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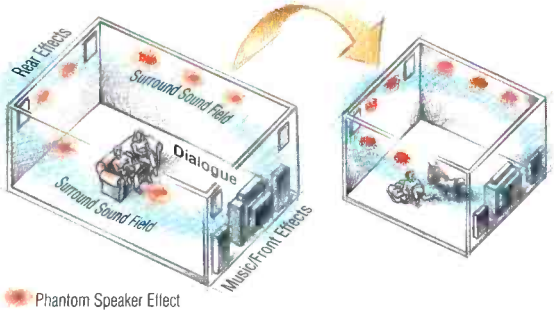

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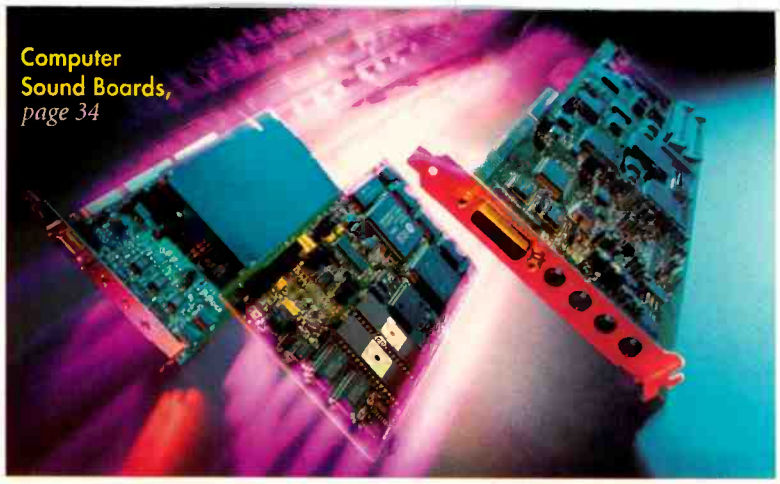

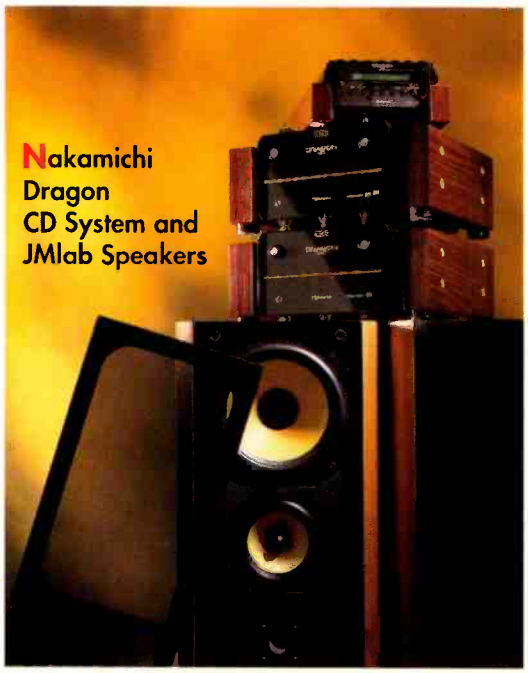

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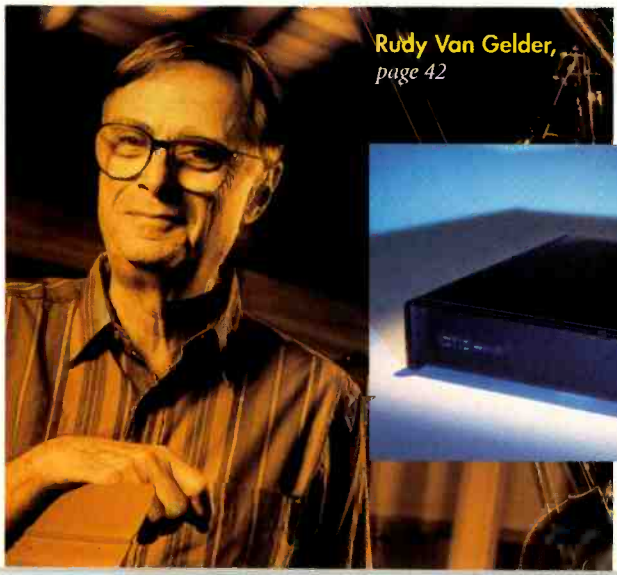


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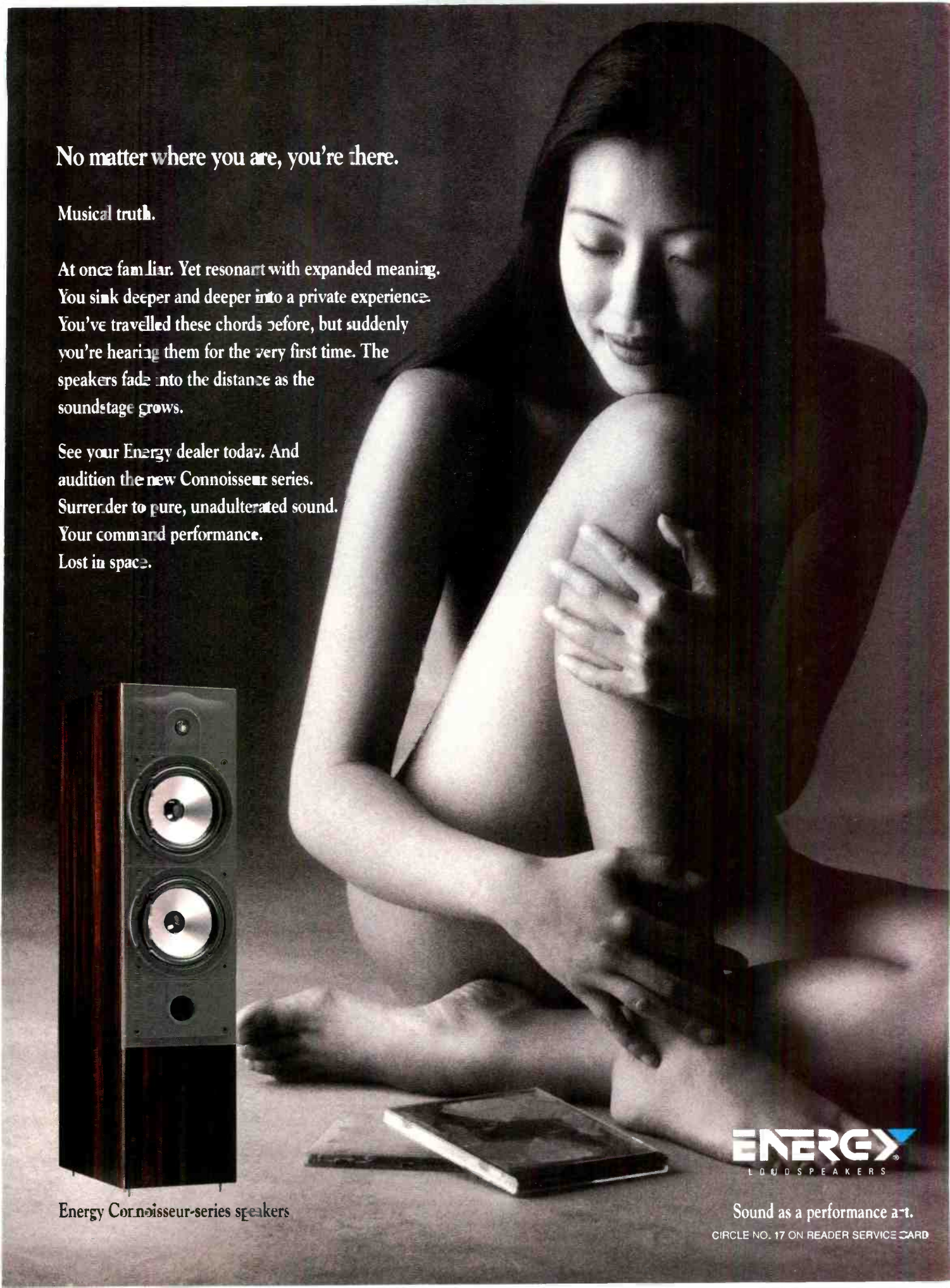

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WHAT'S NEW

Mesa Engineering Amp

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McIntosh Multizone Controller

The McIntosh CR12 lets you select separate A/V or audio-only program sources for any of four zones in your home. Volume level, bass and treble, and automatic muting (when a telephone is used) can be independently controlled for each zone; individual AM/FM tuners can also be used for dedicated broadcasts to each zone. Programming capability allows, for example, separate sources and volume levels for morning wakeups in each zone. The unit can be controlled by a handheld remote beamed at remote infrared sensors or through wall-mounted keypads. Up to six CR12s can be cascaded, for control of up to 24 zones. Price: $3,300.
For literature, circle No. 102

Wright Preamp

Five line inputs and an MM phono input, as well as a tape output, are accommodated by the all-tube Wright PL-1 Series 2 preamp. Mil-spec resistors and metallized polypropylene coupling capacitors are point-to-point wired, eliminating the need for p.c. boards. Frequency response is rated ±1 dB from 10 Hz to 60 kHz. Price: $850.
For literature, call 503/343-1413

Dynaco CD Player

Though not the first CD player to use a vacuum-tube analog section, Dynaco's CDV-1 may be the first to put its tubes on display. The tube input and driver stages operate in Class A, and a volume control allows the CDV-1 to drive a power amplifier directly. On the digital side, it uses a Philips transport and one-bit D/A converters. Price: $699.
For literature, circle No. 101

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AUDIO CLINIC

JOSEPH GIOVANELLI

Tri- and Bi-Wiring Redux

Q *I read in a recent equipment review about a pair of loudspeakers that were capable of being tri-wired. How are such loudspeakers arranged so that they can be bi- or tri-wired? How are they wired to a power amplifier? What advantage does this type of wiring have over a single cable running to a loudspeaker, which is what I have always done?*—Spencer Albion, Oshawa, Ont., Canada

A I have written about bi-wiring in the past, but apparently the subject is still mysterious to many who read this column. I'll try to be really detailed, in the hope that you can gain a better understanding of what is involved.

A loudspeaker system often consists of two sections, or drivers: A woofer and a tweeter. Such a speaker is referred to as a two-way system. Other speaker systems may consist of a woofer, a midrange, and a tweeter—a three-way system. Bi-wiring is a way of feeding each driver of a two-way system independently from the same amplifier; tri-wiring does likewise for three-way systems. (Three-way systems can also be bi-wired, using one cable for the woofer alone and the other for the midrange and tweeter.)

For two- or three-way systems to operate properly, the audio spectrum must be divided into "slices." In the case of a two-way system, the spectrum is divided, using a crossover network, so that the low and mid frequencies are fed to the woofer and the higher frequencies are fed to the tweeter. In the case of a three-way system, the lower frequencies are sent to the woofer, the frequencies in the middle of the spectrum are fed to the midrange driver, and the higher frequencies are fed into the tweeter. Most loudspeakers, particularly in the low and medium price brackets, provide only a single pair of input connections, which feed the entire crossover network.

To make bi-wiring and tri-wiring possible, the network must be designed so that each driver can be fed independently via its own terminals. A loudspeaker system that is designed in this way can be connected to the amplifier via a single wire pair, and the speaker terminals jumpered, so that the drivers are connected in parallel. But for bi-wiring or tri-wiring, these jumpers are removed, and separate cables are run between the power amplifier and each pair of speaker terminals. Notice that although we are using the same power amplifier to feed each driver in our system, we are using different cables to feed each one. (There also are systems that employ a separate amplifier to power each driver. This is called biamping or triamping.)

Why go to the bother of bi-wiring? The best reason is that, because of the lowered d.c. resistance of multiple cables, there is less tendency for ringing at the speaker's crossover points. Suffice it to say here that ringing produces a smearing of the music. Another reason often cited is better control by the amplifier over each driver, with less mutual influence between crossovers and between drivers. Any sonic improvements obtained through this wiring approach are going to be subtle, and I can't tell you whether it all will be worthwhile.

Obviously, bi-wiring doubles the quantity of speaker cable required to hook up a system, and tri-wiring triples it. If you prefer using very exotic, expensive speaker cable, these wiring schemes can materially increase the cost of the installation over that of conventional wiring.

Cassette Heads and Frequency Response

Q *In "Trouble in Treble City" (November 1994), a reader complained that tapes made on his three tape decks gained or lacked highs when played on the other decks. Your comments on azimuth adjustment were helpful and appropriate. But you didn't follow through on the equalization aspect. If the decks were of different makes and models, the problem might be in the design of the various playback heads and consequent differences in equalization of the playback amplifiers.*

Playback EQ is adjusted for flat response from a standard test tape. Record EQ is then adjusted for flat record/play response, which in turn is affected by the deck's play head and playback EQ. This can cause differences in treble response when tapes are interchanged between decks.

This problem will continue until all cassette heads are manufactured to the exact same standards—which I don't expect will be very soon in coming. Frequency response anomalies are just a frustrating part of life in the cassette world.—Kurtis Vanel, Bernaby, B.C., Canada

A If the playback EQ was so well matched to the play head that playback response was perfectly flat, then the playback system would have no effect on record EQ, and you'd be wrong. But since this is never quite the case, you probably have a point.

A more likely cause, aside from mismatched head alignment between decks, would be the effect of mismatched record sensitivity settings on Dolby noise-reduction circuitry or of mismatched threshold settings of the three decks' Dolby NR decoders. You could check for this by making test recordings on each deck with the NR shut off, and keeping it off when playing these tapes back on the other decks.

If one or more decks have auto reverse, you may also run into problems caused by mismatches in the tape path as the tape runs across the head assembly in each direction.

LP DSP

Q *My CD changer has digital signal processing built into it. Using its DSP "rock" and "jazz" settings certainly helps enhance CDs. Can DSP also be used to enhance the sound from my LPs? If I buy an A/V receiver, will I need a separate DSP in it, or can I use the one in my player?*—Theodis Whiteside, Jr., Little Rock, Ark.

A DSP unit does not "know" what program source is feeding into it: It will work as intended, regardless of source. But the DSP system built into your CD player will only be able to process CDs if there is a

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If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1633 Broadway, New York, N.Y. 10019. All letters are answered. In the event that your letter is chosen by Mr. Giovanelli to appear in Audioclinic, please indicate if your name and/or address should be withheld. Please enclose a stamped, self-addressed envelope.

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We want to buy into the illusion that a live music event is happening in our homes... The ARC SDP1 helped me get much closer to that illusion...

Adding surround sound through the SDP1 was like switching from solid state to tubes without sacrificing the resolution...

The SDP1 weaves its most powerful spell on concert recordings...

With the SDP1, the listener cannot avoid involvement and it takes much less effort to suspend disbelief...

The SDP1 removes the wall; it restores the continuum of sound between the instruments and the listener. This effect is subtle but profound. It is a revolutionary improvement in the credibility of reproduced music."

By Tom Miiller
Reprinted from
THE AUDIO ADVENTURE
April 1995, Vol.2, Issue 4

PURE. SIMPLE. NATURAL. The critics agree.

"The Audio Research SDP1 plays music with superb sonic fidelity, much better than other surround processors.

As things stand today, the Audio Research SDP1 is clearly focused at the listener who is unwilling to compromise the basic sonic fidelity and spatial imaging of the front stage space, who is unwilling to settle for less music than he hears today from his high end stereo system.

On music recordings, all the musical information is up front in this front stage space. All other surround processors degrade this vital information. Only the SDP1 does not.

In fact, the SDP1 can enhance this front stage information. The SDP1 can help the center stage space become deeper, richer, and more realistic, enhancing the believability of the musical event on stage. It can even improve the apparent fidelity of instruments playing center stage. The natural musical nuances of each instrument can be more clearly heard when each instrument is surrounded by its own portion of believable stage space.

Congratulations to Audio Research for having the courage to uphold their tradition and stick to their guns. It's paid off with a unique surround processor that redefines the fidelity standard for music lovers interested in surround sound."

By J. Peter Moncrieff
Reprinted from
IAR HOTLINE! 68-70
December 1994

"For those of us who have succumbed to the enticements of surround-sound for music, Audio Research's SDP1 is... cause for rejoicing because someone has finally done music surround right...

Audio Research is, to my knowledge, the first company to offer completely distortionless stereo channels in a surround decoder...

I wasn't surprised to find the SDP1 the best-sounding surround decoder I've ever heard—or, rather, not heard...I could hear no "sound" from the decoder whatsoever... I guarantee you won't find another surround decoder that has any less effect on the front channels than this one...

If you have any misgivings about getting into surround-sound for your music listening, the Audio Research SDP1 should dispel them. It passes the all-important front channels completely unscathed, it does as good a job as any decoder can with the surround channels..."

By J. Gordon Holt
Reprinted from
STEREOPHILE
Vol.18, No. 8, August 1995

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way to route other program sources through it. The DSP section of an A/V receiver will certainly process any signal you choose to feed through the receiver, though the effect may not be identical to that from your CD player—it may be better, worse, or just different.

"Static" with VHS Hi-Fi

Q *Sometimes I hear a soft, static-like crackling on the Hi-Fi soundtracks of many prerecorded VHS Hi-Fi tapes but not on their linear tracks. A slight adjustment of the tracking control will sometimes lessen the problem but never eliminate it. Not all tapes have this problem, yet those that do exhibit it on all three of my Hi-Fi machines. Would you suspect my equipment, hookup, cables, dry environment, etc. to be the cause of this? Is it due to some inconsistency between record and playback standards?*—Richard A. Lipari, Chicago, Ill.

A The "static" is, I believe, related to the switching between the VCR's two playback heads. If the mechanical switching during playback occurs at different times from those which occurred during recording, there will be some static. This is often caused by damaged tape edges, which make the tape skew so that the switching times don't match. As you have noticed, it can often be reduced, and even eliminated, by an adjustment (sometimes considerable) of the tracking control.

Rental tapes are more prone to tracking problems. This is largely because they have been played many times, often on decks whose guides are so badly aligned as to cause edge damage.

Problems can also occur with your own tapes, if you make them on "bargain" blank cassettes. These "cheapies" may have been poorly slit and have edge problems from the start, often exacerbated by poorly made cassette shells that also cause alignment problems. Such tapes may also have coating and binder problems. High-grade tapes from recognized manufacturers are now cheap enough that you shouldn't have to skimp and compromise your recordings.

Also note that misadjusted tracking controls can cause tracking errors on the recordings *you* make. Such tapes would play properly on your machine but wouldn't track correctly when played on properly adjusted machines unless you adjusted their tracking controls. However, unless all three of your VCRs are identically misadjusted (which is most unlikely), this is probably not the cause of your problem. You'd know if one of your VCRs had tracking misalignment, since its tapes would then need tracking-control adjustments when played on your other two decks.

Who Needs Separate D/A Converters?

Q *Why are there stand-alone D/A converters? Don't CD or LaserDisc players already include such converters?*—Rick Wang, Irvine, Cal.

A Having separate components instead of a combination unit lets you select the best of each. And in many cases, as you can see from *Audio*'s test reports, separate D/A converters do outperform the D/A sections in CD players.

Separates also let you upgrade piecemeal. If your CD player has a digital output, you can hook it up through a separate D/A and see if you hear the difference. If you decide to buy the D/A, you can later try a dedicated transport and see if it, too, improves your sound. And when improved equipment comes along, you can replace only the component you consider "obsolete."

It's About Timers

There are two ways to set up a cassette deck for timer-operated recording that were not covered by the question and answer on this subject in the February 1995 issue.

First, I've seen universal remote controls (such as the Memorex CP-8) that had a built-in timer. If the tape deck can be controlled by a wireless remote, such a remote could be programmed with the deck's recording functions. You could then use the remote to start the deck recording (or playing) at a preselected time. As an additional benefit, this system can be made to operate other devices. For instance, it could be set to turn on a receiver, have it tuned to a particular station, and then start the tape deck to record the program.

Second, you could record on a Hi-Fi VCR, using its built-in timer, and then copy that recording onto a cassette deck. The high quality of the original recording should ensure a satisfactory copy, and you have a chance to edit the tape, if need be, during the transfer.—Michael Sock, Providence, R.I. A

Definitive's New BP2000 Brings You the Ultimate Listening Experience!

"The first speaker I have been able to audition in my own familiar surroundings that has given me that special thrill that usually costs ten or more times its price to obtain."

–Julian Hirsch, *Stereo Review*

"Frankly, if circumstances allowed, I would choose these speakers for myself."
–Julian Hirsch, *Stereo Review*

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Now, with the BP2000, Definitive literally reinvents the loudspeaker. We have combined a six-driver dual D'Appolito bipolar array with a built-in (side-firing) 300-watt powered 15" subwoofer. (Yes, a complete powered subwoofer built into each speaker!) The result is extraordinary sonic performance beyond anything you've ever heard.

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Battery-Powered Amps

Dear Editor:

I read Bascom H. King's article "Switched-On Amps: Power with a Pulse" (February 1995) with interest.

Now, for some questions. First, will battery power supply be a viable option for the amplifiers discussed, since they have very modest power requirements? Second, in regards to the battery power supply, since switching amp use very little power, would ordinary car batteries work to power them? Consider this: One 75-AH battery would be big enough to power a 300-watt/channel Class-D stereo amp for about 12 hours; an ordinary car battery charger could be used to charge the battery when the amplifier is off. And a dedicated control box could be used to manage charging the battery. If off-the-shelf components could make up most of the battery supply, the price would be *low—not* $3,000!

Arild Gjeldnes
Jesus Pobre, Spain

Author's Reply: Yes, indeed, battery power is a viable option for powering switching amplifiers. A simple external charging circuit is needed also. For example, the Infinity car audio switching amplifiers could certainly be used for home use with a battery. Incidentally, one doesn't need to use a battery as big as a car battery; motorcycle or smaller gel-cell batteries work quite well. For instance, the Arnoux 7B amplifier uses a 10-AH battery, and it runs the amp for most of the day at low to medium volume with the charger disconnected. Still, for serious use at higher power levels, a car battery would be best.—*B.H.K.*

Living in a Vacuum?

Dear Editor:

I was very disturbed by the two power amplifier reviews by Bascom H. King in the July issue.

The first amp reviewed was the Cary Audio Design CAD-805 mono amp, a vacuum tube design that, according to my 1945 edition of the *Radiotron Designers Handbook*, is reminiscent of amps of that era that were used primarily in public address systems. The second amp, the Carver Research Lightstar Reference, a solid-state design using innovative power-supply design techniques, is a logical progression in the advancement of audio power amplifier design.

What disturbs me is the fact that even though the solid-state design exhibited measured performance vastly superior to that of the vacuum-tube design, the "listening test" which followed in both cases negated the effort spent in that testing.

The description of the sound of the CAD-805 starts with, "I must admit I was quite impressed with the sound of the CAD-805s when I first got them going. There was, indeed, an ease to the sound that made it a pleasure to listen to music with these amps." Compare that with the description of the Lightstar Reference, the solid-state design: "At first encounter, the Lightstar Reference sounded a bit obscure and unclear." The text that followed showed an obvious prejudice for the vacuum-tube design.

I was "stung" by the high-fidelity bug in the early-1960s at the age of 12. I gravitated toward *Audio* magazine as my prime source of information because of its objectivity in product reviews and the depth of the technical articles. Your publication, among others, influenced my professional growth in the field of electrical engineering.

I'm disappointed that a young person of today might think the years of study required to become an audio engineer are not justified, because ancient, marginal tube designs produce superior sound to designs that require years of experience, many man years of research and development, and a commitment to improving the status quo in amplifier design.

High-fidelity sound reproduction is as close as many of us in the engineering field will come to promoting the arts, by bringing the sensation of the musical experience to others. There is much work to be done, but the work should be focused on the known problems, not amplifier design using ancient technology.

There are not many publications that provide the kind of information *Audio* has provided over the years. Please do not lose sight of this.

Bob Smith
Los Altos, Cal.

Author's Reply: I am glad Mr. Smith was disturbed by my reviews! If nobody got disturbed, I wouldn't be doing a good job as a reviewer. Getting people disturbed is the precursor to possibly changing their thinking.

In my reviews, I do make measurements to the best of my ability, and where possible, I try to relate them to possible sonic results. To be honest, though, the measurements that most of us reviewers make don't relate very well to the sonic results. In my listening and use tests, I try to describe how the equipment sounds to me and whatever reactions I have to it, sonic and otherwise.

I do have my feelers out looking for new measurements that relate to sonic experience, but they don't seem to be in great abundance. I am open to suggestions for new measurement techniques that possibly relate better to the sonic experience.

With the above in mind, I fail to see how the listening tests negate the effort spent in testing the amplifiers. Furthermore, I don't see how my comments that follow the measurements for the solid-state amplifier show any obvious prejudice for vacuum-tube designs, as there is no mention of them at all in this text! I wouldn't worry too much about members of the younger generation who want to become audio engineers being discouraged by the good sonic attributes of "ancient, marginal tube designs." Those young people who are destined to become good audio engineers will learn from the past, use their ears to *listen*, and find a way to combine what is legitimately good about those old designs into whatever new technology that they will be practicing.

In the final analysis, what matters more to me is how an audio component handles real music signals in an actual music reproducing system than how it measures on the test bench.—*B.H.K.*

Open-Reel Fan

Dear Editor:

I would like to see *Audio* do an article on the state of open-reel recorders today. It is

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sad that no magazine runs articles about them anymore. There still are open-reel recorders being manufactured, such as by Nagra and Studer. Also, I'd like to see an article on the state of blank open-reel tape.

Phillip R. McCreary
Columbus, Ga.

Editor's Reply: As we have noted before, open-reel recorders today are aimed at the professional market and, as such, are outside *Audio*'s focus on the consumer industry—a focus applauded by the great majority of our readers. We did, however, run an article in the April 1994 issue on the splicing and care of open-reel tape, "Jurassic Tape: How To Be a Good Audio Dino."—*E.P.*

Time Delay and Diffusion in Surround Sound

Dear Editor:

I would agree with Tomlinson Holman's excellent article on surround speakers (July 1995) that diffuse sound is required at the side speakers in a theater setting. On average, the listener sitting in the audience is located closer to the side speakers than to the speakers in the front, which are typically 40 to 100 feet away. With that setup, the directional cues from the front channels must be given preferential treatment.

In a home setting, however, the side speakers are likely to be only 10 to 15 feet from the front speakers. With such placement, the front channels are likely to swamp any perception of the side channels, due to the precedence effect. In cases such as this, a more directional radiator may be more appropriate.

Ronald B. Levine
Philadelphia, Pa.

Author's Reply: There are two cases regarding the difference in time delay between front and surround speakers. For matrixed sound, like Dolby Stereo, both the cinema processor used in theaters and the controllers used at home have delay lines in the surround channel. In the cinema processor, the delay is adjustable, so that surround sound arrives at typical listening locations approximately 15 to 20 mS after the direct sound. In home controllers, a similar time delay is used, but due to the room size, the actual time delay is shorter. The results are the same, however.

The reason for having the surround sound delayed in a matrixed system is, as Mr. Levine's letter suggests, the suppression of crosstalk into the surround channels: It is important that this crosstalk be suppressed so that dialog, for instance, constantly sounds in front. This is accomplished by using the precedence effect to advantage.

In a fully discrete system, on the other hand, there is no need to delay the surrounds in order to suppress crosstalk. Delay will nonetheless be available on controllers, so that home conditions may better mimic dubbing stages by delaying the surrounds to "put them into sync" with the front channels. In addition, Home THX AC-3 controllers will have separate center and subwoofer delay controls, ensuring that time-of-arrival synchronization at listening locations can be achieved. For the subwoofer channel, this is a distinct advantage because it permits the subwoofer to be placed in a corner for best coupling into the room, while simultaneously allowing its output to combine with front speakers displaced from it.—*T.H.*

Speakers, Call and Response

Dear Editor:

I'd like to respond to several minor qualitative boo-boos in Hank Zumbahlen's otherwise informative "Zobels and All That" (June 1995).

First, the acoustic center of a driver isn't "located" anywhere; it moves with respect to frequency. The impedance of a driver is capacitive at some frequencies, inductive at others, and purely resistive at both the resonance point and the point of minimum impedance above resonance. This causes phase shifts in input current, and results in displacement of the acoustic center as frequency changes. Mechanical considerations also have an effect.

Second, low amplifier impedance does nothing to "control" induced EMF in the voice-coil. Induced voltage is proportional to voice-coil velocity. This voltage at no time "sees" the low amplifier output impedance. Such a situation would cause an enormous current flow in opposition to the amplifier's output voltage, an obvious impossibility. What the back EMF "sees" is amplifier voltage in opposition to, and always greater in magnitude than, the induced EMF itself. Current is driven through this circuit by a single net voltage (measured at the amp output), and low output impedance is still important to damping. Back EMF is reflected in high speaker impedance and reduced current flow.

To be fair, both these subjects are widely misunderstood, but I think you ought to run an article covering these types of concerns by D. B. Keele before you publish one like this. I remain a loyal subscriber (due in part to Mr. Keele) and greatly miss the late Bert Whyte's column.

Andrew R. Lewis
Englewood, Colo.

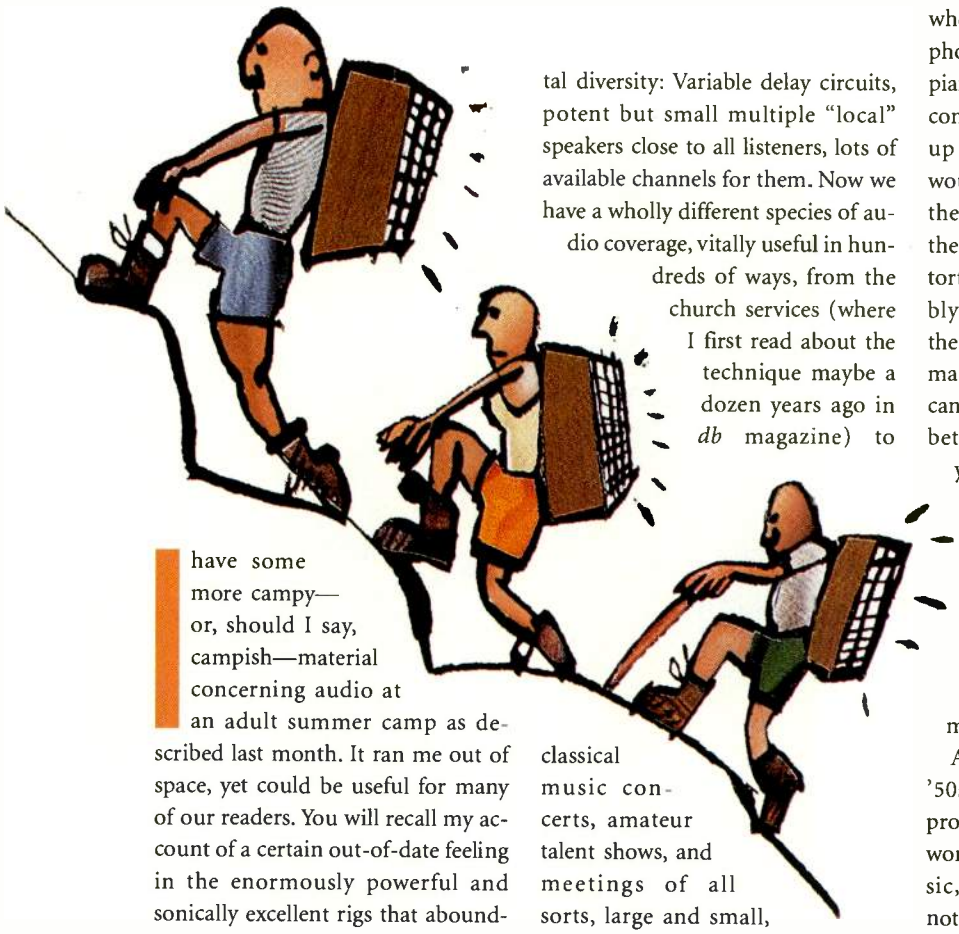
Author's Reply: Thanks for your interest in my article. In response to the points you praised:

First, you state that the acoustic center is not located anywhere and then say that it "moves." I maintain there is an acoustic center; the fact that it moves was a detail beyond the point I was trying to make. I was discussing the use of all-pass filters used as time delays in active crossovers. The point was made that there was no practical passive counterpart available. If you mount drivers on a standard flat baffle, the acoustic centers will not align. This is why audiophiles sometimes tilt speakers back a bit. Several high-end manufacturers (such as Thiel) use a sloping baffle or separate subenclosures that physically offset to adjust for this effect (B & W and Vandersteen, for example).

