, however, indicate noise from 10 kHz on up, a classic result of noise shaping; this noise probably peaks at around -60 dB, up in the megahertz region. The blip at 120 Hz is the only notable power-line factor and, at -100 dBFS, is hardly worth concern. Since the blip appears at both signal levels and only in the right channel, I presume it's caused by a minor grounding problem. The CL-5's

A-weighted S/N was about 96 dB; along with the spectral analyses, this is quite good performance but not quite the best I've seen for players in this price range.

The CL-5's defect-tracking ability was outstanding; the player handled defects up to 1.55 mm long (on Pierre Verany test CD



**THE CL-5 SOUNDED
NEUTRAL, AIRY,
TRANSPARENT, QUICK,
AND WELL ETCHED.**

PV.788031/32) without hanging or producing audible clicks. Impact immunity in the highly scientific, thump-on-the-chassis test was superb when I thumped horizontally; I had to bruise my knuckles (anything for the sake of science) to induce a skip. Vertical immunity was almost as good, though recovery from severe skips was somewhat slower than average.

Use and Listening Tests

The California Audio Labs CL-5's operation was entirely straightforward, and the changer proved smooth, quiet, and reliable except in fast-search mode. When I held down either "Search" button for more than 4 seconds or so, the search increased to roughly 60 times normal playing speed. A couple of times, however, after a second or two of high-speed searching, the CL-5 leapt ahead one or more tracks, unbidden. On the other hand, this happened on only two discs; since I don't recall trying these discs on other players with two-speed search, I can't be sure whether the problem lay in the CL-5, the discs, or both.

I auditioned the CL-5 through a Citation 7 preamp (in its two-channel stereo mode), a Parasound HCA-2003 power amp, and B&W 803 Matrix Series 2 loudspeakers; I also did considerable near-field listening at my studio console through a small tube

amp and NHT SuperOne speakers. What I heard was generally unremarkable, in the very best sense of the term. The CL-5 had a very neutral tonal balance, yet it was always quite airy and transparent. The sound had a quick, well-etched feel on complex, energetic musical textures.

Transients had lots of bite and sparkle, but sounds rarely if ever seemed harsher or hotter than they should have. In fact, the CL-5 was smooth: Massed strings were attractively warm yet open and defined, with lots of timbral detail but little harshness or screech. A favorite CD of Tchaikovsky's First Symphony (Sony Classical SK 48056) showed this off to great effect, especially in the second movement.

Solo piano also reproduced very nicely. A CD of Handel keyboard suites played by jazzman Keith Jarrett (ECM New Series 1530, a very pristine recording, wherever you stand on its musical values) sounded extremely clear and ambient. Long decays were not absolutely free of grain or "extra texture" (as has been my experience of virtually all CD players except for a bare handful that mostly cost far more than the CL-5), but they were very nearly so. The balance of detail and warmth seemed strongest on pop/rock recordings. Janis Ian's *Breaking Silence* (Morgan Creek 2959-20023), an old standby for its superb detail and effective dynamics, sounded terrific from beginning to end. The transparency was excellent, as was the agility on hand percussion and acoustic guitars, and there was a lovely ambient space to the sound.

In short, California Audio Labs' CL-5 sounded very fine and more than competitive with many another player or changer in its price range. This is, of course, a subjective judgment. But I stick by it despite the CL-5's generally ordinary (yet still fairly impressive) performance on the test bench, which I checked only after I'd nearly finished my listening. This could prove the importance of subjective observation—or only the power of suggestion, since I obviously knew the CL-5 was high-end and expensive from the start. Either way, this is a very well-made, good-performing, fine-sounding changer. Weighting its ratio of price to performance will be an individual matter, best left to equal parts rationale, listening, and "feel." A

DENON, continued from page 44

Digital movie soundtracks, but I could hear something amiss on well-recorded stereo. I preferred the sound of the DAC in my Sony CDP-XA7ES player to the sound of the DAC in the Denon. Okay, so the Sony's converter is extraordinary, and the player alone costs a bit more than the AVR-5600. But I also preferred the MASH converter in my old Sansui CD-X711 to the Denon's DAC.

Movies fared much better than CDs; maybe I become less critical with so much going on. Yet I didn't feel that the AVR-5600 provided quite the same bass impact as my reference audio system when I listened through the same speakers and subwoofer. I can't make quick and direct A/B comparisons in my home theater (nor can one match



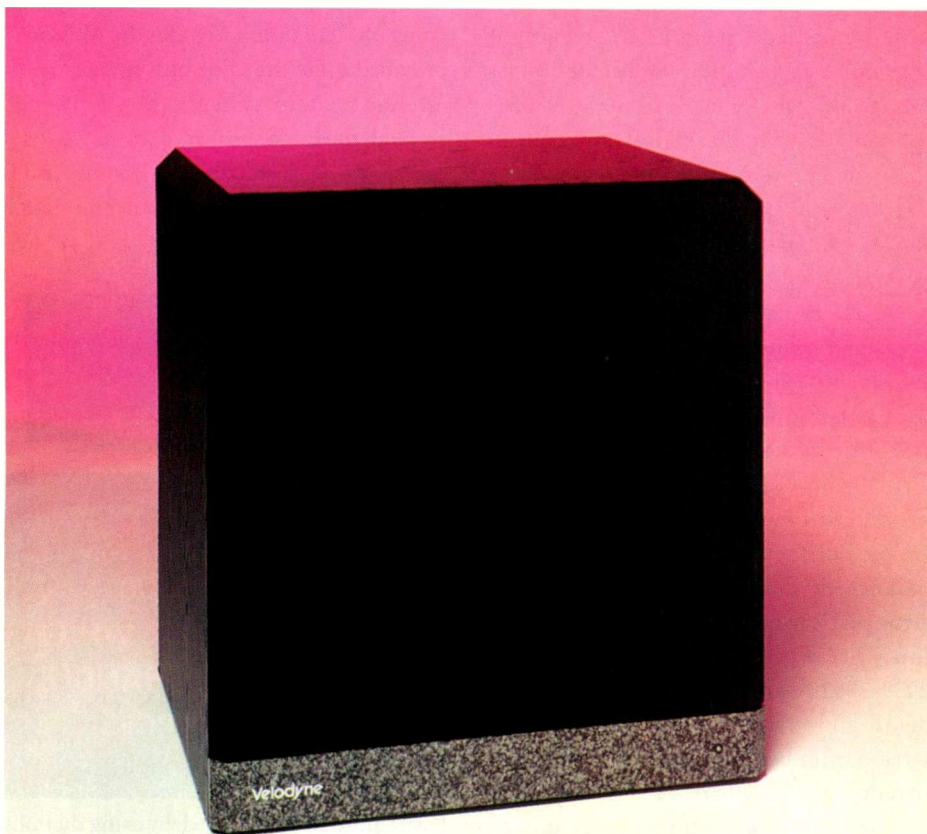
**IN A NOVEL TWIST,
THE AVR-5600
LETS YOU CHOOSE WHICH
DIGITAL INPUTS HANDLE
WHICH SOURCES.**

levels quite so precisely when using digitally adjusted attenuators), so I'm less sure of my conclusions—but that's how I felt.

As I said at the beginning of this review, the Denon AVR-5600 fulfills my wish list of features better than other receivers I've seen. A more robust and generally capable A/V receiver would be hard to come by. It could use a better manual (Denon tells me one's in the works), and it could also use a few modifications to improve the converters and remove a few operational oddities (limited bass response in some channels under some conditions, swaybacked response, etc). Some of these may require only software modifications (so much is done in software these days!); others may require component changes. I hope Denon will make them, because the AVR-5600, which is already a very good receiver, has the potential to be a really great one. A

EDWARD J. FOSTER

VELODYNE F-1800RII POWERED SUBWOOFER



It's impossible to think about buying a subwoofer without considering Velodyne. (Okay, so it's not impossible, just pretty dumb.) Among the cognoscenti, Velodyne *means* subwoofer. And the company got that reputation precisely by designing and manufacturing subwoofers like the F-1800RII.

The F-1800RII is a servo-controlled, 18-inch powered subwoofer of mammoth capability. Like other subs in Velodyne's F series, it is built around the company's patented High Gain Servo System, which "measures cone movement 3,500 times a second to correct for distortion-creating errors and deliver clean, precise sound." Presumably, the rate at which cone movement

is measured refers to the switching (sampling) rate of the built-in Class-D power amplifier. (This amp is rated at 600 watts continuous and 1,000 watts peak.)

As you may know, the output devices of Class-D amplifiers operate as on/off switches. This mode of operation results in extremely high efficiency (theoretically approaching 100%) because the output transistors are always either saturated or non-conducting; therefore, they dissipate negligible power except at the instant of switching.

Undoubtedly, Class-D operation would be used far more widely in audio than it is except for one nasty little gremlin: For good sound quality, the switching frequency

must be many times higher than the maximum frequency to be amplified—at least 10 times higher, and preferably more. That can present problems for wideband, high-quality audio applications. It's hard to get power transistors to switch that fast, and when they do, a greater percentage of their time is spent switching (which is when they consume power) and generating high-frequency garbage from switching transients. However, switching speed is not a problem for a subwoofer amp, which need handle only the deep bass. Thus, Velodyne's choice of this amplifier topology for the behemoth F-1800RII was a wise one.

I'm not exaggerating when I call the F-1800RII a behemoth. Although it's relatively small for an 18-inch powered subwoofer, it weighs 100 pounds. In part, this is attributable to its monster driver, which uses a 13-pound magnet in a 23¾-pound magnet structure. Much of the rest is due to the cabinet: It takes a mighty rigid box to contain the back-wave of this titanic driver, especially since the F-1800RII's cabinet is sealed.

I suspect that Velodyne chose a sealed enclosure over a vented one to facilitate application of its servo-control technology. In an ideal sealed system, the driver cone is the only source of sound; there's no vent or passive radiator to worry about. In theory, by measuring cone position and using feedback to servo-control it, the servo can generate an acoustic output that exactly matches the input signal—i.e., produce a system that has flat frequency response and generates zero distortion.

Since it's difficult to measure cone position directly, Velodyne attaches a low-mass accelerometer to the voice coil and (presumably) double-integrates its output to yield a signal proportional to cone position.

Rated Frequency Response: 15 to 120 Hz, ± 3 dB.

Dimensions: 21¼ in. W x 23½ in. H x 18½ in. D (54 cm x 59.7 cm x 46.7 cm).

Weight: 100 lbs. (45.4 kg) each.

Price: \$1,999 each.

Company Address: 1070 Commercial St., Suite 101, San Jose, Cal. 95112; 408/436-7270.

For literature, circle No. 93

This signal is then compared with the input, and the difference between the two is fed to the power amplifier and used to “servo” the cone into the proper position. In the case of the F-1800RII, the result is a subwoofer whose frequency response is said to be within ± 3 dB from 15 to 120 Hz and whose distortion usually remains under 1%.

Although the servo is said “to improve linearity and reduce distortion approximately 30 times over conventional, non-servo systems,” partial credit for the F-1800RII’s performance also goes to its driver’s unusual voice coil. Two coils are wound on the driver’s 3-inch former, and each coil is placed in a separate magnetic gap. The coils operate in push-pull (that is, they’re wired out of phase) and provide a linear displacement of $1\frac{1}{8}$ inches. As a result, according to Velodyne, the motor system’s distortion products “are reduced by a factor of two over conventional single-coil structures.”

Like most powered subwoofers, the F-1800RII can be driven by line- or speaker-level signals. RCA jacks serve as input and

VELODYNE'S F-1800RII IS A SERVO-CONTROLLED POWERED SUBWOOFER OF MAMMOTH CAPABILITY.

output connectors for unbalanced line-level signals, while XLR jacks are used for balanced line-level inputs. (Balanced outputs are not provided.) Multiway binding posts (which, unfortunately, do not accommodate banana plugs) serve as inputs and outputs for speaker-level signals.

A switch enables you to set the F-1800RII’s nominal high-pass crossover point at 80 or 100 Hz. The high-pass crossover is said to work on both the line- and speaker-level connections; with the speaker connections, the actual crossover point will depend on the impedance of the speaker you use and its reactive characteristics in the crossover region. If you wish, the low-pass section can be bypassed for use with an external crossover. When in use, the filter’s low-pass crossover frequency is continu-

ously adjustable from 40 to 120 Hz. Velodyne says the low-pass crossover has a 12-dB/octave initial slope and ultimately achieves a 48-dB/octave slope. Presumably, the six additional filter sections needed to go from 12 to 48 dB/octave are always in the circuit, to prevent aliasing in the Class-D amplifier even when the crossover filter is switched out.

Controls are, as usual, on the rear panel. One switch enables you to reverse the subwoofer’s polarity, should this provide a smoother transition between the F-1800RII and your main speakers. There’s also an infrasonic filter that can be switched to roll off response below 15 Hz for recordings with content that far down or below 35 Hz for rock and movies. (The 35-Hz cutoff is also a Home THX requirement to correct for low-frequency room gain.) A remote with power, volume, and muting controls comes with the F-1800RII; it was not available for my evaluation, but the volume control on the back panel offers continuous control of sensitivity and served my needs just fine. A jack is provided to connect an auxiliary infrared remote receiver if the F-1800RII is placed where its own “eye” can’t pick up the control beam.

A toggle switch (“Auto/On”) determines whether the F-1800RII turns itself on and off in response to input signals (“Auto”) or remains on so that it can respond to the remote control. A rear-panel rocker switch can be used to power down the amplifier completely if it’s not going to be used for an extended period. The amp connects to the wall socket with a detachable IEC line cord.

The F-1800RII has compression circuitry that is said to keep the amplifier from clipping or the cone from exceeding its 2-inch maximum displacement. Other circuitry protects against amplifier overheating and low line voltage. Although the F-1800RII is magnetically shielded for video use, Velodyne warns that the shielding may not be adequate for “certain extremely sensitive installations.”

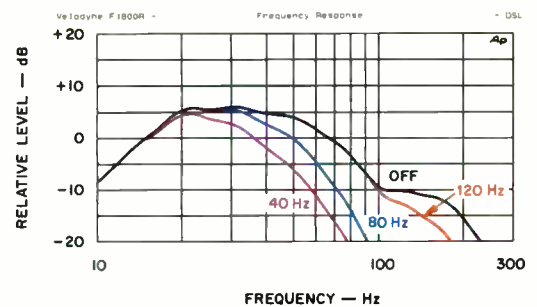


Fig. 1—Frequency response.

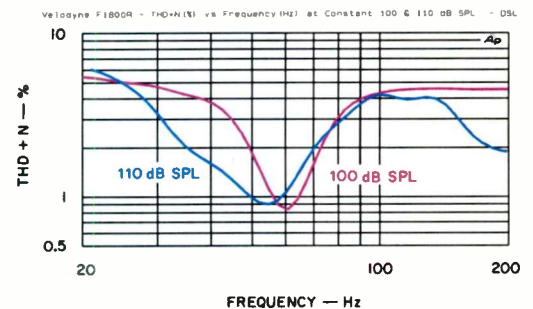


Fig. 2—THD + N vs. frequency.

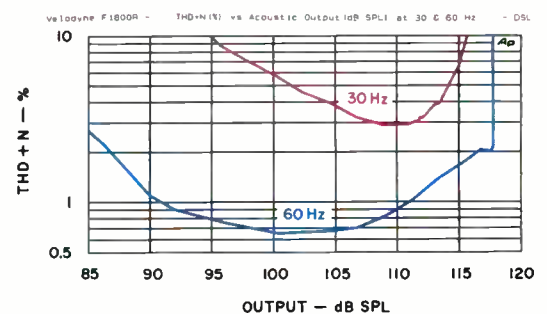


Fig. 3—THD + N vs. output level.

Measurements

To test the Velodyne F-1800RII, I placed it on the floor, a few inches away from a wall. A microphone was 1 meter in front of the cabinet, and I removed the subwoofer’s grille to give the cone free motion. At the acoustic wavelengths involved, I was pretty much measuring the F-1800RII in the near field, under quarter-space free-field conditions (i.e., with no opposing walls that could create standing waves).