On your second point, I disagree completely. If the voice-coil of a speaker is connected to the output of an amplifier, it most certainly does see the output impedance of the amplifier as its load. Practically all modern amplifiers can be thought of as voltage sources. This means that the amplifier will provide whatever current is required to hold the output voltage at its proper level—within its range, obviously. It is this property that controls the back EMF. I think we are talking about the same effect here, just from different vantage points. Also realize that while the speaker does generate back EMF, its power capability is low. I greatly encourage you to respond if you wish. Discussion is, by far, the best path to understanding.—*H.Z.*

EDWARD TATNALL CANBY

QUICK: SOME DELAY!



I have some more campy—or, should I say, campish—material concerning audio at an adult summer camp as described last month. It ran me out of space, yet could be useful for many of our readers. You will recall my account of a certain out-of-date feeling in the enormously powerful and sonically excellent rigs that abounded in the camp, mostly all going at once and with no distinction between indoors and outdoors (no windows, only screens).

The equipment was strictly stereo, largely out of pairs of hefty speakers set up to cover audiences large and small, usually from a pair of up-front locations. For small it works; for large there are major problems of coverage. That is indeed the way we always did things in the days, in the many decades, before digital and multiple small speakers. We don't anymore—thank the gods of audio!

The big change was mainly due to developments made possible by digital diversity: Variable delay circuits, potent but small multiple "local" speakers close to all listeners, lots of available channels for them. Now we have a wholly different species of audio coverage, vitally useful in hundreds of ways, from the church services (where I first read about the technique maybe a dozen years ago in *db* magazine) to classical music concerts, amateur talent shows, and meetings of all sorts, large and small, announcements and speeches made to large gatherings—you name them. It is a fantastic improvement in what once was just called P.A., Public Address, drastically altering major aspects of audio, even including recording.

PUBLIC SOUND SYSTEMS SHOULD BE LESS LIKE LOCOMOTIVES, MORE LIKE TROLLEYS AND SUBWAYS.

Yet little of this, remarkably, was evident at my camp in Maryland. Nor, come to think of it, at several other similar camps I have visited on vacation. I wonder how many thousands of places all over the country are the same? Big, too-loud sound, mostly up front, progressively less intelligibility towards the rear, only a small portion of the listeners ideally placed for best hearing. Regrettably, still all too common.

I can think of so many horrible examples out of the past! In the early 1930s, my Harvard music professors, who were gingerly converting to the phonograph (electric) in place of the piano for everything, would put a big console or even a small table phono up on a lecture platform. They would aim it straight in the face of the nearest listeners and then turn the volume up full—hideously distorted, of course—while almost visibly plugging their own ears with their fingers. How they hated those machines! I kept saying to myself, it can't be that bad—there must be a better way. It was the same a few years later when I taught music at Princeton.

Much of my life since those days has been devoted to experiments trying to improve the *use* of audio so it could do its best in such situations. In the 1930s it was an uphill job, let me tell you.

And not much different in the '50s, at least in the academic and professional worlds. That great and wonderful pioneer in electronic music, Edgard Varèse, actually knew nothing about electronics but, in the way of genius, saw what could be done with that medium (he had assistance!). Varèse planned to put on his last big piece, "Déserts," alternating orchestra and taped factory sounds, with the same gruesome technique: Two speakers, in this case huge Altec Voice of the Theatre jobs, right at the edge of a concert hall stage and aimed directly at the front-seat audience members not 10 feet away. Talk about assistance; I

Illustration: Scott Menchin

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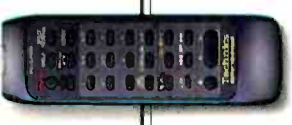

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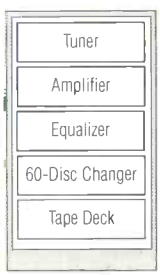

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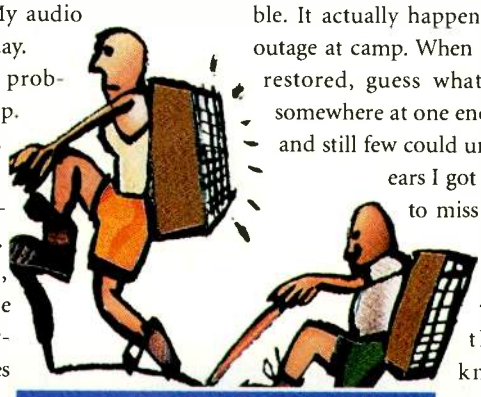
actually persuaded him to reverse those speakers and aim each one at the slanting side walls of the stage, for a reflected but bearable sound, also avoiding the nearby musicians. I think I saved a good many people's hearing. My audio Good Deed for the day.

There were real problems at my camp. True, two speakers up front and well separated are an improvement over one. True, most people, and especially the young, expect enormous audio volumes and do not complain. Nevertheless, in every sort of concert or live act there was very loud volume, a few hands over ears in the front rows and sometimes shouts of "louder, louder" from the rear. It was a decidedly poor system any way you look at it, the height of inefficiency for the conveying of acoustic information to a live audience.



WITH TWO SPEAKERS, SOUND WAS TOO LOUD AT THE FRONT AND TOO SOFT IN THE BACK.

A curious analog suddenly occurs to me. One of the greatest-ever inventions in electrically powered transportation was what is called multiple unit control, replacing a single locomotive pulling a string of cars. It was first developed by the trolley man's genius, Frank Sprague, in the 1890s. Each car is self-powered and self-braked, with all controls operated from the front car's cab. Enormous advantages! We take them for granted. But when, as a kid in 1927, I visited London and discovered the famous Underground, deep round tubes with round cars for a close fit, all the trains had locomotives in front. British traditionalism? Our subways, the first in 1904, have always had multiple control, if sometimes with a few "trailers" (not any more). Do you follow my analog? Our big P.A. speakers were all too much like unwieldy locomotives.

At camp this older technique reached its nadir in the dining room. Another long, large wooden building with crosswise tables, an aisle down the middle and cafeteria-style food service down each side, next to open screened windows, as usual. Roar of conversation—a person with a message could yell for minutes before achieving semi-silence, and then a mere acoustic voice, unpowered, would still be unintelligible. It actually happened during a power outage at camp. When the P.A. system was restored, guess what came out, down somewhere at one end? Great vocal blast, and still few could understand. With my ears I got little, and was sorry to miss important changes in the schedule.

You would think somebody there would have known, and have made a permanent installation long since: Multiple small speakers, mounted directly overhead on the conveniently available wooden cross beams; delayed maybe, so all would hear at once. Nice low volume, completely intelligible. What a difference! Curiously, those same beams were used exactly in that fashion for multiple overhead fans, pushing air gently downward, drawing in cooler air from outside. (Where the speakers would be small, the fans were the opposite, big and slow turning, making virtually no noise.) How about two enormous fans up front? Thankfully, no. But speakers, yes.

I admit that the use of time delay is very confusing in this and other situations for many a non-engineer. I was not clear as to where the "live" announcements were coming from. I could not find it for a while but finally located the position—at the midpoint of the hall. But the sound did not come from there. Nor could I locate where the loudspeaker or speakers were. General confusion.

In any delay system, the timing of each of the numerous outlets must be suited to the distances involved and the desired mix of direct and amplified signal. An orchestra is one thing, a person speaking into a microphone quite another. Those who make such installations can easily explain how this is done—all I know is that with digital well in hand and multiple channels easily available, the many-speaker system is not a problem

in present engineering terms. Those who haven't tried it, take note.

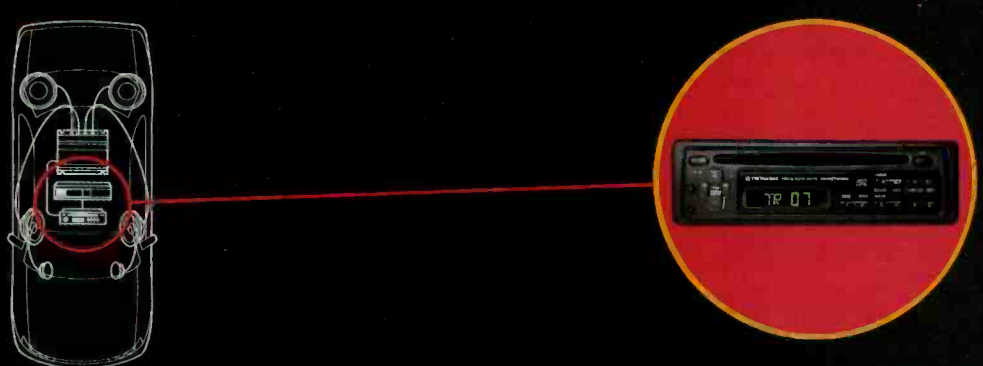
The ultimate in sophisticated delay was surely achieved a few years back in the huge Carlos Moseley outdoor P.A. for the New York Philharmonic and the Met Opera summer concerts, as designed with immense imagination by the well-known Chris Jaffe and his associates, Mark Holden and Paul Scarbrough. When I wrote about it at length (January 1991), the system was having its first outdoor trials. It has been in routine use ever since, for perhaps hundreds of concerts. One of our editors recently heard it in a "remote" appearance, I think in Philadelphia, and was impressed. I feel I must keep plugging this system of widely distributed loudspeakers, each radio-controlled, with delay adjusted to fit and an ingenious simulation of stereo that sounds like stereo at each location (as between neighboring speakers), yet has no specific directionality. (If you are looking at and listening to an orchestra a quarter-mile distant, there is no observable side-to-side separation!)

I should cite, finally, the early use of the quiet multiple-speaker system by, of course, the Audio Engineering Society for its many spoken presentations. I have never studied the details, but long ago became aware of the low-level and completely understandable speech, every word perfectly clear (except when some eloquent genius moved absent-mindedly so far away from the mike that no power of electronics could equalize the volume!). This is the way it should be, always, in every situation where live speech or music is distributed to a sizable audience, with or without delay. Even in portable form.

MY CAMP'S 12-HOUR POWER OUTAGE BROUGHT WHAT I CONSIDERED A WELCOME SILENCE.

The director of the camp session did a noble job despite 104° temperatures and 12 continuous hours of power outage (for me a welcome silence!). Copies of these articles go to him, helpfully I hope. A

The Road Kill Diaries

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May 3
Hung out with the other rodents.
Ran out in the road.
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JOHN EARGLE

DOLBY AC-3: LONGER LIFE FOR THE LASERDISC

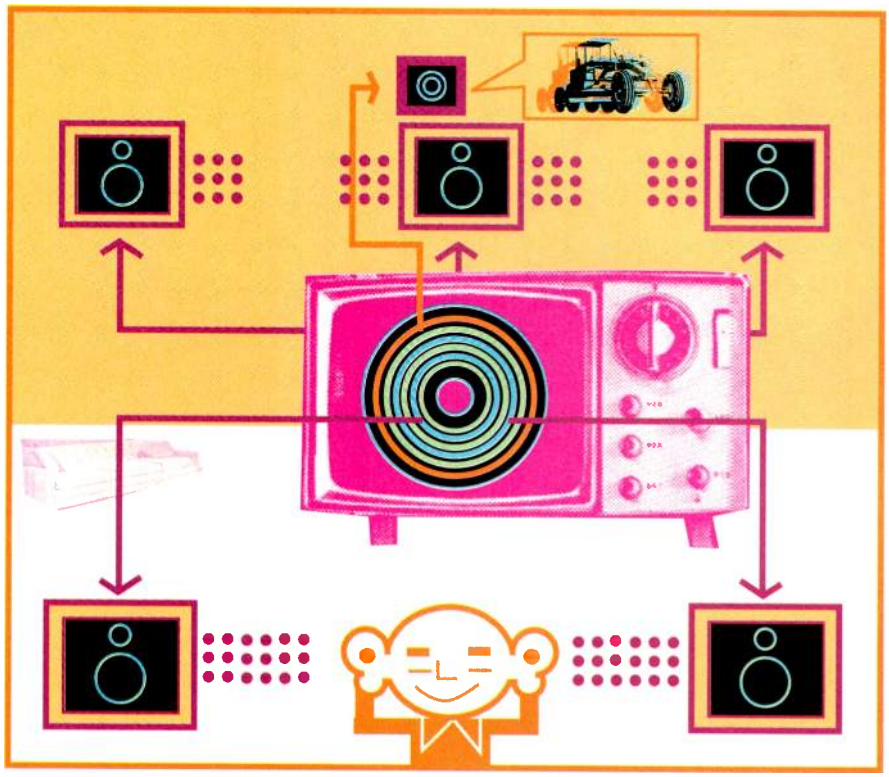


Illustration: Claudia Newell

Press events ordinarily introduce some new product or service. However, when Dolby Laboratories officially launched the AC-3 multichannel coding system at the EIA's Specialty Audio & Home Theater Show in Chicago last June, few attending journalists were unaware of it. Indeed, so many in the press had already seen demonstrations of the system that the event was almost a nonevent. Nevertheless, Dolby's announcement can be seen as the latest in a line of events and products that stretch back some 20 years.

When you last went to a movie, chances are you were listening to Dolby Stereo Optical soundtracks, unless the theater's marquee specifically said "Digital." Dolby Stereo Optical was developed during the 1970s as an alternative to traditional (but very expensive) multichannel technology that had been introduced in the '50s, when movies made their big move into stereo. With Dolby Stereo Optical, the two channels on the film are encoded so that four channels of sound can be produced in a movie theater: Left-, center-, and right-front channels behind the screen, and a single surround channel for the multiple loudspeakers located on the side and back walls of the theater.

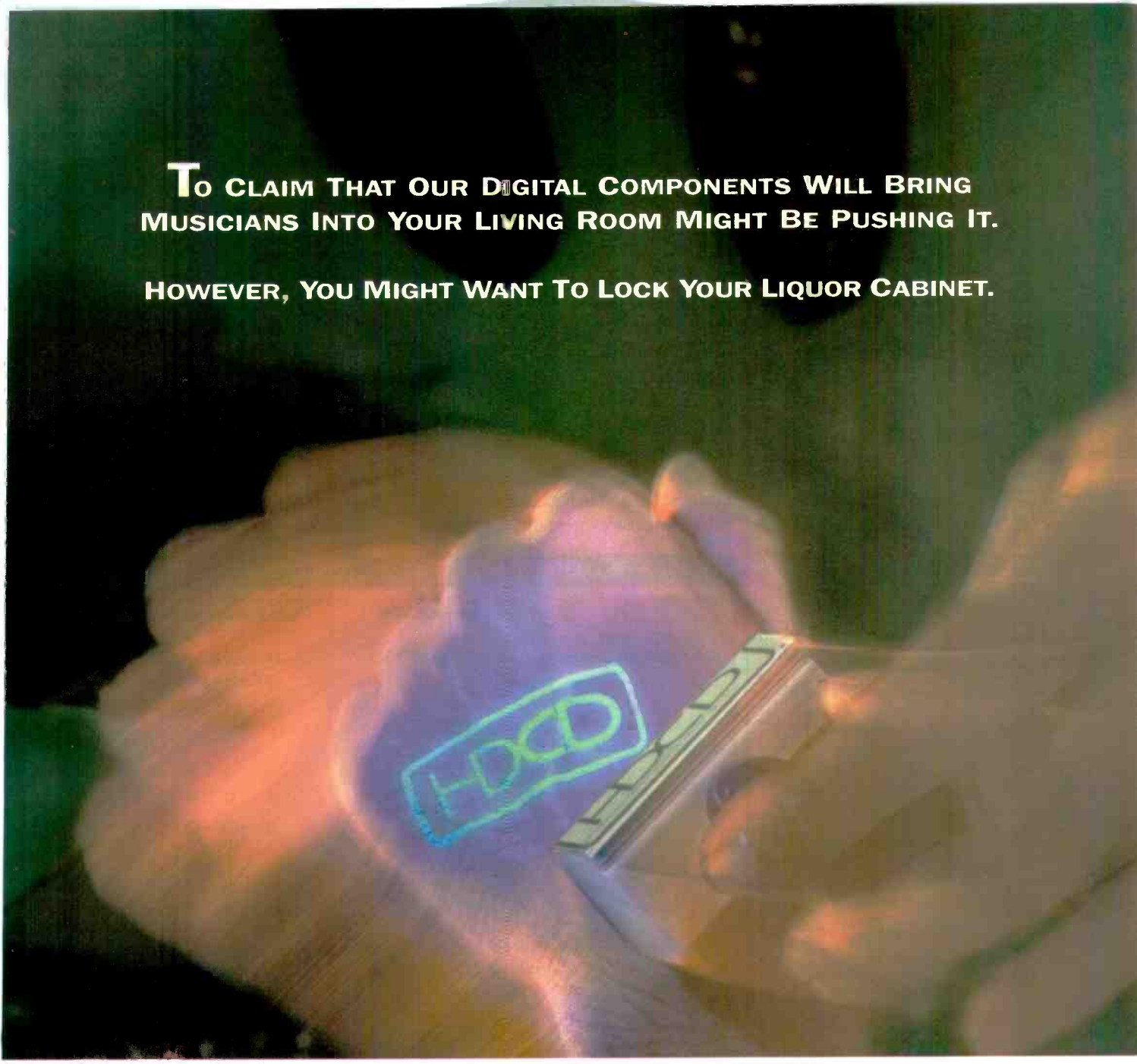
DOLBY'S AC-3 IS SEEN AS A VAST IMPROVEMENT OVER PRO LOGIC; IT CAN'T BE HELD BACK.

Eventually, the Dolby-encoded soundtrack found its way onto the stereo audio track of VHS tapes and LaserDiscs. When these are played back through receivers equipped with Dolby Pro Logic decoders, the same surround sound that you enjoy at the movies can be heard at home.

Home theater is currently one of the fastest growing segments of home entertainment, and a quick glance at the catalog of any mid-priced supplier of audio electronics will indicate that audio/video receivers far outnumber stereo receivers. Dolby Laboratories estimates that, by the end of 1994, there were more than 15 million Dolby Surround systems in homes worldwide, with about half of them in the United States and Canada. More to the point, about 3.6 million were sold in 1994 alone, indicating that the market is still ramping up.

There is also a growing market for audio-only CDs with Dolby Surround encoding. These discs contain two stereo channels, but with added attention paid to the steering cues in the program which, in a surround setup, direct in-phase program material to the front center and direct random-phase material to the surround loudspeakers. In addition, most A/V receivers have special operating modes for enhancing music, as opposed to the normal movie soundtrack mode of operation.

When it comes to digital sound in the movie theater, there are presently three competing systems. All of these are discrete—that is, not matrixed. Dolby's system is known as SR-D. The "SR" refers to the two analog tracks on the film (making it backwards compatible), while the "D" stands for the digital information, which is encoded in a format known as AC-3. The other two competing digital systems are Sony's SDDS and Digital Theater Sound's DTS; like SR-D they also have analog stereo tracks for compatibility.



To claim that our digital components will bring musicians into your living room might be pushing it.

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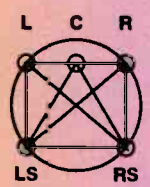
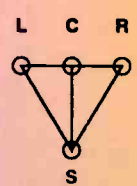
All three of these systems conform to recommendations made by an SMPTE (Society of Motion Picture and Television Engineers) study group. This committee recommended that a minimum of five full-bandwidth channels and a single special-effects (subwoofer) channel be made available to the movie industry for digital presentation in the theater. Three of these channels are placed behind the screen, in a left, center, and right array. The other two full-bandwidth channels are assigned to surround left and right, and the sub channel is assigned to special low-frequency loudspeakers located behind the screen. The format is familiarly called "5.1," for the five main channels and the single 100-Hz limited-bandwidth channel.

IT WAS ONLY A MATTER OF TIME UNTIL 5.1-CHANNEL DIGITAL SHOWED UP IN CONSUMER PRODUCTS.

It was only a matter of time before the 5.1 digital technology would become a consumer option, specifically with movies on LaserDisc. In January 1994, Pioneer Electronics demonstrated a LaserDisc on which both the AC-3 code and standard analog stereo tracks were present. The demonstrations were well received, and Pioneer stated that players and recorded product would be coming in late 1995. That time is

DOLBY AC-3 VS. PRO LOGIC

	Dolby Surround AC-3	Dolby Surround Pro Logic
Surround Channels	Stereo, full range (3 Hz to 20 kHz)	Monaural, limited range (100 Hz to 7 kHz)
Low-Frequency Effects Channel	Yes (3 to 120 Hz)	No
Panning Options		
Channels	Six discrete; each channel can carry a different signal simultaneously	Four derived; only one dominant signal can be decoded at a time
Other	Improved sound imaging via "time alignment," i.e., making it sound like each speaker is the same distance from the listener	Economical way to achieve high-performance surround sound
	Appropriate compression adjustments during low-volume playback of dynamic movie soundtracks (late at night, for instance) to ensure low-level program content is retained	Surround sound from any nonencoded stereo source
	Decoders programmable to route low bass only to channels in the system equipped with wide-range speakers or subwoofers	Compatible with all current and future two-channel formats

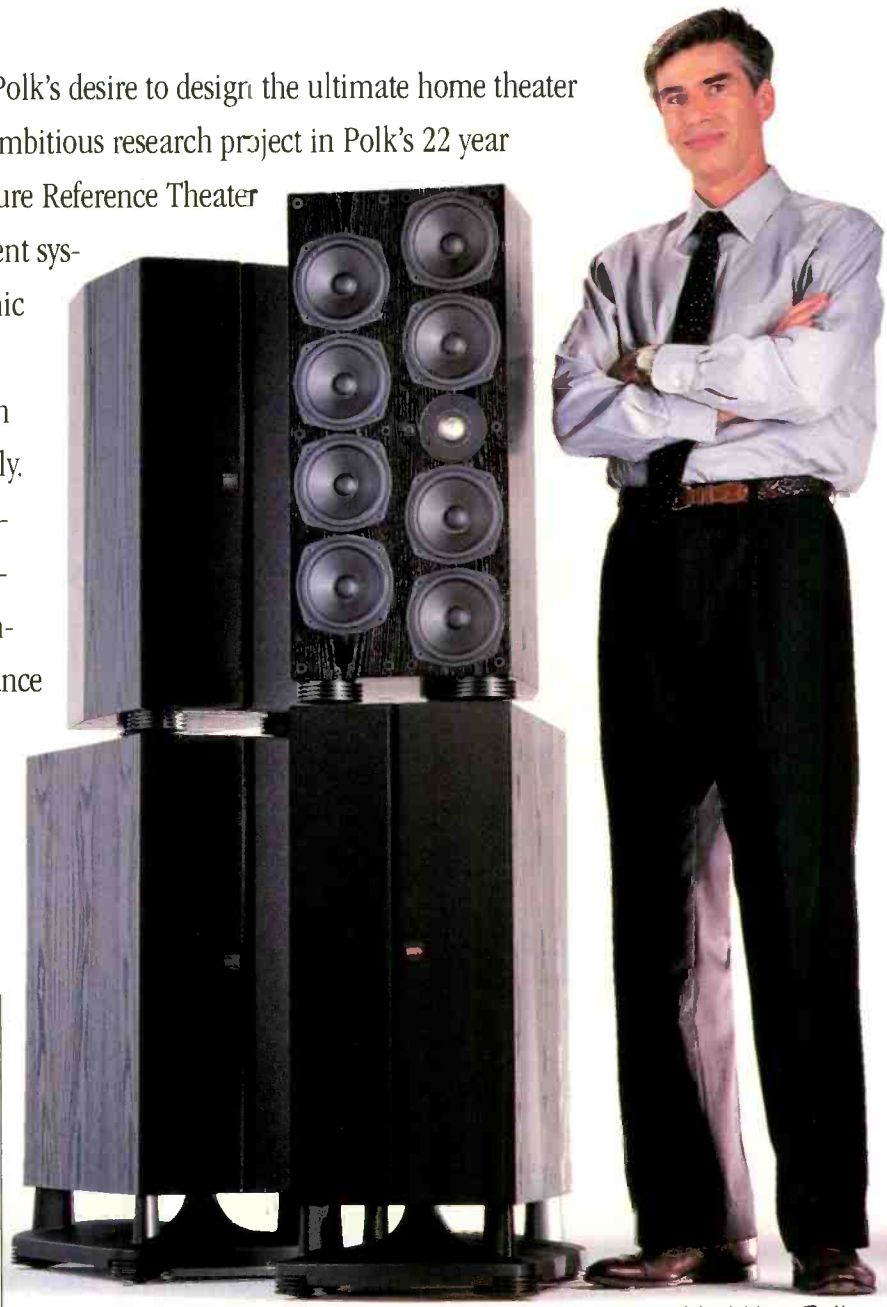
"Matthew Polk Redefines State-Of-The-Art ... Again."

MATTHEW POLK'S HOME THEATER SYSTEM CAN NOW BE YOURS

What started out as Matthew Polk's desire to design the ultimate home theater system turned into the most ambitious research project in Polk's 22 year history. The result, the Signature Reference Theater (SRT), is a home entertainment system of such enormous dynamic range, accuracy, clarity and power that listening will touch you physically and emotionally.

Five proprietary Polk technologies, including Polk's legendary SDA imaging, are combined to bring you "Performance Without Limits".

For more information and the location of a Polk SRT dealer near you, call (800) 377 - POLK.



The SRT system consists of 35 active drive units housed in seven enclosures (including two 300 watt powered subwoofers) and a Control Center with wireless remote.

Matthew Polk
Co-founder, Polk Audio

WARNING: THIS SYSTEM IS CAPABLE OF EXTREME SOUND PRESSURE LEVELS. SRT SYSTEMS ARE SUPPLIED WITH A SOUND PRESSURE LEVEL METER TO HELP YOU DETERMINE SAFE LISTENING LEVELS.

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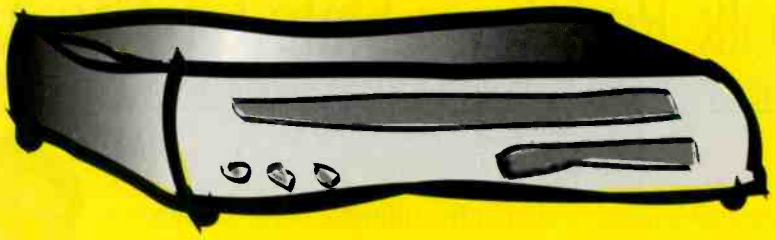

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DATA REDUCTION FOR SURROUND

All of the digital systems proposed for movie surround operate on one data-reduction plan or another. So great is the basic data rate, and so small the information space available, that considerable measures must be taken in order to make AC-3, DTS, and SDDS work at all. A number of psychoacoustical techniques are beneficially exploited here; the most important of these is spectral masking—the observation that a tone in one frequency band will mask tones in a higher band if those tones are below a certain threshold level.

In order to make the system work, the music spectrum in each channel is broken up into a set of sub-bands. These are analyzed every handful of milliseconds, and their contents are compared with a psychoacoustical "hearing" model (in the form of a lookup table). From this, it can be determined how many bits may actually be required to encode the data in a given band and at a given level. On average, as few as four bits may be required, since lower level signals are masked. The system can thus function at an average four-to-one data-reduction ratio, since full 16-bit quantization is no longer required for acceptable sound quality.

This analysis assumes that we are taking the program one channel at a time. If we look at the ensemble of channels, as in a 5.1 system, and encode them jointly, it is observed that the system complexity varies only as the square root of the number of actual channels. What this means is that a five-channel system will be only $\sqrt{5}$ (about 2.24) times more complex than a single-channel system. Quite a saving!

Other tricks are available: The analysis time can often be lengthened, and signals in one channel can mask those in another. These are just two of the possibilities.

One of the ironies of data reduction is that the two systems that led up to the current state of the art, the Digital Compact Cassette (DCC) and the MiniDisc (MD), are virtually nonexistent as marketplace entities. But their technology lives on. *J.E.*

now here, and Dolby Laboratories made the first official consumer launch of AC-3 at the EIA-sponsored Specialty Audio & Home Theater Show last June.

Dolby has an interesting task on its hands. On the one hand, Dolby Pro Logic, the stereo-based surround system, is still growing and winning new adherents daily. On the other hand, AC-3 is seen as a giant improvement over Pro Logic, one that cannot be held back. After all, think of all the movies with digital sound made in recent years, waiting to be released (or rereleased?) on discrete surround. And the tricky job is to introduce another golden egg-laying goose without interfering with the one already at work!

THE TRICK FOR DOLBY IS TO PROMOTE AC-3 WITHOUT KILLING OFF PRO LOGIC.

How will the future of discrete surround sound for video unfold in the near future? Some interesting points should be raised here. It is acknowledged that the LaserDisc, no matter how fine its quality in both picture and sound, is a difficult medium to manufacture. As an analog system (for the video portion), it is subject to myriad manufacturing problems and handling problems by the consumer. Ultimately it will be replaced by one or both of the two standards now being considered for digital video. The Super Density Digital Video Disc (SD-DVD), proposed by Time-Warner/Toshiba and now endorsed by an impressive coalition of software companies, will use AC-3 as the primary carrier for its surround soundtracks. The Sony/Philips Multi-Media Compact Disc (MMCD) camp has not decided on a sound carrier as of this writing.

The changeover to the new CD-sized digital video media could begin as soon as next year but will take three or four years, depending on who's doing the prognosticating. It's going to be interesting. A

If you think the ultimate speaker system would have a subwoofer, you're half right.

The dual-subwoofer *Ensemble*® speaker system by Henry Kloss. $599.99 factory-direct.

Ensemble is Cambridge SoundWorks' very best speaker system. It involves no compromises in performance, no cost-saving shortcuts. As a result, its performance stands head-to-head with audiophile tower speakers selling for well over $1,000 a pair, yet its unique four-piece design literally disappears in your room.

There is no other speaker system like it.

Designed to perform in your home – not in a laboratory.

It has always been true that speaker placement in the listening room has a significant effect on the sound of any speaker system. No matter how a speaker may perform in a laboratory or a specially-designed showroom, at home the acoustics of the listening room significantly affect the sound.

Most positions in a room where you might place a speaker tend to emphasize one portion of the musical range, and tend to de-emphasize some other portion of the musical range. For example if you place a conventional speaker close to a room corner which will enhance the bass response, that location may hinder the upper ranges of music.

Ensemble's unique four-piece design eliminates this dilemma.

Big sound without the big boxes.

Ensemble consists of four separate speaker units; two for each stereo channel. Two powerful, but ultra-slim subwoofers reproduce the deep bass, while two compact satellite units reproduce the rest of the range.

By separating the low bass from the rest of the musical range, *Ensemble* is able to reproduce just the right amount of energy across the musical spectrum, without turning your listening room into a stereo showroom.

"Crisp, balanced sound, stereo imaging is phenomenally sharp – some of the best I've heard...some of the speakers I'm comparing it to cost $1900 to $2800"

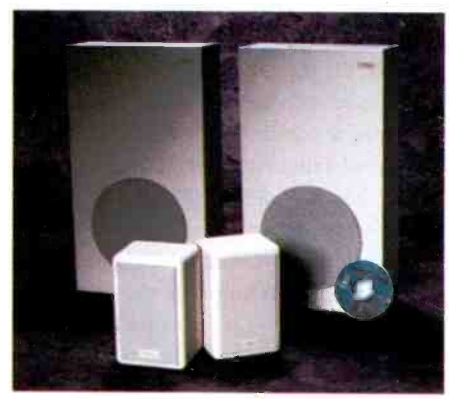
High Performance Review

You can place the subwoofers on the floor, up against a wall, or in a corner – all places that allow them to reproduce bass notes efficiently. These locations are also often out-of-sight, which can be a real decorating advantage. The satellite speakers can then be placed out in the room, at ear level, positioned to create a realistic stereo image. They can be hung directly on the wall, placed on shelves, or mounted on stands.

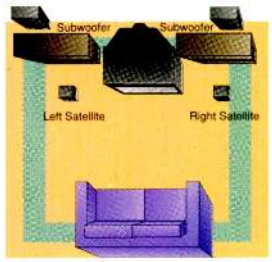
Why two subwoofers?

Subwoofer/satellite speaker systems that use one subwoofer can and do sound terrific (in fact, we offer a full range of single-subwoofer systems). But for the ultimate in breathtaking, accurate sound reproduction, and the most powerful bass performance, you should have two subwoofers. Here's why:

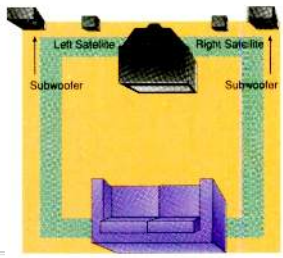
• *Increased sound pressure levels and power handling capability.* Quite simply, *Ensemble's* dual subwoofer system, with its two 8" long-throw woofers, will play louder and take more power than single-subwoofer speaker systems, including our own. This is even more significant if you are using *Ensemble* in a home theater, since authentic low bass sound effects in movies require extra-powerful bass output.



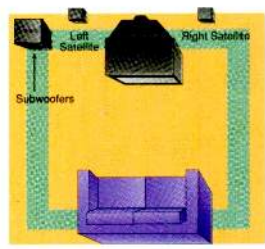
Ensemble is now available with either its original charcoal Nextel finish with black subwoofers, or a new version with white hand-finished satellites and white vinyl subwoofers for no additional charge.



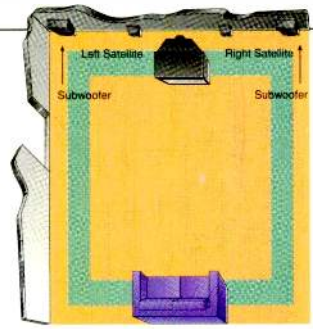
Ensemble's ultra-slim (4 1/2") subwoofers can be put in out-of-the-way places – even behind or under furniture.



Ensemble's dual subwoofers accurately reproduce the stereo bass on some modern digital recordings, adding to imaging realism.



Ensemble's dual subwoofers can be placed together in a corner to achieve very high bass output for reproducing low-frequency movie sound effects with incredible realism.

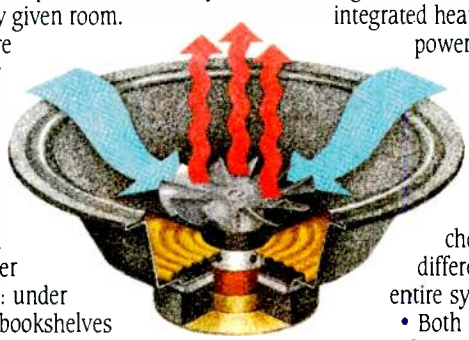


In larger rooms with big openings into other rooms, *Ensemble's* dual-subwoofer design assures uniform bass throughout the room.

• *Uniform bass response throughout the listening room.* Depending on room acoustics and speaker placement, a system can produce bass "nulls" and "peaks" in different areas of a room. Two subwoofers can solve that problem. To quote *Audio* magazine, "At low frequencies, strong and widely spaced room modes are occurring... some locations have a lot of bass while others lack bass. When two subwoofers are placed in the room, better uniformity of bass response is obtained."

Cambridge SoundWorks "may have the best value in the world."
Audio Magazine

• *Ultimate placement flexibility.* It is our experience that room placement is the ultimate key to real-life performance of any given speaker in any given room. *Ensemble* offers more placement flexibility than any other speaker we know of. Its subwoofers are only 4 1/2" thick, so you can actually put them in places where no other subwoofer would fit: under furniture, on top of bookshelves or behind draperies. You can also put one on one side of the room, and the other on the opposite side, which turns out to be correct placement in many cases.



• *Two-channel bass on modern recordings.* Some modern recordings, especially two-microphone recordings of full orchestral works, have stereo bass imaging. *Audio* magazine says, "Using two subwoofers provides more realistic bass and takes advantage of program material with fully stereo bass."

No compromises. No shortcuts.

Don't be fooled by *Ensemble's* price. It's affordable because of our efficient factory-direct sales system.

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

• The speaker drivers used in the satellites and subwoofers are of the highest quality. The 8" long-throw woofer drivers, designed by Henry Kloss and manufactured by Cambridge SoundWorks, use a unique, integrated heat sink for increased power handling capacity.

• Each satellite and subwoofer contains the precise response-tailoring crossover circuitry it requires. This allows you to choose from several different ways to wire the entire system.

• Both the satellites and subwoofers use gold-plated five-way connecting posts.

• Durable, acoustically transparent metal grilles protect the speaker drivers, instead of the inexpensive cloth grilles used by many systems.

• Last but not least, the entire *Ensemble* system has been painstakingly fined tuned (or "voiced") by Henry Kloss for proper octave-to-octave tonal balance. Because it does not give undue emphasis to any one octave of music, *Ensemble* has a rich, natural, accurate sound normally associated with the best (and most expensive) of conventional speakers under laboratory conditions.

"smoother than many more expensive speakers...it is hard to imagine going wrong with Ensemble.."
Stereo Review Magazine

You can spend hundreds of dollars more for a speaker system that doesn't sound as good. Or you can buy *Ensemble*– direct from Cambridge SoundWorks, or at Factory-Direct Speaker Walls in Best Buy stores.

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Ensemble is available factory-direct for only **$599.99** with a full 30-day risk-free home audition. Listen to *Ensemble* in your home, with your music. If you aren't happy, return it within 30 days for a full refund. We even reimburse your original UPS ground shipping charges in the continental U.S. Call today.

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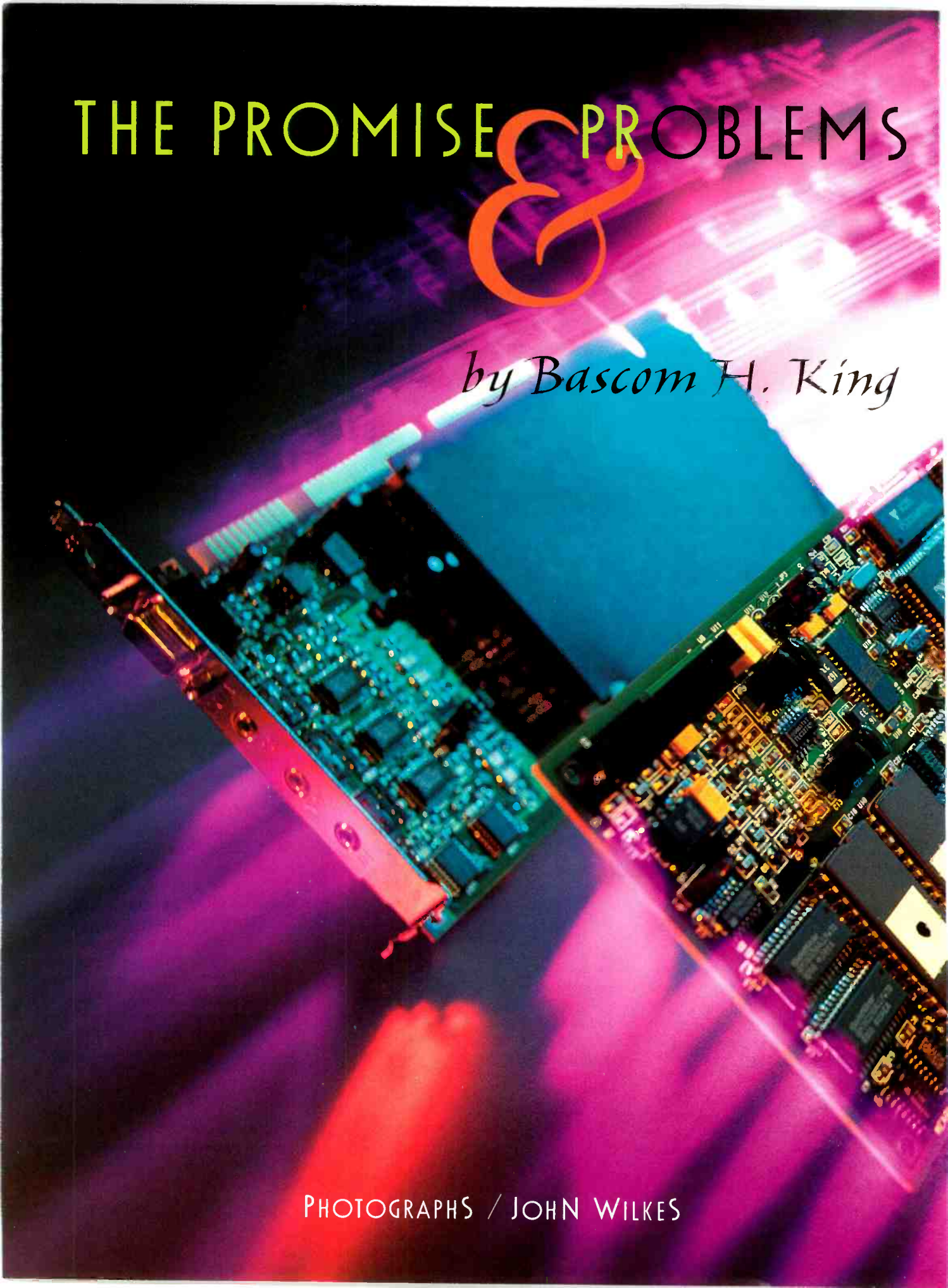
Are "tower" speakers better?

A great many people presume that very large, very expensive "tower" speakers are inherently better than subwoofer/satellite speakers. Nothing could be further from the truth. If you were to take apart a high quality tower speaker and *Ensemble*, you'd see both use premium quality drivers, crossovers and cabinets. The physical volume of the cabinets enclosing each speaker driver is carefully matched to the demands of that driver. With *Ensemble* you get all the quality components and precise engineering of premium tower speakers – built into four smaller cabinets instead of two large ones. Separate cabinets give you room placement flexibility to get optimum performance in your listening room.

THE PROMISE & PROBLEMS

by Bascom H. King



PHOTOGRAPHS / JOHN WILKES

# of COMPUTER SOUND BOARDS

Audio and computer technologies have long been converging. Digital audio systems, such as CD, use computer technology wholesale, while many a tuner, tape deck, or preamp incorporates microprocessor control. At the same time, "multimedia" computers incorporate audio facilities for music production (directly, as synthesizers, or via MIDI instrument control) and for reproduction of sounds from games, from CD-ROMs, and even from music CDs. Computers can record digital audio, too, to hard disk or to CD.

It was easy to ignore computer sound boards when all they could do was reproduce the bleeps and bonks of computer games and when games were the only applications using them. Now, however, serious application programs, from business presentations to CD-ROM reference software, often employ audio. In addition, today's computer sound cards claim CD-quality recording and playback. We asked Bascom King to see how well two of the best-known PC sound cards deliver on that promise—and asked computer and audio authority John Woram what's involved in turning a PC into a multimedia system. *I.B.*

With the right sound board (or card), a computer can make the most of game and multimedia programs and act as the centerpiece of a digital home recording and editing studio—of sorts. Even multimedia computers, which by definition include sound cards, can sometimes benefit from an upgrade to a better card.

My intention in measuring these sound cards was to compare their performance to the standard attainable with CD players in order to see if the claimed "CD quality" label was, in fact, accurate.

The two cards tested here, Creative Labs' Sound Blaster AWE32 ($399.95) and Turtle Beach's Monterey ($399), share a number of useful capabilities. Both can record and play back digital sound, with 8- or 16-bit resolution, from analog sources, CD, CD-ROM, or synthesized signals generated by the board itself. Both can mix and alter audio signals. They can control or be controlled by musical devices using the Musical Instrument Digital Interface (MIDI) Standard, and they include joystick ports for use with games and other software.

Both cards require PC-type computers with 80386 (or later) processors, an empty 16-bit slot, and at least 2 megabytes (MB) of RAM. Users who intend to record should also have plenty of hard-disk space available.

Beyond that, the two boards differ considerably. For instance, Creative Labs' Sound Blaster offers both FM synthesis (for backward compatibility with older programs and the generation of nonimitative sounds) and the more realistic-sounding wavetable synthesis; the Turtle Beach offers only wavetable synthesis. These boards adhere to the General MIDI specification, which defines patch numbers for 128 musical-instrument sounds and sound effects, and they surpass the required 24-note polyphony. Both can, in fact, handle 32-note polyphony, though the Turtle Beach goes beyond the Standard's minimum of 16 MIDI channels, handling 48 channels.

The AWE32 is compatible with virtually all PC games that use sound (for which "Sound Blaster compatibility" is a watchword), but it is not compatible with all Windows multimedia applications. The Turtle Beach, which is compatible with those applications, lacks Sound Blaster compatibility for games.

The Sound Blaster interfaces with the computer through direct memory access (DMA), which can temporarily swamp slower computers if you're processing 16-bit audio. Turtle Beach's Hurricane architecture allows sound data to move through the PC roughly eight times faster.

MIDI FACILITIES

The Sound Blaster AWE32 supports the General MIDI Standard and is compatible with Sound Canvas (GS) and MT-32 sound sets. An onboard ROM holds 1 MB of sound samples. And since the AWE32 uses the E-mu EMU8000 sound and effects chip, it also supports E-mu's SoundFont audio library of sampled sounds, which can be downloaded into the AWE32's onboard 512-kilobyte RAM (expandable to 28 MB) for added sound variety and flexibility.

The MIDI facilities can be expanded, sometimes to near-orchestral levels, by plugging in Sound Blaster-compatible modules from Kurzweil, Roland, or others. These modules add additional sampled sounds and effects.

The Turtle Beach Monterey, which uses the Motorola DSP-56001 chip, holds 4 MB of 16-bit samples in ROM. Its SampleStore memory also accepts additional wavetable samples but can be expanded only to 4 MB. The Monterey actually combines Turtle Beach's Tahiti sound card and Rio MIDI synthesizer, physically grafted together.

Either board can apply a wide range of effects to sounds. The Monterey's spec sheet lists eight flavors of reverb and six of echo, plus "Fast Delay" and "Lotsa Repeats." Users can also program their own effects. The AWE32's specs list reverb, chorus, pan, and QSound Virtual Audio.

AUDIO FACILITIES

Turtle Beach stresses audio quality, including detailed (and impressive) audio performance data in its spec sheet; many other sound-card spec sheets (including the SoundBlaster's) omit this information. The Monterey's A/D converters are 16-bit sigma-delta types, with 64-times oversampling. The 18-bit D/A converters, also sigma-delta types with $64f_s$ oversampling, use $8f_s$ interpolating filters. The Motorola DSP56001 chip can perform operations like real-time adaptive differential pulse-code modulation (ADPCM) decompression, and provides the needed horsepower for future multimedia standards like data compression.

All analog inputs and outputs of the Monterey are at line level, so you'll need an external amp, as well as speakers, to hear its output. You can, however, hook headphones to its line output.

The AWE32 does have an amplifier, rated at 4 watts peak music power per channel into 4-ohm loads, so it can drive speakers directly. It also has a microphone input and microphone; the Monterey does not.

HARDWARE DIFFERENCES

Both cards require 16-bit slots, but the AWE32 is full-sized, while the Monterey is, at 8½ inches, only about 60% as long; this may be useful in some crowded computers. The Monterey's Rio MIDI circuitry is on a smaller daughterboard.

The AWE32 has digital connections for use with CD-ROM drives, and both cards have analog inputs for CD audio (see John Woram's sidebar "Adding Multimedia to Your PC"). The AWE32 also includes direct support for Sony, Mitsumi, and Creative Labs CD-ROM drives, saving the space (and cost) otherwise needed for these drives' proprietary interface cards.

SOFTWARE

Both boards include software for mixing, record-level monitoring, and sound recording and editing. Since the Sound Blaster has a microphone, it has speech-recognition software, too. Less predictably, it also has software to read text as speech. Other Sound Blaster software can embed .WAV waveform sound files in other files that accept OLE (object linking and embedding).

TEST CONDITIONS AND SETUP

With sound cards, as with two-head tape recorders, you can monitor input signals as you record, but you cannot monitor the actual recording as you make it. However, since the recording is on hard disk, the wait to "rewind" the recording for playback and jump from one part of a recording to another is almost imperceptible. It is technically possible, but not trivial, to monitor what is being recorded; while a few other sound cards permit this, neither of the cards reviewed here do.

To measure various parameters as a function of frequency and amplitude, recordings of these various sweeps are made on the computer's hard drive and then played back. To record stereo information at a 44.1-kHz sampling frequency takes a *lot* of hard-drive space. Each minute of recording takes up about 10.5 MB. A number of test recordings for measurement can fill up a drive real fast, especially when Windows is installed along with a number of sound-card-specific programs. When measuring played-back frequency sweeps, it is relatively easy to set the Audio Precision System One test gear to track the incoming frequency and automatically plot a performance parameter as a function of frequency. But measuring a played-back sweep as a function of recorded amplitude gets quite a bit harder; the instrument loses its ability to track the incoming amplitude at low levels, due to wideband noise from the device under test. One way around this is to record a number of individual signal amplitudes, record the playback data, and have the Audio Precision system make a plot out of it.

I used two PC computers to do this testing, a 486DX-33 and a 486DX2-66. The Monterey was in the DX-33 along with 100- and 240-MB hard drives and 4 MB of RAM; this machine was running Windows for Workgroups 3.11 and DOS 6.0. The AWE32 was in the DX2-66, with a 100-MB drive and 8 MB of RAM, which was running Windows 3.1 and DOS 6.2. (My resident lab computer, an Everex 1800B 286, did its usual duty of running my Audio Precision system.) I found that disk-compression and disk-caching software (such as MS-DOS DoubleSpace and SMARTDrive, respectively) could cause problems keeping up with the thirsty data demands of stereo 44.1-kHz recording and playback, so these programs weren't used. It should be noted that these computers were set up for optimal measurement of sound cards, with minimum problems. With other computer-system configurations, available resources, etc., there might be some problems in recording and playing back stereo 16-bit material without interruption. In general, you need at least a 486DX-33, 8 MB of RAM, and a fast, large hard drive—despite the lower minimums quoted by the manufacturers.

I have seen two sound-card topologies. In one, the monitor path just goes through the linear audio circuits on the card; the AWE32 follows this pattern. The other, as used in the Monterey, sends the monitored signal through the A/D and D/A conversion processes. In the first case, one has to record and play back to find out the overall record/play characteristics. In the latter case, it turns out that the behavior in the monitor mode for measurements of frequency response is substantially the same as when actually measuring the record/play characteristics. Of course, you still have to record and play back test files in order to measure all of the cards' characteristics meaningfully.

MEASUREMENTS

Figure 1 shows the overall record/play frequency response of both cards. As can be seen, the Monterey has the flatter frequency response, with the AWE32 having more roll-off at the frequency extremes. The 20-kHz value, some –16 dB, is a bit excessive. Also, the AWE32 has a small but noticeable (about +0.1 dB) upper-midrange rise, presumably due to its tone-control algorithm. I would rate the Monterey, but not the AWE32, in the CD-quality league here. However, both these cards have far less low-frequency roll-off than many other sound cards do.

FIG. 1— Record/play frequency response.

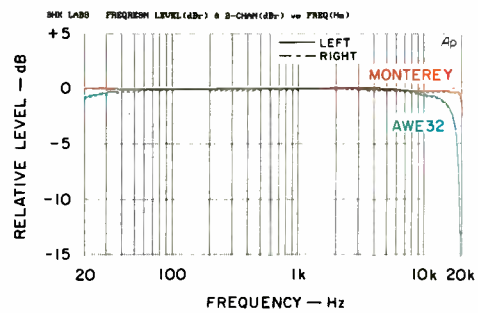
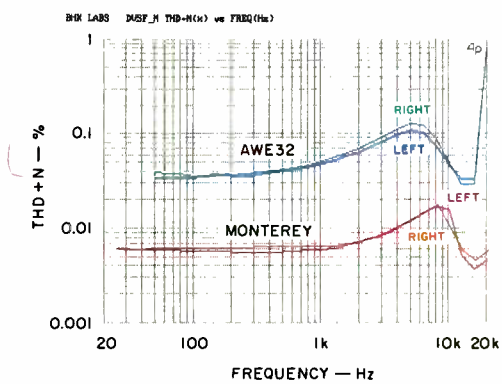


FIG. 2— THD + N vs. frequency.



ADDING MULTIME

In putting a multimedia system together, there's the easy part (buying the hardware) and the hard part (getting it to work). If you get a CD-ROM drive and sound card in a bundled package, the bundler has presumably made sure the devices are compatible, thus making the easy part even easier. However, such packages often include a pair of so-so loudspeakers and perhaps other stuff you don't really want. So you may very well decide that it's preferable to pick and choose among available components, in order to get just what you need without paying for things you either already have or that you don't want. With that in mind, here's a quick overview of a few multimedia hardware options for a Windows-based PC system, followed by a few thoughts on surviving the hard part.

CD-ROM

These days, most multimedia software requires CD-ROM drives. For this reason, many sound cards have built-in controllers for such drives. Some, like the Creative Labs Sound Blaster tested by Bascom King, are designed to work with drives that would otherwise require proprietary interface cards (but such drives are rapidly disappearing). Others have controllers for a single CD-ROM drive using the far more common small-computer systems interface (SCSI) connections. If a card is designed to control a drive you already have or if you just know you'll never want to add another SCSI device (say, a second CD-ROM, another hard drive, or some other peripheral), then such a sound card offers an efficient means to get up and running with minimal fuss. But the same option becomes redundant if you already have a SCSI controller on board or becomes limiting if you expect to add additional devices in the future. In that event, you can get more bang for your buck by buying a sound card that omits the SCSI connector. Use the controller you already have, or get one that supports more than one device.

Many new computers have Extended IDE (EIDE) or ATAPI hard-disk interfaces; EIDE/ATAPI CD-ROM drives are now becoming available. But most of the computers in the field that don't already have multimedia facilities predate EIDE. And since most of the CD-ROM drives now available require a SCSI controller, I'll concentrate on SCSI drives.

If your computer does not already have a SCSI controller, you'll probably need one to support a SCSI CD-ROM drive. But if your system is already set up for SCSI, you certainly don't need another controller just for the sake of this drive. If your system does not already have one, add a Future Domain SCSI Controller Kit for support of up to seven SCSI devices. The kit's adaptor card supports both internal and external devices.

In assembling or modifying any multimedia hardware system, don't overlook the SCSI terminators that must be enabled on the devices at either end of the physical chain and disabled everywhere else. For example, if you already have a SCSI controller and hard drive, both devices are presumably terminated. If you attach a CD-ROM drive to a connector on the flat cable between the controller and the hard drive, then its termination must be off. However, if the new drive is placed at either end of the signal chain, then its termination must be on and the termination on the device now in the middle of the chain must be off. If you need to disable termination on a SCSI hard drive, you may have to remove it from the system, turn it over, and search for a tiny jumper on the drive's circuit board.

With luck, you won't have to bother with this if the controller itself becomes an intermediate device in the SCSI chain. For example, the Future Domain controller mentioned above has an auto-termination circuit that senses the controller's location in the chain. If it finds the device is at either end, termination is enabled; otherwise, it's not.

As another consideration, every SCSI device must have a unique ID number (0 to 7). The controller itself is ID 7, while 0 and 1 are usually reserved for hard disks. If the new CD-ROM drive is the only other SCSI device in the system, set its ID to any number from 2 to 6. Otherwise, just make sure the number does not conflict with some other device already installed. The appropriate ID is usually set by a DIP-switch block on the drive's rear panel. Note that the ID number is simply a logical designator and has no relationship to the device's physical position in the SCSI chain.

As a final interface consideration, note that a CD-ROM may contain audio in any of three formats: Conventional CD audio (16-bit PCM at 44.1 kHz), MIDI sequences and instructions, or waveform (.WAV) files. Conventional CD digital audio is converted to analog at the drive itself; only this signal can be heard at the drive's front-panel headphone jack. An external CD-ROM drive has twin RCA

by John M. Woram

phono jacks on the rear panel, while an internal drive usually has a three- or four-pin Berg connector on its rear panel. In either case a dedicated cable carries analog audio from the CD to the sound card. An external drive's analog output can be easily connected to the line input jack on the card's adaptor bracket or routed to an external amp.

A bit more attention must be paid to the digital interface cable between an internal drive and the sound card, which handles MIDI and .WAV files. Although a recent MPC (Multimedia PC) Level 2 spec lists pin 1 to 4 assignments as left, ground, ground, and

right, the pins on many sound cards don't conform to this standard. For example, the pins on one popular sound card are left, (common) signal ground, right, and chassis ground. As a result, an MPC Level 2 cable connected to this card will feed only one audio channel (left or right, depending on which way the connector is placed over the pins), with the other channel shorted out.

As a compatibility test, I tried to match an MPC-2 CD-ROM drive with a noncompliant sound card. Since the cable supplied with the drive did not match the sound-card connector, I called various multimedia vendors to see what could be done to resolve this problem. Only one (NEC) responded, immediately sending out a complimentary adaptor. The rest either had no suggestions or simply ignored my inquiry. And so, a word to the wise: Be prepared to rewire your own cable, or else make sure this won't be an issue before making a purchase.

Once the hardware interface is complete, it's time to tackle the other half of the difficult part, which is the software support. Since CD-ROM drive support is not built into the disk operating system (MS-DOS versions up to 6.22), a software device driver must be loaded into memory as the system starts up. In addition, the data structure on a CD-ROM does not match that found on conventional diskettes and hard disks. Therefore, the Microsoft CD-ROM extensions file (MSCDEX.EXE) must also be loaded. To help keep things confusing, the device driver is loaded via the CONFIG.SYS file, while the extensions are loaded in the AUTOEXEC.BAT file. And as if that's not enough, both lines must contain a common driver signature so that the driver and the extensions can find each other. Accordingly, you should find lines such as these in your own startup files:

```
in CONFIG.SYS:
device=filename.SYS /d:MSCD000

in AUTOEXEC.BAT:
C:\DOS\MSCDEX.EXE /d:MSCD000
```

In practice, filename.SYS will be the actual name (and path, if necessary) for your own device driver. This example assumes the CD-ROM extensions file is in the C:\DOS directory, although yours might be in the C:\WINDOWS directory or perhaps elsewhere. Finally, note that the common driver signature (/d:MSCD000, in this instance) appears on both lines.

Assuming the CD-ROM drive is physically installed and lines such as those shown above are in your own startup files, basic DOS functions should work once the system is up and running. In other words, you should be able to log onto the drive, view a directory listing, copy files from a CD-ROM to the hard drive, and so on.

Saving the worst for last, the final step is to configure the sound card's interrupt request (IRQ), direct memory addressing (DMA), and input/output (I/O) port address. The sound card uses its assigned IRQ line to let the computer's microprocessor know when it needs attention or else turns to DMA to bypass the CPU and communicate directly with computer memory. The I/O addresses identify the ports by which data flows back and forth. Needless to say, all three parameters must be selected with care so that sound-card operation won't cause a conflict with other devices that also use one or more of these services. Depending on the specific sound card, you may need to specify these settings via jumpers or switches on the card and/or by setting software parameters.

No matter what settings you or the setup procedure select, one thing is fairly certain: Initially, it won't work. Multimedia devices seem to have a talent—some might call it a gift—for finding a configuration that will conflict with at least one other device. As a result, you'll be treated to an endless ding-ding-ding loop or some other indignity when you try to access the system. The usual cure is to change an IRQ and/or DMA setting until you find the combination that works. If you know what settings are taken by other devices, then the work is half done; just choose other values. But if you're not sure about this, then a certain amount of guesswork may be in order. If all else fails, try IRQ 7, 10, or 15 and any DMA setting from 4 to 7.

If you think there should be a simpler way, there is: In most cases, Microsoft's new Windows 95 eliminates the need for the AUTOEXEC.BAT and CONFIG.SYS lines cited earlier, as well as doing a pretty good job of finding, and using, multimedia settings that won't cause trouble with any of your other hardware devices. A

With either card, when square waves were recorded and played back (not shown), the ringing at their leading and trailing edges were mirror images of each other. This shows that both cards have essentially linear phase characteristics, a desirable quality that's typical of digital audio devices and a function of using finite-impulse response (FIR) filters.

Figure 2 shows both cards' THD + N at full-scale input level as a function of frequency. The measurement filter bandwidth was 22 kHz, in order to get the best picture of in-band distortion values. The high value of distortion near 20 kHz for the AWE32 has two causes. The Sound Blaster is generating real difference tones here. However, the measurement is also a bit inflated because it is expressed as a percentage of the signal level in a region (18 to 20 kHz) where the actual signal level is rolled off, as was shown in Fig. 1. As a point of reference, a good CD player would have distortion values between 0.002% and 0.003%. Many separate D/A converters measure in the range of the Monterey. The AWE32's somewhat higher THD + N would not be considered CD quality.

Figure 3 shows both cards' THD + N for a 1-kHz signal as a function of recorded input-signal amplitude, with a measurement bandwidth of 400 Hz to 22 kHz. This test reveals distortion artifacts at lower levels, such as idle-tone generation.

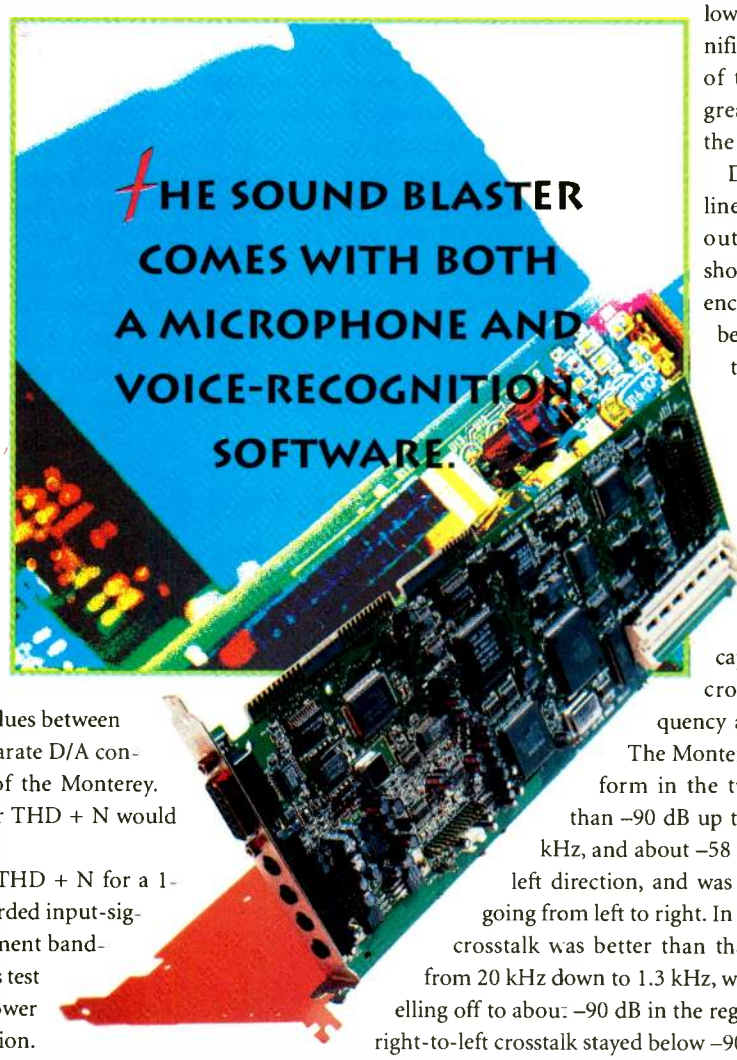


TABLE I—Record/playback S/N ratios, in dB.

CREATIVE LABS SOUND BLASTER AWE32

Bandwidth	LEFT	RIGHT
Wideband	67.6	67.0
22 Hz to 22 kHz	76.6	75.8
400 Hz to 22 kHz	77.1	76.5
A-Weighted	79.3	78.8

TURTLE BEACH MONTEREY

Bandwidth	LEFT	RIGHT
Wideband	68.6	68.9
22 Hz to 22 kHz	83.9	86.2
400 Hz to 22 kHz	84.3	86.8
A-Weighted	86.3	88.4

At levels below full scale, where the highest distortion occurs, it is frequently just a measure of noise. In the case of the Sound Blaster AWE32, there is some distortion at full scale (an innocuous 0.035%), which quickly disappears in the noise at about 10 dB below full scale (dBfs). More significant, the general noise level of the AWE32 is about 10 dB greater than the noise level of the Monterey.

Deviation from input/output linearity, or correspondence of output for a given input, is shown in Fig. 4. (The zero reference level for the Monterey has been displaced 6 dB for clarity.) Again, the Monterey is the winner here. I might add, however, that some high-end D/A converters have measured worse than the AWE32 in this test.

The interchannel crosstalk (not shown) for both cards indicated some capacitive coupling, in that the crosstalk increased with frequency at a rate of 6 dB per octave. The Monterey's crosstalk was more uniform in the two directions; it was better than –90 dB up to about 350 Hz, –70 dB at 4 kHz, and about –58 dB at 20 kHz in the right-to-left direction, and was about 3 dB better yet when going from left to right. In both directions, the AWE32's crosstalk was better than that quoted for the Monterey from 20 kHz down to 1.3 kHz, with left-to-right crosstalk levelling off to about –90 dB in the region from 50 to 100 Hz, while right-to-left crosstalk stayed below –90 dB up to about 1.7 kHz and finished at about –64 dB at 20 kHz. All in all, pretty good crosstalk performance for a piece of audio gear in general, but not as good as the better CD players and external D/A converters can do.