Frequency response is shown in Fig. 1; note that the frequency scale starts at 10 Hz, not 20 Hz! I measured response with the F-1800RII’s low-pass crossover at its highest (120-Hz), middle (80-Hz), and lowest (40-Hz) settings and also with it switched out. The curve taken with the filter off reveals

this subwoofer's full capability; in the other curves, the low-pass filter's effect is overlaid on the basic response. Except above 100 Hz, there's no difference between response with the filter off and with it set to 120 Hz.

I'm frankly astounded by these results. Never have I seen such flat or such extended bass response in any speaker—subwoofer or not—and I've been at this game longer than I care to admit! With the low-pass crossover off (or set to 120 Hz), the response is within ± 6 dB from 11.2(!) to 88 Hz and within an incredible ± 1 dB from 18 to 50 Hz. The sub's high-frequency extension (defined as the -6 dB end of the ± 6 dB range) varies from 49 to 87 Hz, depending on the crossover setting.

Figure 2 shows total harmonic distortion plus noise (THD + N) versus frequency with the subwoofer's input level adjusted to maintain constant sound pressure level at the test microphone. Both at 100 and 110 dB SPL, distortion is lowest at about 60 Hz; I therefore suspect that's approximately the frequency of the Velodyne's acoustic resonance. Even so, response extends for several octaves below resonance (as you can see in Fig. 1, response at 60 Hz is actually a few dB down), presumably because the servo system drives the subwoofer harder and harder as frequency decreases.

My presumption is further supported by the distortion curve taken at 110 dB SPL, which ends abruptly at 21 Hz. For these tests, I started at 250 Hz and then proceeded downward in frequency. When the generator reached 21 Hz, the drive level had gotten so high that the F-1800RII's protection circuit triggered and the internal amplifier began to cycle on and off rapidly. After I gave it a few minutes off to regain its composure, the Velodyne functioned perfectly again.

Figure 3 shows THD + N versus acoustic output at two test frequencies. Normally, I would have taken this measurement only at the frequency of maximum sensitivity (which, in a sealed-box speaker, should correspond to system resonance). But because the F-1800RII's servo flattens response by boosting the drive, there's no "natural"

point of maximum sensitivity. Therefore, I ran one curve at 60 Hz (the point of minimum distortion, as seen in Fig. 2) and another curve an octave lower.

Figure 3's 60-Hz curve is relatively simple to interpret. The downward slope between 85 and 100 dB SPL suggests that electronic or acoustic noise is probably dominating the measurement and that the distortion itself is most likely well under 1%. Above 107 dB SPL, the curve rises, indicating actual distortion. The curve's sharp upward snap above 117 dB suggests that the F-1800RII's protection circuitry activated at that level.

The curve taken at 30 Hz in Fig. 3 echoes the 60-Hz curve's shape but indicates a fair amount of THD + N between 95 and 105 dB SPL (just where THD + N reaches its minimum with the 60-Hz test frequency). It hits its minimum at 110 dB SPL and then rises gradually in a classic manner that suggests true distortion. Admittedly, 30 Hz is a pretty tough test of any speaker (I doubt that many subwoofers could handle it at all), but there was a point to my madness: When a speaker is fed a signal an octave below its resonance, that resonance tends to "encourage" second-harmonic generation. So if I was right in suspecting that the FR-1800II's resonance was 60 Hz, a 30-Hz test tone would be absolutely worst case.

So, does the F-1800RII's servo work? Of course it does. How else would the response be so flat? The argument that distortion is eliminated because the voice coil is servo-controlled, however, relies on two major assumptions: first, that there is no cone breakup (i.e., that the cone acts as a true piston in following the motion of the voice coil) and, second, that nothing but the cone is radiating sound. Neither assumption is likely to be completely true in the real world. Cone breakup cannot be totally eliminated, the driver's surround and spider are in motion and generate sound, and no cabinet is completely "dead."

Use and Listening Tests

Make no mistake about it: The F-1800RII's driver moves a hell of a lot of air

at these frequencies and levels, and because the enclosure is sealed, the air pressure within the cabinet must be enormous. Some of that sound is likely to leak through the foam that supports the treated-paper cone; some probably affects the cone itself. And though I can testify that Velodyne's box takes the pressure with relative equanimity, it's not completely vibration-free—I've yet to see a speaker cabinet that is. None of this is meant to disparage Velodyne's approach. Far from it: I know of no other speaker that can generate 110 dB SPL at frequencies below 20 Hz while generating less than 10% THD! But there are limits to everything.

**NEVER HAVE I SEEN
SUCH ASTOUNDINGLY
FLAT AND EXTENDED
BASS RESPONSE
IN ANY SPEAKER OR SUB!**

MEASURED DATA

Data was taken in quarter-space free-field, 1 meter from front of enclosure. Unless noted or implied, data was taken at maximum gain with the crossover switched off, from the unbalanced inputs, and with both channels driven equally.

Minimum Input for 100 dB SPL at 30 Hz from 1-Meter Distance: Unbalanced input, 1.5 mV with both channels driven and 3 mV with one channel driven; balanced input, 2.7 mV with one channel driven.

Maximum Acoustic Output at 1 Meter and 10% THD + N: At 60 Hz, 117.8 dB SPL; at 30 Hz, 116 dB SPL.

Frequency Response at 120-Hz Crossover Setting: 11.2 to 88 Hz, ± 6 dB.

Crossover-Frequency Range (-6 dB): 49 to 87 Hz.

Lowest Frequency for 110 dB SPL at 10% THD + N: Below 20 Hz.

In a world where many so-called "subwoofers" simply generate enough distortion to trick the ear into "synthesizing" the fundamental frequency, the Velodyne F-1800RII delivers the real McCoy. This is bass that doesn't end, in frequency or in level! It is bass that literally is felt as much as heard—on occasion, more felt than heard. That, in and of itself, says a lot about the cleanness of the Velodyne F-1800RII's sound; only a clean sub can "silently" punch you in the gut. Tie down the knickknacks, honey, this baby's really awesome!

Make enough trouble and people always start talking



At Carver, we've found that making trouble is usually the first step in making real audio progress. For nearly twenty years we've built audio components around controversial design concepts in order to break through traditional price/performance barriers.

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Carver Research Lightstar Reference Amplifier

Recommended Component, *Stereophile*, April 1996
(Vol. 19, No. 4)

"Innovative, powerful (350 Wpc) power amplifier that impressed RD [Robert Deutsch] with its dynamics and sense of power in reserve, while sounding impressively neutral."

Carver TFM-35x THX Amplifier

Stereophile Guide to Home Theater, Fall 1996
(Vol. 2, No. 3), Robert Deutsch

"It's very modestly priced but doesn't sound like it... There are two groups of audiophiles to whom I particularly recommend the TFM-35x: those who are drawn to the tonal qualities of tube amplifiers but don't want the responsibility of their care and feeding, and those who are attracted to the sound of the Carver Lightstar Reference but deterred by the price... In the right system, it can give the big boys a good run for their money."

Carver AV-806x Multi-channel Amplifier

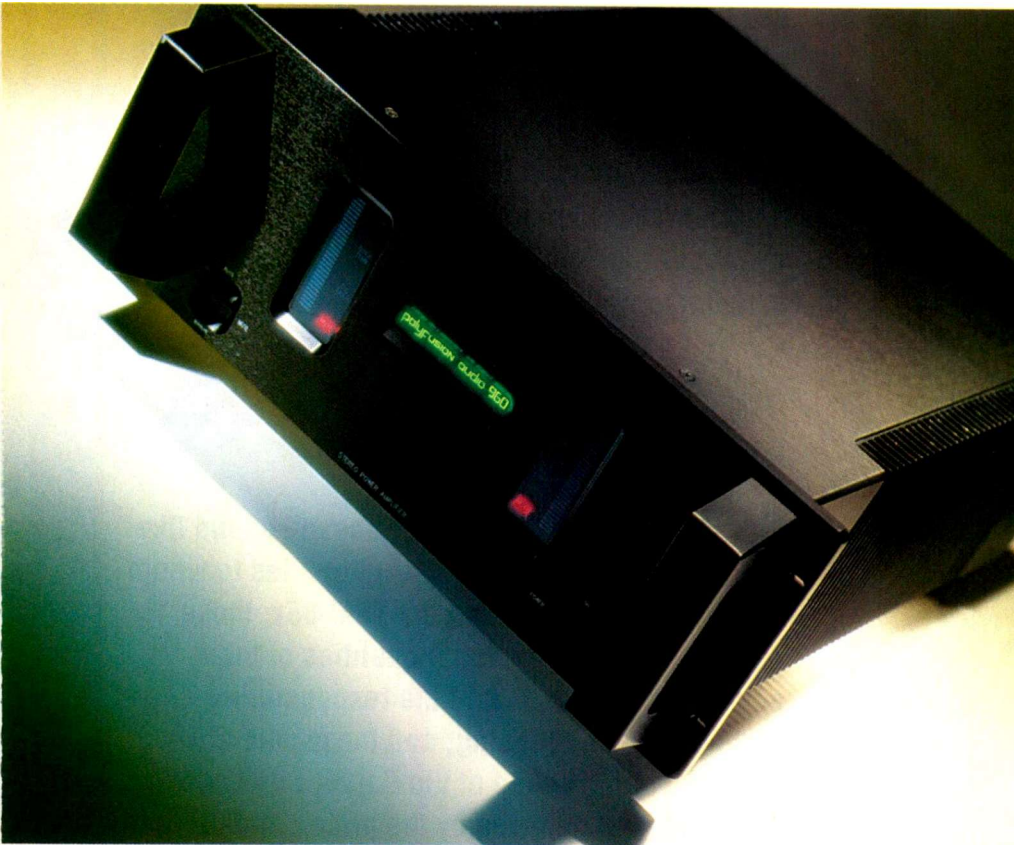
Recommended Component, *Stereophile*, April 1996
(Vol. 19, No. 4)

"I was expecting competent performance; what I got instead was magic," enthused TJN [Thomas J. Norton] about the six-channel Carver... "My favorite current multichannel amp."

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POLYFUSION AUDIO 960 AMPLIFIER



The Model 960 is Polyfusion Audio's top power amplifier (the company also makes two lower-power amplifiers and several preamplifiers and digital-to-analog converters). Rated at 200 watts per channel into 8-ohm loads, the Model 960 is a hefty 70-pound brute of an amp.

At the lower right of its attractive front panel is a rocker power switch, and opposite it, on the right side, is another rocker that switches the amplifier between automatic and manual muting. The panel's most prominent feature is a pair of illuminated, vertical display windows, one for each channel. In addition to bar-graph level meters, the windows contain indicators for clipping, overheating, DC fault, and muting. A switch on the bottom of the amplifier, near the right front, turns the level dis-

play on or off. The central logo window provides additional diagnostic information about the state of the positive-rail fuses. If the left-channel fuse blows, "Polyfusion" in the logo goes out; if the right-channel fuse opens, "Audio 960" goes dark.

The rear panel has rubber feet at the four corners, to prevent damage to protruding parts when the amp is set upright on its back. Two pairs of five-way binding posts for speaker connections (one pair per channel) are near the panel's edges. Between the output terminal pairs are the input connectors. These connectors are in two vertical arrays, each consisting of a high-quality phono jack for unbalanced input, a toggle switch for selecting unbalanced or balanced input, and an XLR connector for balanced input. An IEC AC cord socket and fuse are at the lower center.

Most of the 960's interior volume is taken up by its very capacious power supply. A large toroidal power transformer in the center is covered by a gold-anodized aluminum plate. This plate serves to mount a terminal strip with jumpers for accommodating different AC line voltages and as a heat sink for the two main bridge rectifiers. Oriented in a line from front to back, on either side of the power transformer, are two banks of four 47,000-microfarad filter capacitors, totalling an impressive 376,000 microfarads! A printed circuit board links the individual capacitors in each bank and also carries the main supply-rail fuse holders, a 1-microfarad film bypass capacitor for each of the 47,000-microfarad electrolytics, and two yellow LEDs—with associated dropping resistors—to indicate when the capacitors are holding a (potentially dangerous) charge.

Each amplifier module consists of a p.c. board mounted to its associated heat sink. Brackets on the fronts and backs of the heat sinks extend to the front and rear panels, thus making up the length of each side. The output terminals are mounted to the rear brackets and extend through a hole in the back panel. By disconnecting two ribbon cables and three wires to the filter-capacitor bank p.c. boards, you can remove a module for service. Another p.c. board, mounted behind the front panel, holds all of the indicator circuitry. The Model 960 is nicely made, neatly wired, and appears to use appropriate high-quality parts.

Measurements

The Polyfusion 960's voltage gain was 26.1 dB in each channel and input mode, and the amplifier did not invert polarity.

Rated Power: 200 watts per channel into 8 ohms, 400 watts per channel into 4 ohms, or 600 watts per channel into 2 ohms.
Distortion: 0.02% THD at rated output.
Dimensions: 19 in. W x 8 in. H x 22¼ in. D (48.3 cm x 20.3 cm x 56.5 cm).
Weight: 70 lbs. (31.8 kg).
Price: \$4,950.
Company Address: 30 Ward Rd., Lancaster, N.Y. 14086; 716/681-3040.
 For literature, circle No. 94

My usual frequency response test at the 2.83-volt (1 watt into 8 ohms) output level with open-circuit, 8-ohm, and 4-ohm loading revealed little difference as a function of load. It was therefore no surprise that the NHT dummy speaker load hardly altered the response at all: less than 0.1 dB relative to 8-ohm loading over the 20 Hz to 20 kHz audio range. Response was up 2 dB at 10 Hz, however.

Out of curiosity, I used the Micro Cap IV program on my computer to model the amplifier as an equivalent op-amp along with the complete servo circuit. This model showed a different response, with a broad hump of 0.33 dB centered around 100 Hz and output at 10 Hz down almost 2 dB.



**A DUMMY SPEAKER LOAD
BARELY AFFECTED
THE 960'S RESPONSE—
LESS THAN 0.1 dB
OVER THE AUDIO BAND.**

Hmmm. Then I checked the 960's frequency response as a function of output level and found that it changed. Figure 1 illustrates this phenomenon. The response below 200 Hz changes from one shape below 1 volt output to another shape above about 1.7 volts. The top curve in the figure is what my original measured curves looked like, whereas the bottom curve is similar to the response my computer model predicted. Apparently, the servo is designed to act in some nonlinear fashion that Polyfusion considers sonically beneficial (see "Circuit Highlights").

Square-wave response is shown in Fig. 2. The top and middle traces—for a 10-kHz waveform at 10 volts, peak to peak, with 8-ohm loading and then 8 ohms in parallel with 2 microfarads—are typical of most solid-state amplifiers. In the bottom trace, for a 40-Hz square wave, you can see the ef-

fects of the level-variant response. Two waveforms are superimposed: The one with more tilt is scaled at 1 volt/division, whereas the one with the flatter top is a 10-volt peak-to-peak signal scaled at 5 volts/division. High-frequency rise and fall times were about 3.2 microseconds at 10 volts, peak to peak, into 8 ohms.

Common-mode rejection ratio (CMRR) for the balanced inputs was similar in the two channels. From 20 Hz to 2 kHz, it was 66 dB for the left channel and 74 dB for the right. CMRR decreased to 61 and 68 dB at 20 kHz for left and right channels, respectively.

Figure 3 shows total harmonic distortion plus noise (THD + N) and SMPTE intermodulation (IM) distortion as functions of output power at 1 kHz into 8- and 4-ohm loads. The 4-ohm curves don't continue into clipping because the amplifier's protection circuitry started cutting in just beyond 400 watts output.

THD + N as a function of frequency, taken at several power levels, is plotted in Fig. 4. The rise in distortion below about 500 Hz is most likely due to whatever characteristic of the servo circuit causes the change in frequency response with level. A spectrum of the harmonic-distortion residue of a 1-kHz, 10-watt signal into 8 ohms is plotted in Fig. 5. Both even and odd harmonics are present but quickly recede into the noise floor.