Signal-to-noise ratios at various measurement bandwidths are enumerated in Table I for both sound cards. For these measurements, the line-level inputs that I was using for recording were terminated in 25 ohms and turned fully up, while other inputs were turned down. Noise levels for the AWE32, previously commented on, are some 15 dB higher than good CD player performance. The Monterey is closer to CD performance.

Input impedances for the line-level inputs were about 115 kilohms for the AWE32 and about 62 kilohms for the Monterey.

Output impedance at the line outputs was about 70 ohms for either card. The Monterey could easily drive a load of 600 ohms or even lower impedance, such as 40- or 50-ohm headphones, with relative ease. It would put out about 600 mV at about 0.01% distortion into the Joseph Grado Signature HP-2 headphones I used for some of the listening tests. By contrast, the line output of the AWE32 could put out about 73 mV into the HP-2 'phones (and

some 800 mV at the onset of clipping into a 600-ohm load, which should be totally adequate for line out use). Of course, higher power demands for headphones and speakers can be satisfied by the onboard power amplifier. Neither card's measured performance was affected by the IHF load of 10 kilohms in parallel with 1,000 pF, which means that they should drive any practical load.

The AWE32 inverted signal polarity, both in its monitor output mode and when playing back a recording. The Monterey maintained input-signal polarity in both modes.

I noticed something else when checking the AWE32 card for signal polarity. In order to avoid overloading the AWE32's line input circuitry, I put a 50-kilohm stereo volume-control box between this input and the output of the external D/A converter that was converting my test generator's digital signals to analog. When I happened to switch my test generator from the polarity-test waveform to a 1-kHz sine wave, I noticed that the distortion from the AWE32 was about 0.15% at full-scale input in monitor mode, even though it had been only about 0.033% when fed directly from the Audio Precision's analog output. It turns out that the AWE32's line input circuitry is sensitive to source impedance, and the output impedance of the external volume control (10 to 20 kilohms, at the volume settings I used) caused this distortion increase.

The meter facilities for setting record levels were accurate enough, and were set for 0 dB in the case of the Monterey's VU meters and full deflection in the bar-graph display in the AWE32. Both systems appeared to respond to the program's peak, rather than average, level.

FIG. 3— THD + N vs. recorded level.

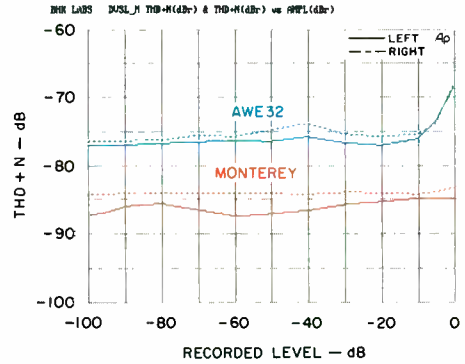
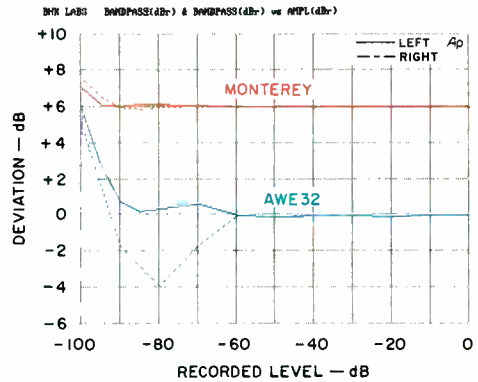


FIG. 4— Deviation from linearity (Monterey curve offset by 6 dB for clarity).



USE AND LISTENING TESTS

To test the sonic attributes of these sound cards, I brought a Parasound C/DP-1000 CD player/transport into the lab, recorded a number of pieces of music on both sound cards, and then played them back through a pair of Grado HP-2 headphones. I compared the sound of the source in monitor mode with the playback. Generally, I was impressed. Both cards sounded pretty damn good. However, I could easily hear small pops and clicks with both cards at the start and finish of a recording. The 2-V full-scale output of the CD player would overload the circuitry of the AWE32's line input, which really surprised and annoyed me. No amount of juggling the input gain or input level with the AWE32's mixer software fixed this problem; I had to reduce the actual input level to the card (which I did with my volume-control box). Without testing, I presumed that the CD input, internally accessed via a connector on the card, has appropriate input signal acceptance. By contrast, the Monterey's mixer application has a neat input-level sensitivity adjustment, and the card easily accepted the 2-V full-scale signal.

I then took both computers into my listening room and set them up to work with my main sound system. Here, the Parasound CD player fed a First Sound II passive signal selector and volume control that, in turn, fed the inputs of a pair of Cary Audio CAD-805 single-ended triode amplifiers. The CAD-805 amps drove my resident B & W 801 Matrix Series 3 speakers. This let me compare the sound of the source coming directly from the CD player with the playback from the sound cards, by switching the First Sound's input cable between sources. I felt the Monterey softened the sound a little and set the soundstage a bit farther back, but otherwise, it sounded quite good. The AWE32 had a tendency to be a little edgy and to reduce the sense of dimension and space in recordings with good ambience. Otherwise, it sounded pretty good too. Overall, I preferred the reproduction from the Monterey.

At a reasonable playback level, I listened to the noise out of the speakers with both cards, though I could hear a little hiss from the AWE32 that wasn't audible with the Monterey. True, this was with my head in the speakers—but at high playback levels with speakers real close, as in typical multimedia setups, the noise from the AWE32 could be audible. Nevertheless, I think either card would satisfy most sophisticated multimedia users.

The application software that I used consisted of the sound mixers supplied with each card, which I used for level setting, muting inputs, etc. Although the AWE32 comes with an excellent Windows record and playback application (the Monterey doesn't have Windows record/playback software), I used WinDAT from Voyetra Technologies for recording and playback with both sound cards.

Despite their differences, I liked both boards. I plan to buy the two of them for use with my computer programs, for experiment, and for just plain fun. A

COMPANY ADDRESSES

CREATIVE LABS, 1901 McCarthy Blvd., Milpitas, Cal. 95035

TURTLE BEACH SYSTEMS, 52 Grumbacher Rd., York, Pa. 17402

THE AUDIO INTERVIEW
BY JAMES ROZZI

RUDY VAN GELDER

Dr. Rudy Van Gelder's formal education was in optometry, but his heart and the majority of his professional years have been devoted full-time to the recording industry. Ask any jazz buff about Rudy, and they'll name him as the recording engineer responsible for all of those classic Blue Note and Prestige records, among almost countless others. Ask Rudy about Rudy, and he usually won't talk at all. This interview, one of the very few interviews Rudy has granted in his 40-plus years in the business, was conducted in his Englewood Cliffs, New Jersey, studio, a gorgeous facility just across the George Washington Bridge from Manhattan. I thank him for sharing his history and views. *J.R.*

It's a given in the jazz world that you have set the standards for jazz recordings for the past 40 years. In an ever-changing industry, how do you continue to maintain consistent quality in your recordings?

I prefer to do my own masters, my own editing. By "my own," I mean I want it to be done here. It's not that I influence what it is. It's just that I need to be involved in the whole process—up to and including the finished product—in order to give my clients what they expect from me, which is the reason they're coming here. They agree upon that before we can do anything. This is really the only major stipulation I have, that I do that process. It's not because it's expensive, because the expense is minimal. I purposely keep it that way because I don't want the money to be a part of their decision. The point is that I'd like to have at least some measure of control over the finished sound before it's sent for replication to the plant.

This is contrary to the way most studios work.

The business, at least from my viewpoint, has really become fragmented—more like the movie industry. There are engineers who do jazz recording who don't own the studio and don't have anything to do with the maintenance, ownership, or operation of the studio. They just go to a studio as a freelance engineer and use the facility for their own clients. Obviously, that's not the situation here. I own the studio. I run the studio. I maintain it. It's my responsibility. I'm here every day, not someplace else. It reflects me.

Being involved in the complete digital post-production process is highly unusual for any studio. Would you please explain it?

Once we have gotten to the point of recording and mixing the two-track tape that has all of the tunes the client wants for the CD, the next step is for me to get together with the producer or musician—whoever is in charge of the project—and sequence it. We have to put the tunes in the order that they will appear in on the CD, get all the timing in between the songs precise, and take all the noises out. As for the medium for that, the most common medium is DAT. Now, most people—including musicians and producers, except for those who work here—believe that this is a master tape. But no DAT can ever be a master tape. That format was not designed to be, and is incapable of being, a master. There are other elements required for CD replication that cannot be incorporated into a DAT. There is just no room on a DAT for the information

CAPTURING *the* STATE

of the ART

I own the studio. It's my responsibility.
I'm here every day, not someplace else.
It reflects me.

PHOTOGRAPHS BY ROBERT LEWIS

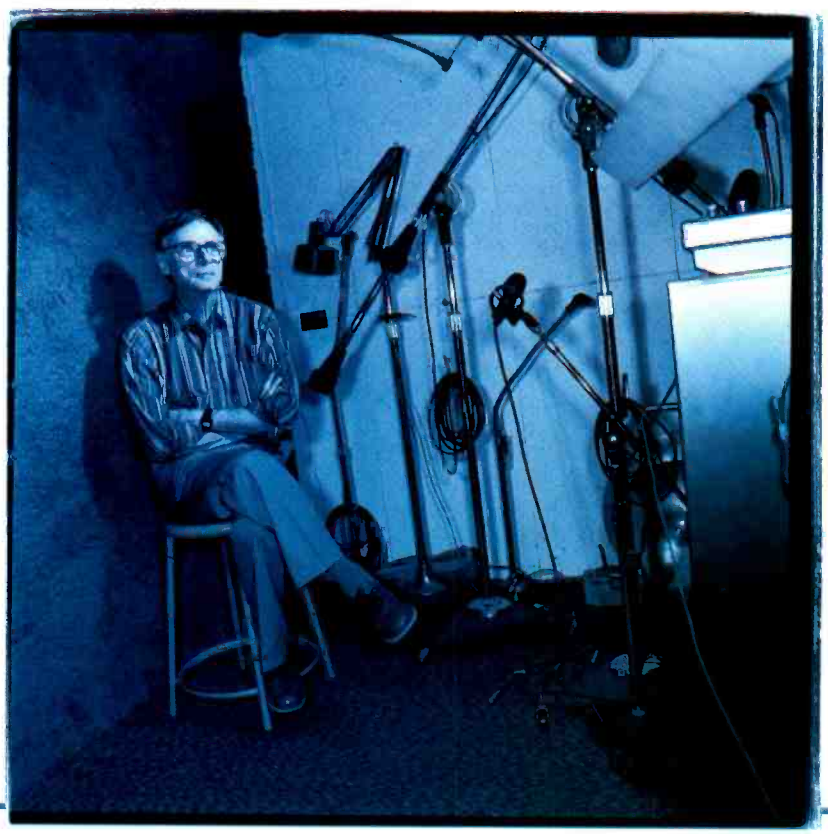
which tells your CD player to go to track one when you put a CD in and press "play." The information that makes this possible has to be incorporated on the CD. The DAT must be transferred to another medium that incorporates this information. This studio uses a CD-R. Prior to the CD-R, 1630 was the de facto standard. I consider that now obsolete. Most recording studios do not get involved in this process.

If most recording studios don't get involved in digital post-production, then how is it commonly done?

The very fact that most recording studios don't care to do it has created the existence of what are called mastering houses. They don't have studios. They don't even have a microphone. They just put the numbers on there and then transfer from one medium to another.

Why are you so concerned with accomplishing this process yourself? Isn't the equipment expensive?

Yes, it's very expensive, very difficult to acquire and maintain. The problem is that there can be processing at this stage, quite extensive processing.



Intentionally changing the sound from that of the DAT?

Intentionally changing the sound! Changing the loudness to softness, the highs to lows. Yes, it's a very elaborate procedure; it is a part of the recording process that most people don't even know exists.

Who is responsible for making the decision to alter the sound at this late a stage in the recording process?

Whoever is following the course of the project, usually whoever is paying for it or their representative. I'm now defining why I insist on doing everything myself. And you can extend this into the reissue process too. Reissuing is nothing but post-production. The people who were originally involved in the recording are no longer there, or they no longer own it. These mastering decisions on reissues are being made by someone else, someone affiliated with the company who now owns the material.

What are your feelings on issuing alternate takes?

Now, to me that's just a sad event which has befallen the record industry. The rejected outtakes have been renamed "alternate takes" for marketing reasons. It's a disservice to the artist. It's a disservice to the music. It's also rampant throughout the land, and I'm just telling you how I feel about it. I would recommend to all musicians: Don't let the outtakes get out of your hands. Of course, that may be easier said than done.

I've made thousands of LP masters, and

You must be disappointed by much of what has been released as alternate takes.

Yes, when I hear some of this stuff, I'm reminded of all the problems I had, particularly on these outtakes. It's like reliving all of the difficulties of my life again. So I don't take a lot of pleasure in that because I know I can do a lot better now, and all that does is reinforce my uneasiness. Of course, when it was a recording problem, the music was usually still so good that it was worth it to me. And the fact that it's still being heard—in many cases being heard better than ever before—is an incredible experience. And it's clean, with no noise. I don't like to complain too much.

I feel that way very often myself, the way you described, being able to hear the music better than ever. I'm not a person who locks into the sound as closely as I do the music. The music is all-important to me, but sometimes I become distracted by how bad the sound is. It seems that a big problem in translating those old recordings onto CD is the sound of the bass. It becomes very boomy.

Well, you can't blame that entirely on the people who are doing the mastering. That particular quality is inherent in the recording techniques of the time—the way bass players played, the way they sounded, the way their instruments sounded. They don't sound like that now. The music has changed the way the artists play. Now everything has got to be loud. A loud drummer today is a lot louder than a loud drummer of 30 or even 20 years ago. It's all relative. But as far as that certain quality you're talking about, some of it is very good, by the way. There were some excellent

bass recordings made at that time because the bass player and I got together on what we were trying to do.

Considering the reverence given to the historical Blue Note recordings and the fact that they were accomplished direct to two-track, do you get many requests nowadays to record direct to two-track?

Usually they say, "I want to go direct to two-track like the old days." And I say, "Sure, I'll do that." I can still do it, or we can record to the 24-track digital machine. As far as the musicians are concerned, regarding their performance out in the studio, that's transparent to them. There's no difference in the setup. I sort of think two-track while I'm recording and actually run a two-track recording of the session, which very often serves as the finished mix. But this is the real world now. The musicians will listen to the playback, and the bass player will say, "Gee, I played two bad notes going into the bridge of the out-melody. Can you fix that, Rudy?" Now, it used to be that when a client asked for a two-track session, I would never run a multitrack backup. They didn't want to get involved in it, for money reasons. They didn't want to spend the money for the tape or didn't want to have to mix it after the session. I went along with that for a long time. But the bass player would still come in, hoping to fix wrong notes, and I'd sit there like a fool and say, "Well, I can't do anything about it. The producer didn't want to spend the money for multitracking." So I decided I wasn't going to do that anymore. I think of it as a two-track date—we're talking about a small acoustic jazz band now, not any kind of heavy production thing—and I run a multitrack backup. Then when the bass player asks to fix a couple of notes, I look at the producer or whoever is paying for the session, and that becomes his decision, not mine. He now has to answer the bass player.

I'm glad to see the LP go.

So the final product may consist of both multitrack and two-track recordings?

That happens. Right. And my life is a lot happier. And the producers have come around a little bit too.

How did you first become affiliated with Alfred Lion of Blue Note Records?

There was a saxophone player and arranger by the name of Gil Mellé. He had a little band and a concept of writing, and I recorded him. This was before I met Alfred. I recorded it in my Hackensack studio in my parents' home. So somehow—and I was not a party to it—he sold that to Alfred to be released on Blue Note. And Alfred wanted to make another one. So he took that recording to the place he was going. It happened to be in New York at the WOR recording studios. He played it for the engineer, who Alfred had been using up until that time, and the engineer said, "I can't get that sound. I can't record that here. You'd better go to whoever did it." Remember, I wasn't there; this is how it was related to me. And that's what brought Alfred to me. He came to me, and he was there forever.

Those Blue Note records, they're just so beautiful. . . .

Masterpieces.

Did Alfred and you work at producing those jazz masterpieces? Did he have you splice solos?

Yes, he did. He was tough to work for compared to anyone else. He knew what he wanted. He knew what that album should sound like before he even came into the studio. He made it tough for me. It was definitely headache time and never easy. On the other hand, I knew it was important, and he had a quality that gave me confidence in him. The whole burden of creating for him—what he had in mind—that was mine. And he knew how to extract the maximum effort from the musicians and from me too. He was a master at that. I think one of the reasons our relationship lasted so long was because he listened to what other people were doing parallel to our product. I don't believe he ever heard anything that was better than what we were doing. I have no doubt that if he had heard someone doing it better than what I was doing, he would have gone there. But he never did, and that made it possible for me to build this studio. I knew he was always there.

Once you developed that sound, you knew exactly what to do initially. When the musicians walked in, you knew right where everything should be regarding microphone placement and all of that. And you went from there. From that point, it was just minor alterations according to that session.

That's very well put, and do you know why that was? Because Alfred used to come here often. He used to bring the same people out in various combinations. They all knew what I was like. Everybody would come in and know exactly where their stand was, where they would play. It was home. There were no strangers. They knew the results of what they were going to do. There was never any question about it, so they could focus on the music.

Then when Bob Weinstock of Prestige Records started with you, there was that whole crowd of musicians, sometime crossing over personnel.

Well, Weinstock would very often follow Alfred around, but with a different kind of project in mind. And you know, when I experimented, I would experiment on Bob Weinstock's projects. Bob didn't think much of sound; he still doesn't. He doesn't care. So if I got a new microphone and I wanted to try it on a saxophone player, I would never try it on Alfred's date. Weinstock didn't give a damn, and if it worked out, great. Alfred would benefit from that.

I've always thought of the Prestige dates as a more accurate indication of what was happening in the clubs. Although I know that after a Blue Note session wound down, the musicians could go out into the clubs and play original tunes, with Prestige it was mostly standards. That's what they went out and jammed on. And that deserves documentation as well.

Good riddance.

Absolutely. I agree with that, and I've said so, though not as well as you did. I wouldn't

want the world to be without them. There are people who say that the difference between Blue Note and Prestige is rehearsal. That's just glib. That's bullshit. That's not even a fair way to put it. It resulted in a lot of my favorite recordings. You know, those Miles [Davis] Prestige things . . . they can't hurt those things. It's really one of the most gratifying things I've done, the fact that people can hear those. It's really good.

When you were in the control booth listening to the sessions, were you ever aware that those sides would end up as classics?

Well, you can't see into the future. I had no way of knowing that. But I knew every session was important, particularly the Blue Note stuff. The Blue Note sessions seemed more important at the time because the procedure was more demanding. But in retrospect, the Prestige recordings of Miles Davis, the Red Garland with Philly Joe Jones, the Jackie McLean and Art Taylor, the early Coltrane—sessions like that—turned out to be equally if not more important. I always felt the activity we were engaged in was more significant than the politics of the time, to the extent that everything else that was happening was unimportant. And I still feel that way. I treat every session . . . every session is important to me.

The music has changed the way the artists play.

Have you done any classical or pop?

There was a long period of time parallel to those years when I was working for Vox, a classical company. I would get tapes from all over Europe and master those tapes for release in this country. I did that for 10 years or more. So I had three things going: Blue Note, Prestige, and Vox. Each of them was very active. And I did some classical recordings: Classical artists, solo piano recordings, a couple of quartets.

How about pop?

A lot of that popular stuff came with Creed Taylor later in the '70s. He was oriented more toward trying to commercialize jazz music. You're familiar with his CTI label? That's another world altogether. That's when we started to be conscious of the charts. I love the sound of strings, particularly the way Creed Taylor handled them with Don Sebesky. And I love an exciting brass sound too. Creed is a genius as far as combining these things that we're talking about. I'm not at all isolated in the world of a five-piece be-bop band. As a matter of fact, sonically, this other thing is more rewarding.

What are your feelings on digital versus analog?

The linear storage of digital information is idealized. It can be perfect. It can never be perfect in analog because you cannot reproduce the varying voltages through the different translations from one medium to another. You go from sound to a microphone to a stylus cutting a groove. Then you have to play that back from another stylus wiggling in a groove, and then translate it back to voltage. The biggest distorter is the LP itself. I've made thousands of LP masters. I used to make 17 a day, with two lathes going simultaneously, and I'm glad to see the LP go. As far as I'm concerned, good riddance. It was a constant battle to try to make that music sound the way it should. It was never any good. And if people don't like what they hear in digital, they should blame the engineer who did it. Blame the mastering house. Blame the mixing engineer. That's why some digital recordings sound terrible, and I'm not denying that they do, but don't blame the medium.

Now everything has to be loud.

A lot of people argue that digital is a colder, sterile sound. Where do you think that comes from?

Where does it come from? The engineers. You've noticed they've attributed the sound to the medium. They say digital is cold, so they've given it an attribute, but linear digital has no attributes. It's just a medium for storage. It's what you do with it. A lot of this has to do with the writing in consumer magazines. They've got to talk about something. What should be discussed is the way CDs are being marketed as 20-bit CDs, but there is no such thing as a 20-bit CD. Every CD sold to the public is a 16-bit CD. You can record 20-bit and it is better than 16-bit, but it has to be reduced to 16-bit before you can get it onto the CD. History is repeating itself. It reminds me of when they marketed mono recordings as "remastered in stereo." All they did was put the highs on one side, put the lows on the other, and add a lot of reverb to make it believable. Then they'd sell it as a stereo record.

Do you feel today's jazz musicians stack up to the players of the 1950s and '60s, Blue Note's heyday?

Well, there are a lot of great kids around. You know, technically they're great. I feel they're suffering from a disadvantage of not being able to play in the kind of environment that existed then. You don't want me to make a broad statement saying, "Gee whiz, it was better 20 years ago than it is now." First of all, I don't believe that. I don't even think of it that way.

Do you see yourself as a technician and an artist?

Absolutely. When you mention the technical end, the first thing I think of is making sure all the tools are working right. The artistic part is what you do with them. The artistic part involves everything in this place. There's nothing here that isn't here for an artistic reason. That applies to the studio. The whole environment is created to be artistic. It's my studio and it's been this way for a long, long time, and people like it. It's even mellowed through the years, and people are aware of that. Musicians are sensitive to that. Someone came in here only yesterday and said, "If the walls could repeat what has happened here. . . ." A

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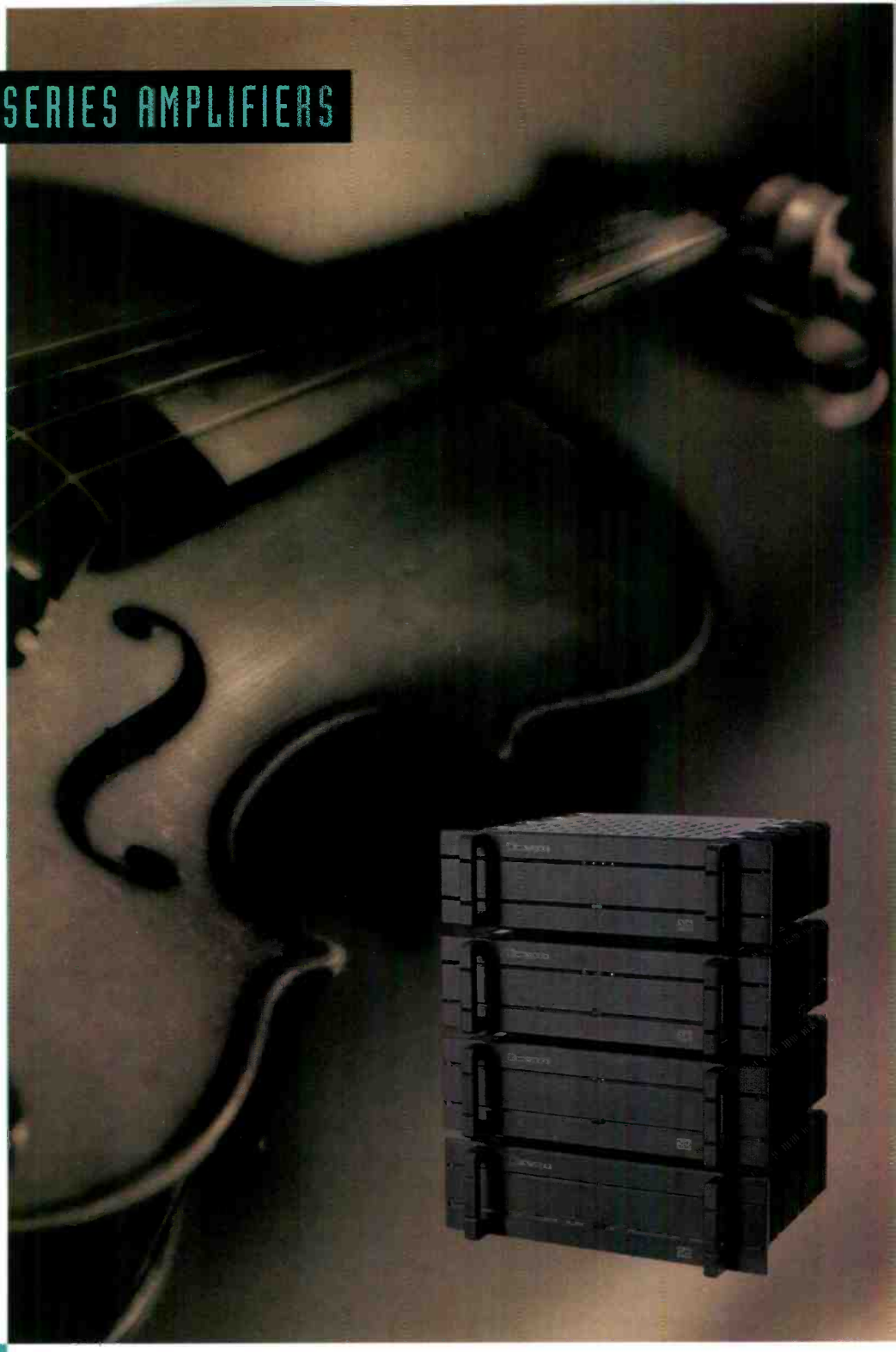

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EQUIPMENT **PROFILE**

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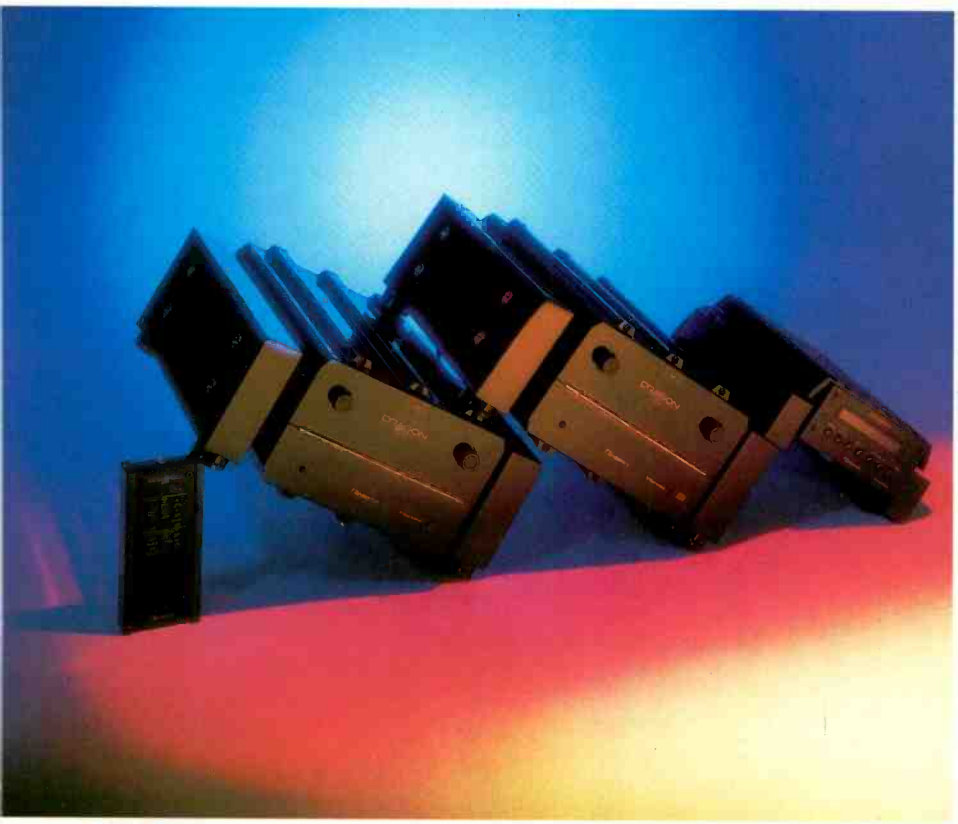
NAKAMICHI DRAGON CD CHANGER AND DRAGON DAC D/A CONVERTER



The Nakamichi Dragon has emerged from his lair in Kodaira. His fiery breath can be felt halfway around the world. He's entered my lab in Connecticut and stalked my listening room. This is a new Dragon, not an upgrade of the original Dragon cassette deck (now discontinued) or a turntable like the Dragon-CT. This is a modern Dragon, a CD changer built around Nakamichi's MusicBank mechanism, plus an accompanying D/A converter that uses Nakamichi's Enhanced Linearity DAC.

The new Dragon comes as four physically separate components: A seven-disc MusicBank changer, a converter, a unit combining the power supply with the system's main controls, and a wireless infrared remote. Although the changer has its own converter, Nakamichi does not intend to sell it separately. This Dragon is a family animal. And although the Dragon DAC could stand alone (assuming a power supply were available for it), it too will be sold only as part of the system, which will set you back a tidy $9,700.

THE DRAGON MAKES A VISUAL AS WELL AS AN AURAL STATEMENT, LOOKING LIKE NO OTHER HOME CD CHANGER.

This Dragon makes a visual as well as an aural statement. It looks like no other CD player I've seen, though it does bear a family resemblance to the Nakamichi 1000 car system (reviewed in the June 1995 issue). The changer and DAC are housed in identical enclosures, of heavy extruded aluminum, that have three massive ribs running front to back, on top and bottom, and two similar ribs on each side. The aluminum is finished in high-gloss black. Each enclosure is mounted by its side ribs to high-gloss rosewood side pieces more than 1½ inches thick. Rubbery feet at the front and back of each block are the only contact with the mounting surface. This arrangement is said to form the first line of defense against external vibration. The wood and feet absorb vibration, and the system is balanced so that vertical shock from the mounting surface has minimal chance of affecting the mechanism or electronics.

As a second line of defense, the MusicBank changer mechanism is mounted on a steel subchassis that floats on viscous dampers, isolating it from external vibration along all three axes. Any minuscule vibrations set up by the mechanism are suppressed with dual internal dampers.

The third line of defense against outside forces is the "Air Shield" chassis. The joints between the two halves of the aluminum extrusions, as well as those between chassis and front and rear panels, are sealed with elastomeric gaskets. The front surface is machined from 10-mm aluminum and hinged in the middle. To load discs, two thumbscrews are released, and the upper half of the panel hinges down. This reveals seven illuminated buttons with lit numbers beneath each. When a button is pressed, a loading tray emerges. When the button is pressed again, it draws the CD into the mechanism to load it into the appropriate slot on the "stocking" elevator. As the tray loads, it does a little shuffle to settle any out-of-kilter disc into the well. What a nice thought! After as many as seven discs have been loaded, the upper half of the door is raised and sealed against a foam gasket with the two thumb screws.

As mentioned earlier, the DAC and transport are housed in identical enclosures, as Nakamichi believes that its

Photos: Michael Groen

"Tri-Stage Isolation" is just as important in preventing sound-debilitating jitter in the electronics as it is for preventing problems in the transport. In fact, Nakamichi is so strong on its Air Shield design that both DAC and changer come with sealing screws to plug the holes left in the housing when the shipping bolts are removed.