The Polyfusion 960's interchannel crosstalk performance was outstanding. In either direction, right to left or left to right, and with balanced or unbalanced input connections, channel separation was better than 110 dB from 20 Hz to 20 kHz.

The 960's A-weighted noise ranged from about -91 to -93.7 dBW for the two channels, whether in balanced or unbalanced mode. The absolute level of the output noise between 22 Hz and 22 kHz ranged from 81 to 116 microvolts.

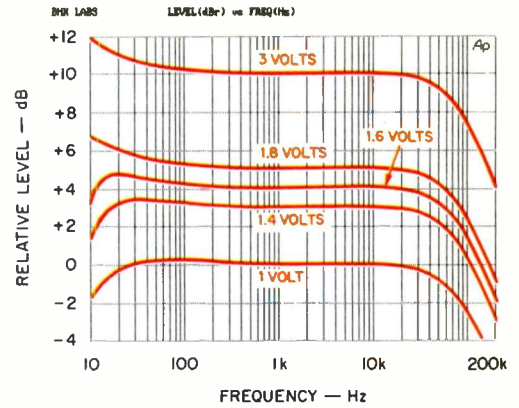


Fig. 1—Frequency response into 8 ohms at various output levels.



Fig. 2—Square-wave response for 10 kHz into 8 ohms (top), 10 kHz into 8 ohms paralleled by 2 μF (middle), and 40 Hz into 8 ohms (bottom). The overlaid 40-Hz traces represent response at two different output levels, with the one showing the flatter top scaled at the same 5 volts per vertical division as the 10-kHz traces and the other scaled at 1 volt per division (see text).

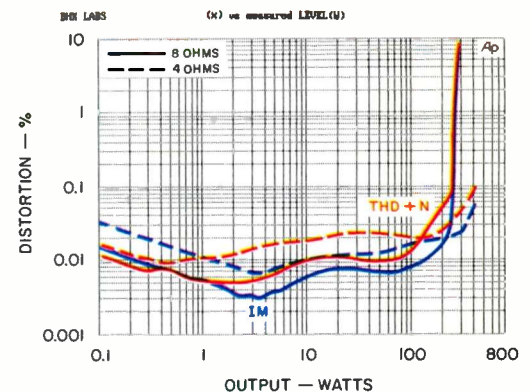


Fig. 3—Distortion vs. power, THD + N at 1 kHz and SMPTE IM.

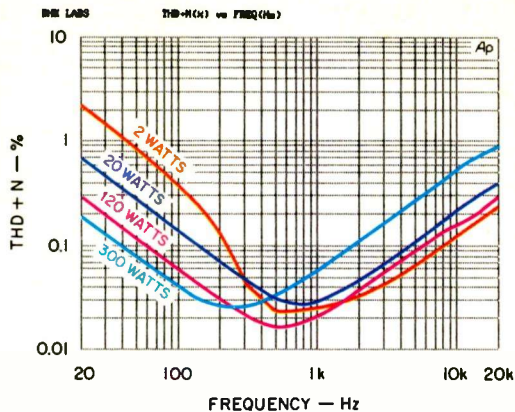


Fig. 4—THD + N vs. frequency into 4 ohms.

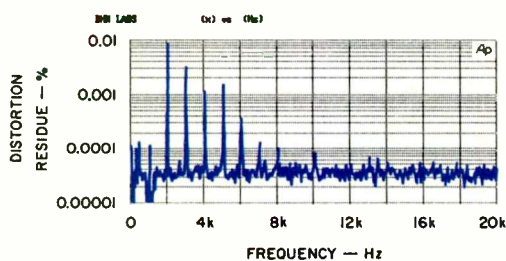


Fig. 5—Harmonic-distortion spectrum for 1-kHz signal at 10 watts into 8 ohms.

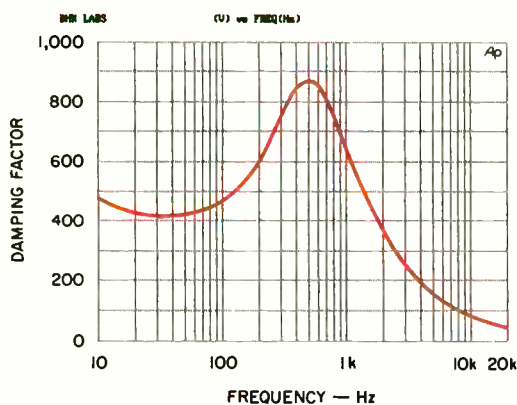


Fig. 6—Damping factor vs. frequency into 8 ohms.

Damping factor versus frequency is shown in Fig. 6. The curve's shape is rather unusual. Damping factor is very high (which is to say, output impedance is very low) at around 500 Hz, reaching almost 900, and, as is typical, falls off at higher frequencies, to about 100 at 8 kHz and 50 at 20 kHz. What's odd is the depression in the curve below 500 Hz, though it never dips below 400 in that range. It most likely is

caused by the action of the output-centering servo getting into the act in the lower part of the audio range and thereby increasing the output impedance.

The Polyfusion 960's output DC offset measured -0.5 millivolts in the left channel and -3.7 millivolts in the right. Input impedance was 524 ohms in balanced input mode and 26.4 kilohms in unbalanced input mode.

With the IHF tone burst, dynamic power into 8 ohms was 280 watts, with no sag over the course of the 20-millisecond burst, yielding a dynamic headroom of 1.5 dB relative to rated continuous output. With 4-ohm loads, the dynamic current limiter started to engage before the amp actually voltage clipped. I was able to get 421 watts before limiting set in, for a dynamic headroom of 0.21 dB. With 2-ohm loads, I could get about 360 watts before the current limiters cut in. The limiting manifested itself in the tone-burst output as an absence of complete cycles of the signal, along with sharp discontinuities in cycles where the limiter cut in. Steady-state outputs at the visual onset of clipping or current limiting were 250, 400, and 350 watts for 8-, 4-, and 2-ohm loads, respectively.

The AC line current drawn by the 960 was about 2.4 amperes when it was quite cold and 2.1 amps when it was fully warmed up. I measured the voltage drop across the various source resistors in the output stage and deduced an output-stage idling current of some 450 milliamps, or a power dissipation of some 65 watts per channel—a healthy amount, to be sure, but more or less normal for MOS-FET output stages.

Use and Listening Tests

I first listened to the Polyfusion 960 on a pair of Genesis V speakers. I had a bit of a surprise at first; when the turn-on delay ended and the amplifier came out of muting, I heard a loud pop through the speakers. This led me to believe something was

wrong, but it turned out to be a natural consequence of the 960's load sensor. The Genesis V's low-frequency crossover has a series capacitor that blocks DC. When faced with such a DC open circuit, which is otherwise an acceptably high impedance, the load sensor puts out about 18 volts DC. When the turn-on delay times out, the amp comes out of mute and suddenly connects to the load, producing a pop through the

ASSOCIATED EQUIPMENT USED

Equipment used in the listening tests for this review consisted of:

CD Transports: Sonic Frontiers SFT-1, Conrad-Johnson DR1, and Counterpoint DA-11A

CD Electronics: Genesis Technologies Digital Lens anti-jitter device; Classé Audio DAC-1 and Sonic Frontiers SFD-2 Mk II D/A converters

Phono Equipment: Oracle turntable, Well Tempered Arm, Accuphase AC-2 moving-coil cartridge, and Vendetta Research SCP-2C phono preamp

Additional Signal Sources: Nakamichi ST-7 FM tuner, Nakamichi 250 cassette deck, and Technics 1500 open-reel tape deck

Preamplifiers: Forssell balanced tube line driver, Anthem Pre 1, and my own passive signal selector/volume-control unit

Other Power Amplifiers: Sonic Frontiers Power-3 mono tube amplifiers, Quicksilver M135 mono tube amplifiers, and Crown Macro Reference

Loudspeakers: B&W 801 Matrix Series 3s, augmented from 20 to 50 Hz by two subwoofers, and Genesis Technologies Genesis Vs

Cables: Digital interconnects, AES/EBU balanced Illuminati DX-50; analog interconnects, Transparent Cable MusicLink Reference (balanced) and Music and Sound (unbalanced); speaker cables, Transparent Cable MusicWave Reference

Other: TAD Systems Power Purifier on AC lines to all D/A converters and preamps

CIRCUIT HIGHLIGHTS

Polyfusion Audio requested I sign a non-disclosure agreement to get a schematic of the Model 960. Accordingly, I can discuss the circuitry in only a general way. I will say that there are definitely some unusual things going on in this design.

The signal circuitry consists of seven main functional blocks. The unbalanced inputs are connected to one terminal of the input selector, which comprises the first block. The balanced inputs are applied to the input of a noninverting op-amp (a popular Burr-Brown device), configured as a unity-gain differential amplifier, which comprises the second block. The input selector's wiper, or output, is routed to the input of another of these op-amps (the third circuit block), but connected for a gain of about four times. Following this input amplifier is the fourth block, a series electronic switch that is normally configured to pass the signal into the power amplifier proper, the fifth system block.

The power amplifier itself is a fully complementary design consisting of a J-FET differential first-stage amplifier, a bipolar transistor LVA (last voltage amplifier), and an output stage using six pairs of MOS-FET power devices. Overall negative feedback is applied from the output back to the input differential amplifier. Gain is set at five times (about 14 dB) and, in combination with the four-times gain of the input op-amp, sets the overall gain at 20 times, or 26 dB. A servo circuit that compares the DC level at the output to ground keeps output DC offset to a minimum.

Comprising the sixth function block is the Model 960's extensive protection cir-

cuitry. This starts at the fundamental level with the AC line fuse, a 15-ampere slow-blow type, and the power-supply rail fuses, which are 7-amp fast-blow types. An output relay connects the amplifier to the load after a short power-on delay. Any one of the following conditions will open this relay: turning the front-panel muting switch on, loss of AC power, excessive DC voltage at the output, excessive power-supply current into the amplifier modules, too low a load impedance, or excessive temperature on the heat sinks.

Currents for the positive and negative power-supply inputs to each channel are sensed by separate circuits. If the current on either supply rail is excessive, the electronic switch that comprises block four will change state, disconnecting the power amplifier proper from the input signal. This happens almost on an instantaneous, per-cycle basis. When the current overload is just beyond the triggering threshold, individual signal cycles are removed from the amplifier output; if the current overload becomes more severe, the output relay opens up. A last, but interesting, feature of the protection circuit is a load sensor. When the amplifier is muted for any reason, the sensor injects a measured DC current into the load. If the voltage it senses across the load with this current flowing is below a certain threshold, corresponding to a load impedance that it considers too low, the load sensor prevents the amplifier from unmuting.

The circuitry for the front-panel displays makes up the Model 960's seventh functional block, and the main power supply is the eighth. *B.H.K.*

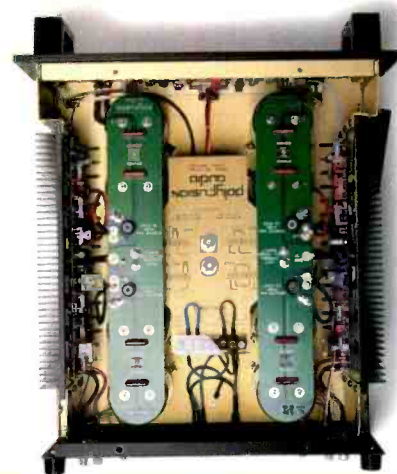
speaker as the crossover capacitors discharge the 18 volts back through the now-active amplifier. The cure for this annoyance was to start the amp up with 4- to 8-ohm resistors temporarily bridged across the speaker terminals and then to take them off after the amp un-muted. I dwell on this a bit because there are other full-range speakers from Infinity, Genesis, and possibly others with series capacitors in their

crossovers that will react similarly with the Model 960.

My initial reactions to the 960's sound were somewhat mixed. They ranged from thinking the amp sounded dark and closed in to thinking it sounded reasonably good. After a number of separate listening sessions, interspersed with lab measurements (and perhaps because it became more broken in over this period), the 960 ended up

sounding quite good on the Genesis speakers. Its sound was characterized by a smooth, somewhat laid-back perspective, with little irritation yet good resolution and detail. Space, dimension, and sound-staging were very good. The blend of this amp's sound in the lower midrange to the Genesis V's powered woofer system was good.

With B&W 801 Matrix Series 3 speakers, I thought the same things about the sound of the 960 as with the Genesis Vs. However, the amp was now also handling the bass—and good, robust, powerful bass it was.



**THE 960 PRODUCED
SMOOTH, DETAILED SOUND
WITH GOOD, ROBUST,
AND POWERFUL BASS.**

Tight and tuneful, it was as good as I've heard with the 801s. The overall sound of the 960 on the 801s was relaxed, realistic, musical, and enjoyable.

Playing the low-sensitivity B&W 801s, I was easily able to clip the amp on wide dynamic range drum solos, but the 960 handled this gracefully and thus did not sound unduly bad. With the Genesis Vs, which are a lower-impedance load but don't load the amp in the bass range, the 960 played louder than I could stand, without limiting in any audible way.

The Polyfusion Audio 960 amplifier was a pleasure to listen to. I would commend it to anyone seeking a high-performance, high-power solid-state amplifier. *A*

RCA RC5200P DVD PLAYER

Few advances in home entertainment technology have been as eagerly anticipated as the digital videodisc (DVD). The period leading up to the introduction of the Compact Disc 15 years ago was similar, but because there was some initial reluctance on the part of record labels to embrace

The launch was originally supposed to occur last September but was delayed initially by the movie industry's requirement that an effective copy-protection scheme be developed and subsequently by the computer industry's demand that the scheme adopted be streamlined. (In its original form, the copy-protection

player rather than a prototype. It also let me check out performance using my own system. Earlier DVD demonstrations I had attended, while impressive, were in unfamiliar surroundings with unfamiliar ancillary components. Whatever the quirks of my own room and equipment, at least they are something I am familiar with and have control over. As with any evaluation, such points of reference are important guideposts.

Despite the technological sophistication it embodies, the RC5200P is a model of simplicity. The front panel has a minimum of controls—an AC power switch and a headphone volume control at the left, basic function controls at the right—that flank an unobtrusive display centered beneath the disc tray. On the rear panel are a Toslink optical digital audio output, stereo analog outputs, and composite-video (RCA) and S-video outputs. One of the main differences between the RC5200P and its big brother is that the more expensive RC5500P provides full 5.1-channel Dolby Digital (AC-3) decoding internally and hence has six analog audio outputs; the RC5200P, like most other DVD players, requires an external Dolby Digital decoder for 5.1-channel playback.

One of my frequent criticisms of audio and video components is that their remote controls often are too big and too complicated. In that regard, RCA has done an admirable job of designing a remote that controls a myriad of functions without being bulky or confusing. There's a numeric keypad at the top for selecting or programming tracks, a set of transport controls along the bottom that essentially duplicates those on the player's front, a vertical row of buttons for special functions down the right-hand side, and a cursor control in the center. The cursor control's four arrow buttons help you negotiate your way around various on-screen menus, which can be called up from the player itself for initial setup or from a table of contents embedded in the DVD. When

that format, there was little assurance it would become a dominant music distribution medium. Today, however, there seems to be little doubt that DVD will have a major impact on home entertainment.

One major factor is that the disc has both video and computer applications, and work is progressing on a pure audio standard as well. Even if a consensus on audio isn't reached, the DVD standard stipulates that all players must be capable of playing CDs, so the single-source-component world is not far off.

system tended to devour too much of a computer's processing power.) By the end of 1996, however, both those concerns had been addressed, and the path was cleared for DVD.

The timing of the format's North American introduction will be determined by the availability of a large enough supply of software so that early buyers will have something to play, and that is expected to be this spring. In anticipation, several manufacturers are already fairly advanced in the production of players. One, Thomson Consumer Electronics, has four machines, two under the RCA brand, one under the GE brand, and one bearing the ProScan name.

The basic RCA player, the RC5200P (which Thomson hopes to launch at a retail price of around \$599), gave me my first taste of a production DVD

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you have the cursor on the function you want, you use the large "Select" button to activate it, like using the "Enter" key on a computer. To the extent that I was able to use these functions, they seemed very straightforward.

That I couldn't put the RCA RC5200P through all its paces was because I didn't have commercial software. When Thomson sent me the player, a representative explained that the company had enough machines to enter the market right away. However, the movie studios were just gearing up to produce discs, so there were literally

none available. What Thomson did include with the player was a demonstration disc containing an explanation of the system, a description of the company's line of DVD players, and a selection of audio and video samples. The latter were scenes from several recent movies, which I used to check out the RC5200P's performance.

Subjectively, the picture was a knockout from the moment I first popped the DVD into the player. In some ways, the experience was rather similar to my early exposure to Compact Discs: Like most of us, I had become so accustomed to the noise,

distortion, and flutter inherent in analog media that I hardly heard them—until they were no longer there. It was their *absence* that made CD such an impressive system at first, and the absence of video noise and other distractions produced a similar reaction to DVD. There was a kind of silkiness to the picture that I had not seen from even the best laserdiscs.

Perhaps I'm becoming blasé, but the RC5200P's audio performance held few surprises; the soundtracks decoded flawlessly in both Dolby Digital and Dolby Pro Logic, as you would expect. Although the demo disc includes a number of audio-only tracks, they are there mostly so that dealers conducting demos won't have to fumble with extra discs; they are not exactly equivalent to regular CD recordings. But with my

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own CDs and their familiar music, the RC5200P sounded at least as good as the couple of CD-only players I compared it to. And when I checked its error-correction capability by using a test CD's track containing simulated dropouts, the DVD player's performance far exceeded that of any CD player I have evaluated.

But DVD is mainly about video performance, so my main goal was to compare it to what has hitherto been the video standard for most of us, laserdisc. At first glance, DVD seemed to be sharper—and was certainly cleaner—than laserdisc, but the only way to confirm this, short of using test discs I did not have, was to concoct a good A/B comparison.

Most comparisons I had seen used identical monitors side by side, one playing a laserdisc and the other a DVD version of the same program. The trouble with this approach is that tiny variations in adjustment or performance from set to set could affect the results, and I was never really sure how the monitors had been set up in the first place. It seemed to me that the only appropriate way to go about things was to use

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a single TV and switch back and forth between sources.

Fortunately, my monitor is well-suited for such a test: It produces one of the best direct-view pictures I have seen, I'm confident it is adjusted to realize its full visual potential, and it has a range of video inputs that can be selected via the remote. I simply had to connect the RC5200P and a laserdisc player to separate inputs (S-video in both cases) and then switch between them. As source material, I used a laserdisc of the James Bond film *GoldenEye* because several of its scenes were on the demo DVD. The laserdisc was THX-mastered and therefore ostensibly provided as good a picture as you're likely to get from the format.

After a couple of tries, I managed to synchronize the two discs virtually frame for frame and then proceeded to use the swap button on the TV remote to toggle between them. I anticipated having to squint at details in the background to see much difference between the pictures—laserdisc is already a fine video medium, after all.

But there was no need—the differences were dramatic. When I switched from laserdisc to DVD, not only did the video noise—already quite low—simply disappear, but the picture took on a crispness that I frankly was surprised my TV monitor could produce. For example, when a building exploded in *GoldenEye*, the laserdisc picture looked like a big orange blob, whereas the DVD image had remarkable definition: I could see individual licks of flame and smoke. And DVD revealed the lines in actor Pierce Brosnan's face and fine details in background rocks and trees as James Bond soars off a mountain precipice on his motorcycle and climbs into a diving airplane (even the airplane's wing struts were ultra-sharp, compared to the laserdisc rendering). In *Twister*, as a car drives over a causeway and cows go flying by in the distance, individual raindrops were clearly visible on the car windows. One of the few specifications RCA provides for the RC5200P is a horizontal resolution of 540 lines, compared to about 400 for laserdisc; on the evidence of my eyes, the spec may be right. Even severely letterboxed images, which normally tend to get lost on my 27-inch screen, had lots of detail. The RC5200P definitely produced the best picture I have seen outside a TV control room.

In some ways, this must be considered a preliminary report on DVD. Although the RCA RC5200P is capable of doing all the format's tricks (multiple languages, switchable aspect ratios, etc.), they depend on a disc's being encoded for those functions; the demo disc I had, unfortunately, was not. By the same token, in early demonstrations of the system in prototype, motion artifacts were often visible, resulting from the digital compression scheme. I saw none in this case. However, that's mostly a matter of care during mastering, and I presume that great pains were taken in producing a disc

intended to sell people on the system. Nevertheless, that the RCA RC5200P player performed so spectacularly, even under what might be regarded as "hothouse" conditions, proves that DVD is capable of such performance. When DVD becomes a commercial reality, there will undoubtedly be some less-than-perfect transfers, just as there are some lousy-sounding CDs and crummy-looking laserdiscs out there. But that shouldn't take away from the fact that the DVD system itself is excellent and that a player as relatively modest as the RCA RC5200P will enable you to realize its benefits. A

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When you've got questions about Audio and Video,

see a specialist

Q

My T.V. picture looks great to me. Should I have it adjusted by a trained technician anyway?

A

Absolutely. Most T.V. pictures are intentionally set incorrectly by the manufacturers for various reasons (mainly to make the picture appear brighter). Even sets with Color Temperature Controls are off D65 (NTSC color of white) due to production tolerances. In every case we have seen, nailing down 6500 degrees and gray scale tracking yields an image lush and saturated, with diversity of color not previously enjoyed. Image detail can also be greatly enhanced by a qualified technician. This procedure involves finding the maximum peak white level that the television can produce without video amp clipping, power supply overload, or beam and phosphor over-saturation. These calibrations require experience and instruments, but the results yield beauty and enjoyment far beyond just a great picture. The image becomes engaging and a bunch more fun to watch.

—Steve Abeln
Shimek's Audio/Video
Anchorage, Alaska



shimeks audio
video
car audio

Q

What are watts?

A

There is a lot of jargon thrown around in this industry with watts being near the top of the list. It is likely the most misused and misunderstood term used by sales people and customers alike. Watts are the quantitative measurement of power. For our industry we are referring to electrical power. Power is produced by a receiver or amplifier when it supplies voltage and current to a load also known as a speaker. How much power, or watts, is generated, is a product of how much voltage and current the amplifier can produce. They all have their limits! Bad things happen to the amplifier and speaker when an amplifier is asked to supply more power than it can produce. Power is necessary for our stereo systems to operate but is not completely responsible for how good they sound nor for how loud they play! The best thing to remember about watts is that all receiver and amplifiers have them. Comparing watts will most likely not yield the expected results. When in doubt, talk with a specialist retailer.

—David Sherman
Modern Music Audio & Video
Memphis, Tennessee



Each month, Audio Magazine's feature "See a Specialist" showcases 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, exemplify the best audio/video dealers from New York to California. The chosen dealers 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 :
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Q

Should I buy a front or rear projection television?

A

With the increasing popularity of home theater systems, more and more people are looking seriously at the idea of a really big T. V. For the true theater experience, nothing beats a large front projection image. But deciding which size and design of big screen requires some careful consideration. Room shape, size and layout are critical factors when determining projector placement and ideal screen size. Ambient light control is also an important factor to consider. Daytime viewing requirements may dictate a rear projection unit, which will perform better in well lit environments. In either case, a consultation with an experienced audio/video contractor may be the best investment a potential home theater owner can make to ensure a "two thumbs up" movie viewing experience.

—Steve Baker
Wild West
Reno, Nevada

Q

What component should I consider first when buying or upgrading a stereo system?

A

The primary component in any stereo or A/V system is you, the listener. You need to satisfy your listening habits and musical preferences to have an enjoyable system. To this end, always bring some of your own music to evaluate components. If you listen to music late at night at low volumes while family members are asleep, then you need to find components that have exceptional low level clarity. Conversely, if you want the sound to envelope you and you need to feel the music, then you want to find equipment that can play at live levels without harshness or hardness. Much can be learned by listening to store demo material. By bringing your own selections, you will give these prospective components a real world test—your real world. Also, bring along one or two poor recordings to learn how prospective components react to less than audiophile quality material.

—Joe Weber
Corner Audio
Portland, Oregon



WILD WEST



VMPS FF-3 SPEAKER



Seven drivers, laid out in a symmetrical array, are on the VMPS FF-3 front panel.

We should not let the latest developments in digital and audio/video technology blind us to other improvements in audio. Speakers, for example, are far better than they were several years ago. Although the improvements have been evolutionary rather than revolutionary, the benefits are usually far more audible than those in D/A converters and CD players, for example. Today's high-performance speakers have much flatter frequency response than their predecessors and offer striking improvements in dynamic range, resolution, transparency, bass power and extension, and sound-stage realism.

The VMPS FF-3 (\$4,400 a pair) is a good case in point. This is a product in which evolution has clearly paid off. The FF-3 is a smaller version of the FF-1, which I reviewed in the June 1994 issue. However, the FF-3 has a completely new midrange driver that radically improves the speaker's smoothness and musical realism. Its soundstage is even better than the FF-1's, and there's a smoother transition from the midrange to the bass. Similar improvements have been incorporated in the FF-1, but the FF-3 is a much better speaker than the original FF-1. In fact, a properly set up pair of FF-3s provides a remarkably realistic illusion that you are actually sitting in the middle of a concert hall.

The FF-3 builds on the strengths of the FF-1. Extensive efforts have been made to reduce cabinet vibration and coloration. The FF-3 is truly massive, weighing 265 pounds. As you might expect from its weight, the FF-3 is also large (although it is smaller than the FF-1); it is 63 inches high, 13 inches wide, and 18 inches deep. The front baffle is a 3-inch, medium-density fiberboard laminate, and it has 2-inch-thick sides and back. It contains large H-braces, and the cabinet's interior is coated with a heavy damping compound, Soundcoat. This borosilicate compound was invented to control the noise in marine engine rooms; VMPS claims that it reduces panel vibration in the FF-3 by an additional 10 dB over a relatively broad band.

The FF-3 is well finished, and its curved edges and narrow width do reduce its visual impact. Nevertheless, big is big! This is not a speaker for small listening rooms or those who want their audio equipment to be invisible. Yet size, like weight, has its advantages. It takes a large cabi-

**THE FF-3 IS ONE OF
THE FEW SPEAKERS THAT
CAN REALLY DELIVER
THE BOTTOM OCTAVE.**

net to produce bass that extends down to the FF-3's rated 24 Hz at -3 dB. It takes a large front panel for the designer to be able to place seven drivers

in a fully symmetrical array that enables them to act as a natural-sounding apparent point source. And it takes a tall front panel for the designer to place the drivers high enough from the floor so that they'll be at the optimum listening height.

The FF-3 has an unusually complex driver array. A 10-inch, slot-loaded, down-firing passive radiator provides sub-bass. This passive radi-

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ator is mass-loaded and offers adjustable damping. A 10-inch, woven-carbon-fiber woofer is at the top of the front panel, and an identical woofer is at the bottom. These woofers have damped baskets and 3-inch phase plugs. The phase plugs, an unusual feature of VMPS speakers, are intended to reduce the amount of midrange information and distortion produced by the dust cap at the center of the woofer while improving focus and clarity.

The FF-3's most striking drivers are its two Dynaribbons. These new midranges, made by SFA USA and exclusive to the VMPS line, look like small washboards and have an unusual design. They have serpentine voice coils, and their flat polymer diaphragms, which are corrugated and dimpled for strength and rigidity, are suspended at the edges by a mechanism that provides damping and centering while allowing linear travel. A slotted, distributed, push-pull magnet structure provides equal drive force over each midrange's entire diaphragm. VMPS believes that these low-moving-mass midranges offer many of the advantages of ribbons, planars, and electrostatics while providing more efficiency, linearity, and control.

The remaining drivers in the VMPS FF-3 are two Vifa 1-inch metal-dome tweeters and the same leaf-type ribbon super-tweeter used in the FF-1. Unlike the FF-1, however, the FF-3 has an internal crossover. This crossover uses top-quality components, including Wondercap/Hoveland Musicaps, Solen polypropylene capacitors, and bobbin-less coils. The midrange and treble wiring is silver-plated, solid-core, and Teflon-insulated; the wire to the woofers is 8-gauge. The crossover's basic design is a quasi-second order filter with 6- and 12-dB slopes. Two sets of input terminals enable biamping or bi-wiring.

The FF-3 offers an unusually wide range of adjustments. Separate midrange, treble, and super-tweeter level controls are on the back, but you must use them judiciously. Minor adjustments make major differences in sound; the recommended settings VMPS has marked on the back panel may well be the best in most setups. The FF-3 is also designed so that you can adjust the damping on the passive radiator, a feature likely to be of considerable value to many people. Slight changes in bass damping can help in

getting the most extended deep bass and best transient response in a particular listening room and location. This makes the FF-3 an exceptionally good buy for audiophiles who want deep bass in a mid-sized listening room.

One thing became very clear during my extended listening sessions with the FF-3. Once it was properly placed, adjusted, and broken in, this speaker was capable of producing a remarkably natural concert hall sound, and it reproduced the natural sound of acoustic instruments with extreme accuracy. Its soundstage was highly detailed without being overprecise or unnatural. The FF-3 is the first VMPS speaker whose midrange and resolution equals the quality of its bass and dynamic range, which have always been the strength of the VMPS line.

The FF-3 was remarkably free of audible deviations in frequency response and timbre. Its overall spectral balance was slightly on the soft side, in the sense that its upper midrange and treble response were closer to the overall balance of speakers like the Quad ESL-63 than to the frequency response of speakers like the Thiel CS7. The FF-3 also reproduced dynamic transients in ways that were closer to the performance of the B&W 801 Matrix Series 3 and Quad ESL-63 than to that of the Thiel CS7 or Apogee Studio Grand. The FF-3's overall character was similar to what you'd hear in the middle of a well-balanced or slightly warm concert hall than the more forward sound of the Thiels and Apogeos. It's the difference between sitting in rows D through F and rows M or N.

The FF-3's resolving power was excellent. This impressive speaker did an excellent job of revealing musical nuances and differences between associated components. It clearly revealed the sometimes striking differences in the deep-bass energy and transient response of different digital signal processors and in upper midrange and treble harmonics.

More important, the FF-3 did an excellent job in reproducing the full range of solo piano, violin, and other instruments

and in delineating voices. The difference between different makes and types of instruments was exceptionally clear, yet there was no highlighting of any part of the frequency band or shift in sound character according to loudness. Some top speakers make instruments seem slightly more live, but the FF-3 never made a natural, high-quality recording of solo instruments or voice seem unnatural or unreal. As an example, play the voice and musical instrument tracks on Alan Parsons' and Stephen Court's *Sound Check* album (Mobile Fidelity SPCD 015).

The VMPS FF-3 provided very realistic bass. It had most

of the energy and deep bass extension of the FF-1, and it's one of the few speakers that can really deliver the bottom of the bottom octave. The FF-3 favors realism over the emotional and musical impact of most previous VMPS speakers I've heard. It did very well with bass spectaculars, but there was no overhang to boost the impact of the bass. Detail was very good, and the transition from the mid-bass to the midrange was very realistic. (This may not always please rock and synthesizer fans, but it helps yield excellent reproduction of organ music and drums.) The FF-3 could handle extremely demanding organ recordings, such as the Dallas Wind Symphony's *Pomp & Pipes* (Reference Recordings RR 58). I suspect that most audiophiles will find their listening rooms impose more coloration on the bass they hear than this speaker does.

The FF-3's midrange was exceptionally clean and far closer to the neutrality of the best electrostatics and planars than the midrange of any previous VMPS speaker. As I mentioned, the FF-3 did not appear to have quite the dynamic speed and life of the Thiel CS7s and the Apogee ribbons, but this is not a criticism. Anyone who has ever changed positions during a live performance has heard similar differences in sound, and it is very difficult to determine what sound is "right"—if such a term can be applied at all.