The Dragon PS power supply/controller is much smaller, but it, too, is in a high-gloss black aluminum case mounted between high-gloss rosewood side rails that hold it above the mounting surface (albeit not with the isolation used for the Dragon CD and the Dragon DAC). Five buttons are spread across the front, below the display. From left to right, these are "Power" (off or standby), "Play/Pause" (which doubles as power on), two "Disc" select keys (one to switch to the next higher numbered slot, the other to the next lower one), two "Track" skip buttons (which double as cueing controls when held down), and a final button, "Digital Input," that toggles between the Dragon DAC's A and B inputs.

The remote matches the rest of the system. You'll find no plastic here; the heavy aluminum housing is finished in high-gloss black with glossy rosewood sides. There are 14 buttons; seven provide direct access to any disc, and an eighth chooses random play of all tracks on all discs. Any of these eight serves to turn on power, as does the play/pause control. Discs can be selected by two "Disc" up/down keys, as on the main controller, but these do not turn on the system. Tracks can be skipped or cued with a pair of "Track" keys, just as on the main controller, but there is no means to access a track directly or to search for index marks. The final button ("Repeat") sets up a repetition of all seven discs; single tracks and discs cannot be played repeatedly, nor are there means for "marking" a segment for repeat play or programming the playback order of tracks or discs. Re-pressing "Random" or "Repeat" cancels the mode.

The front panel of the Dragon CD's Air Shield cabinet opens for disc loading.

On the back of the Dragon PS are two power jacks that feed d.c. to the Dragon DAC and the Dragon CD; a multipin "System Control" connector interfaces with the Dragon CD. An a.c. input connector with detachable line cord is on the far left as you face the rear panel. On the back of the Dragon CD are input connectors for the d.c. feed and system-control cables, a pair of high-quality Teflon-insert, gold-plated, "Analog Output" RCA jacks, and a similar jack for the "Digital Output." The Dragon DAC simply has a power connector, two "Digital Input" jacks (neither with optical counterpart), and a pair of "Analog Output" jacks. Input and output jacks are the same as used on the Dragon CD. Nakamichi provides cables for all interconnections.

Measurements

The topology of the Dragon DAC converters differs materially from that used in the Dragon CD, so I tested both. Again, Nakamichi does not plan to sell the Dragon CD separately from the Dragon DAC, but I was intrigued to find out how the Dragon CD's converter would compare, even if it wasn't going to be used.

Nakamichi describes the internal Dragon CD's converters as "High-precision . . . dual 18-bit D/A converters with (an) 8-times-

SPECS

CD CHANGER
D/A Converter Type: Dual, 18-bit with eight-times oversampling digital filter.
Wow & Flutter: Below measurement limits.
Frequency Response: 10 Hz to 20 kHz, ±0.5 dB.
THD: 0.008% or less at 1 kHz and 0 dB.
S/N: Greater than 92 dB, IHF A-weighted.
Dynamic Range: Greater than 90 dB.
Channel Separation: Greater than 88 dB.
Analog Output Characteristics: Level, 1.5 V for 0 dB at 1 kHz; impedance, 600 ohms.
Digital Output Impedance: 75 ohms.
Dimensions: 12⅝ in. W x 5⅞ in. H x 11¾ in. D (32.1 cm x 14.8 cm x 29.9 cm).
Weight: 18 lbs., 11 oz. (8.5 kg).

D/A CONVERTER
Type: Dual, 20-bit, push-pull with eight-times oversampling digital filter.
Sampling Frequency: 32, 44.1, or 48 kHz.
Frequency Response: 5 Hz to 20 kHz, ±0.5 dB.
THD: 0.0025% or less at 1 kHz and 0 dB.
THD + N: 0.003% at 1 kHz and 0 dB.
S/N: Greater than 105 dB, IHF A-weighted.
Channel Separation: Greater than 100 dB.
Analog Output Characteristics: Level, 1.5 V for 0 dB at 1 kHz; impedance, 600 ohms.
Dimensions: 12⅝ in. W x 5⅞ in. H x 11¾ in. D (32.1 cm x 14.8 cm x 29.9 cm).
Weight: 17 lbs., 10 oz. (8 kg).

POWER SUPPLY
Power Requirements: Available for 120, 230, 240, or 110 to 127/220 to 240 V a.c., 50/60 Hz, according to country of sale.
Output Voltage: 12 V d.c.
Power Consumption: 30 watts maximum, with both Dragon CD and Dragon DAC connected.
Dimensions: 8 in. W x 3⅜ in. H x 9 in. D (20.2 cm x 8.7 cm x 22.8 cm).
Weight: 7 lbs., 12 oz. (3.5 kg).

REMOTE-CONTROL UNIT
Dimensions: 2⅝ in. W x 1 in. H x 6 in. D (6.8 cm x 2.5 cm x 15.4 cm).
Approximate Weight: 13 oz. (380 grams), including batteries.

SYSTEM
Price: $9,700.
Company Address: 955 Francisco St., Torrance, Cal. 90502.
For literature, circle No. 90

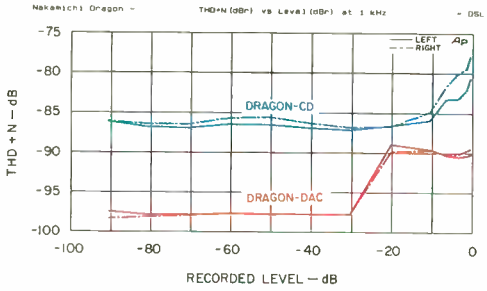


Fig. 1—THD + N vs. level.

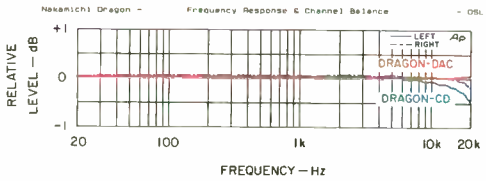


Fig. 2—Frequency response and channel balance.

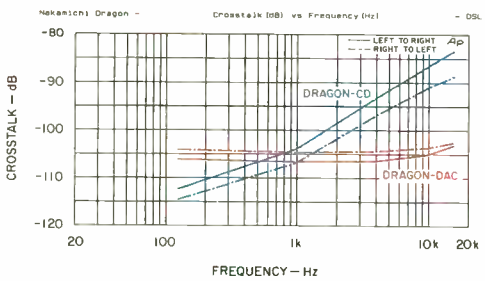


Fig. 3—Stereo crosstalk.

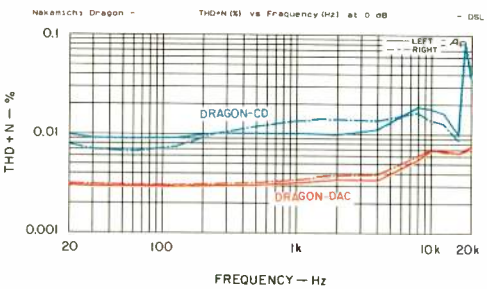


Fig. 4—THD + N vs. frequency.

Rear panel of the Dragon CD

oversampling digital filter . . . [using] meticulously selected circuit components." The Dragon DAC's converters, on the other hand, use Nakamichi's "EL" (Enhanced Linearity) topology to "achieve true 20-bit resolution at low signal levels," as described below.

The Dragon DAC employs two EL 20-bit converters per channel, in a push-pull configuration that is said to cancel common-mode noise and other extraneous influences. Each channel uses two 18-bit dual DACs, so there are four converters per channel and eight converters in all. (The DAC chips are custom versions of the Burr-Brown PCM1700P.) Each half of the balanced configuration uses two of these converters: After the input data is converted to 20-bit form, one DAC chip handles the four most significant bits, the other the remaining 16 bits. (This digitally amplifies the lower level signals, which are attenuated after conversion and before mixing with the signal from the upper four bits. Nakamichi says this adds four bits of precision to the low-level signals, yielding its claimed 20 bits from 16-bit data.) With such an arrangement, "crossover" occurs at –24 dBfs, as you can see from the sudden drop in THD + N between the –20 and –30 dBfs test levels in Fig. 1. But even at higher recorded levels, the Dragon DAC performs extremely well: Worst-case THD + N is –89.3 dB, an improvement of more than 12 dB over the Dragon CD's converters. Because the crossover occurs four bits down, I've changed the Dragon DAC's secondary numbers in the Measured Data Table for THD + N at 1 kHz (but not the Dragon CD's) from my usual –10 to –30 dBfs to –30 to –90 dBfs. The Table shows worst-case data.

The EL converter feeds a "discrete" third-order Bessel filter and is driven by an SM5843 20-bit digital filter with eight-times oversampling. The output filter has an isolated-ground local regulator to prevent power-supply noise from contaminating the analog signal ground. The desired digital input is selected by a 74LS151 switch that is isolated from the controller by a photocoupler for similar reasons. After the switch, a YM3623B receiver phase-locks the system to any of the three standard sampling rates (32, 44.1 or 48 kHz). There is no indication that the cutoff frequency of the output filter changes accordingly. Data is reclocked in the Dragon CD.

THE DRAGON CD'S FREQUENCY RESPONSE IS DECENT, BUT THE DRAGON DAC'S IS TRULY RULER FLAT.

Although the Dragon CD's frequency response is decent (–0.52 dB at 20 kHz, worst case), the Dragon DAC's is truly "ruler flat" (see Fig. 2). Channel balance of both systems is exemplary, testifying to close component tolerances in the analog circuitry. Channel separation (Fig. 3) in the Dragon CD is nothing to sneeze about (better than 83.5 dB across the board), but that of the Dragon DAC is extraordinary—more than 102 dB, worst case! Obviously, Nakamichi has taken extreme care with circuit layout.

Output level was less than the quasi-standard 2 V, but the difference is unimportant. Output impedance of the Dragon DAC was less than the Dragon CD's, but again the difference is inconsequential.

Significant differences in the relative performance of the converters can be found not only in the THD + N versus level curves of Fig. 1 but also in the THD + N versus frequency curves of Fig. 4. The Dragon DAC's distortion is far less at all frequencies than the Dragon CD's. By today's standards, the Dragon CD's converters are rather pedestrian, and contamination sneaks up past 0.08% at 18 kHz. The Dragon DAC's artifacts, on the other hand, are more than an order of magnitude lower, which qualifies its performance as outstanding.

There also are clear differences in low-level linearity, as seen in Fig. 5. Even in the poorer channel, the Dragon DAC is just

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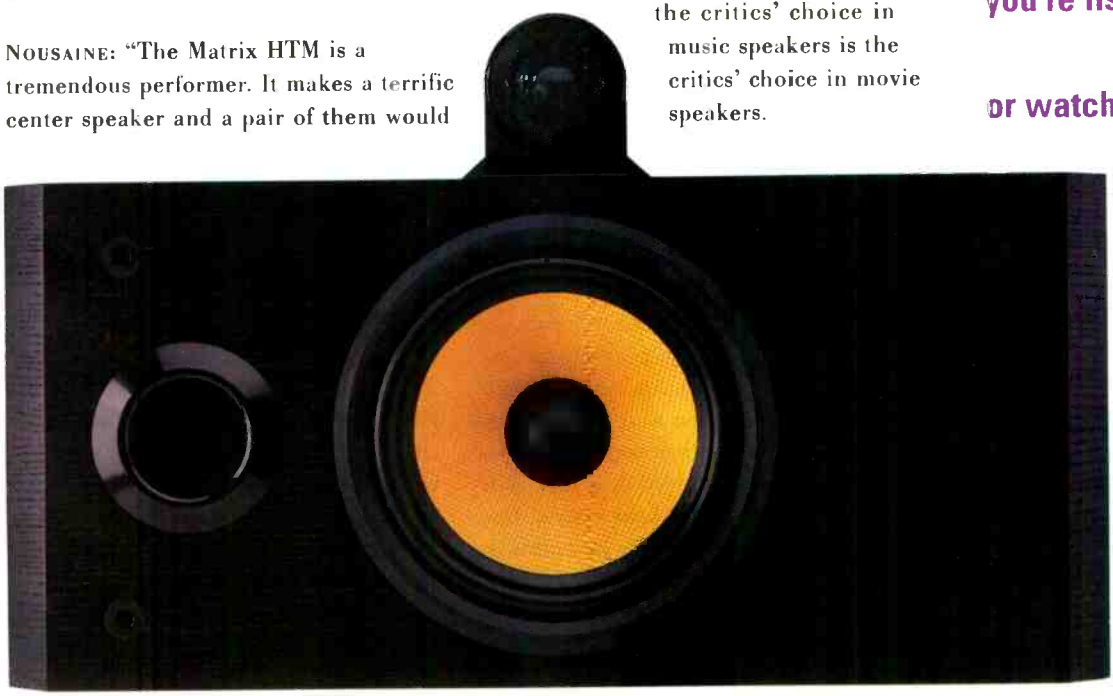

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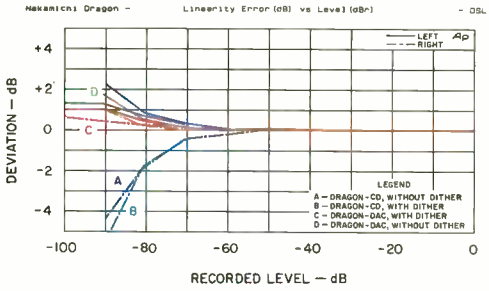


Fig. 5—Deviation from linearity.

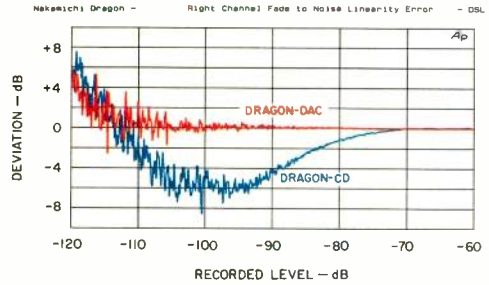


Fig. 6—Fade-to-noise test.

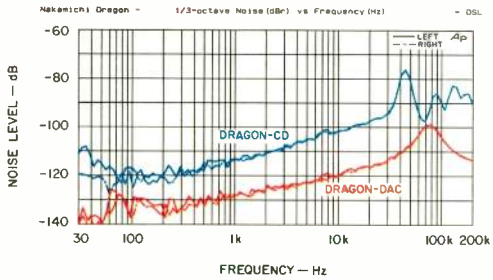


Fig. 7—Residual-noise spectrum.

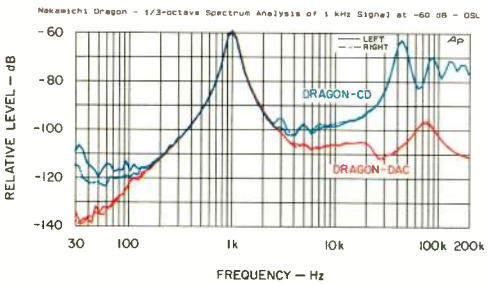


Fig. 8—Noise spectrum with 1-kHz, –60 dBfs signal.

Rear panel of the Dragon DAC

about perfectly linear to –70 dB re: full scale (–70 dBfs). The error is barely more than 0.5 dB at –80 dBfs, and under 1.75 dB at –90 dBfs. With a dithered recording, linearity error drops to a mere 1 dB at –90 dBfs and hardly more than that at –100 dBfs. Extraordinarily good! In comparison, the right channel of the Dragon CD's converter shows significant error at –60 dBfs, and the error exceeds 4.3 dB at –90 dBfs. Nor do matters improve on dithered recordings.

Similar effects can be seen in the fade-to-noise curves of Fig. 6. I've shown the right channel because it was the worse one on the Dragon CD; there was very little difference between the Dragon DAC's channels. Spectral analyses of residual noise (Fig. 7) and of a 1-kHz, –60 dBfs recording (Fig. 8) also demonstrate the superiority of the Dragon DAC over the Dragon CD. Note the absence of low-frequency noise in the Dragon DAC's output and its excellent suppression of the 44.1-kHz sampling component. Also note the absence of harmonics in Fig. 8. The Dragon CD's output includes an unusual amount of the sampling signal and its harmonics, as well as the third, fifth, and seventh harmonics of the 1-kHz tone.

The A-weighted S/N ratio is 17 dB better on the Dragon DAC than on the Dragon CD. However, this measurement says more about the analog electronics than about the converters, which are not exercised by the "all-zeroes" recording used for the test. The figures for quantization noise, however, do reflect converter action. Here, too, the Dragon DAC outperforms the Dragon CD, albeit by a lesser margin (7 dB). Dynamic range is calculated from the noise and distortion generated when converting a –60 dBfs, 1-kHz recording and maximum output of the system. Here the Dragon DAC outperforms the Dragon CD by about 12 dB on an A-weighted basis and more like 4.5 to 6 dB on an unweighted basis.

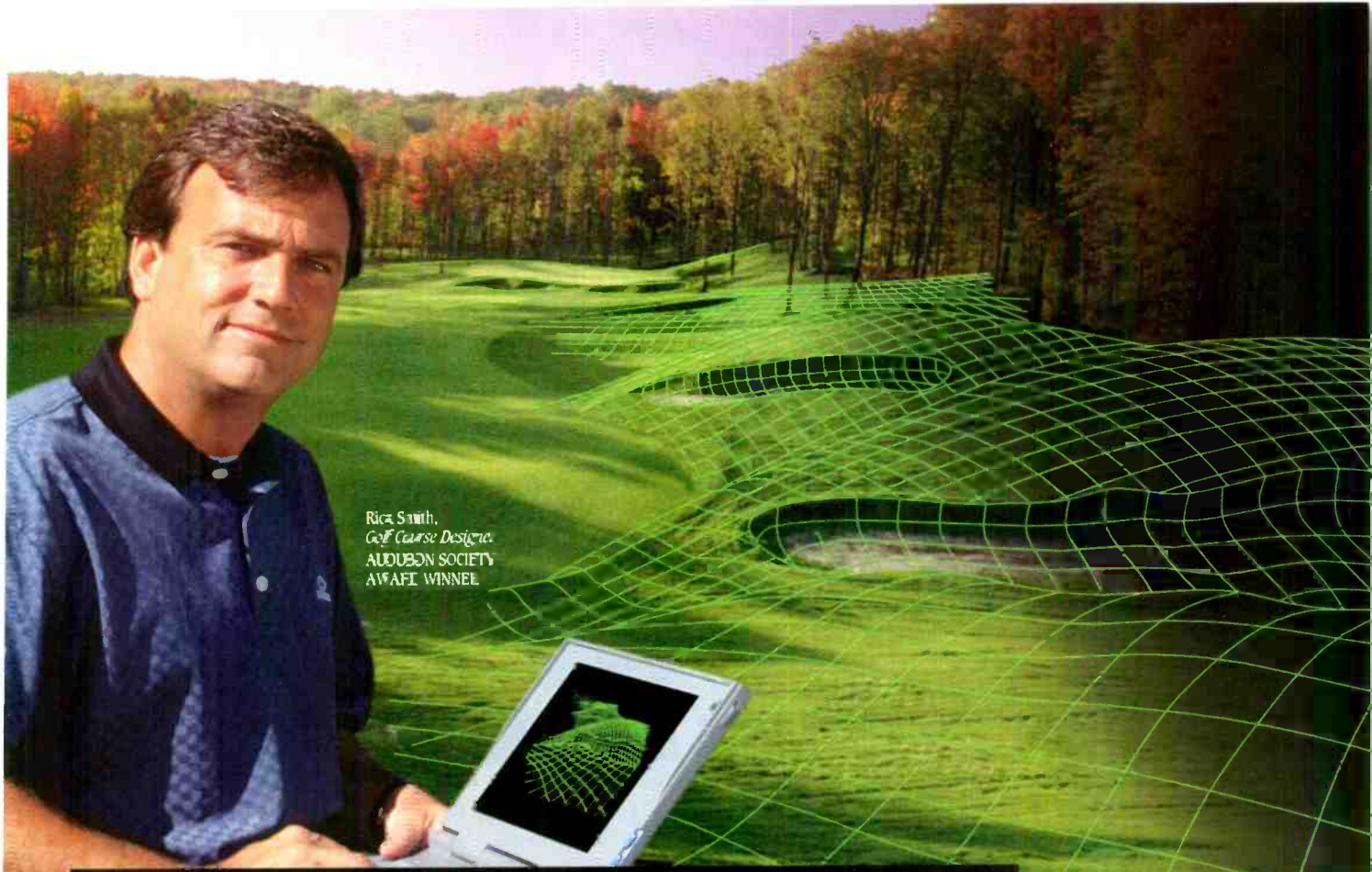
The Dragon's Breath

I loaded the Dragon CD with a full complement of discs and gave it a workout. For the record, disc changing time came out to just under 8 S; skipping to the next track took under 2 S. You can't load a disc during play, but the system does return to the previous disc after gobbling up the new one. It doesn't return to where playback left off, however, but cues to the start of track 1. If you're indecisive when using the track-scan/track-skip key, you may accidentally skip to the next track rather than scan the current one. The only way to prevent this is to keep the key depressed for what seems an eternity before scanning starts, so it's easy to give up and tap again—which takes you straight to the next track. I found these controls far more reliable on the controller than on the remote.

Although Nakamichi normally provides a digital interconnect between the Dragon CD and the Dragon DAC, my early sample didn't have one, so I substituted a precision cable from MIT. To make a direct comparison between the sound of the converters, I connected both to separate inputs of my Apt preamp. The difference in output levels (0.8 dB) would tend to tilt judgment in favor of the Dragon DAC, but I tried to take this into account as best I could. I repeated the listening tests with only one converter connected at a time, to sidestep any problem that might occur when both were connected to the same box.

THIS SYSTEM IS ON A PAR WITH THE BEST; ITS BASS IS WARM, FULL, AND FAT AND ITS TREBLE CLEAR AND BRILLIANT.

Although I used quite a number of CDs during my listening evaluation, my final judgment is based mainly on the following list: A collection of Bach works for harpsichord played by Trevor Pinnock (Deutsche Grammophon Archiv 435795); *The Young Beethoven*, with Igor Kipnis on fortepiano (Epiphany EP-1); *Smetana: The Complete Czech Dances* featuring Antonin Kubalek on an American Steinway D in the Troy Savings Bank Music Hall (Dorian DOR-



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90122); Debussy's Nocturnes and his Symphonic Fragments from *Le Martyre de Saint Sébastien* with Esa-Pekka Salonen conducting the Los Angeles Philharmonic Orchestra (Sony Classical SK 58952); a reissue of Volume II of the Sheffield/Leinsdorf Sessions (Sheffield Lab 10052-2-G); the *Kodo Heartbeat Drummers of Japan* (Sheffield Lab 1222-2), and finally, a sampler disc from Nakamichi that has several cuts from the Proprius label, including "Cantate Domino."

I chose each recording for a specific reason. Since Nakamichi has a harpsichord in its concert hall, where, presumably, its listening tests are conducted, I thought to include the Pinnock in my lineup. I chose the Kipnis because I know his fortepiano and the venue in which the Epiphany recording was made. The Dorian disc is an excellent piano recording, with marvelous ambience, so it made the lineup. The Sony and Sheffield reissues were included because each was transferred to CD using "20-bit" processing (Sony's Super Bit Mapping and Sheffield's 20+→16 Ultra Matrix Processing) and should push the converters to their limits. I included the Kodo disc, because if anything would prove the worth of Nakamichi's Air Shield cabinet design, the huge O-Daiko drum certainly would. Finally, I selected the Nakamichi sampler because it reflects the company's thoughts on good CD sound (and I agree).

THE DRAGON PS IS THE SYSTEM'S CONTROL CENTER AS WELL AS ITS POWER SUPPLY.

The effectiveness of the Air Shields was judged using the Dragon DAC converter. Ah, the power of suggestion. When I manipulated the doors myself, I thought I heard a difference. Bass seemed tighter with the doors closed, and the treble was smoother and silkier. But then my life companion raised and lowered the shields on both the Dragon DAC and Dragon CD, individually and together, without my knowing which condition applied. I only tried to judge whether anything had changed, not which condition sounded best. Since I had audible clues when she changed conditions (the thumbscrews rattle slightly), she'd occasionally "fool" me by opening and then quickly closing the shields and/or doing the opposite, with a few extraneous rattles thrown in for good measure. When we tallied the score, I was right half the time (which is to say, I could not reliably discern a difference whether the doors were sealed or not), even with the O-Daiko cut played at high volume.

There was no mistaking the difference in sound between the two converters; the Dragon DAC so outperforms the Dragon CD's built-in electronics that I can readily see why Nakamichi hesitates to sell one without the other. The Dragon DAC is an exceptional converter; from a technical standpoint, it's one of the finest I've measured, and its sonics are on a par with the best I've ever heard. Its bass is warm, full, and fat and its treble clean and brilliant. Some might say the bass is a bit too fat and the treble a bit too brilliant, but I don't think it quite goes over the edge of musical propriety.

The Dragon DAC excels in its uncanny ability to unearth detail and ambience. My listening notes consistently refer to these characteristics—the ambience of the Troy Music Hall, the inner detail of the Debussy, the finger cymbals and distant voices accompanying the O-Daiko—as being all clearly outstanding. I could consistently tell one converter from the other in these respects, and preferred the Dragon DAC. The only recording in which ambience seemed better with the Dragon CD (strangely enough) was the "Cantate Domino" cut on the Nakamichi sampler. But although the changer's internal D/A converter seemed to have a bit more ambience, the Dragon DAC produced a much smoother sound, so I'd still choose to use it.

Clearly, Nakamichi has gone to extraordinary lengths to dot every "i" and cross every "t" in the design of its new Dragons, but I'm puzzled about the underlying design philosophy. That this is an expensive system doesn't overly concern me. (It just makes me wish I earned more!) And the fact that this system has ventured well beyond the point of diminishing returns vis-à-vis sound quality per dollar doesn't much concern me, either. Every Nakamichi Dragon has made that heroic quest, and—thank heavens—there will always be folks for whom price is no object when pursuing the Holy Grail. What does concern me is the sacrifice of basic conveniences. Must I give up direct track access and the ability to program an evening's music in order to placate this Dragon? Being a classical music freak, I'd gladly forgo cutesy features like random playback—and repeat playback, if it means repeating every disc in the bloody elevator—to grab this Dragon by the tail and program it. A

MEASURED DATA

DRAGON DAC
Line Output Level: 1.595 V.
Line Output Impedance: 100 ohms.
Channel Separation: Greater than 103.2 dB from 125 Hz to 16 kHz.
THD + N at 0 dBfs: Less than 0.0072% from 20 Hz to 20 kHz.
THD + N at 1 kHz: From 0 to –90 dBfs, –89.3 dB; from –30 to –90 dBfs, 98.1 dB.
A-Weighted S/N: 110.8 dBfs for infinity-zero signal.
Dynamic Range: A-weighted, 99.6 dB; unweighted, 97.7 dB.
Quantization Noise: –93.1 dBfs.

DRAGON CD
Line Output Level: 1.455 V.
Line Output Impedance: 980 ohms.
Channel Separation: Greater than 83.5 dB from 125 Hz to 16 kHz.
THD + N at 0 dBfs: Less than 0.083% from 20 Hz to 20 kHz.
THD + N at 1 kHz: From 0 to –90 dBfs, –77.1 dB; from –10 to –90 dBfs, 84.0 dB.
A-Weighted S/N: 93.9 dBfs for infinity-zero signal.
Dynamic Range: A-weighted, 87.0 dB; unweighted, 91.5 dB.
Quantization Noise: –86.0 dBfs.

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EQUIPMENT **PROFILE**

D. B. KEELE, JR.

JMlab SPECTRAL 913.1 SPEAKER

Focal, S.A. is a French company known for its high-quality speaker drivers; JMlab is its speaker system division. Focal sells many drivers for use in home construction projects, and many more as an OEM supplier to companies all over the world, including such well-known American manufacturers as Avalon, Legacy, Snell, Swans, Thiel, Westlake Audio, and Wilson Audio. However, finished speakers actually comprise over 70% of Focal's business. The American sales arm, JMlab America (a division of the Prism Audio Group), markets more than 30 models in the U.S., ranging in price, per pair, from $495 for a small two-way unit up to $65,000 for the extreme high-end Grande Utopia. The 913.1 comes near the top of the Spectral line in the U.S. Only three JMlab systems exceed it in price: The Antea ($6,495), the Alcor ($11,000), and the aforementioned Grande Utopia.

The 913.1 is a fairly large and heavy three-way speaker using dual 8-inch woofers in a rear-ported vented box. The other drivers are a 5-inch midrange and a 1-inch, titanium inverted-dome tweeter. One of the two parallel-connected woofers is mounted near the top of the front panel; the other is near the middle of the panel, below the midrange and tweeter.

The 913.1's enclosure is a hefty double-sided design consisting of a main cabinet constructed of ¾-inch MDF covered on the sides by 1-inch slabs of African anigré wood. The cabinet contains two equal-volume enclosures for the woofers, each vented to the rear through a tube 2⅛ inches in diameter and 6 inches long. The midrange is mounted in its own sealed chamber, a 6-inch diameter tube which connects the front and rear of the enclosure. All drivers are mounted to the front panel with socket-head machine screws. The systems are supplied with spikes that can be screwed into the bottom of the cabinet. The 913.1's grille is made from ½-inch MDF and is attached to the front panel with six plastic projections that mate with plastic fittings in the cabinet.

The system's high-excursion 8-inch woofers have diecast baskets and Polykevlar cones. Polykevlar, a Focal exclusive, is a sandwich of resin-bound hollow microspheres between two sheets of Kevlar. This combination is said to have light weight, rigidity, and excellent damping, but without the coloration of conventional Kevlar construction. The woofer's voice-coil is of flat ribbon wire wound on a Kapton former, 1½ inches in diameter.

The 5-inch midrange also uses a Polykevlar cone and features a stationary conical phasing plug. A 1-inch voice-coil, wound on a Nomex former, surrounds the phasing plug and vibrates in relation to it. No dust cap is used or required.

The 913.1's tweeter utilizes an inverted metal dome made of a material that Focal calls Tioxid, titanium that is covered with a thin film of titanium dioxide, and suspended with a flexible, flat foam surround. Unlike the voice-coils of conventional convex-dome tweeters, which are larger than their domes, the inverted-dome tweeter's voice-coil is significantly smaller than its dome, and drives it from its center. The tweeter uses a large magnet, 3¾ inches in diameter,

Photos: Michael Groen

that raises the tweeter's overall weight to a hefty 3 pounds.

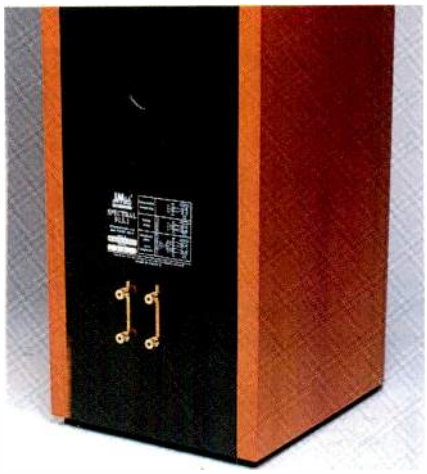
The system's crossover is constructed on a large, 6 x 10-inch p.c. board that is attached to a removable MDF panel mounted on the bottom of the cabinet. The parallel-connected woofers are driven by a third-order, 18-dB/octave, low-pass filter (two series inductors with a series capacitor and resistor to ground). The midrange is fed through a modified bandpass network formed of a third-order, 18-dB/octave, high-pass network plus a high-frequency rejection circuit. The latter is a parallel-resonant LC tank, tuned to 7.9 kHz, in series with the input. (For you electrical engineers out there, it's a third-order, elliptic low-pass filter with a zero in the stopband at 7.9 kHz, which provides a rapid roll-off with a slope approaching 24 dB/octave between 4 and 7 kHz.)

The crossover contains 20 components (five resistors, five inductors, and 10 capacitors, all premium quality) that function as 16 distinct parts, considering paralleled units. The three largest inductors have ferrite cores. Connections between crossover and speakers use 14-gauge stranded wire, soldered at both ends. All drivers are connected in positive polarity.

Input connections are via two bi-wirable pairs of gold-plated, heavy-duty binding posts at the bottom rear of the cabinet. Terminal spacing is a nonstandard 40 mm (1⅝ inches), so standard double-banana plugs will not work. For normal wiring, the two pairs of input terminals are connected together with large brass bus bars, 0.2 inch in diameter and 2½ inches long. These bus bars go into the holes in the terminal posts, where they will prevent normal-gauge speaker wire from being inserted, so single banana plugs must be used.