The balance of recordings, electronics, interconnects, and speaker wires I used played a large part in my reactions to this

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VMPS speaker. I found, for example, that the FF-3's midrange did a very good job of matching the sound of Classé Audio electronics but did less well with Krell electronics. Likewise, the FF-3 did much better with cables that emphasize flat, fast response than some of the high-end wires that claim to smooth the upper octaves or sound more tube-like.

The FF-3's upper-octave balance was slightly softer than I remember the FF-1's as being, but there was a very realistic match with the sound of the Dynaribbon drivers. In fact, you should not boost the treble control of the FF-3 much beyond the manufacturer's recommended setting. As with every other speaker I have auditioned that has treble and midrange level controls, you should set the treble energy to provide the most natural overall musical sound after you have achieved the best midrange setting, not vice versa.

The FF-3 provided an unusually natural balance of upper-octave energy at my listening position. This balance, by the way, may not suit audiophiles who are more into sheer sonic detail than musicality. But I was struck by the fact that high-frequency harmonics were natural in terms of their energy and their impact in defining the soundstage. In particular, the VMPS loudspeaker did an exceptionally good job of reproducing higher frequencies of the violin on Arturo Delmoni's *Bach, Kreisler, Ysaye* (Water Lily Acoustics WLA-WS-07).

The FF-3 not only reproduced the upper octaves of solo instruments well, it also revealed the kind of detail in orchestral and complex musical passages that require good resolution and a musically realistic frequency balance. The FF-3's treble and upper-midrange dispersion provided very good and stable reproduction of the direction and placement of instruments and voices. The FF-3 is a speaker that combines excellent focus with a relatively wide sweet area for listening, and it did an exceptional job of making small musical groups seem like they were really in the room. To hear this effect, listen to Gary Shocker's album *Flutist* (Chesky CD 46) and the Newman & Olt-

man Guitar Duo's recording *Passions* (Sheffield Lab 10058-2-F).

Like the original FF-1, the FF-3 handled dynamic changes well, from the softest shifts to the sharpest peaks. This is a speaker that can play cleanly to the limit of what any sane listener could ever want. Once again, however, I should stress that the FF-3's transient reproduction was slightly less fast or live than that of some other speakers. This is not to say that it did not have a high degree of transparency; it did. But the FF-3's transients and dynamic nuances were more like those you'd hear sitting in the middle of a concert hall than the more up-front sound of some competing speakers.

The FF-3's soundstage was remarkably coherent and exceptionally wide; it neither lost depth or natural detail nor created a hole in the middle. VMPS suggested that these speakers be placed very wide apart and angled toward the listening position. With this placement, I could hear about as much soundstage detail as orchestral recordings can provide without

**THE FF-3'S SOUNDSTAGE
WAS DETAILED
WITHOUT BEING
OVERPRECISE
OR UNNATURAL.**

stretching or distorting the sound of solo instruments, voices, or small jazz groups. This integration of soundstage detail, dynamic nuances, and accurate timbre with its middle-of-the-hall sound is one of the FF-3's many strengths. It is one of the few speakers that can get the best out of recordings of massive works, such as Mahler's Eighth Symphony.

The FF-3 is a major step forward for VMPS. It has the most musically realistic balance of any VMPS speaker that I have heard, and it is one of the best monitors available in its price range. It is also a speaker that audiophiles can integrate into their systems and get a consistent level of musical realism. With the right source material and electronics, the FF-3 can provide an exceptional sense of sitting mid-hall at a live performance—regardless of whether that performance is solo instruments, jazz, a rock band, a full orchestra, or grand opera. High fidelity is always a matter of creating illusions, but the FF-3 is further proof that today's best speakers are making the illusion seem increasingly real. A

Life's philosophical sound check

ultimately boils down to this:

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what's cool. Or, you can trust

your own gut. And your own

ears. And in the process, actually

evolve your own standards.

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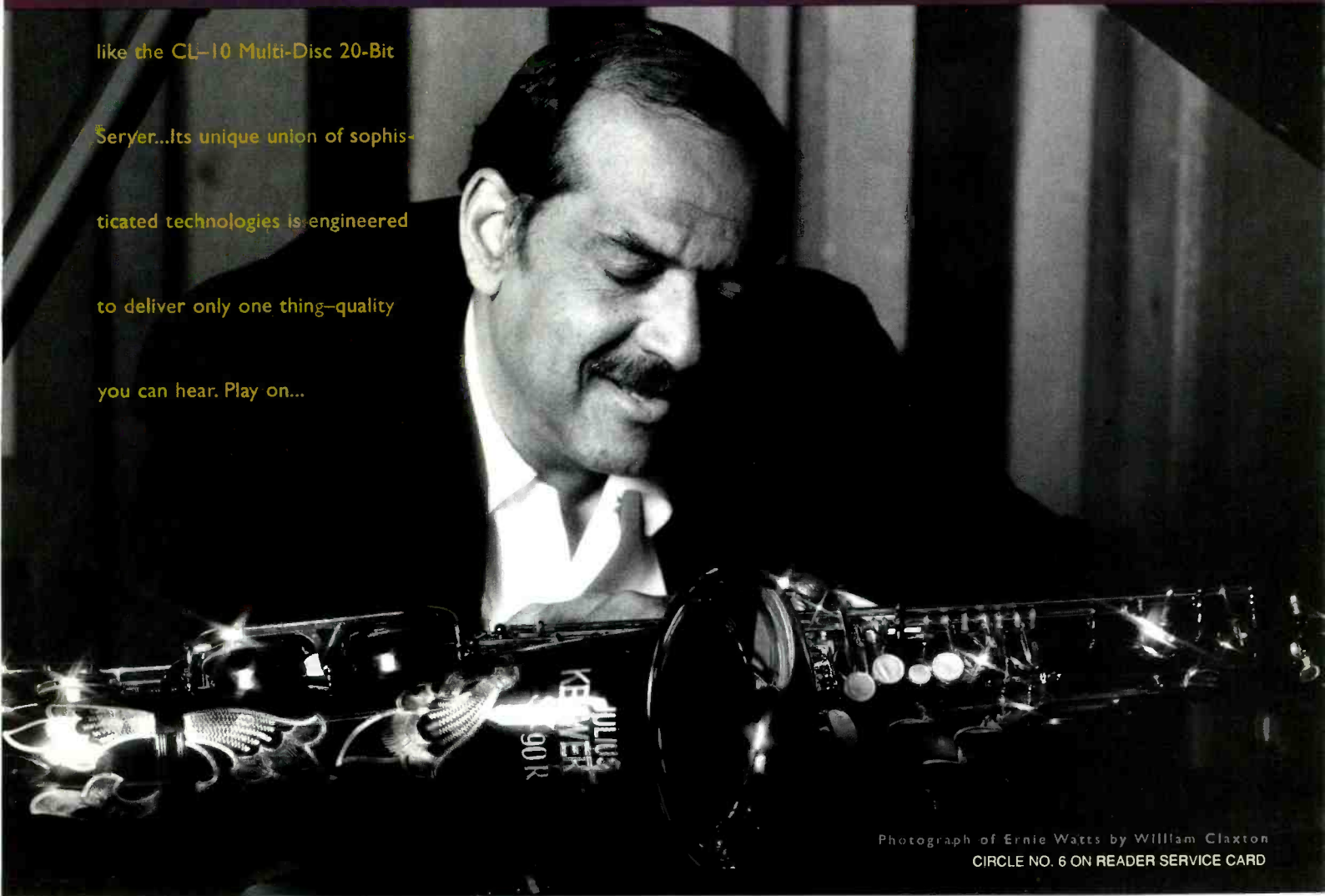
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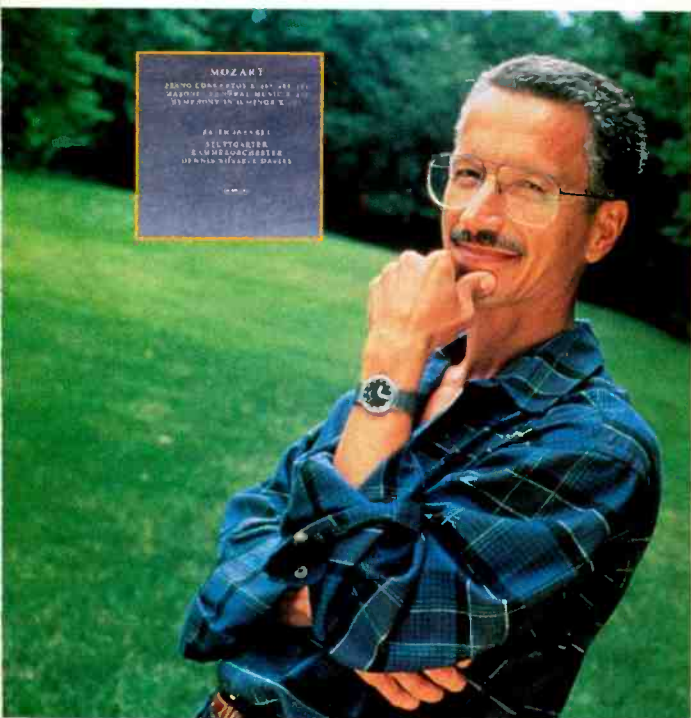


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CLASSICAL RECORDINGS



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Mozart: Piano Concertos Nos. 21, 23, and 27; Symphony No. 40; Masonic Funeral Music

Keith Jarrett, piano;
Stuttgart Chamber Orchestra,
Dennis Russell Davies
ECM NEW SERIES ECM 1565/66
Two CDs; DDD; 2:10:48
Sound: A, Performance: A

When I have heard jazz pianist Keith Jarrett play classical music in the past, his work has struck me, above all, as careful-careful, so that no touch of “jazziness” should intrude. And doubtless there are listeners out there ready to pounce should a nuance go the wrong way. These Mozart performances sound significantly more relaxed. Jarrett even feels enough at home to add his own decorations at times, particularly in the beloved C-Major Concerto (No. 21, K. 467). These details are very much at home in the music, implying that Jarrett is, too.

It’s rather an odd program. I’m not sure why the orchestral works were included, though they’re well played and welcome. A fourth concerto would have seemed more logical. But we’ll let that pass. The sound is fine, if not particularly ripe, and the Stuttgart group is justly famous for its music-making. Jarrett sounds downright prim, however, compared to fellow jazz pianist Chick Corea. If some are ready to pounce on Jarrett, they will pounce on Corea. It’s not just that some of his ornaments have a distinctly jazz ring, he even provides his own, deeply jazz-flavored cadenzas in the finale to the A-Major Concerto (No. 23, K. 488—one of the concertos in the Jarrett set) and in the first and last movements of the D Minor (No. 20, K. 466).

Heresy, you cry? In Mozart’s day, pianists were expected to improvise their own cadenzas, and to that extent Corea here is more authentic

than any established Mozart pianist I can think of. If the improvisation is anachronistic to the concerto by some two centuries, well, that’s history. Artur Schnabel, a sometime composer as well as a renowned pianist, was roundly criticized for the density and dissonance of his improvised cadenzas. Since his day, few have ventured away from the cadenzas as written out by Mozart or Beethoven and included in the published scores. More power to Corea for going where the majority of pianists fear to tread.

Corea also undertakes an authenticity of a still more controversial type. He frequently plays improvised continuo during the tutti (and even during some more thinly scored orchestral passages) where no piano part appears in the score. His Mozart style is particularly idiomatic in these continuo passages—so much so that I failed to recognize his interpolations on first hearing. But it remains a matter of musicological debate whether such piano continuo was considered normal practice in the days of Mozart and Haydn.

But it doesn’t end there. Both concertos begin with a vocal improvisation by Bobby McFerrin, who hands off to Corea for further improvisation and a deft segue to the opening of the concerto as written. The orchestra plays everything straight throughout. The jazz introductions are interesting, to be sure, but they don’t have much to do with the concertos. Corea manages to incorporate more of Mozart—and of the specific concerto under consideration—in his improvisations than does McFerrin, but they remain unnecessary and for many, I’m sure, intrusive appendages.

Even if you object to these introductions, they’re worth putting up with for the sake of the performances overall. Corea may not have quite the polish or the purely classical style of Jarrett, but he has more verve. In performance—though rarely on records—there are times when the music seems to take charge

**The Mozart Sessions
(Mozart: Piano Concertos Nos. 20 and 23; “Song for Amadeus”)**

Chick Corea, piano;
Saint Paul Chamber Orchestra,
Bobby McFerrin
SONY SK 62601; DDD; 66:36
Sound: A, Performance: D to A+

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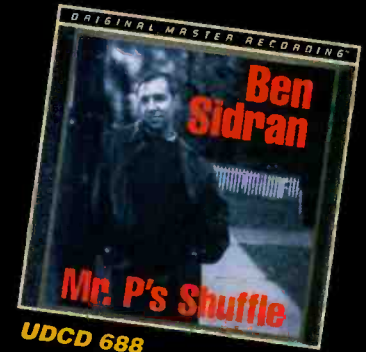
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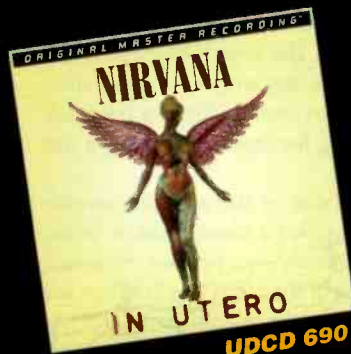
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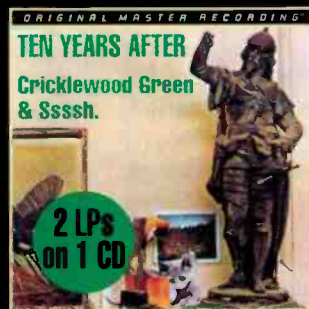
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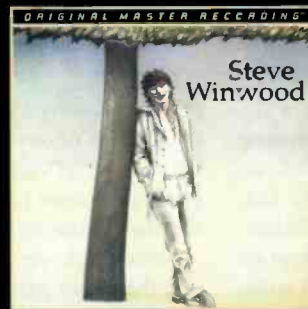
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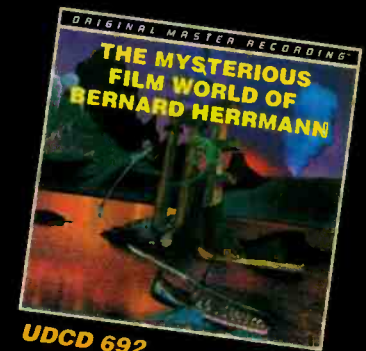
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and carry the musicians along, like so many expert surfers riding the same wave. It's wonderful when that happens, and it happens to Corea and his crew, particularly in the finale of No. 23.

Sony's pickup is closer and less reverberant than ECM's, and the Saint Paul orchestra has an altogether richer sound, with clearer instrumental differentiation. The soundstage is wide and convincing in both cases. The ECM pickup may be a bit deeper—and perhaps slightly cleaner, though the greater reverberation could mask distortion products—but Sony's sound is more appealing on balance.

I must admit to strenuous reservations about the jazz interpolations of McFerrin & Company. Yet I'm also fascinated by them.

of deafness). As a young man in 1792, Beethoven left his hometown of Bonn and moved to Vienna, the musical capital of Europe. Within a short time he was known as a rising star on the keyboard, and his compositional talent seemed only an aid to his performance pursuits.

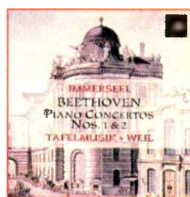
On March 29, 1795, Beethoven premiered his own piano concerto at the Tonkünstler-Societät in the Burgtheater. Although it was sandwiched within the performance of an oratorio by Antonio Cartellieri, Beethoven's youthful work was very well received at the time. Music scholars still argue whether this

similar to the instrument on which Beethoven performed, he plays both concertos with sensitivity and elegance.