SPECS

Type: Three-way, floor-standing, vented-box system.
Drivers: Two 8-in. cone woofers, 5-in. cone midrange, and 1-in. titanium inverted-dome tweeter.
Frequency Response: 35 Hz to 25 kHz, +0, –3 dB.
Sensitivity: 93.5 dB at 1 meter, 2.83 V rms applied.
Crossover Frequencies: 500 Hz and 3.5 kHz, with 18-dB/octave slopes.
Impedance: 8 ohms average, 4 ohms minimum.
Maximum Amplifier Power: 175 watts continuous, 250 watts program power.
Dimensions: 43¾ in. H x 11¼ in. W x 14⅜ in. D (111 cm x 28.5 cm x 36.5 cm).
Weight: 86 lbs. (39 kg) each.
Price: $4,295 per pair.
Company Address: c/o Prism Audio Group, 14038 Tanglewood Court, Dallas, Tex. 75234.
For literature, circle No. 91



The terminals can be bi-wired but cannot be used with standard double-banana plugs.

Measurements

Figure 1 shows the on-axis anechoic frequency response of the Spectral 913.1. Measurements were taken at a distance of 2 meters from the front of the cabinet, on the midrange axis (as recommended by the factory). A voltage of 5.66 V rms was applied (equivalent to 8 watts into the rated 4-ohm minimum impedance) and then referred back to 1 meter with a 2.83-V rms input (equivalent to 2 watts into 4 ohms). A combination of ground-plane and elevated free-field measurements was used to derive the curve, which was then averaged with a tenth-octave filter.

THE SPECTRAL 913.1'S LOW-FREQUENCY OUTPUT WAS IN THE TOP 25% OF ALL SPEAKERS I HAVE TESTED.

If you exclude a high-frequency rise above 15 kHz, the on-axis curve is quite flat and fits within a tight, 4.5-dB window from 50 Hz to 18 kHz. Distinguishing features include a moderately elevated low end between 60 and 500 Hz, roughness above 800 Hz, a slight dip at 11 kHz, and a rising high end above 12 kHz. A separate frequency response measurement extending to 30 kHz (not shown) revealed a high-frequency dome-resonance peak at 21 kHz (which reached a level of 97 dB) and then a rapid roll-off at higher frequencies.

Averaged from 250 Hz to 4 kHz, the sensitivity of the 913.1 measured a high 90.0 dB, which is 3.5 dB below JMlab's rating. The right/left match of the speakers was poor, with the left being some 0.5 to 1 dB above the right below 2 kHz, and below the right by about 1 to 2 dB above 3 kHz. The major difference occurred in the high-frequency range, above 11 kHz, where the left unit was some 2 dB below the right. The grille caused moderate response deviations above 2 kHz, with maximum deviations of about +2 and –3.5 dB in the range from 3 to 9 kHz.

A frequency response check, taken with the woofers reversed at the rear terminals, revealed that the lower crossover was at about 320 Hz rather than the factory-rated 500 Hz. With this reversal, there was a very sharp null, about 50 dB at 320 Hz. The sharpness of this null indicated that the woofer and midrange are solidly in phase throughout their crossover region when connected normally, an ideal situation.

The phase and group-delay responses of the 913.1, referenced to the tweeter's arrival time, are shown in Fig. 2. Also shown is waveform phase, a measure which predicts waveshape fidelity in specific frequency ranges. The phase curve is quite well behaved but rotates 300° between 1 and 10 kHz. When averaged above 1 kHz, the group delay indicates an approximate time offset of about 0.2 mS between the midrange and woofer, with the midrange output delayed behind the tweeter's. The waveform phase curve indicates that waveshapes will not be preserved within any

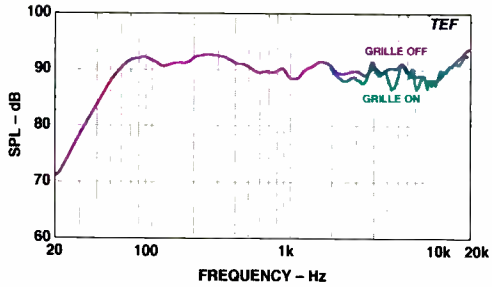


Fig. 1—One-meter, on-axis frequency response.

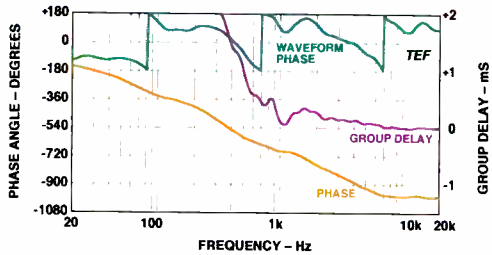


Fig. 2—On-axis phase response, group delay, and waveform phase.

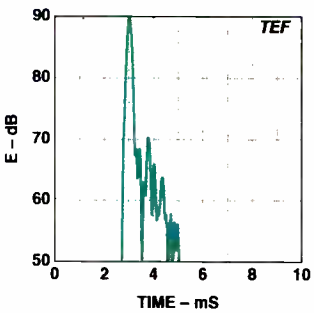


Fig. 3—Energy/time response.

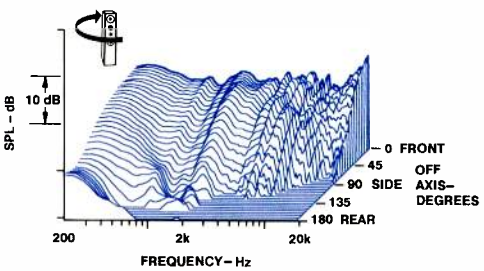


Fig. 4—Horizontal off-axis frequency responses.

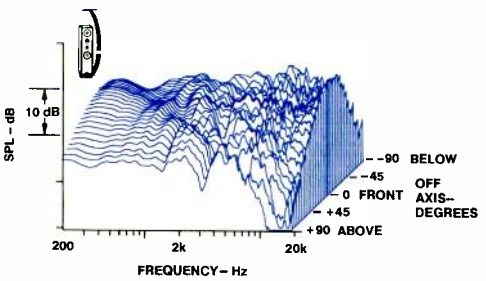


Fig. 5—Vertical off-axis frequency responses.

frequency range, because the phase values are not at or near either 0° or ±180° over any significant frequency band.

Figure 3 shows the Spectral's 1-meter, on-axis, 2.83-V rms energy/time response. The test parameters were chosen to accentuate the system's response between 1 and 10 kHz, which includes the upper crossover region. The main arrival, at 3 mS, is quite compact but is followed by one significant response, down about 20 dB and delayed about 0.76 mS after the main arrival.

The unsmoothed horizontal off-axis responses of the 913.1 are shown in Fig. 4. (The bold curve at the rear of the graph is the on-axis response.) These responses are quite similar over the whole frequency range, particularly in the important main coverage window (±15° of the axis), where no narrowing of high-frequency response is evident.

Figure 5 shows the vertical off-axis curves of the 913.1. (The bold curve in the middle of the graph is the on-axis response.) Within ±10° of the axis, the curves are fairly uniform and symmetrical (on an up/down basis) through the upper crossover range (2.5 to 5 kHz). Although exhibiting some curve-to-curve variation, the overall vertical coverage does not show any dramatic peaks or nulls in the off-axis response. On average, the vertical off-axis response is quite uniform.

Figure 6 shows the Spectral's impedance magnitude versus frequency. In the bass range, below 100 Hz, the characteristic two peaks and a dip of the vented box are evident. The 4.7-ohm dip at about 27 Hz indicates the approximate location of the vented-box tuning. In the audible range (20 Hz to 20 kHz), an impedance maximum of 14.6 ohms is reached in the bass range, at 50 Hz, and a minimum of 3.0 ohms at the slightly higher frequency of 90 Hz.

The system's max/min impedance variation from 20 Hz to 20 kHz is a fairly high ratio of 4.9 to 1 (14.6 divided by 3.0). This means the cable series resistance should be limited to a low maximum of about 0.044 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, 14-gauge (or larger), low-inductance cable should be used with this speaker.

Figure 7 shows the complex impedance of the 913.1, plotted over the range from 5 Hz to 30 kHz. Although well behaved, the curve exhibits many major and minor loops. The two largest loops correspond to the two impedance peaks of the vented box. The next smaller loop corresponds to the impedance rise at about 700 Hz. Two very small loops occur at 148 Hz and 4.4 kHz for unknown reasons. A single 913.1 will not be a bad load for any competently designed amplifier, although its low 3-ohm minimum and fairly large impedance variations

I KNEW THAT IF THESE SPEAKERS WERE MADE AS WELL AS THEY WERE PACKED, THEY'D BE VERY GOOD, INDEED.

may cause response aberrations when connected to amplifiers having low damping factors, such as tube units.

A high-level sine-wave sweep revealed a quite rigid cabinet with very low activity of the sides and top at any frequency. The 8-inch woofers have a healthy travel capability of about 0.6 inch, peak to peak, and overload quite gracefully. A moderate amount of dynamic offset was noted at sine-wave levels above 14 V rms. The vented enclosures work very well and reduce the cone excursion at box resonance by a significant three-fourths (x 0.25), comparing response with port open to port closed. Minimum woofer excursion occurred at 33 Hz, the system's vented-box resonance. Port wind noise at high power levels was very low at and near box resonance.

Figure 8 shows the 3-meter room response of the 913.1, with both raw and sixth-octave smoothed data. The system, in the right-hand stereo position, was aimed

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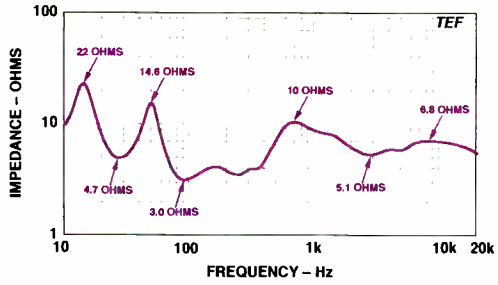

Fig. 6—Impedance.

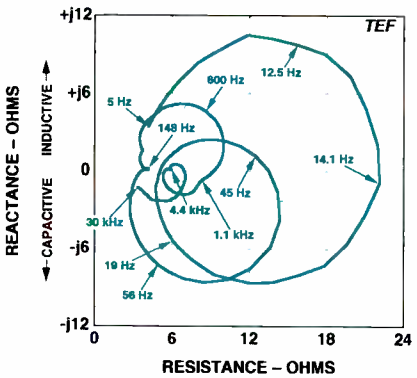

Fig. 7—Complex impedance.

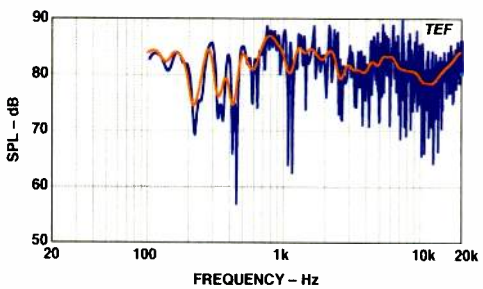

Fig. 8—Three-meter room response.

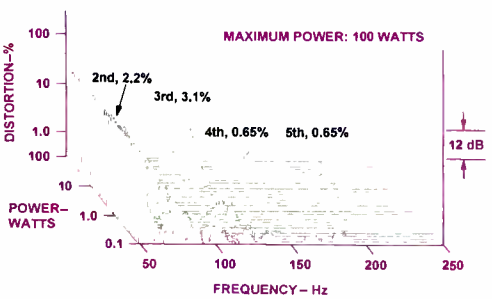

Fig. 9—Harmonic distortion for E_1 (41.2 Hz).

laterally at the test microphone, at ear height (36 inches) at the listener's position on the sofa. The speakers were driven with a swept sine-wave signal of 2.83 V rms (corresponding to 2 watts into the 4-ohm impedance). The direct sound and 13 mS of the room's reverberation are included.

If you exclude dips in the floor-bounce range, between 200 and 500 Hz, the averaged curve is well behaved and fits a fairly tight, 8-dB window. With these dips included, the averaged curve still fits within a looser but not-so-bad window of about 12.5 dB. Distinguishing features include a peak at 800 Hz and a general downward trend in response from 1 to 10 kHz, followed by a dip at 12 kHz and a rise at higher frequencies.

Figure 9 shows the E_1 (41.2-Hz) bass harmonic distortion of the Spectral 913.1, with input power ranging from 0.1 to 100 watts (20 V rms into 4 ohms). The second harmonic reaches only a low 2.2%, while the third rises only to a moderate 3.1%. Higher harmonics are 0.65% or lower at full power. At 1 meter in free space with a 100-watt input, the system generates a fairly loud 100 dB SPL at 41.2 Hz.

The A_2 (110-Hz) bass harmonic distortion (not shown) was below the floor of my measuring gear and hence was below 0.33% at full power at all measured harmonics.

The A_4 (440-Hz) harmonic distortion is shown in Fig. 10. The second harmonic rises only to 1.3% at full power. Higher harmonics were below the floor of my analyzer at all power levels up to 80 watts. However, at higher power levels the speaker's output exhibited a harsh sound that corresponded with a sudden appearance of the third and fifth harmonics (at 2.0% and 4.0%) at the 100-watt level. Investigations described later revealed that a saturating inductor in the midrange part of the crossover caused symmetrical rounding of the midrange's waveshape.

The IM versus power, created by tones of 440 Hz (A_4) and 41.2 Hz (E_1) of equal power, is not shown. At 100 watts, the IM rose only to 1.3% at full power, a very low value. This low IM value is a direct result of the low woofer-to-midrange crossover frequency, which occurs between the frequencies of the test signal. The test tones are handled separately by the woofer and tweeter.

The short-term peak-power input and output capabilities of the Spectral 913.1 are shown in Fig. 11 as a function of frequency. The test signal was a 6.5-cycle, third-octave-bandwidth tone burst. The peak input power was calculated by assuming that the measured peak voltage was applied across the 4-ohm impedance.

The peak input power starts very strong (240 watts at 20 Hz), rises to a peak of 700 watts at 31 Hz (near the box tuning), stays within a narrow range until 250 Hz, falls to a minimum of 270 watts at 400 Hz, and then rises rapidly into the range of 6 to 8 kilowatts above 2 kHz. A reduction in power handling is noted above 13 kHz due to distorted waveshapes.

Between 200 and 800 Hz, the peak input and output were limited primarily by the midrange's generating a harsh, hollow sound. Severe symmetrical rounding of the output acoustic waveshape was noted in this range. Suspecting inductor saturation in the crossover, I drove the midrange direct, bypassing the internal network. This resulted in considerably more input power handling and much higher clean acoustic output, as shown.

At 400 Hz, when the 913.1 was connected normally, its clean peak maximum output sounded rather anemic. When the midrange was driven directly, the output was much louder and sounded quite robust and clean. The cause of this waveform distortion was saturation of the core of a 2-mH shunt inductor in the midrange circuit.

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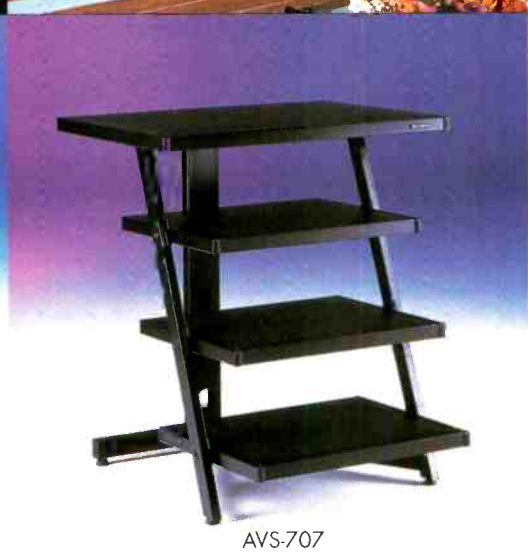

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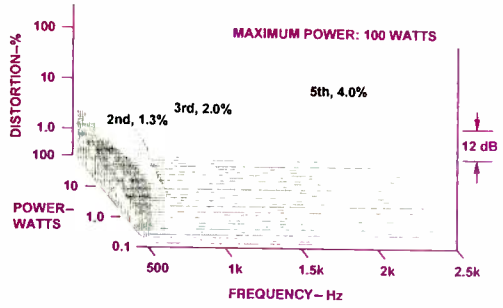

Fig. 10—Harmonic distortion for A_4 (440 Hz).

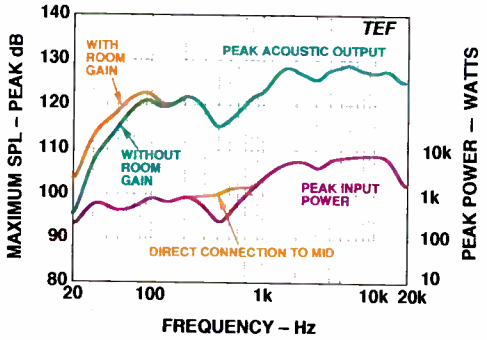

Fig. 11—Maximum peak input power and sound output.

Saturated shunt inductors cause symmetrical rounding or clipping of the waveform, while saturated series inductors cause triangularization of the waveform. The distorted waveshape driving the midrange was confirmed by observing its voltage drive with an oscilloscope.

With room gain, the maximum peak output SPL of the system starts at a healthy 104 dB at 20 Hz, rises rapidly to a peak of 123 dB at 80 Hz, and then, after maintaining levels of about 121 dB to 250 Hz, falls to 115 dB at 400 Hz. It then rises into the loud range of 125 to 129 dB above 1.25 kHz. The dip in maximum output at 400 Hz coincides with the limited power handling noted in the same range. The peak output crosses the 110-dB SPL level at a low 25 Hz and then crosses the 120-dB SPL level at a significantly low 50 Hz. Its strong low-frequency output places the 913.1 in the top 25% of speakers I have tested.

Use and Listening Tests

When I unpacked the Spectral 913.1s, I was very impressed with the design and quality of the shipping containers. The speakers were packed in no fewer than three separate boxes cocooned inside each other! Often, the shipping containers I receive, which have passed through the New York offices of *Audio* and have been unpacked and repacked once, are in shambles. I frequently have to request new containers so that equipment can be returned safely to the manufacturer after I review it. This was not the case with the 913.1s. After unpacking them, I thought that if these speakers were designed and manufactured half as well as they were packed, they must be very good indeed. They did not let me down.

The 913.1s are very handsome. The African anigré wood of the side panels is somewhat similar to a medium or light oak in grain and coloring, but with a slight orange tint. The appearance, fit, finish, and workmanship of the cabinet are excellent. All parts fit together well, and the total assembly is very solid. The speakers are quite heavy for their size and bulk, but fairly easy to move around. The grille is essentially captured between the wood side panels. Tolerances are so tight that the grille is somewhat difficult to remove.

The owner's manual is, of course, printed in both French and English and consists of a large, somewhat odd-sized (8¼ x 11¾-inch) triple foldup of six pages. Although generic to all the JMlab products, the manual contains a lot of useful information. The translation from French is a bit awkward in spots, however, with sentences like: "This parameter is directly related to the linearity of restitution of your listening room." JMlab suggests a live-end/dead-end style of room, but with the speaker at the live end of the room and the dead end behind the listener.

The speakers are quite easy to hook up, due to their very accessible terminals. Unfortunately, as mentioned earlier, the terminals' nonstandard spacing precludes use of standard, ¾-inch-spaced double-banana plugs, and the connection straps used when not bi-wiring preclude the use of bare wire, tips, or spade lugs.

Listening was done with the Spectrals set up in my usual locations, aimed in toward my listening position and placed 8 feet apart and far from the rear and side walls. I listened from a point equidistant from the speakers, 10 feet away. Listening gear included Onkyo and Rotel CD players, a Krell KRC preamp and KSA250 power amp, Straight Wire cabling, and B & W 801 Matrix Series 3 reference speakers.

First listening exhibited lively dynamics, a powerful and extended low end, and a smooth, even character with wide dispersion. Further listening revealed some minor flaws but, everything considered, the Spectral 913.1s did a very credible job.

The jazz piano on *The Wonderful Sound of Three Blind Mice* (Three Blind Mice GS CD004) was reproduced with quite energetic dynamics and a smooth, open sound. The acoustic bass sounded quite even and clean, with minimal emphasis or de-emphasis of particular notes. Some slight forwardness was noted, as compared to the B & W speakers.

THE 913.1s WERE VERY FOCUSED, WHILE PRESERVING THE AMBIENCE OF THE SOURCE MATERIAL.

The dynamic range and high output capability of the 913.1s was demonstrated very well with a recording of Beethoven's "Wellington's Victory," complete with cannon and musket shots, on The Cincinnati Symphony's *Battle Music of Beethoven and Liszt* led by Erich Kunzel (Telarc CD-80079, a favorite of mine). The Spectral 913.1s shine on this kind of material, because their high sensitivity and power handling result in clean reproduction of the high peak pressures required when this music is played at high levels. Here, the JMlab speakers did just about as well as my reference B & W 801s, exhibiting only slightly less bass on the cannon shots. Actually, "Wellington's Victory" describes a battle between the French and the British, which the British won decisively. In my own French-versus-British showdown (JMlab versus B & W), the French do much better!

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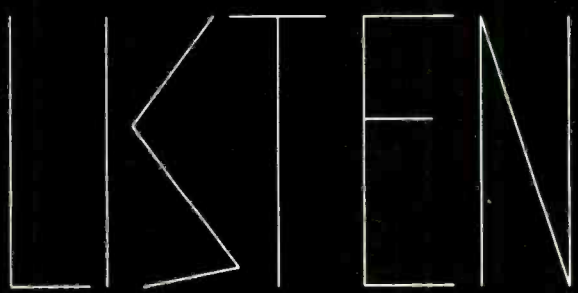

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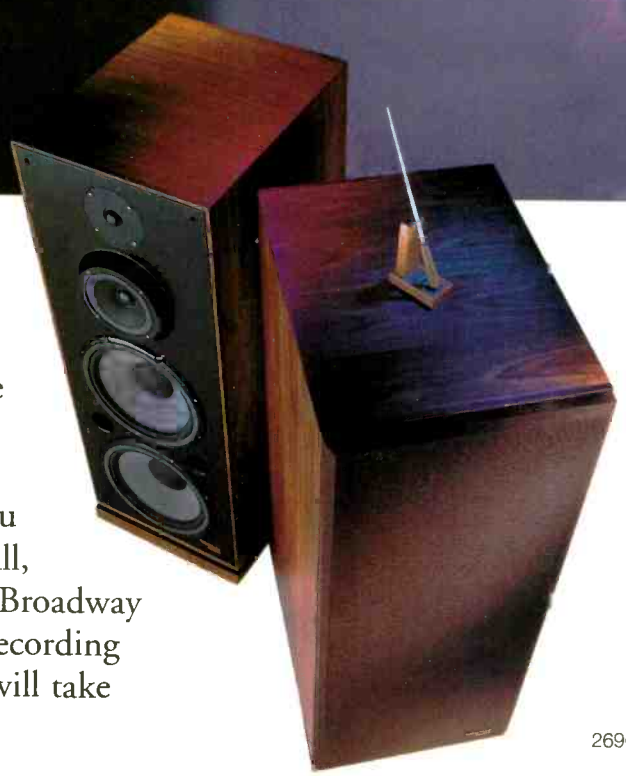

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On older, not-so-clean analog vocal recordings, the 913.1s exhibited some high-frequency emphasis and harshness on sibilants that the B & Ws did not exhibit. On clean vocal recordings, they did just fine.

On pink noise, the 913.1s did show significant midrange tonal changes when I stood up. Octave-to-octave spectral balance on pink noise was quite acceptable; I heard minimal tonality. These speakers did, however, sound somewhat different than the B & Ws on pink noise. The differences were not bad, just different, and are hard to describe.

On third-octave, band-limited pink noise, the 913.1s generated some usable output in the 20-Hz third-octave band, somewhat more usable output in the 25-Hz band, and very strong and clean output at all higher bands. Port wind noise was quite low. The JMlabs' low-frequency output, although quite robust, was still not quite as clean as the B & W systems' when reproducing the same levels.

In a second listening session, after I took the measurements, I couldn't find any particular music material that demonstrated the reduced maximum output of the JMlab speakers in the 400-Hz range. What did reveal the problem was a recently recorded CD of my special tone-burst signals.

On large-scale symphonic music, such as *Latin American Ballets* (Dorian DOR-90211), the 913.1s demonstrated lively dynamics and a wide and accurate soundstage while being quite neutral and well balanced, with an extended frequency response. Tip-top information on percussion was reproduced with a bit more emphasis than I heard with the B & W 801s. The JMlab speakers also did very well on less dynamic classical music, such as string quartets, where the 913.1s' stereo focus was very good while preserving the recorded ambience of the source material.

Although $4,295 a pair is a significant amount of money, the Spectral 913.1s did quite well in both my measurements and listening tests, and they compete very well with other systems in their price range. They exhibited a very dynamic, even, and smooth sound, with an extended bass response. The speakers sounded very good on all types of music, including material that profits from being played very loud. Definitely consider them. A

EQUIPMENT PROFILE

BASCOM H. KING

MUSEATEX BIDAT D/A CONVERTER

Photo: Michael Groen

The Museatex Bidat D/A converter is the result of more than eight years of effort by Ed Meitner and his design team, whose work I admire for its originality and uniqueness. Since my last review of Meitner's equipment (the PA-6i preamp, November 1988), Museatex has merged with a/d/s/, with Ed Meitner serving as Vice President of Research and Development.

Inputs on the Bidat's rear panel are ST (AT&T glass), S/P DIF coax, AES/EBU balanced, and Toslink, allowing connection to all standard digital equipment. For analog outputs, the Bidat has a set of balanced XLR connectors and a pair of unbalanced outputs via high-quality phono connectors. A DIN connector, labelled "Option," is provided for connection to the optional wired remote control. Since the Bidat is partially a computer and occasionally may need resetting, a reset button is located on the rear panel, just below the DIN connector. A power on/off switch and IEC line-cord socket are stacked vertically at the right-hand edge of the rear panel.

A removable metal plate on the bottom of the Bidat provides access to a DIP switch that selects which input and absolute polarity the unit will default to when it powers up, and whether the remote-control input will be active or not.

The only controls visible on the Bidat's front panel are two flush-mounted push-button switches at the far right; these push-buttons control input selection and absolute output polarity. The display, to the left of center on the panel, indicates which input is selected, the absolute-polarity state, and whether the unit is locked onto an input signal. The display lights are a very appealing blue.

The optional remote only controls volume, by varying the reference voltages at the D/A converter. Museatex says this does not degrade digital resolution, as a conventional digital volume control would.

Two technical features set the Bidat apart from other D/A converters. First, it has a proprietary data receiver arrangement, called C-Lock by Museatex. Second, and equally (if not more) intriguing, is the use of a signal-adaptive digital oversampling filter. Both of these techniques are patented. Ed Meitner has also patented a number of the other digital signal-processing concepts used in the Bidat and elsewhere—including the common practice of reclocking the clock signals applied to a DAC in an external D/A converter or within the digital electronics in a CD player.

Circuit Description

The unusual and elegant qualities of the Bidat's circuitry show up right at the input selector. Each input path uses two 74HC-series inverters to square up the received

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Frequency Response: 20 Hz to 20 kHz, +0, –0.5 dB.
THD + N: –90 dB.
Noise: Better than –90 dB from 0 to 30 kHz, via optical or electrical inputs.
Jitter: Less than 10 pS, with no periodicity.
Interchannel Level Matching: Within 0.1 dB.
Digital Filtering: Eight-times oversampling.
Inputs: ST glass optical, Toslink optical, 75-ohm coaxial, and AES/EBU balanced.
Output Impedances: Balanced, 600 ohms; unbalanced, 300 ohms.
Output Level: Maximum, 3.5 V rms.
Dimensions: 14½ in. W x 3 in. H x 13½ in. D (36.8 cm x 7.6 cm x 34.3 cm).
Weight: 17 lbs. (7.7 kg).
Price: $1,999; wired remote volume control, $399.
Company Address: c/o a/d/s/, One Progress Way, Wilmington, Mass. 01887.
For literature, circle No. 92

signal. Instead of the usual signal-selector IC, the Bidat uses combinational logic, in which 74HC-series "OR" gates select the input signal to pass on to the subsequent circuitry. If an optical input is selected, only its optical receiver is powered up, while any wired input (coax or AES/EBU) that is not selected has its input pulled low by a shunt transistor. The selected signal is passed on to the input receiver and C-Lock circuitry.

The C-Lock input receiver derives its clock signal in an equally original way. In

TWO MAIN TECHNICAL FEATURES SET THE BIDAT APART FROM OTHER D/A CONVERTERS.

the conventional approach, a phase-locked loop (PLL) in the input receiver generates a clock signal at a multiple of the input data rate—typically 64 times the sampling frequency ($64f_s$), or 2.8224 MHz for CD. In order to lock reliably onto the input signal, this PLL usually has a wide bandwidth of about 20 kHz or so. This bandwidth allows any audio-frequency jitter in the incoming signal to pass right on through to the clock signals generated by the input receiver. The better D/A converters use a secondary PLL, with a low bandwidth, to further process the receiver's clock-signal outputs before delivery to the DAC circuitry, since it is at the DAC that jitter can manifest itself as distortion in the recovered audio signal.

In the C-Lock approach, a signal at twice the sampling frequency is derived directly from the incoming S/P DIF data stream without using a PLL circuit. This $2f_s$ signal, unlike the PLL-derived conventional clock signal, isn't affected by edge jitter in the audio data portion of the input signal. This is because the detection of the $2f_s$ signal is at the beginning of each audio frame, in what is called the preamble section, away from the frame's audio data. The derived $2f_s$ signal is fed to a PLL circuit having a low jitter-cutoff frequency of about 10 Hz. In this PLL, a voltage-controlled crystal oscillator (VCXO) generates a master clock signal at $384f_s$, which is divided down to $2f_s$ for comparison in the PLL's phase detector. (Other needed clock frequencies are derived by suitable division of the master clock.) An input receiver is utilized in the Bidat to generate the output data format and clock signals needed by the following digital filter. The input to the receiver is the selected signal. In this arrangement, however, the receiver is fed the stable clock signal from the aforementioned PLL instead of using its own, internally generated, clock signal.

Data and clock outputs of the receiver are routed to the digital filter section, which (as alluded to above) is an intelligent signal-adaptive system. Two custom Motorola DSP56001 DSP devices are utilized, one per channel. Two digital filters are generated by each DSP, one optimized for best transient response, the other for flattest frequency response with maximum out-of-band attenuation. A discontinuity detector scans the digital audio data ahead of the eight-times-oversampling interpolation filter. If a transient pulse is detected, output data is taken from the transient-optimized filter, during a windowed timeout relating to the length of the transient. If no transient is detected, the flat-response filter is selected. If a transient occurs while data is being taken from the transient-optimized filter, the window time is restarted.

Data output of the digital filter section is applied to the input of the DAC circuitry. The Bidat utilizes a Philips SAA7350 and TDA1547 together to form a very high-quality, one-bit DAC system. A pair of one-bit data streams and a clock signal couple the output of the SAA7350 (which is used, alone, as a one-bit DAC in a number of D/A converters) into the input of the TDA1547. The TDA1547 then performs the switched-capacitor filtering that produces the analog output voltage. Because the clock signal going into the TDA1547 is the critical one, as far as possible

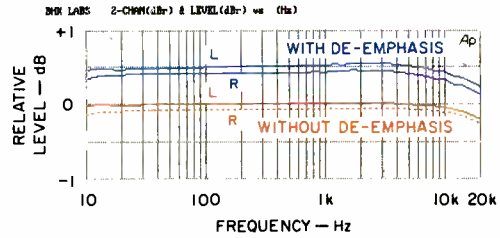


Fig. 1—Frequency response; curve with de-emphasis offset 0.5 dB for clarity.

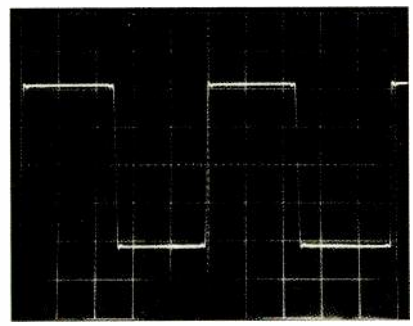


Fig. 2—Square-wave response at 1 kHz.

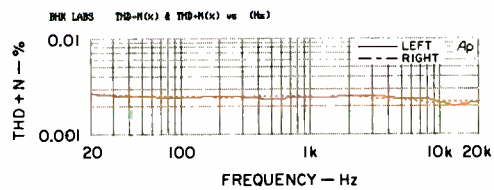


Fig. 3—THD + N vs. frequency at 0 dBfs.