The members of Tafelmusik have a reputation for excellence in authenticity. They perform on period instruments (whose makers are listed in the booklet), and their interpretations are thought through and well executed. The scholarship that underpins the group's recordings is also of the highest caliber. Program notes for this disc were written by the eminent H. C. Robbins Landon, one of the greatest musicologists alive today and an expert in the time of Beethoven.

The union of Tafelmusik's musicianship, van Immerseel's pianoforte, and Sony Classical's recording technology provides an effective bit of time traveling. This CD is a superb example of Beethoven as he would have wanted to hear it.

Patrick Kavanaugh



ROMANCES

More than any other violinist I can think of, Gil Shaham seems to have inherited the mantle of Fritz Kreisler in terms of supple, apparently effortless, and utterly winsome fiddling. This collection of popular pieces—by Elgar, Beethoven, Dvorák, Tchaikovsky, Svendsen, and, yes,

Gil Shaham, violin;
Orpheus Chamber Orchestra
DEUTSCHE
GRAMMOPHON
449 923; DDD; 57:32
Sound: see text,
Performance: A+



Kreisler himself—is delectable! The orchestra sound is immaculate, when you get to focus on it. Trouble is, Deutsche Grammophon has captured the soloist so that the fiddle seems enormous, filling the space between my speakers, though it's not particularly loud. Shaham's fans may love this. But audiophiles...?! *Robert Long*

The filler, an improvisation by McFerrin and Corea on a fragment of a Mozart piano sonata, seems all of a piece—like a brief jazz session with Mozart “sitting in.” The rest, however, suffers from a sort of schizophrenia. Both personalities are wonderful, but there are glaring disparities between them. Jarrett is disturbed by no such dichotomy, but neither is he as exciting.

Robert Long

Beethoven: Piano Concerto No. 1 in C Major, Op. 15, and Piano Concerto No. 2 in B-Flat Major, Op. 19

Jos van Immerseel, piano;
Tafelmusik, Bruno Weil

SONY CLASSICAL SK 68 250

DDD; 61:47

Sound: A, Performance: A+

So many of Beethoven's sublime compositions are revered that it's easy to forget his early career as a virtuoso pianist (which would later be cut tragically short with the onslaught

premiere featured his Concerto in C Major, Op. 15, or Concerto in B-Flat Major, Op. 19, but the concert's success encouraged the composer/performer to eventually create five of the finest examples of this genre.

Since Beethoven played these works himself, the piano parts originally looked more like sketches than finished pieces. At a similar premiere, Beethoven's page turner was quite mystified to find a part filled with blank staves and only an occasional music notation. Imagine that man's incredulity when Beethoven opened this empty score to perform and then nodded his head at regular intervals to have those mostly blank pages turned before him!

In Beethoven's day, it was the custom for the performer to improvise (then called “extemporization”) all cadenzas, an art that has sadly declined in the 20th century. Nevertheless, pianist Jos van Immerseel rises to this task with extraordinary skill. Using a pianoforte that spans only five octaves, quite

Corigliano: Creations and Other Works

I Fiamminghi (The Orchestra of Flanders),
Rudolf Werthen
TELARC CD-80421; DDD; 61:48
Sound: A, Performance: A

John Corigliano says that he wants his music to communicate. He should be more than pleased, in that case, with this collection of six orchestral works, two of which are world-premiere recordings. The sounds he evokes from the orchestra are not only communicative, they often are also nothing short of gorgeous. If you're looking for demo material, you just found it.

“To Music,” one of the premiere recordings, might be called a rumination on Schubert's “An die Musik”—or perhaps even more on the meaning of the poem that Schubert set. “Creations,” the other world premiere, is a two-part piece for orchestra and narrator (Ian McKellen) on the creation of the world and then the story of Adam and Eve. The other pieces are “Voyage for Flute and String Orchestra” (with flutist Paul Edmund-Davies), “Campane di Ravello (A Celebration Piece for Georg Solti),” “Elegy for Orchestra,” and “Promenade Overture.” The “Elegy” of 1965 is the earliest work on the disc and “To Music” the latest (1995).



The pickup, in a Belgian church, is just right: lush enough to make the most of Corigliano's wondrous sonorities without blurring details. My only complaint with the sound is that while everything else delivers a believable perspective, McKellen's narration has been subjected to some obvious gain riding. Perhaps I should not hold that against the recording, however. “Creations” is based

on music specifically intended for broadcast, and the artificial means of balancing narration to orchestra may be inherent in the original intent. I do find it a bit off-putting, though.

Robert Long

Bliss: A Colour Symphony and Adam Zero

English Northern Philharmonia,

David Lloyd-Jones

NAXOS 8.553460; 74:20

Sound: A, Performance: A+

Naxos, the most successful budget classical label today, has branched out from the standard repertory and is offering some off-the-



beaten-path material, long the province of its full-price sister label, Marco Polo. With this Arthur Bliss recording, Naxos again serves up a winning combination of

worthwhile music, excellent performances, and state-of-the-art sound at a bargain price.

The spelling of Colour Symphony spots Bliss as a British composer even to those unfamiliar with his music. He lived in England and the United States, successfully working in a witty modern style that was usually tonal and sometimes influenced by jazz and the music

Northern Landscapes

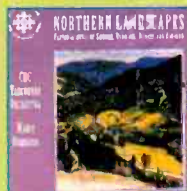
Pastoral Music of Sweden, Denmark, Norway, and Finland

CBC Vancouver Orchestra, Mario Bernardi

CBC RECOLETS SMCD 5157; DDD; 66:23

Sound: A, Performance: B+

There is lovely music in these pieces, including some familiar Grieg and some less



familiar works by Larsson, Frumerie, Wirén, and even Sibelius. They're caught in exceptionally clean sound in the Orpheum, a refurbished

theater in Vancouver that has pleasant though unspectacular acoustics, judging from this disc. The orchestral playing is generally very good and often quite luscious, and the conducting is apt. A persuasive case for the exploration of Scandinavian byways, in music if not in person.

Robert Long

hall. A book on heraldry, which discussed the symbolic meanings associated with the primary colors, provided inspiration for Bliss's four-movement symphony. For example, "Purple," the opening movement, suggests a stately royal march with trumpets.

John Sunier

Paganini: Music for Strings and Guitar

Julian Gray, guitar; The Diaz Trio

DORIAN RECORDINGS DOR-90237

DDD; 63:02

Sound: A-, Performance: A

When we hear the name Paganini, most of us think of the notorious violin virtuoso who was Europe's musical star in the 1820s and '30s. (He admitted: "I am not handsome, but when women hear me play, they come crawling to my feet.") But Niccolò Paganini was also a noted guitarist who composed more than a hundred solo guitar works as well as chamber music for guitar and strings.

Julian Gray and his friends in the Diaz Trio give us a splendid taste of this genre, from the melodrama of the "Recitativo" in the Quartetto 15 to the lyric simplicity of his cantabile for violin and guitar. This is easy music to enjoy, and the players obviously spent a lot of time together during its preparation. Neither the compositions nor the recording itself have pretensions of genius, but the final result is worth hearing—especially for the growing audience that appreciates the guitar in a chamber music setting.



Patrick Kavanaugh

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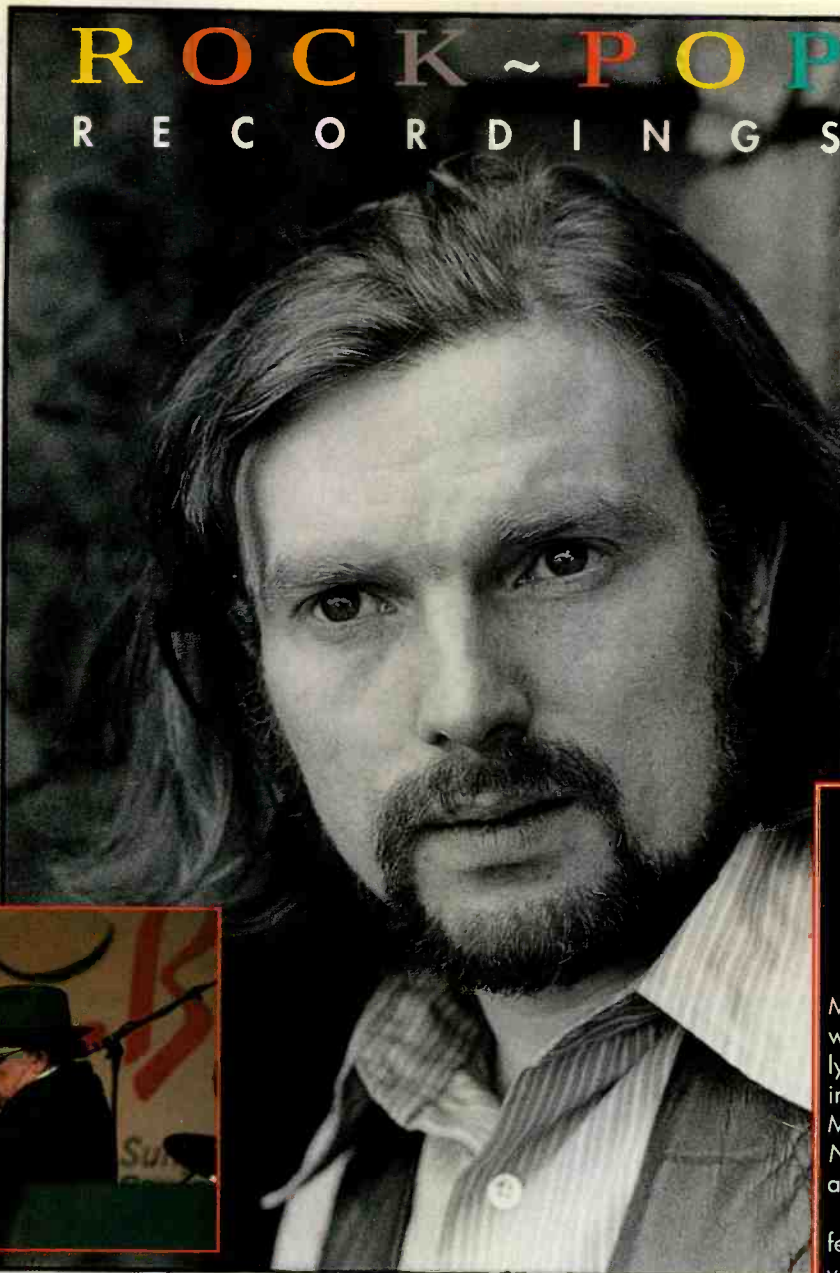
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The Healing Game

Van Morrison

EXILE/POLYDOR 537 101, 53:40

Sound: B, Performance: A

Fans will surely be delighted, or even taken aback, by what *The Healing Game* offers: a vigorous, revitalized George Ivan Morrison. Then again, they should have seen it coming. After all, he's been busily pumping out recordings right from the start of the decade. That's pretty remarkable for an artist with more than 30 years in the biz, and it's too late to stop now. *The Healing Game* is his strongest collection of tunes since 1990's *Enlightenment*. Morrison is

equally at home in a wide range of genres: R&B, folk, jazz, rock, ballads, blues, and Irish music, not to mention his ventures into the world of trance.

On *The Healing Game*, Van summons up deep primordial stuff, reminding us that he's a soul singer by way of Belfast. But his musical roots predate rock 'n' roll. Morrison is unabashedly influenced by Ray Charles, John Lee Hooker, Sonny Boy Williamson, and, of course, Muddy Waters. And for Van, the feel is everything. Throughout the album, he consistently finds just the right

groove. Most of the tracks feature horns—longtime Morrison cohort Pee Wee Ellis's mighty baritone sax along with Leo Green's tenor, Matt Holland's trumpet, and Haji Akbar on flugelhorn. Too bad Van didn't pick up his sax and join the lineup, but he teases us with some gutsy harmonica blowing instead. Morrison's ever-evolving band has solidified to the point where he always has what he needs for a song. Perhaps that's why he sounds extra confident this time out.

The Healing Game is a distillation of all that's good about Van Morrison in the '90s. He's working on a larger canvas now—less micro, more macro. But Morrison's sense of intimacy is still there. He's nearly bursting at the seams as he declares, "I've got fire in my heart and fire in my

notdunjusta

Dogon

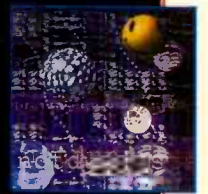
NEW DOG 32057, 71:59

Sound: B, Performance: B

Dogon, the duo of Venezuelan Miguel Noya and American Paul Godwin, uses most of the techniques currently popular in ambient and techno music, including synthesizer grooves, World Music touches, and vocal snippets. But *Notdunjusta* rises up from ambient anonymity with some creative touches.

On "Chet's Dream," a female voice intones inversions on the word "fondue" as loops evolve into an immersing well of serene cycles. The disc's title is taken from "25 Ohm," a piece of exotic babble that includes the sampled phrase, "Because it was not done, just ahhh..." looped into a quirky, arrhythmic synthesizer bloop and squawk.

But amidst the quirk, Dogon has strong melodic sensibilities that emerge in the serene "Lieno," as cellos and pianos coalesce out of a mist of electro sounds. Not everything works, but that's why Dogon is so refreshing; it doesn't have a formula, and even its experiments are tempered by seduction and irony. (Available from New Dog Records, 52 Colin P. Kelly Jr. St., San Francisco, Cal. 94107.) *John Diliberto*



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belly too." "It Once Was My Life" and "Sometimes We Cry" are the album's twin peaks, with funky horns that mingle with a street-corner chorus; Van's acoustic guitar on "Piper at the Gates of Dawn" revisits his seminal *Astral Weeks* sound. He's joined on this haunting song by his old friend Paddy Maloney, who plays Uilleann pipes and Irish whistle. It's a great, great tune, but the Irish/impressionistic feel doesn't quite mesh with the rest of the goings-on. Morrison gets back to business on the title cut, channeling through to his "backstreet jellyroll" and getting lost in his reverie. And wherever that is, it's the right place for Van Morrison.

Steve Guttenberg

Spice

Spice Girls

VIRGIN 7243 8 42174, 40:07

Sound: A, Performance: B

Fads are a curious thing. Sometimes they balloon so large and ponderous—as in the case of all-girl, U.K. vocal troupe Spice Girls—that it becomes difficult to separate kitsch from composition. Overseas, these lascivious lasses are all the rage. Following their No. 1 European hit "Wannabe," they became hot tabloid topics. "Spice Girl Geri Burned Me Out in Bed," says Stud" was one recent U.K. headline, while a British *Hard Copy*-type program swore it would uncover another Spice-



ster's failed modeling career. What does all this gossip have to do with the Girls' debut? A lot, actually.

Musically, there is nothing happening here that anyone even vaguely acquainted with the disco movement hasn't heard before. "Wannabe," for example, bounces along on a buoyant synth rhythm, with the Girls—each of whom has cultivated a separate "personality" and style of dress for video purposes—yelping calls-and-responses before harmonizing on a chirpy, syrup-thick chorus. As pop songs go, it's about as intriguing as Elroy Jetson's little "Eep Opp Ork" ditty penned for his sister Judy's cartoon idol, Jet Screamer. But that's Spice Girls' great secret: They behave like cartoon characters. Happily. Like ABBA on Prozac. They can be taken seriously, simply because they hope you won't take them seriously. Hate them, and they'll only grow stronger.

Can double negatives such as this still make a positive in the angst-fueled alterna-world? Certainly not in the States, where Spice Girls' faux pop/soul shtick will probably be viewed as one big Limey in-joke. But if you divorce yourself from the urge to scrutinize it, *Spice* is a tasty spoonful of fluff that momentarily pleases the palate as it slides down your gullet. Which is the one thing most folks forget about

Mary Chapin Carpenter

With a warm lilting voice, a penchant for heartfelt prose, and the kind of easy-flowing rhythmic sensibility that makes heartland rock such an accessible, and successful, phenomenon, Mary Chapin Carpenter has risen above the yokels to become America's Everywoman singer/songwriter.