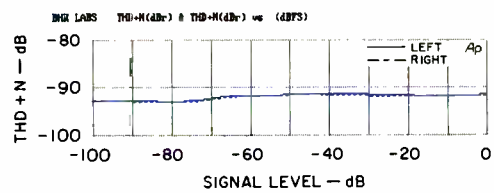


Fig. 4—THD + N vs. signal amplitude at 1 kHz.

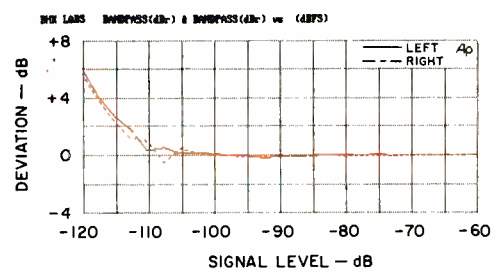
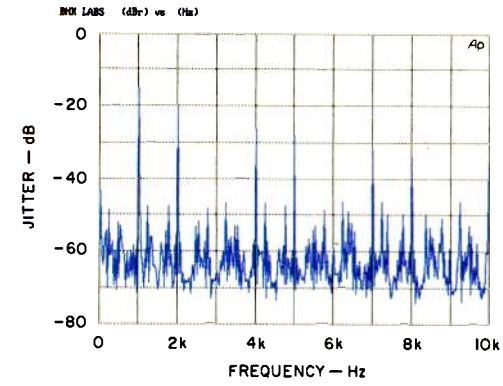


Fig. 5—Deviation from linearity, for 1-kHz signal.



A

B

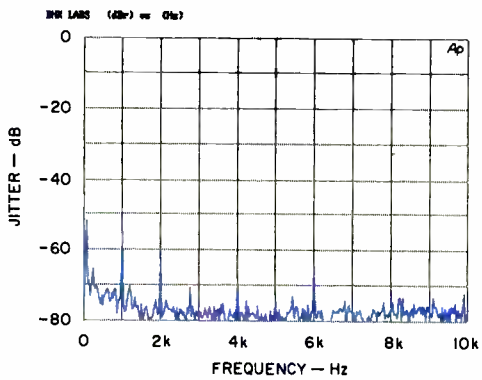


Fig. 6—Spectrum of jitter in S/P DIF signal from CD player/transport (A) and in 8f_s left/right clock at input to DAC (B).

contamination of the final audio output is concerned, both one-bit data lines (left and right) and the clock signal are reclocked with separate flip-flops before entering the TDA1547. The reclocking signal for the flip-flops comes from the master VCXO in the input/receiver circuitry's phase-locked loop.

Audio outputs of the TDA1547 are in differential form. Separate output amplifiers, which also function as third-order multiple-feedback low-pass filters, amplify each output phase from the TDA1547 and drive the XLR balanced output connector. The balanced outputs also drive the RCA unbalanced output jack, via another output amplifier which converts the differential signal to a single-ended one. (These output amplifiers are all AD845 op-amps.) From a purist point of view, this would make the balanced outputs a better choice (if the following equipment has balanced inputs), since they have one fewer amplifier in their signal path.

The output circuitry includes several bits of analog sorcery. The capacitors in the output amplifier's filter network (small film capacitors, not electrolytics) are biased with a d.c. voltage to improve their "sound." Each output amplifier has a constant current source connected from its output to the negative supply rail, to improve output-stage linearity. Servo op-amp integrators are connected from the balanced main amplifier outputs back to their respective noninverting inputs through a voltage divider. This arrangement reduces d.c. offset to negligible values.

Two power transformers are used in the Bidat, one for digital and one for analog circuitry. In the analog supply, separate secondary windings are full-wave bridge rectified to feed the voltage regulators that produce +14 and –14 V d.c. These voltage regulators each consist of a zener-follower circuit, with the zener diodes fed from a constant current source. Separate transformer windings are used in the digital supply and are full-wave bridge rectified and applied to several voltage regulators. One supply feeds +15 V to the PLL and C-Lock circuits that use this voltage. The other supply has two main voltage regulators; one powers the DSP circuitry while the other powers the input receiver, PLL, and DAC. The digital and analog sections of the TDA1547 switched-capacitor filter in the DAC each get their +5 and –5 V requirements by local regulators fed from the analog supply's output of +14 and –14 V.

Measurements

Output voltages at digital full scale (0 dBfs) were 3.21 V for the left channel and 3.19 V for the right, via the unbalanced outputs, while the balanced-output voltages were 3.20 and 3.19 V, respectively. Output impedances were 300 ohms in unbalanced mode and 600 ohms in balanced mode. Subsequent tests were all run via the unbalanced outputs, unless otherwise noted, as the results from the balanced outputs were essentially the same.

Frequency response at 0 dBfs, with and without de-emphasis, is plotted in Fig. 1. The response with de-emphasis has been displaced upwards by 0.5 dB for clarity; it rolls off the highs a little more than the normal response, without de-emphasis.

Figure 2 shows the superior transient response of the adaptive digital filter when handling a transient signal, such as a square wave. I have also seen unusually low square-wave ringing in Krell and Wadia D/A converters, whose digital filter algorithms favored time-domain behavior. However, these converters had quite high harmonic-distortion readings as the test frequency approached 20 kHz, due to inadequate rejection of aliasing frequencies. Nothing that I have seen comes close to the square-wave fidelity of the Bidat. Further, as we shall shortly see, there is no harmonic-distortion rise near the upper end of the audio range.

LINEARITY WAS SUPERB, AND THE NOISE AND S/N FIGURES ARE BETTER THAN FROM MOST ONE-BIT CONVERTERS.

Total harmonic distortion plus noise (THD + N) versus frequency, at digital full scale and with a 22-kHz measurement bandwidth, is shown in Fig. 3, and THD + N as a function of digital signal level is plotted in Fig. 4 for a 1-kHz test tone. These distortion results are all very good. Continuing on the subject of linearity, note in Fig. 5 the superb input/output linearity of the Bidat for input signals in the range of –60 to –120 dBfs at 1 kHz. In the noise-modulation test (not shown), a 40-Hz signal was presented at input levels of –60, –70, –80, –90, and –100 dBfs and the output was measured by sweeping a third-octave filter from 300 Hz to 20 kHz. All the traces essentially overlaid each other—excellent behavior.

Interchannel crosstalk, both with unbalanced and balanced outputs, was better than –110 dB up to 1 kHz, rising slightly to

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Table I—Signal-to-noise ratios. Quantization noise was –92.7 dB for the left channel and –93.4 for the right channel; dynamic range was 95.7 dB for either channel.

	S/N, dB	
	LEFT	RIGHT
–120 dBfs Signal		
Wideband	65.8	66.0
22 Hz to 22 kHz	93.0	93.0
400 Hz to 22 kHz	93.2	93.1
A-Weighted	94.4	94.4
Digital-Zero Signal		
Wideband	65.8	66.0
22 Hz to 22 kHz	97.3	97.0
400 Hz to 22 kHz	97.5	97.1
A-Weighted	98.9	98.5

about –93 dB at 20 kHz at the unbalanced outputs and about –103 dB at the balanced ones. Crosstalk was very similar in both directions, for either output.

Quantization noise, dynamic range, and S/N are presented in Table I. These numbers are very good and better than I have seen from most one-bit D/A converters. With wideband measurement, S/N is lower than when measured only in the audio band, due to high-frequency noise above that band; this noise is caused by the noise-shaping process inherent in one-bit converters. The in-band measurements with a digital-zero signal are not as good as those attainable with good multibit D/A converters.

Figures 6A and 6B show how effective the C-Lock circuit is in removing jitter from the incoming S/P DIF signal. Figure 6A shows a spectrum of the jitter on the S/P DIF signal at the digital output of a Philips CD921 CD player, a relatively new design. (This curve may look pretty bad, but it is typical of a lot of CD players used as CD transports, which tend to use undersized, poorly designed, digital-output isolation transformers. Good CD transports have a *lot* less jitter under these conditions—more like 40 to 50 dB down in a measurement such as the one in Fig. 6A.) The audio signal itself was a 1-kHz, –90 dB, undithered signal from the Columbia CD-1 test disc. Note how much of the spectrum is signal-correlated! Most of the other discrete frequencies in the spectrum are harmonics of the signal frequency or intermodulation products of the signal with the block rate of the S/P DIF data (1/192 of the sampling frequency, or about 230 Hz). The fundamental jitter component, at 1 kHz, is about 1.68 nS, peak to peak, or 594 pS rms. (Full scale on these plots is 10 nS, peak to peak.) This data was taken with a jitter detector of my own design, which is as sensitive as a DAC to all the jitter in the data (digital audio) area of the S/P DIF subframes.

I ENJOYED THE BIDAT'S GOOD DEFINITION, CLEAN SOUND, AND FIRM BASS.

Figure 6B, by contrast, shows how much less jitter is present in the C-Lock-derived, $8f_s$, left/right clock signal driving the Philips SAA7350 DAC chip when the Bidat is fed the signal shown in Fig. 6A. (This data was taken with a Meitner LIM Detector, which was loaned to me for this review; however, the results using my own detector were essentially the same.) Note that a jitter component of –60 dB would represent 10 pS, peak to peak, or 3.54 pS rms. Those D/A converters that don't have secondary PLLs to reduce jitter would have the jitter spectrum of Fig. 6A superimposed on all of the recovered clock signals if this particular CD player/transport were used. This could, in my opinion, have an audible effect on the recovered audio.

A few final measurement comments: The d.c. offset at all output terminals was 1 mV or less, absolute polarity was correct as indicated, and a.c. line draw was 200 mA.

Use and Listening Tests

Phono equipment used in my system during the review period included an Oracle Audio turntable fitted with a Well Tempered Arm and a Stanton 981HZS moving-magnet pickup, feeding my own tube phono preamp/passive signal selector/attenuator or a Quicksilver Audio preamp. Counterpoint DA-11A and PS Audio Lambda CD transports were used to drive the Bidat, a Sonic Frontiers SFD-2 MKII, and some experimental D/A converters. Other signal sources included a Nakamichi ST-7 FM tuner and 250 cassette recorder and a Technics open-reel recorder. Preamplifiers used included a Quicksilver Audio, Forssell tube line drivers, a First Sound II passive model, and my own passive signal selector/attenuator. Power amplifiers used were a Crown Macro Reference, Quicksilver M135s, and a Counterpoint NPS-400A hybrid unit. The loudspeakers were B & W 801 Matrix Series 3s, augmented in the range from 20 to 50 Hz by my subwoofer systems, each using a JBL 1400Nd driver in a 5-cubic-foot ported enclosure.

When I got the Bidat warmed up and playing in my system, my first impression was that it was a very good-sounding D/A converter. After measuring it, I again set it up and my initial impression was confirmed. This unit is one I can listen to and enjoy music with. It has good definition with low irritation. Tonal balance seems just a bit laid back, with space and dimension a little foreshortened compared to other converters I have. Bass quality, definition, and "slam" are very good. Compared to the very best setup I've had going recently, and admittedly this is one that costs nearly three times as much as the Bidat, the sound with the Bidat was less clear, more subdued, and not quite so musically convincing.

All in all, though, the Bidat sounded quite good to me and I surely enjoyed my experience with it. It operated flawlessly, in the lab and in my system. Go give this unit a listen. A

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Bob Sireno, Positive Feedback
Vol. 5 No. 5

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Q Is the placement of my speakers important?

A Just as the ultimate sound of a system depends on the equipment selected, the placement of the speakers is equally important. Perhaps the number one rule in speaker placement is the distance between the speakers. This distance will affect various aspects of the sound: Stereo separation, sound-stage width and imaging. A good rule of thumb is to draw an imaginary triangle from the listening position to the center of each speaker. The distance between the speakers should be slightly less than the space between you and the center of one of the speakers. After the speakers have been positioned, we recommend taking the height of the speakers into consideration. In most cases, the tweeter should be at or near ear-level. This should provide a better sense of clarity and imaging. It is our goal to have you listen to the prospective choices in placement situations that will not only benefit the speakers, but are realistic to your home.

—Wanda and Gary Hawkins
Digital Ear
Tustin, California

Digital Ear
AUDIO/VIDEO SYSTEMS

Q What can I add to my audio/video system to make it better?

A For best results, an audio/video specialist will need to make an on-site evaluation of your present equipment and room layout. An in-store evaluation by a specialist can also determine what you should purchase based upon your needs and budget. I have found that the best video addition is to add a projection T.V., preferably 7 ft. to 10 ft. in diagonal measurement, if room size and lighting will accommodate it. This provides a life-like theater effect to visual presentations that smaller sets can't match. The best electronic addition is a surround sound processor with full range stereo rear channels for better and more realistic special effects. The best audible addition is a powered sub-woofer which adds low sounds that even some of the best speakers lack, resulting in more impact, feeling and realism when listening to compact discs, records, videotapes or laserdiscs.

—Robert C. Gutke, E.E.
Standard Audio
Salt Lake City, Utah

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Q A friend of mine replaced all of the cabling in his system, and now cannot stop raving about the difference it made, Basically, what will I notice in my (admittedly mid-priced) system?

A Without knowing more about your system and tastes, I can only give you general ideas. Higher quality cabling will have a dramatic effect on the sound of a system. You will notice sharper imaging and when listening to an orchestra you will hear individual instruments and sections. Bass instruments and percussion will be more rhythmic and dynamic. Vocals will open up and sound more relaxed and natural. One of the advantages of visiting an audio/video specialist is that for many of us, audio and video are our hobbies, our passions. We experiment, and we can show you the things we've found to improve performance in our own systems. An independant audio/video specialist can be an invaluable resource for you in your pursuit of perfection - Use him !

—Barry Bradshaw
Sight & Sound Concepts
San Bernardino, California

SIGHT & SOUND CONCEPTS

Q Can I have a home theater system that will also sound good for music?

A Yes! In fact, many of our best performance audio manufacturers produce equipment which is ideal for home theater. We have found that this equipment, when properly calibrated and optimized for home theater, provides exceptional performance when reproducing music. Better audio/video specialists will have the test equipment and the expertise necessary to design and install a single system which will accurately reproduce both home theater and music.

—Mark Ormiston
Definitive Audio
Seattle, Washington

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EQUIPMENT **PROFILE**

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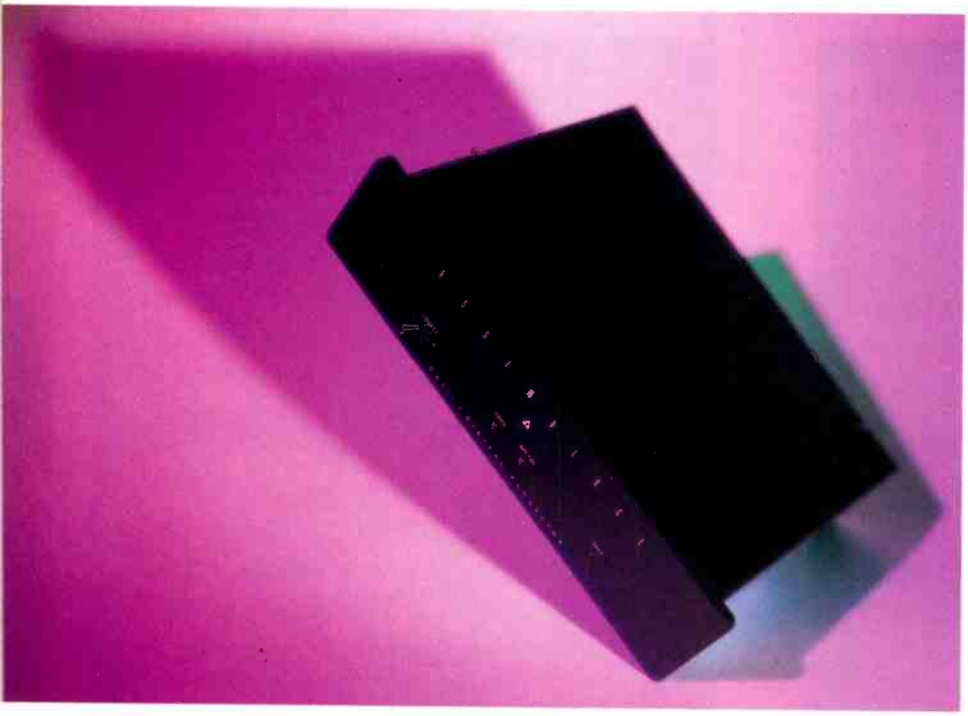
ASSEMBLAGE DAC-1 D/A CONVERTER KIT



Though Sonic Frontiers is known today for its amps, preamps, and CD playback gear, it started in 1988 as a mail-order parts business, branched into kits in 1990, and only began selling factory-wired equipment the following year—which led the company, in 1993, to close the circle by creating The Parts Connection, again selling parts by mail. Now that division has its own Assemblage kit line, aimed at the do-it-yourselfer who has some soldering and wire-stripping skills and a couple of hours to spare.

The first Assemblage kit, the $449 DAC-1 digital processor, is positioned to compete with factory-assembled D/A machines costing much more. One appeal of kit building is the chance to save a worthwhile sum by performing some of the steps normally done at the factory; the saving over the equivalent Sonic Frontiers unit, the Trans-DAC, is $150. The Parts Connection plans to add to the Assemblage line, with kits to build a tube line-stage preamplifier, a stereo amp based on the 300B triode, and an upscale D/A converter. Prices are not yet available for these intended products.

Getting Started

The DAC-1 kit's parts are packaged neatly so as not to put off the inexperienced kit builder. A haphazardly thrown-together bag of parts would be daunting to the budding hobbyist.

The accompanying kit manual presents the builder with 17 easy-to-follow construction steps. The parts are depicted in both an exploded view and in photos accompanying each step. To make this kit accessible to those who are not engineers or technicians, more than 90% of the internal assembly has been performed at the factory. The printed circuit board is pre-loaded with ICs, resistors, capacitors, etc., lest the imprudent beginner produce a smoking amalgam of metal and chemicals. The instructions also include a primer on basic soldering and wire-stripping techniques.

Once assembled, the DAC-1 is smaller than most consumer hi-fi equipment, only 9½ inches wide, 2 inches high, and 7 inches deep. It is heavy for its size, which connotes a more than adequate power supply for a device in this product and price category. The heart of this supply, the power transformer, is of high quality, commensurate with high-end gear costing upwards of a thousand dollars.

The signal path within the DAC-1 is populated with active parts of very good quality, including a pair of Burr-Brown 20-bit 1702 DACs, a Crystal CS8412 input receiver, an NPC SM5813A digital filter, and Analog Devices' AD844 and AD847 op-amps. The careful kit builder will have a competent, finished component that should provide many years of satisfying service. Moreover, should the intrepid audiophile find himself in over his head in constructing the DAC-1, the manufacturer will complete the job for the purchaser at no additional charge or, within 30 days of purchase, return the buyer's money. A completed unit, regardless of whether the owner or manufacturer finally builds it, carries a two-year warranty. There is also a toll-free hotline to call if you encounter a small snag during construction.

Construction Notes

The list of tools required to construct the DAC-1 gives a fair indication of the project's simplicity: Two Phillips screwdrivers,

SPECS

Type: 20-bit, using Burr-Brown PCM-1702 DAC.
Digital Filtration: Eight-times oversampling, using NPC SM5813A.
Sampling Rates: 32, 44.1, or 48 kHz.
Frequency Response: 20 Hz to 20 kHz, ±0.5 dB.
Dimensions: 9½ in. W x 2 in. H x 7 in. D (24.1 cm x 5.1 cm x 17.8 cm).
Weight: 5.3 lbs. (2.4 kg).
Price: $449.
Company Address: c/o The Parts Connection, 2790 Brighton Rd., Oakville, Ont., Canada L6H 5T4.
For literature, circle No. 93

Photos: Michael Groen

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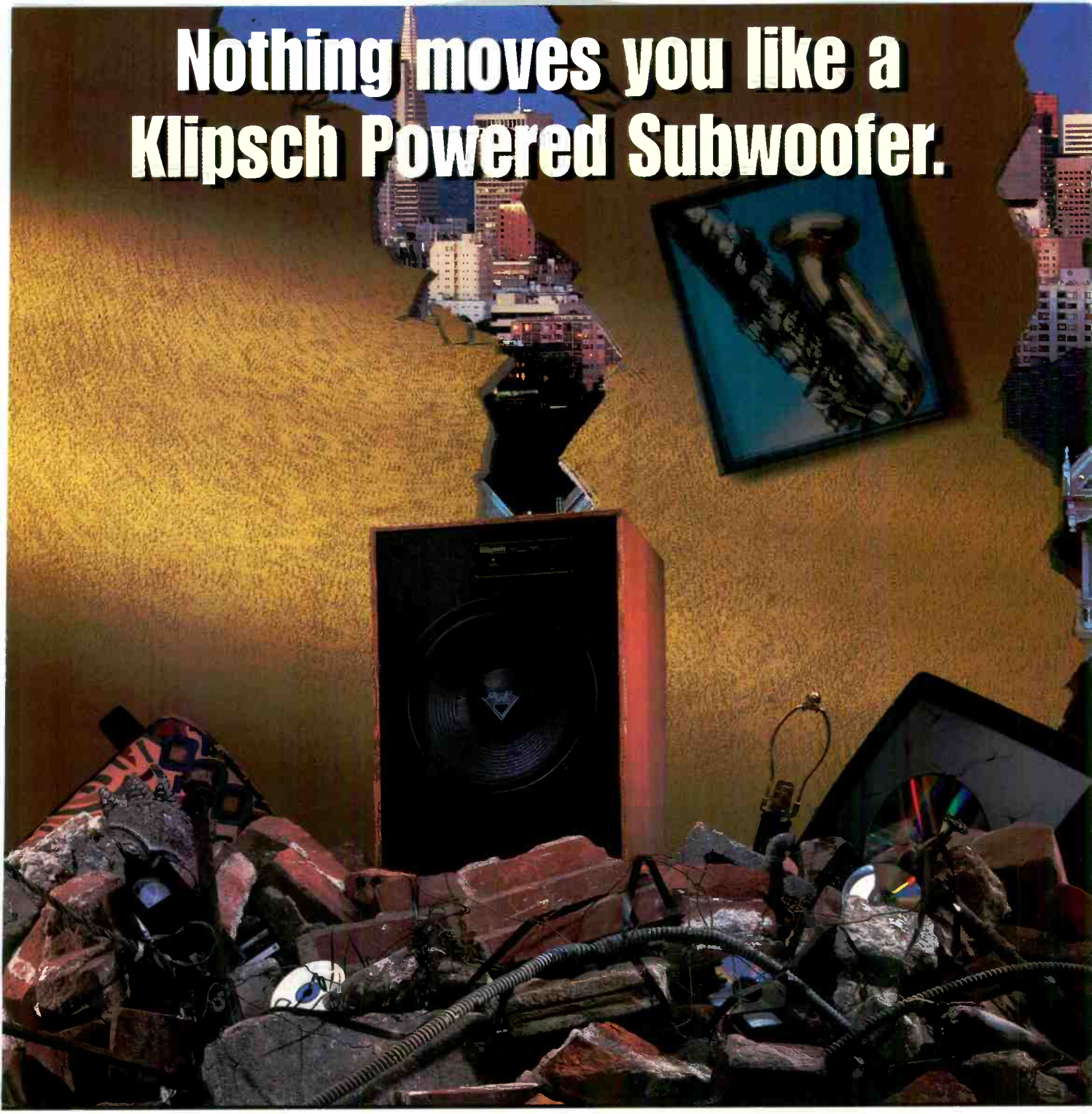

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a pencil-tip soldering iron, a ½-inch wrench, a pair of needle-nosed pliers, a wire stripper, and a ruler. Everything else you need, including solder, is packed in the kit.

The initial steps in construction involve partial disassembly of the unit, as it is most practical to ship the DAC-1 partially screwed together. Next, the constructor's wire-stripping skills are tested. Great care should be taken when stripping the wires; if you must redo this often to get the desired length of clean copper, you may wind up with insufficient wire to complete the job. As the Kimber wire that is supplied to connect the p.c. board to the output jacks has rather stiff insulation, it would be easy to cut into or snip right through the copper conductor. However, anyone with even moderate experience at this should have no trouble.

Soldering is required at the next step, when the Kimber wire is attached to the p.c. board. Thankfully, minimal skill is required. In all of the project, only a few wires are soldered, into well-marked holes in the p.c. board. Thus, there is virtually no chance for the first-time kit builder to mislocate a soldered connection.

Following more wire-stripping and the somewhat delicate insertion of leads for three LEDs, it is time to install the three RCA jacks, a straightforward alignment and nut-tightening procedure. Next looms the only point in the construction when a third hand would be welcomed: The builder must solder the stiff Kimber wire to the positive and negative terminals of the RCA jacks, which can be awkward for anyone but the nimblest technician. After that, the remaining tasks are mere screw twists and the exact positioning of the LEDs in the holes in the faceplate. Then—*voilà*—you're done.

Use and Listening Tests

The Assemblage DAC-1 (which is powered up whenever its removable cord is plugged in) is certainly up to date in appearance and performance. The black, nicely cut faceplate is simply lettered and punctuated by LEDs to indicate which input is active and whether the signal from the transport is locked in.

THE ASSEMBLAGE HOLDS ITS OWN AGAINST EXPENSIVE DACS, GREAT NEWS FOR AUDIOPHILES ON A BUDGET.

The signals I fed to the DAC-1 came from two dedicated transports (the Audio Alchemy DDS II and California Audio Labs Delta Transport, priced at $699 and $895, respectively) and four players used as transports. The players included two upmarket units (the $1,600 Denon DCD-S10 and a two-year-old Sony CDP-X707ES), an inexpensive unit (Denon's DCD-815, $330), and a portable unit (the Optimus 3400, which was recently discontinued).

I also compared the DAC-1 with the converters in the upmarket Sony and Denon machines, and with an Anodyne Group FET-Adapt D/A converter, a discontinued model that originally sold for nearly four times the DAC-1's cost. After checking whether the DAC-1 could hold its own against much more expensive competition, the verdict was good news for Assemblage—and great news for the audio enthusiast on a limited budget.

Other hardware in the system included an Air Tight ATC-1 tube preamp, a QED passive control box, a pair of New York Audio Labs (NYAL) OTL-3 tube monoblocks (triode-modified by George Kaye Audio Labs), and an old transformer-coupled, 50-watt/channel Grant-Lumley push-pull design with a pair of EL34 power tubes per side. Cables in the main system were Kimber silver AG series throughout.

Loudspeakers used in the testing were predominantly Brentworth Sound Lab Type 1s, a design of very high efficiency (100 dB/watt/meter). The DAC-1 was also inserted into a larger system that included Dunlavy SC-IV speakers wired to a Kaye-modified NYAL Moscode 600 hybrid amp, producing some 325 watts/channel, which in turn was partnered with a Convergent Audio SL1 Signature preamp.

Initial impressions were of a robust, yet unimposing sonic character, regardless of the partnering hardware. Once broken in and warmed up, the DAC-1 clearly resolved the most densely scored orchestral material, with only the slightest hint of audible stress. Every other type of music that was auditioned was handled with seemingly errorless aplomb.

Krystian Zimerman's fulminating passages in the Debussy piano preludes (Deutsche Grammophon 435773-2) were cleanly reproduced, with a full measure of the piano's size and more than an inkling of the instrument's tonal signature. In quizzical, introspective passages, Zimerman's superb control was easily appreciated, with no smearing. In these sections, the Sony 707/DAC-1 combination was excellent, exhibiting a solid mid-hall perspective. The Denon/Anodyne combo seemed superior only when vigorous lower octave information might tax a power supply's ability. Then, the Anodyne's beefier supply would not be deterred, whereas the DAC-1 would intermittently render a mid-weight impression, as if Zimerman's left hand was now playing an upright piano.

To make construction easier for the nonengineer or nontechie, 90% of the DAC-1's internal assembly is done by the factory.

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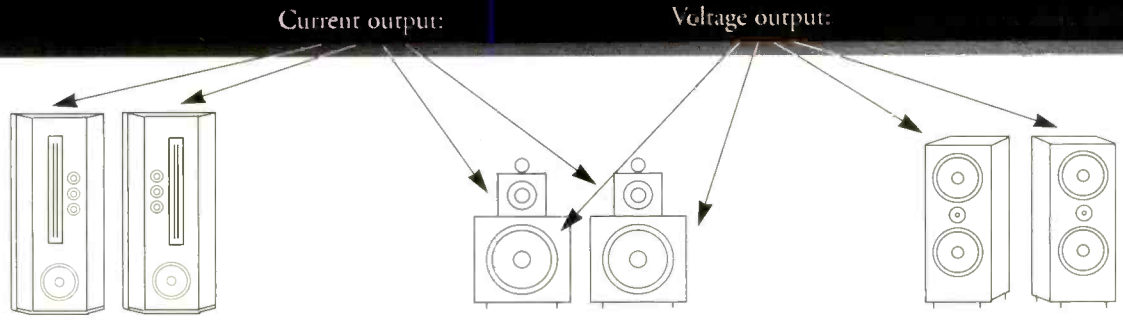
A muscular 600 watt amp with the soul of a 9 watt triode.



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It's not a 9 watt triode of course, and we wouldn't want it to be, but it does share a very important characteristic with one. It incorporates the current-source (high output impedance) property of a triode -- the very property that is *the* dominant factor (perhaps ninety percent) of the sonic magic that makes listening to classic vacuum tube amplifiers so much fun. So when you choose our current-source output connections for your system, you'll have a sumptuous high end, and a midrange that positively glows.

At the same time, the new Sunfire amp, with its uncanny tracking downconverter, has the ability to raise goose bumps with its awesome power. Using 12 herculean International Rectifier Hexfets, it can drive *any* load to *any* rationally usable current or voltage level.

A choice of outputs.

You can connect most speakers to the voltage-source output, with its near zero impedance, to experience the powerful dynamics and tight bass you've always wanted more of.

Or let's say you own electrostatic, planar magnetic or ribbon speakers, then connecting the higher impedance current-source output can coax forth a sensuous, delicately detailed musical voice associated with low-powered classic tube amplifiers.

Or if you're able to biwire, you may just arrive at the best possible interface: voltage output to woofer for incredible bass whack, current output to midrange and treble for a huge three-dimensional soundstage with detail retrieval so stunning that you will often hear musicians *breathing.*

Each choice will reveal the delicate musical soul that complements this amp's astonishing muscle and control. And each will lead to a multilayered soundstage so deep and wide it will take your breath away.

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The basis for all this is designer Bob Carver's versatility. He's worked successfully for over twenty years with both tube and solid state designs, and he understands the intrinsic subtleties of each.

For the new Sunfire, he insisted on an enormous 138 ampere peak-to-peak output current capability with 600 watts rms per channel continuously into 4 ohms* and 2400 watts rms into 1 ohm on a time-limited basis. Courtesy of 24 massive Motorola triple-diffused output devices, each capable of 20 amperes without taxing current reserves.

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Sunfire Corporation

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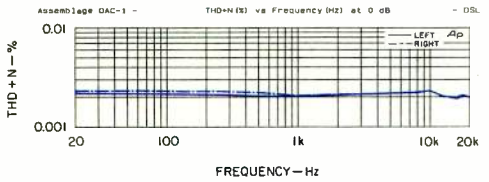


Fig. 1—THD + N vs. frequency.

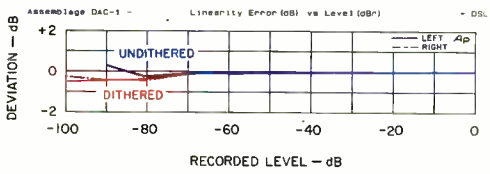


Fig. 2—Deviation from linearity.

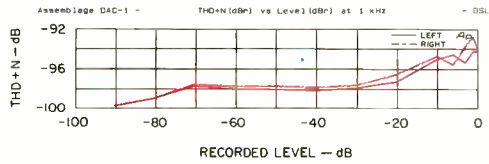


Fig. 3—THD + N vs. level.

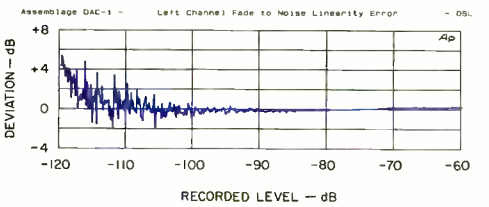


Fig. 4—Fade-to-noise test.

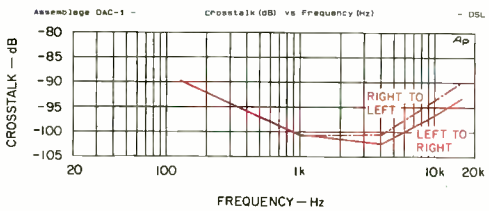


Fig. 5—Stereo separation.