Although she's still marketed through her label's country division, Carpenter's sixth album has as much to do with Nashville as Son Volt or Wilco does. Sure, some of the bass lines are right out of the Music City session book, but Carpenter's heart and soul lie in pop and folk. And as she's progressively moved away from her barroom, tonkified folk meanderings, she's matured musically in a way that few other artists have.

A Place in the World

COLUMBIA

CK 67501, 45:11

Sound: A, Performance: A-



A Place in the World reveals a well-aware soul, one that can pinpoint the muse ("Ideas Are Like Stars") and the tension of as-yet-unrealized dreams ("What If We Went to Italy") without overwrought sentimentality or cheap insights. Stripping the songs of superfluous exteriors, Carpenter's sparseness is a barren cognizance. And when

she inflates her arrangements with the full force of her band (whether it's the easy R&B ebb and flow of "Let Me into Your Heart" or the rushing giddiness of "I Want To Be Your Girlfriend"), she's able to graft her songs into our hearts and souls. Carpenter isn't creating cutting-edge sounds, but there's nothing as cutting as a bleeding heart or the sound of someone crying alone. Vickie Gilmer

fads: They usually catch on because they're a great deal of mind-numbing fun. Nothing more, nothing less.

Tom Lanham

A Normal Family

Baby Fox

ROADRUNNER RR 8856, 41:02

Sound: B, Performance: B

This quirky slab of dub-skewed trip-hop begins with an unlikely rock 'n' roll reference. Imagine Johnny B. Goode (here called "Jonny Lipshake") transplanted to '40s Casablanca in a smoky bar full of shady characters and overflowing hookahs. London trio Baby Fox conjures this cinematic play with voluptuous ear candy. Creating its slo-mo sound from the distilled essence of Jamaican dub, Baby Fox adds reverberating percussion, smoldering strings, and honeyed female vocals warped by a baritone trickster. Like Cole Porter hanging out with the Mad Professor, *A Normal Family* is anything but.

After the sparse opening tracks, the scenery brightens with "Alien Way." This striking, wistful song could be an outtake from the Burt Bacharach/Hal David songbook. As Christine Ann Leach sings of suburban alienation with a lush voice recalling Dusty Springfield's, an eerie synth coos over rupturing slide



guitars and a fractured, spooky rhythm section. The bizarre title track (all of 17 seconds long) segues to Madonna-esque tones on an unusual cover of Marc Bolan's "Girl," and then things go down a bleak tunnel of atmospheric dubspeak with "Black Twister." Baby Fox can't decide whether to go full-out spliff crazy or entertain its pop prowess, so the trio simply does both. "In Your Dreams" is a bass-booming, Orb-meets-Jimmy Cliff spacecape, "Gloria Graham" a Morricone-tinged spoken-word dirge enveloped by swirling strings and rain falling on a tin roof.

Baby Fox doesn't drench its music in the bowl-rumbling bass tones of typical dub or electronics. Instead, the band prefers sparks of glistening color to enliven its twinkling songs. Baby Fox has discovered a unique world of doped satisfaction, dreamy melancholy, and pop nonchalance.

Ken Micallef

Fever In, Fever Out

Luscious Jackson

GRAND ROYAL/

CAPITOL CDP 8 35534, 47:27

Sound: A, Performance: A-

On its last album, 1994's *Natural Ingredients*, Luscious Jackson sought to escape bad relationships and big city hassles by laying down soulful grooves and "dancing all night long." Since then, the band has learned that true freedom comes only from self-content-

ment, so now it's using music to cope with its troubles instead of escaping them.

Fever In, Fever Out couples a seductive blend of rap, funk, pop, and soul with lyrics about conquering weaknesses, coping with depression, and avoiding danger. On "Take a Ride," vocalist Jill Cunniff warns us to "Live slow, die old," and on "Why Do I Lie?" she strives to break a destructive habit: "If you can forgive me for just being human/Then I will try harder to keep my words pure."

This self-actualization is complemented by ethereal moods and textures courtesy of producer Daniel Lanois, who has worked with Bob Dylan and U2, among others. Such a producer may seem a strange choice for a group that once stressed vibe and intent over technical ability. But Lanois' murky, effects-laden

wizardry has inspired Luscious Jackson to stretch its musical parameters further than ever before.

This band's slappy beats, tantalizing grooves, and sultry vocals are still present, but they're intermingled with spacious rhythms and psychedelic flourishes reminiscent of trip-hop artists Portishead and Tricky. The first single, "Naked Eye," embellishes a hook-filled melody with an undercurrent of echoing vocals, galactic sound effects, and dull, metallic percussion, while "Faith" contrasts alluring vocal harmonies with strange keyboard effects that sound like mosquitos flying into a bug zapper.

Luscious Jackson's albums once resonated with the sounds and spirit of its native New York City. With the release of *Fever In, Fever Out*, however, the band has forsaken its hedonistic haven for a healthier, more cosmic environment.

Jon Wiederhorn

Libido Speedway

Orbit

A&M 31454 0652, 55:43

Sound: A-, Performance: B

As their album title suggests, these three Boston boys equate sex with modes of transportation. They open with "Bicycle Song," which conjures up fond memories of Melanie riding her two-wheeler past my window 25 years ago. From there the band pedals into at least one spaceship-sex number ("Rockets") and two car-sex songs ("Nocturnal Autodrive" and "Motorama"). Considerably more flesh-conscious than alternative rock let itself be even a few monkish years ago, Orbit says it wants to make bodies dirty and then have them go out and purchase clean, new bedsheets.

The band has an anxious sound, produced with an unusually sharp clarity and swung around man-sized sprung bass lines. It's speedy, imitation grunge that pushes more than it plods, not quite as skittery rhythm-wise as recent Sponge or Stone Temple Pilots but not wham-bam-thank-you-ma'am cloddishness either. Orbit doesn't exactly rewrite the *Kama Sutra*, but it does have a few climactic tricks up its sleeve; bassist Wally Gagel, after all, co-wrote Folk Implosion's low-fi theme to the movie *Kids* ("Natural One").

Faster tempos result in staccato, Nirvana-like beats. The deep vocals try hard to sound ominous, but Orbit's bounce somehow keeps its heaviness from dragging. The libidos wane some three-quarters of the way through, when the band opts for a bit of detached experimentation. But even then, the souped-up orchestrations and guitar loop-de-loops might excite your nerve endings.

Chuck Eddy



THE ODDS

Nest

ELEKTRA 62006, 41:46

Sound: B+, Performance: A

In a way, some pure popsters are too good. Such bands as Prefab Sprout, Uncle Green, The Ocean Blue, and The Beautiful South lay the hooks on so fat and sweet, their music is almost too perfect, too complete. There's no room for human error and all its attendant charms. The Odds don't make that too-perfect mistake.

This Vancouver quartet is a rock 'n' roll band first, one that happens to excel at laying down nifty melodies. On *Nest*, its fourth album, the band keeps things scruffy. Guitarists Steven Drake and Craig Northey jangle comfortably in the pocket of unpretentiousness; the decibels stay high and the power chords rare. A fuzzy guitar counterlead opens "Say You Mean It, Wondergirl," Pat Steward's hi-hat rides out "Tears & Laughter," a distant trumpet ushers "Hurt Me" into silence, and "Night's Embrace" chugs along potently

in a tight, bristling shuffle. Throughout, guitars resonate in melodic, minor keys, always keeping the core melody at hand and never losing itself in purposeless, note-y solos or riffs. Lyrically, too, The Odds succeed, with smart songs of love and hate, winners and losers, and darkness and light. The storytelling style is reminiscent of The Kinks' Ray Davies. All the way around, The Odds have accomplished what few pop bands today could even envision doing: making the perfect pop album, imperfectly.

Bob Gulla



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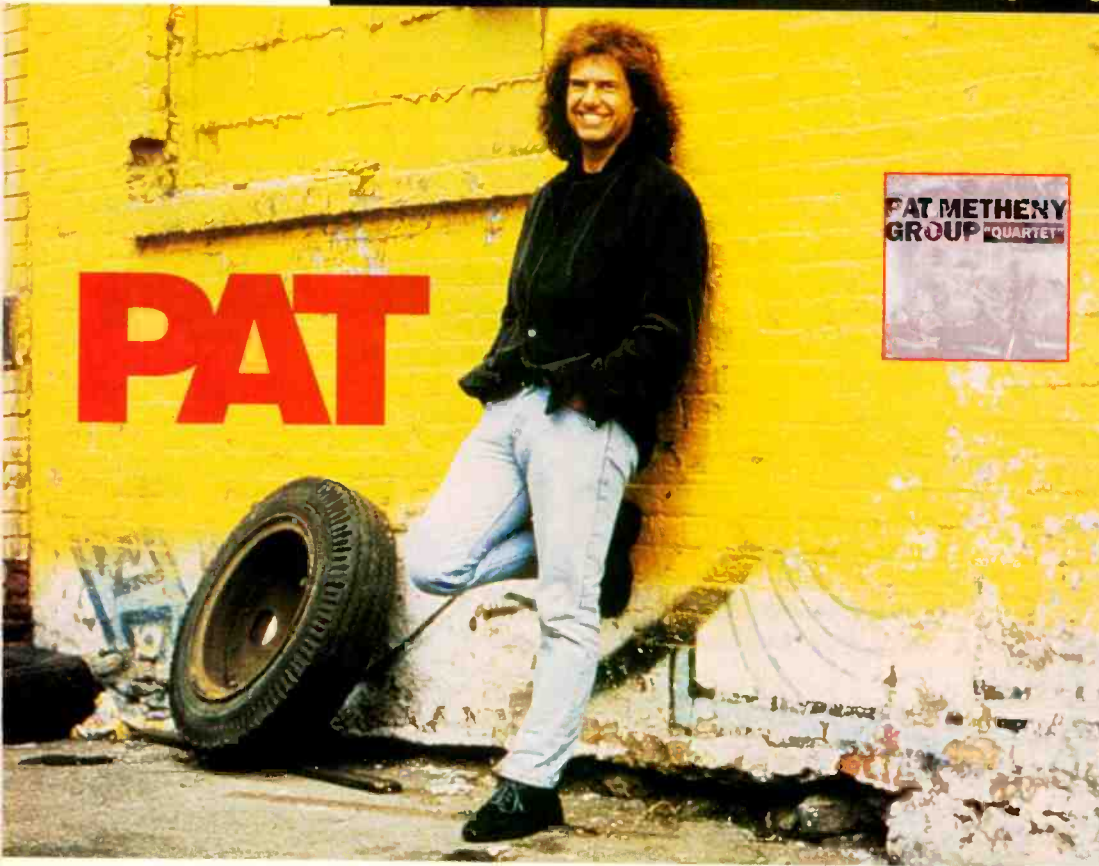
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RECORDINGS



Quartet

Pat Metheny Group

GEFFEN GEFD-24978, 66:01

Sound: A, Performance: A



iles away from the luminous texture-treks that have become The Pat Metheny Group's trademark—since such high points as *First Circle* and *Still Life (Talking)*—*Quartet* finds the group abandoning formula for refreshing, open-ended experimentation. Eschewing vocals, percussion, and, for the most part, synthesizers, the essentially acoustic quartet (Metheny, pianist Lyle Mays, bassist Steve Rodby, and drummer Paul Wertico) works its magic on 15 tracks that were, according to the liner notes, “assembled with little rehearsal, or improvised entirely.” Gone is the populist jazz-lite of *Letter from Home* and the hip-hop excursions of *We Live Here*. Instead, *Quartet* lets the listener in on freer, revealing music that is immediate, complex, and captivating.

At 66 minutes, *Quartet* includes soaring, straight-ahead, moody chamber pieces; Zappa-esque improvs; luxurious ballads; breezy think pieces; and one raspy, Morricone-styled vignette. Recorded after

the final leg of a year-long tour, the music often sounds contemplative and nomadic, as if months spent in buses and airliners had left the group feeling rootless and isolated. Metheny has always made travel music for the mind; *Quartet* is largely a thoughtful journey with brief moments of scenic interaction.

On the album's first track, “Introduction,” Wertico patters the cymbals while Metheny and Mays double a lilting, petal-falling melody. “Montevideo” takes the first left turn, a rambunctious improv where Wertico's street samba erupts from the sound of a traffic collision, leading the group in a funky Brazilian folk song. “Take Me There” is a prime PMG uptempo romp, similar to earlier tracks like “Third Wind” but with a rawer, driving edge from Wertico. “Seven Days” and “Sometimes I See” are selections from the songbook of heartbreakingly pretty Metheny ballads, while “Oceania,” “Double Blind,” and “Second Thought” are sculptured pieces based around taut melodies and constricted movements. “Badland” summons visions of ominous Western expanse with spooky, scraping string sounds and harried, skitterish rhythms. “Language of Time” (the longest track, at 7:32) lets Metheny

Photo: Timothy White

THE GUITAR TRIO

Paco De Lucia, Al Di Meola, and

John McLaughlin

VERVE 314 533 215, 53:07

Sound: A, Performance: A

It's been 15 years since these three six-string guitar virtuosos got together for their first tour, hailed as a “victory for the acoustic guitar.” And while they continue to play with *Passion, Grace & Fire* (their 1983 studio album on Columbia), *The Guitar Trio's* soulful restraint tempers the sheer bravado that was so dominant on their earlier joint efforts.

The concept here is basically the same as it was: quicksilver unison lines, percussive strumming, and lightning solos by three of the fastest guitar slingers in the business. Paco De Lucia

imbues his nylon acoustic lines with flamenco soul, Al Di Meola machine-gun picks with precision and intensity, while John McLaughlin displays uncanny flashes of brilliance and daring on his solos. But aside from all the mind-boggling chops, there is a depth that was sometimes lacking on 1982's live *Friday Night in San Francisco*. Di Meola and McLaughlin reach profound levels of tenderness on Luis Bonfa's samba classic “Manha de Carnaval” and on Di Meola's darkly hued “Azzura.” The three hit a stirring accord on De Lucia's “La Estiba,” engage in some heated exchanges on Di Meola's “Beyond the Mirage,” and dance lithely on McLaughlin's “Midsummer Night.” Exhilarating as always, and occasionally sublime. *Bill Milkowski*

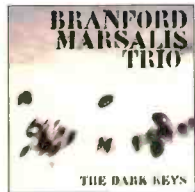


rev his guitar synth in a blowout, sensurround jam, and "Dismantling Utopia" sounds like Monk meets Captain Beefheart—a freaked be-bop melody skirting a madcap, sleazy Latin groove.

In its last album for Geffen, The Pat Metheny Group lets its longhairs down, exposing the jam session at the core of every great jazz outfit. Metheny's new label, Warner Bros., may expect him to be polished and popular, but *Quartet* is strictly for the music. *Ken Micallef*

The Dark Keys

Branford Marsalis Trio
COLUMBIA CK 67876, 62:05
Sound: B+, Performance: B+



Branford Marsalis, the eldest of the Marsalis sibs, could have taken the low road. He could have channeled the momentum from his crowd-pleasing stint as bandleader on "The Tonight Show" to produce mildly engaging, melodic, and easy-to-grasp "smooth jazz." But he didn't. Instead, he recorded *The Dark Keys*, his first album in three years and a challenging, free-form rebuttal to the glut of overly melodized product issued by major labels.

Joined by Reginald Veal on bass and Jeff "Tain" Watts on drums, Marsalis lays his tenor and soprano saxes over propulsive rhythms. Melody enters the fray modestly, with Marsalis choosing to blow in a loosely structured, intuitive fashion. On "Lykeif" he does so tenderly, while on "Hesitation" his playing contains more visceral fury. Only "Blutain," written by Watts, finds Marsalis settling into a relaxed, harmonic vibe. Also of note, Joe Lovano checks in with his tenor on the scrappy "Sentinel," and Kenny Garrett brings his alto into the groove-dominated "Judas Iscariot." Both guest slots are a welcome respite from Marsalis's rhythmic relentlessness.

This is not to say that *The Dark Keys* is a dissonant gamble. Admirers of free improvisation will enjoy Marsalis's nonlinear soloing, but the album isn't all squawk. Watts and Veal, by providing a satisfyingly tight bottom, keep the high end from spiraling off its axis. In the end, though, this is thorny, stimulating stuff and a brawny move for Marsalis. *Bob Gulla*

Tales from Việt-Nam

Nguyễn Lê
ACT WORLD JAZZ/
BLUE JACKEL 9225, 54:45
Sound: A, Performance: A

In the tradition of *Sketches of Spain* and Dave Brubeck's Japanese sojourns comes this latest from Parisian guitarist Nguyễn Lê.

Drawing from folk melodies and indigenous instruments of Southeast Asia, Lê, born in Paris to Vietnamese parents, uses the jazz imagination to capture what is more than a hip travelog. From the vantage point of a native son (not to mention a first-generation post-colonial) searching for his roots, Lê's

engage sundry percussion instruments and the spectral Southeast Asian slide zither (called a dan tranh), which Lê augments with his own fretless guitarwork.

Lê's ensemble at times produces a bland urbanity of occasional keyboard washes. But more often, the tension between hot jazz and

GINGER BAKER TRIO

Falling Off the Roof
ATLANTIC 82900, 57:57
Sound: A, Performance: A

A lanky fellow with bug eyes and flaming red hair, Ginger Baker has always been the most eccentric of rock drummers. With Cream, his bombastic solos sounded like a hurricane collapsing inward; in Blind Faith, his quirky touch primed the band's melodic explorations. Never a swinging drummer in the jazz sense, his playing always seemed a fortuitous accident of rhythmic calamity and bright creativity. In the late '70s, Baker pursued an African direction that complemented his explosion-in-process drumming style.

On Baker's second outing with guitarist Bill Frisell and bassist Charlie Haden, everything falls into place. Whereas their 1994 debut, *Going Back Home*, suffered from a lack of cohesion, *Falling Off the Roof* shows three gifted musicians relating in that telepathic realm of all great jazz trios, that sublime head-space where opposing forces work



to the benefit of the whole. Baker has integrated his African tom fills and dry swing feel with the rapturous musicianship of Frisell and Haden, delivering a fresh and floating sound. When his childlike fours-trading erupts in "C.B.C. Mimps," it's perfectly aligned with Frisell's whirling, sonic curlicues. Baker's equally clackety-clunk percussion comments bounce happily alongside

Haden's fatherly bass solo. "Bemsha Swing" adapts Monk's cubist logic with Baker's ram-bunctious style. Charlie Parker's "Au Privave" stumbles and shimmies, Frisell reacting to Baker's assorted bombs with a beautiful solo that paves the way for perky strutting by guest banjoist Bela Fleck. The title track hovers oddly, with Frisell's gorgeous lucidity and Baker's spastic motions wrestling playfully.

In a wonderful collision of jazz maturity and rock 'n' roll adventure (with a little bit of bluegrass flair courtesy of the humorous Fleck), *Falling Off the Roof* is a tumbling freefall into fun. And that's something jazz can definitely use more of. *Ken Micallef*

Tales from Việt-Nam is, in his words, the "creation of an imaginary folklore," uniting not only Eastern and Western musical notions but also the varied regions and peoples of Vietnam and their diaspora.



Incorporating elements from the north and south of the country, Lê touches on flourishes of theatrical folk opera (adding his own majestic guitar lead to "Trông Com") and acknowledges India's influence with Trilok Gurtu's able tabla. Occasional spoken and sung passages, often mirrored by guitar or muted trumpet, add a rich tonality to the folk melodies. When East meets West, a trumpet and saxophone horn section often presents Asian-sounding riffs; these linear melodies are deftly set swinging by a freewheeling rhythm section. The densely arranged compositions

Vietnamese folk idioms makes for an exciting aural landscape. (Available from Blue Jackel Entertainment, 322 Hicksville Rd., Bethpage, N.Y. 11714.) *Mark Schwartz*

Art Forum

Greg Osby
BLUE NOTE CDP 7243 8 37319, 57:31
Sound: A, Performance: A

For saxophonist Greg Osby, the '90s have been about creating a new fusion: a merging of what is musically popular in African-American culture (not entirely hip-hop but never really far from it) with jazz. *Art Forum*, however, is a straight-ahead acoustic jazz album, one that emphasizes ballads and slow tempos. For an anti-traditionalist like Osby, it took balls to make it.

Art Forum is also the best album Osby has made in years. Although his playing is, unfor-

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tunately, so soft and subtle that it's easy to ignore, group cohesiveness and composition are the focus here. This is pleasant-sounding music, and its lasting impression arises from its entirety—the seamless flow of the compositions—rather than from an individual performance. Which is not to say that Osby is playing with a pretty banality. It's just that, for example, the brilliance of his breathy interpretation of Billie Holiday's "Don't Explain" is easy to overlook.



The duties of chordal accompaniment are divided among pianists James Williams and Darrell Grant, vibraphonist Byran Carrott, and guitarist Marvin Sewell. Coming mid-program in duet with Osby's alto, Sewell's raspy acoustic blues-slide work and overdubbed arpeggios are refreshing and well timed. The guitar's timbre stands out in contrast to the otherwise soft-edged tone taken on by Osby and the other players. Sewell shows up again on "Perpetuity," the album's closer, where he plays variations on an eerie 6/8 vamp in the left channel and solos in the right.

It will be interesting to see if Osby returns to the "new fusion" next time out—and, if he does, which of the compositional advances on *Art Forum* remain.

R. Dante Sawyer

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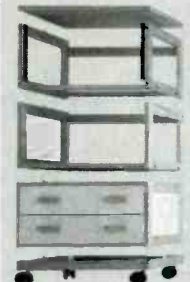


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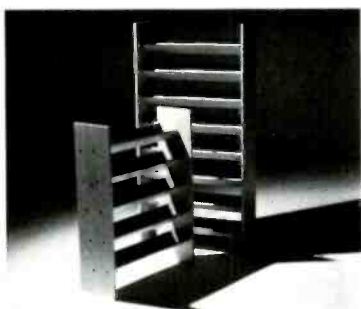
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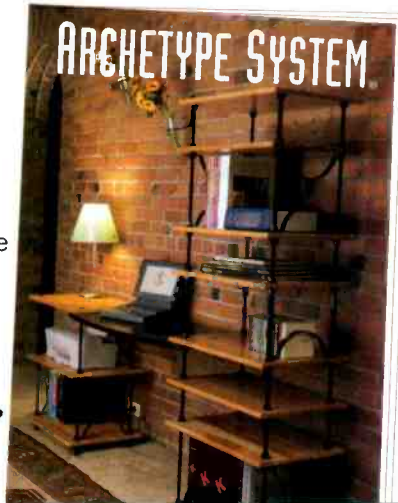
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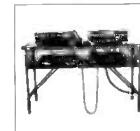
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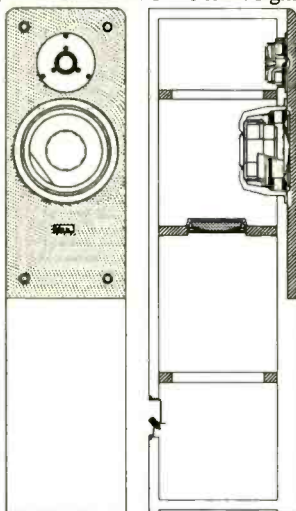
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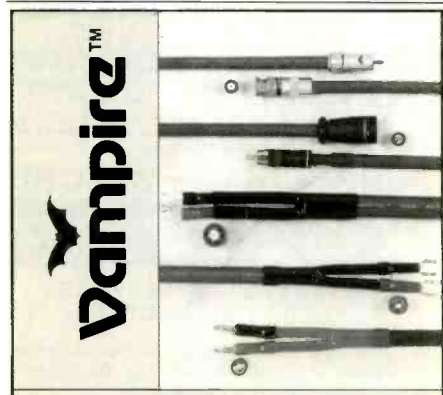
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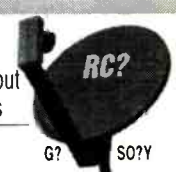
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PER MADSEN RACKIT SYSTEM 19 EQUIPMENT RACK

Over the years, I've stored audio gear on everything from linen racks to bricks and boards to coffee tables—and everything in between. Although I've had some high-end racks as well, the Per Madsen RackIt System 19 is one of the most versatile racks I've ever had the good fortune of using.

Based on easy-to-put-together oak frame modules ranging in height from 5 to 15 inches, this sturdy rack has made my life as a reviewer much easier. For my home theater equipment, I stacked six modules: a 15-inch cassette drawer, three 15-inch rack modules (one with rack rails), a 5-inch rack with a tabletop, and a 10-inch module. This setup holds at least three amplifiers, a preamp, a processor, an equalizer, a VCR, a DSS receiver, and other assorted gadgets.

The two-drawer base module is available for CDs, audio cassettes, and videotapes. Best of all, this rack is on wheels, which makes equipment swaps, wire changes, and carpet shampooing a snap. Unplug the speaker cables and the power strip from the wall (I attached the strip to the back of the tape-cabinet module), and the rack wheels easily across the room, despite the weight of the equipment.



GRADE: A

If you swap your audio components frequently and want an attractive equipment rack, check out the

RackIt System 19. It is not cheap, however; my version retails for more than \$600. (Per Madsen Design: P.O. Box 882464, San Francisco, Cal. 94188; 415/822-4883.)

John Gatski

For literature, circle No. 120

Audio by Van Alstine FET-Valve TOPP DAC

Tubes seem to have found their way into nearly every component category, including digital-to-analog converters. Leave it to Frank Van Alstine to come up with a dandy, stand-alone solid-state/tube hybrid D/A converter.

The FET-Valve TOPP DAC (\$899) is styled in Audio by Van Alstine's plain-black-box tradition. It features a Philips 16-bit, hand-selected converter chip with a four-times oversampling digital filter. The analog stage uses a tube (Chinese 12AX7A) combined with a FET. The only front-panel control is an illuminated on/off switch. The rear panel sports gold-plated RCA jacks for coaxial digital input and analog output.

I tried the TOPP DAC with a \$600 CD player, a \$3,000 CD player, and a portable DAT recorder. With the lower-priced player, the TOPP added a certain musical character that had just a touch of tube warmth. Drum cymbal hits had the air and precise splash of a real drum set, while the CD player (via its internal D/A



GRADE: A-

converter) portrayed the cymbal as a bit overly metallic and closed in. The portable DAT definitely benefited from the TOPP DAC, which delivered more depth and detail in the soundstage.

Versus the \$3,000 player, however, the TOPP DAC was not quite as detailed, but it did make some digital brass recordings a little less harsh. All in all, this is a real nice D/A converter for the money. (Audio by Van Alstine: 2202 River Hills Dr., Burnsville, Minn. 55337; 612/890-3517.)

John Gatski

For literature, circle No. 121

WHIRLWIND CABLE TESTER

Ever had a channel go out on a receiver or amp and you checked everything but the cable? After thinking your multi-hundred-dollar investment was ready for the trash can, on a whim you tried a new cable and the amp worked like new. How embarrassing!

The Whirlwind Cable Tester simplifies cable testing. This \$79.95 black box has jacks for XLR (male and female), 1/4-inch, and RCA plugs. For RCA cables, simply plug one end into one jack and the other end into the other jack. Green LEDs indicate continuity for the ground and pin. No lights means a broken connection, a wire break, or connector corrosion. The tester is also equipped to check 1/4-inch mono/stereo, XLR or "mixed" XLR, and "mixed" 1/4-inch/RCA cables. If pins 2 and 3 are reversed on XLRs, an out-of-phase LED lights up. Status LEDs also indicate which pin is hot on XLR and 1/4-inch cables.

Because I have a huge maze of wires from 10 components in my home theater system, the Cable Tester is invaluable in determining matching ends if I unplug a bunch of cables that all look the same and want to replug them. No audiophile should be without this tester. It has a handy belt clip and runs practically forever on one 9-volt battery. (Whirlwind: 99 Ling Rd., Rochester, N.Y. 14612; 888/733-4396.)

John Gatski

GRADE: A+



For literature, circle No. 122

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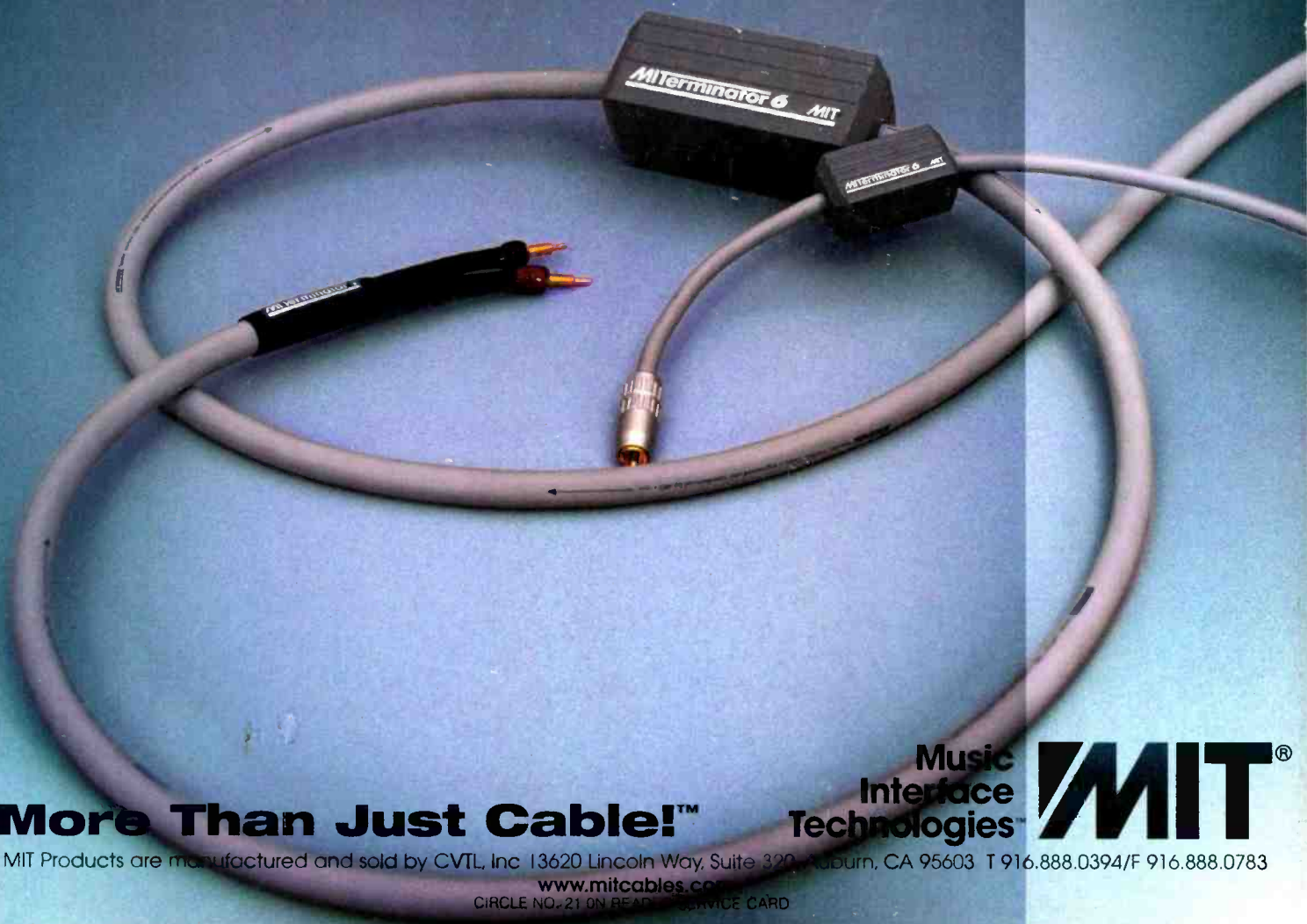
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