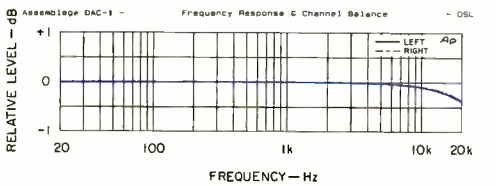


Fig. 6—Frequency response and channel balance.

Partnering either the Audio Alchemy or the CAL Delta with the DAC-1 via the coaxial connection made for a terrific match: A sense of tonal and mechanical imperturbability emerged in the Zimerman and in a starkly portrayed reading of Stravinsky's *L'Histoire du soldat* (Chesky CD122). This disc revealed many noncritical differences in the transports, underscoring the DAC-1's ability to reveal low-level information.

The Optimus portable and midmarket Denon machines also performed very well with the DAC-1. The Optimus fits nicely atop the DAC-1, creating a tidy but tenable playback system for audiophiles with space problems.

To the DAC-1's credit, it delineated Sigiswald Kuijken's masterful playing of his 300-year-old Grancino on the Bach *Sonatas and Partitas* for solo violin (Deutsche Harmonia Mundi 77 043-2-RG) as well as the other, more expensive machines did. However, the Denon DCD-S10/Anodyne combo offered subtle, small advances in dynamic contrast and ambient detail.

Through a cutting-edge playback system, a few cuts on the Brazilian vocal stylist Ana Caram's *Maracanã* (Chesky JD104) project an unnervingly lifelike portrayal of a woman in a state of readiness not to be further described in a family magazine. Properly replayed, the in-the-room effect can be startling, and the DAC-1 was up to the challenge, particularly with the Denon DCD-S10 feeding the signal.

With Sonny Rollins' Prestige classic *Saxophone Colossus* (Fantasy/Original Jazz Classics OJC-291), vintage 1956, the DAC-1 displayed none of the grainy tizziness or tonal thinness that often characterizes inexpensive CD gear. Only some of Max Roach's intricate detail drumming seemed glossed over, prompting a wish for a mint copy of the LP.

The DAC-1 could rock 'n' roll as well, doing justice to The Pretenders' recent compilation *The Singles* (Sire 25664-2). Inventive guitar chords were kept intact, and Chrissie Hynde's voice projected just the right raspy combination of skewed maternalism and taunting alienation.

In summary, the treble performance of the DAC-1 was laudable, given many CDs' limitations in this area. Midrange performance was dictated mostly by the various transports, as the DAC-1 properly passed along the qualities of the signal fed into it. Vocal material might be criticized as being just on the dry side through the DAC-1—but the CD format has been widely criticized for just this, so perhaps the DAC-1 is merely an accurate replayer of CD sound.

During playback of CDs versus the Dunlavy/Moscode system, some minor deficiencies in the DAC-1's mid and lower bass became apparent. Still, those whose systems deliver clean bass below 40 Hz should seek expensive gear more capable of defining the bottom octaves.

If a more rounded, harmonically enriched playback character is desired, one might seek a converter with vacuum tubes in the output stage.

Conclusion

The Assemblage DAC-1 is helping to revive the appealing tradition of Heathkits and Dynakits of the 1960s and '70s. The DAC-1 deserves a resounding recommendation and not simply because it is inexpensive. Over a course of a few months, it was a synergistic part of costly, carefully integrated systems and did not sound out of place. Score one for the avid listener on a budget. *J.C.H.*

Measurements

Let's face it. Despite their claims to the contrary, precious few manufacturers design their own digital-to-analog converters. Sure, they design the circuitry surrounding the converter, but most DACs and the digital filters that accompany them are third-party ICs that are available to anyone. Even hardware manufacturers that own IC foundries gladly sell chips to competitors to get production up and cost down.

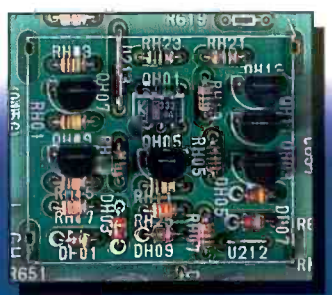
This being the case, why aren't all DACs "state of the art"? Cost is one obvious reason: Not every company will spring for an expensive chip, especially not for products

"RECOMMENDED COMPONENTS..." —Stereophile, Vol. 18 No. 4, April 1995

"Killer $500 CD Player..."

—SAM TELLIG,
Stereophile, Vol. 17 No. 11, December 1994

★★★★★ —What Hi-Fi?, March 1995



Critical analog output stage outperforms conventional op-amp analog output circuits.

Critics agree—the Marantz CD-63 Special Edition plays to rave reviews. Marantz CD players have long been held in high esteem and the CD-63SE continues the tradition. Based on the award-winning CD-63 model (European CD Player of the Year—1994-1995), Marantz engineers applied a number of enhancements to the Special Edition version. Both models feature Marantz' exclusive HDAM discrete analog output stage, which provides a superior analog output signal characteristic, compared to conventional op-amp based designs found in most other models

A host of refinements found in the CD-63SE include oxygen-free copper power transformer windings, selected Cerafine and Silmic audiophile capacitors, chassis and power supply bracing for improved rigidity, and numerous other "tweaks" to bring out the most musicality from your favorite CD's.

For fans of outboard D/A processors, the '63 series is equipped with high quality co-axial digital output (along with optical, also), and excels as a transport alone. Built to the highest standard, the Marantz CD-63SE is, of course, backed by our three year limited parts and labor warranty. Audition the Marantz CD-63 Special Edition soon at your Marantz dealer.

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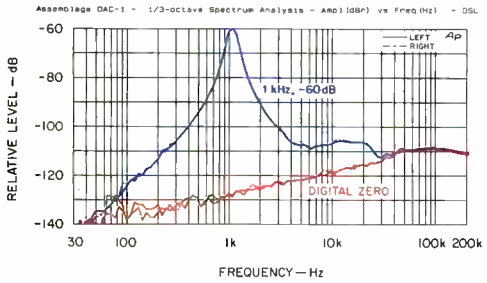

Fig. 7—Third-octave noise vs. frequency for 1-kHz signal at –60 dBfs and for signal at digital zero.

designed to meet a low target price. Carelessness is another reason: The best DAC will not perform optimally with shoddy support. The entire system (including analog circuitry, power supply, and component layout) must work in concert to permit the DAC to attain its potential.

The Assemblage DAC-1, however, is done right. Judged in its entirety, it comes as close to technical perfection as I can recall. Just take a look at the curves of THD + N versus frequency, in Fig. 1. Outstanding! They come as near to the theoretical limits of the CD as I've seen, and do so across the entire frequency range, with none of the typical rise in THD at and above 10 kHz. (More about this later.)

Now look at the plots of linearity error, in Fig. 2. Incredible! There's well under 0.1 dB of error at the –70 dB recording level (–70 dBfs) and only 0.33 dB at –90 dBfs. And that's without dither to help. With a dithered recording, the error barely tops 0.5 dB at –100 dBfs. If there's ambience on a CD, the Assemblage DAC-1 will dig it out.

The THD + N versus level curves of Fig. 3 and fade-to-noise graph of Fig. 4 relate the same tale of perfection. Rarely do you find a DAC whose worst-case THD + N tops out at –92.6 dB at high recording levels and remains below –97.5 dB from –30 dBfs down, as Fig. 3 indicates. In Fig. 4, I've shown the left-channel fade because it seemed ever so slightly worse than the curve taken on the right channel. Technically, however, the two were identical "within the limits of experimental error," and had I run the plots again, the outcome might well have been reversed.

As you would expect from the graph of THD + N versus level (Fig. 3), the DAC-1's dynamic range (not shown) was excellent, approaching 100 dB, A-weighted; even unweighted, it was better than 97 dB, worst case. Thanks to its 20-bit DACs and exceedingly quiet analog electronics, the DAC-1's A-weighted S/N ratio (measured with a "digital-zero" recording) topped 110 dB. But even when the converter was exercised (the "quantization noise" measurement), total noise was almost 96 dB down, which is outstanding.

Figure 5 shows interchannel crosstalk. While I've gotten slightly better numbers on a few systems—precious few, I hasten to add—I have no grief with these whatsoever. When worst-case channel separation approaches 90 dB, we're really splitting hairs. It's far greater than necessary, and I've seen "dual-mono" amps do much worse!

I've held the frequency response data (Fig. 6) until nearly last because I want to discuss these curves together with the spectrum analyses of Fig. 7. Over most of the audio spectrum, response is ruler flat; it's down less than 0.1 dB at 10 kHz. At 20 kHz, response is down a tad less than 0.4 dB. Most likely, this is caused by the analog reconstruction filter. I'm sure that the DAC-1's designers could have used a less aggressive filter and/or one with a slightly higher cutoff frequency to improve the response at 20 kHz. (Not that it's bad; I'm simply splitting hairs to make a point.) However, had they done so, I'm convinced that the noise and high-frequency distortion would have been worse.

Despite the standard nomenclature ("total harmonic distortion + noise versus frequency"), the high-frequency "distortion" shown in Fig. 1 is not "harmonic" distortion at all, since a 22-kHz low-pass filter is used in the analyzer when making the measurement, which suppresses harmonics of any signal above 11 kHz. The distortion is really a form of IM caused by harmonics of the signal beating with whatever residual sampling-rate carrier is present. These "beats," when present, fall well within the audible range and are much more distressing than a loss of 0.4 dB in 20-kHz response. In short, I heartily approve of the approach taken in designing the DAC-1.

Now, if you carefully examine the spectrum analyses (Fig. 7), you'll find hardly any 44.1-kHz sampling-rate component even in the 1-kHz, –60 dBfs plot. And there are no components at harmonics of the sampling rate. Both conditions are unusual, and I believe both contribute to achieving superior sound quality. Note, too, the absence of power-line-related components and the smooth roll-off in low-frequency noise. These characteristics testify to good circuit design, careful circuit layout, and a selection of active analog components that have negligible "popcorn" noise. Care seems to be the hallmark of the Assemblage DAC-1. The channels are perfectly balanced, the output level is "standard," and the output impedance is exceedingly low.

CLEARLY, THE DAC-1 IS OUTSTANDING, A TOTAL DELIGHT AND AN UNUSUAL BARGAIN.

Since the digital-to-analog converters in many of today's CD players are really fairly good, a stand-alone DAC must be outstanding to justify its existence. Clearly, the Assemblage DAC-1 is. What a delight! And what a bargain! *E.J.F.*

MEASURED DATA

Frequency Response: 20 Hz to 20 kHz, +0.00, –0.39 dB.
THD + N at 0 dB: Less than 0.0023%, from 20 Hz to 20 kHz.
THD + N at 1 kHz: From 0 to –90 dBfs, less than –92.6 dB; from –30 to –90 dBfs, less than –97.5 dB.
A-Weighted S/N at Infinity Zero, re: 0 dBfs: 110.0 dB.
Dynamic Range: A-weighted, 98.8 dB; unweighted, 97.1 dB.
Quantization Noise, re: 0 dBfs: –95.8 dB.
Channel Balance: ±0.00 dB.
Channel Separation, 125 Hz to 16 kHz: Greater than 89.8 dB.
Line Output Characteristics: Level, 1.96 V; impedance, 78 ohms.

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AURICLE

JAMES T. FRANE

ACOUSTIC RESEARCH 338 SPEAKER

Founded in 1954 by Edgar Villchur and Henry Kloss, Acoustic Research (AR) became well known for its creation and use of the acoustic-suspension type enclosure. This design uses the spring force of the air in a hermetically sealed cabinet to control the motion of a driver. Acoustic suspension enables designers to achieve extended bass, with low distortion, using a relatively small enclosure.

Company Address: 535 Getty Court, Bldg. A, Benicia, Cal. 94510.
For literature, circle No. 94

In the early 1950s, most speakers that had good bass extension were expensive and required large cabinets. The smaller size AR speakers became quite popular, especially with the advent of stereo, when two speakers were needed. The AR development of dome tweeters in the late '50s added to the popularity of the company's speakers, as dome drivers improved stiffness and dispersion, compared to cones.

AR is now part of International Jensen and recently relocated from Massachusetts to California. Its current offerings range from a small two-way system with a 5¼-inch woofer design to a three-way with a 12-inch woofer. They are embodiments of the company's original design concepts, and improved by the use of the latest technology in drivers. A powered subwoofer and a home theater center-channel speaker round out the line. AR's design goals include wide frequency response and balanced power output across the frequency spectrum.

The 338 is about in the middle of a range of new AR designs. It is of traditional "bookshelf" speaker size and is AR's smallest three-way model. It utilizes a ¾-inch dome tweeter, a 1½-inch dome midrange, and an 8-inch paper cone woofer. The drivers are mounted vertically on the front baffle of an enclosure that is 19 inches high, 10½ inches wide, and 9 inches deep. The tweeter and midrange are on a common vertical centerline, offset to 4½ inches from the cabinet edge, and the woofer is horizontally centered near the bottom of the baffle.

Mirror images of each other, the speakers can be placed with the tweeters and midrange drivers toward either the inside or the outside cabinet edges. The review pair was well finished on all sides in cherry wood vinyl (black vinyl is also available). Input connection is via two gold-plated five-way binding posts that are ¾ inch on center, to accept dual banana plugs, and located in a recessed insert in the lower back baffle. The black plastic grille frame is covered in black double-knit cloth, and the grille is held about ¼ inch away from the front baffle, on posts inserted into sockets.

The size of the enclosures requires the 338s to be elevated in order to position the tweeters at about ear level, and this is how I auditioned them. Their sensitivity is rated as 86 dB with a frequency response of 55 Hz to 20 kHz, ±3 dB.

I placed the 338s 7½ feet apart and about 9¼ feet from the listening position. The backs of the speakers were 2½ feet from the back wall, and the nearest side wall was about 1¾ feet from them. I tried them

Photo: Michael Groen

both facing straight ahead and angled toward me, with and without the grilles. (The 338s have an appealing appearance even without the grilles, although the dome drivers will then be exposed to curious fingers.) I found the sound to be better with the speakers toed in and pointing directly at the listening position, sans grilles, and placed so that the tweeter and midrange were toward the inside edges. I tried the 338s at various distances from the rear wall and found that the closer they were to it, the shallower the soundstage became.

The speakers were driven with a Carver TFM-42 power amp controlled by a Carver CT-17 tuner/preamp. The interconnect cables were Monster Cable, and loudspeaker cables were Kimber 4PR. A Sony CDP-C315 CD player, a Dual CS5000 turntable with Shure's V15 Type V cartridge, and the Carver tuner were used as signal sources. I listened to acoustic jazz, vocals, classical, and vintage rock music.

AT $649.95 A PAIR, THE AR 338s ARE MODERATELY PRICED, WHICH BELIES THEIR PERFORMANCE.

Mechanical components can benefit from a break-in period, depending on the time required for their materials to reach an equilibrium point. Right out of the box, the ARs had a well-balanced low-frequency response that extended down to the mid-50-Hz range. This might have been because the already compliant suspension of the acoustic-suspension woofer didn't require much of a break-in period. Initially, the sound seemed to emanate directly from the speakers, resulting in a somewhat "closed-in," boxy sound, but after a few days of use, the soundstage broadened and deepened. As more time passed, the stage stretched between, behind, and often to the outsides of the speakers when I played good source material. Any tendency toward boxiness disappeared. This change might have occurred as the midrange driver suspensions loosened and stabilized with use. The bass output did not change character over time, although it eventually reached down into the mid-40-Hz range. The highs decreased slightly when I moved from a seated to a standing position, particularly with pink noise. Horizontal power output seemed consistent over a wide area, as I found good listening positions virtually anywhere between the speakers. At $649.95 a pair, these are not high-priced speakers, and the price belies their performance.

I frequently attend live music performances, using them as my standard of reference. Although the ARs didn't convince me the music was live, they acquitted themselves well in terms of tonal balance, dynamics, consistency, and presentation of the performance venue. The differences between good and poor recording techniques were readily apparent. The flat bass response allowed the reproduction of male voices without any hint of congestion or "chestiness." Female voices were well reproduced and sounded very natural. Accurate timbre clearly distinguished different instruments. The bite and rasp of a trumpet, the soulful depths of a tenor sax, the scrape of a well-rosined bow on strings, and the spread of a full orchestra were quite realistic, given good recordings. There was no confusion between the sounds of violins, violas, cellos, and double basses. The high-frequency output was smooth and very extended, without stridency or harshness. The 338s created a very enjoyable listening session, no matter the type of music.

The major area of performance with which some may find fault is in the reproduction of the lowest octave (below 40 Hz). While larger woofers can add impact, a heightened sense of realism, and the foundation of the lowest musical octave, an 8-inch woofer can move only so much air. Yet although the lowest octave is essentially missing (what is there is at a much decreased level), its absence is neither really detrimental nor likely to be noticed with most music. I have listened to speakers costing more than twice as much as the 338s that were not as musically involving. I listened for long periods of time to the ARs without experiencing any sign of fatigue, often finding myself stopping other activities just to concentrate on the sound.

The AR 338s are very much worth auditioning, and I got very good sound from them after the break-in period. A

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On the DA-10

"So what kind of animal is the Counterpoint? It is very much in the top league. But above all else, it is future proof. So as well as being both exotic and sexy, the Counterpoint is goddam sensible..".-**Alvin Gold, Audiophile Magazine, U.K.**

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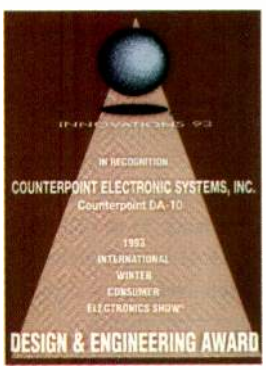

In Vienna, noted musicologist **Dr. Ludwig Flich** put the DA-10 in **REFERENCE CLASS,** the highest rating.

In Japan, the DA-10 was selected as **COMPONENT OF THE YEAR** by **Stereo Sound.**

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"If a transport can ever be described as near ideal, then the DA-11 deserves that accolade...That's the kind of musical involvement that this transport/dac(DA10/11) has on offer: the music comes alive in the living room."-**Eric Braithwaite, U.K.**

"By building such quality from relatively modest blocks, Counterpoint has demonstrated a mastery of the digital medium. A mastery that demands our recommendation.-**RECOMMENDED COMPONENT, HI FI CHOICE , U.K.**

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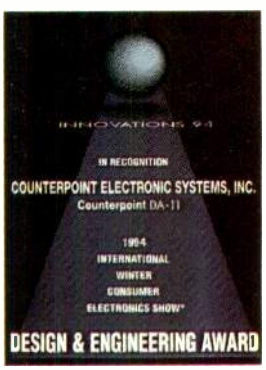

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AURICLE

EDWARD M. LONG

MY DISC
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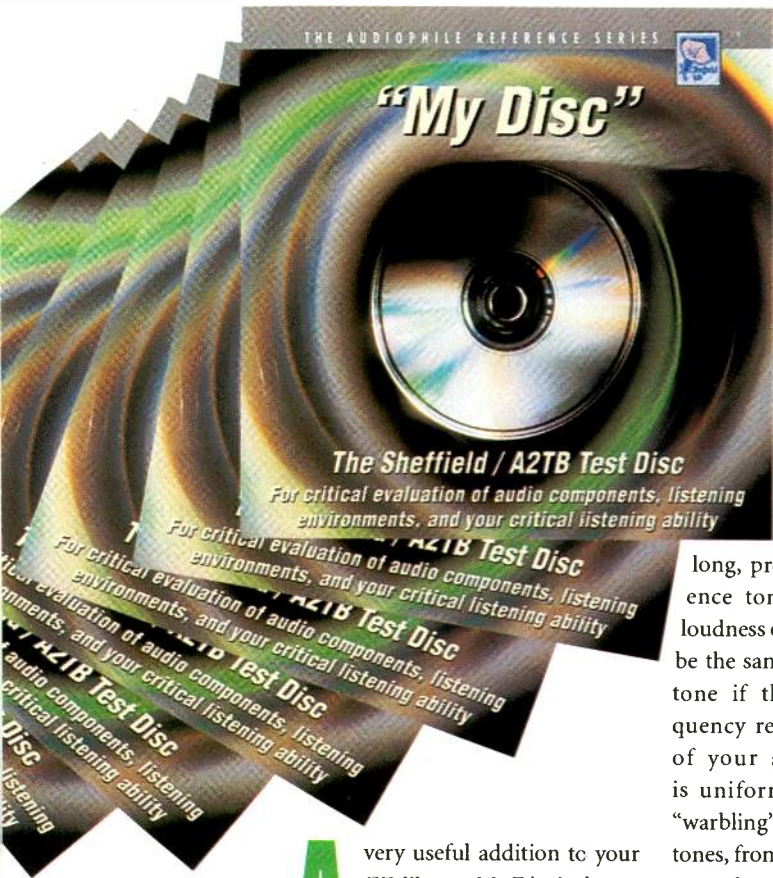

A very useful addition to your CD library, My Disc is the result of a collaboration between audio consultants Richard Clark and David Navone, publishers of Autosound 2000 Tech Briefs, and Oscar Ciornei and Doug Sax of Sheffield Lab Recordings. My Disc not only has musical selections (on the first six tracks) but also has 80 tracks with test signals and auditory tests. Many of these tests cannot be found on other CDs. For example, after tracks 7 and 8, which have very accurate signal levels at –20 and 0 dB, respectively, tracks 9 through 18 have octave-wide warble tones that are very useful for determining the response of loudspeaker systems and earphones. The center frequencies of the warble tones are 20, 62, 125, 250, and 500 Hz, and 2.5, 5, 10, 15, and 19 kHz. (The limitation of the CD format does not allow for signals above 20 kHz.) Each tone in the series is 3 seconds long, preceded by a 1-kHz reference tone for comparison. The loudness of each of the tones should be the same as that of the reference tone if the frequency response of your system is uniform. The "warbling" of the tones, from 20 Hz to 19 kHz, helps to prevent the buildup of standing waves in a room, especially in the lower frequency range.

A USEFUL ADDITION TO YOUR CD LIBRARY, MY DISC HAS TESTS THAT CAN'T BE FOUND ON OTHER CDs.

I really appreciate the thought that went into making track 19, where you'll hear a voice counting from 1 to 25. Although it may appear simple, it was recorded with a Brüel & Kjaer instrumentation microphone that makes the voice extremely natural, with no colorations or "enhancement." This track can help you assess colorations caused by your listening room's reflections and standing waves; if you use it to help you decide which new loudspeaker system to buy, it will quickly sort out the choices.

Tracks 20 and 21 are for identifying right and left channels. Track 22 is a voice check for left- versus right-channel polarity. Track 23 is a series of four pulses; the first three are positive, and the fourth is negative. This track has appeared before, as track 10 on The Sheffield/Coustic Setup and Test CD (10040-2-T), a disc primarily for car audio and home theater systems. I have used this track to determine, by listening, the correct absolute polarity of the acoustic output of earphones and speaker systems. Because the test signals on track 23 are hard to capture on anything but a digital oscilloscope, track 24 has a continuous sine wave, with its negative side clipped, to allow a technician to see the proper polarity on an analog 'scope.

Tracks 25 and 26 feature three people talking, first individually and then all at once. These tracks help determine the accuracy of image placement by speaker systems—and your ability to use your speakers to resolve complex sounds binaurally. Tracks 27 to 32 will help determine how well speaker systems and room acoustics are working together with regard to image placement and coloration. You will quickly hear differences with this test, allowing you to make adjustments in speaker placement to minimize these differences.

Tracks 33 to 40 contain a 45-second musical excerpt, recorded from 0 dB on track 33 to –70 dB on track 40. Track 41 is total silence. Track 42 is a high-frequency signal for use with test instruments.

Tracks 43 and 44 have, respectively, correlated and uncorrelated pink noise. Track 45 has pink noise raised in 1-dB steps every 3 seconds; track 46 uses 3-dB steps. Tracks 47 to 56 have third-octave filtered pink noise

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from 31.5 Hz to 16 kHz. You could use a Radio Shack sound-level meter to check the frequency response of your system at different room locations.

Tracks 57 to 59 have continuous and warble tones for checking response and resonances. Tracks 60 to 62 contain sweeps, for use with instruments. Track 63 has the musical note A_4 (440 Hz), to check speed accuracy of a CD player. Tracks 64, 65, and 66 have 100 Hz, 1-kHz, and 10-kHz tone bursts. Tracks 67 and 68 feature 100- and 1,000-Hz square waves. The purpose of tracks 69 and 70 is to show the effects of dynamic compression.

Tracks 71 to 76 demonstrate the sound of distortion added to a test signal in controlled amounts, allowing you to explore your own listening capabilities. Tracks 77 to 82 are intended to show the same thing, this time with a musical excerpt. These tracks prove that it is easier to hear distortion when you listen at moderate levels, where your auditory system is not overloaded.

ON SEVERAL TRACKS, THE ACCURACY OF THE SPATIAL INFORMATION IS UNCANNY.

Tracks 83 and 84 are intended to demonstrate the effects of low-frequency time delay on the quality of reproduced sound. A low-pass filter causes the sound below 100 Hz to be delayed by about 7 mS without affecting the signal's overall frequency response. (It would be interesting to have a test signal with the range below, say, 2 kHz delayed by 1 or 2 mS.)

Tracks 85 and 86 were recorded at the Indianapolis Motor Speedway with "In The Ear" (ITE) microphones that were developed by Mead Killion of Etymōtic Research. These tracks are best heard over earphones (ideally the Etymōtic ER-4 "In The Ear" model). The accuracy of the spatial information is uncanny when you refer to the notes that accompany My Disc. This experience alone might be worth the $29.95 cost of this CD.

My Disc should be in the collection of every serious audiophile. A

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CLASSICAL RECORDINGS

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The Schumann Edition—The Four Symphonies; Piano Concerto, Op. 54; Manfred Overture; Overture, Scherzo and Finale, Op. 52; Konzertstück for Four Horns and Orchestra; Two Symphonic Etudes (arr. Tchaikovsky)

Soloists; Seattle Symphony, Gerard Schwarz
DELOS DE 3146
Four CDs; 3:51:11
Sound: A, Performance: A

Is everybody aware that the heartland for Romantic music has definitively moved to the West Coast, in particular to the Pacific Northwest? That's far from its longtime home amid the old, big-name eastern orchestras. Set aside four hours or so to listen to this mammoth collection from Seattle, and you may draw the same conclusion.

Regardless of what *The New York Times* might say, for many ears the old orchestras have been just too tired of Romantic music to play it well, unless whipped to a frenzy by some European conductor. These westerners, whether native or adoptive, are obviously eager, willing, and enthralled with their own production. As for their technical expertise, it is standard professional-American, which means high—east or west. That's why I say "definitive."

Yes, I played every note—and several of the discs twice through. I marvelled at the sense of unreserve, of a new freedom, and rejoiced in the long, drawn-out breath of the music, the quintessence of the Romantic ideal. And this in spite of Gerard Schwarz's very lively tempi, much faster than anyone did Schumann in my early days. It must have originally been this way, says my musical ear. But the many slow segments, too, are given new breadth and continuity: Listen in particular to the one-time somewhat-embarrassing ending of the "Manfred" Overture, where the hero dies at length, his heart pumping ever slower, *ad infinitum*. Here it is no longer uncomfortable—rather, it is convincing, moving, and impressive. That favorite overture was never more beautifully projected.

I hear a new Schumann in these four hours, and perhaps, at last, it is the true composer, revived.

Edward Tatnall Canby

Borodin: String Quartets, Nos. 1 and 2

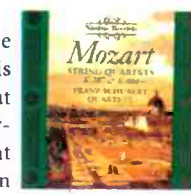
The Lark Quartet
ARABESQUE Z6658
CD; DDD; 65:11
Sound: B–, Performance: A–

The Lark's very individual performances are beautifully conceived and depend on the group's singer-like sense of instrumental coloration as a route to emotional fine-tuning and characterization. This gives the performances a special focus and passion that I find quite compelling. And it's particularly nice to have both of Borodin's quartets, rather than yet another No. 2 by itself. The recording, made in a Pur-

MOZART STRING QUARTETS

K. 387 and K. 464

Franz Schubert Quartett
NIMBUS NI 5433, CD; DDD; 66:17
Sound: A, Performance: A



A particularly fine Mozart quartet is followed by a great one, in excellent performances that are caught with pinpoint precision in an arc across your soundstage. The ambience is lush but stops short of becoming overbearing. A slightly leaner sound might have earned a grade of A+, however. The spatial differentiation between first violin and the second is among the factors that make this a demonstration-grade chamber music CD. *Robert Long*

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chase, New York hall whose properties have served Arabesque well in the past, is less successful than usual. The sound is rather harsh—which may be a question more of the Lark's properties than those of the pickup or the hall—and spatial relationships as well as some of the musical textures are less than ideally clear. *Robert Long*

Ricercar Keyboard Music in Germany Before Bach (Froberger, Böhm, Kuhnau)

Gavin Black, harpsichord
PGM 101, CD; 63:51
Sound: B, Performance: B–

Well, well. Hello, Herr Froberger and, yes, Herren Böhm and Kuhnau! It has been a while. In my distant college years these gents were called "pre-Bach" composers. Now they are thought of as "Music Before Bach." Does anything change?

Harpsichord instead of piano, but after well over a half-century I find them, remarkably, as I remember when I plodded through endless pages of Froberger on my rented upright college piano. He was a dogged, determined German if there ever was one—at least on paper. And that is exactly the way he sounds now in Gavin Black's careful harpsichord renditions. What more can a performer do?

Ah, musicology! Written descriptions of Johann Jacob Froberger's playing, after his death, are wildly different. It seems that he was a sensational touring artist, doing remarkable things with his music that no one else could duplicate: A thoroughgoing Romantic, as we might put it, embellishing the mere printed notes with breathtaking improvisations, highly flexible rhythms, et cetera. You can draw your own conclusions.

There is no question at all that Froberger accounts for much of the more dogmatic and long-lasting Bach counterpoint. Bach even borrowed the obsolete title "ricercar" in his later work to indicate a determined academism. Right on, Herr Bach!

You will find the lengthy Praeludium by Georg Böhm lively after Froberger, and as for Johann Kuhnau, he wrote music with detailed "stories" that were quite sensational in their time—thousands of words of explanation plastered all around the musical notes. Forget all that, and just listen.

Black's modern harpsichord is not modelled on any particular instrument out of the past, which is unusual today. It is modest and proper for the music: Two keyboards, three "stops"—one of them somewhat twangy, but the long bass strings are sonorous.

Another interesting historic anomaly here is quite noticeable to a quick ear: Some of the chords sound distinctly out of tune. Deliberately so. The instrument is tuned to a precursor of modern equal temperament, immortalized in Bach's "Well-Tempered Clavier," where all keys sound the same. This earlier tuning made each key sound differently "out of tune," giving each a special character that was relished, it seems, at the time. This is virtually impossible for modern ears to understand, however authentic the sound.

A perceptive discussion of audio recording levels by Gabe Wiener, PGM's big cheese, is in the CD booklet. You should read it.

Edward Tatnall Canby

Schubert: Die Schöne Müllerin

Peter Schreier, tenor; Konrad Ragossnig, guitar
BERLIN CLASSICS 0011232BC
CD; ADD; 63:50
Sound: B+, Performance: B+

Schubert reportedly composed many of his songs in bed, with his guitar as accompaniment. While the present accompaniments are "reconstructed" from the published piano parts, they give an idea of what the song cycle may have sounded like at the moment of its creation. Admittedly, the potential revelations are balanced by missing felicities that only a piano can supply. Lieder-lovers will want this as a companion recording, not as their only *Schöne Müllerin.* Tenor Peter Schreier is at his intelligent best in this 1982 analog recording, and the sound is good if unspectacular. *Robert Long*

Bach à la Carte: Four Different National Flavors

David Schrader, harpsichord
CEDILLE CDR 90000 020
CD; DDD; 77:15
Sound: B, Performance: B+

A nice title for a straightforward recital of standard Bach keyboard works: Two suites, the Italian Concerto (solo harpsichord), and the always challenging Chromatic Fantasy and Fugue. We leave Germany and visit France, England, and Italy, in name at least, according to Bach's somewhat parochial idea of these other countries, never having visited them.

David Schrader is currently Chicago's semi-official "old music" keyboardist—harpsichord, fortepiano, and organ—with numerous recordings on the Cedille list. Curious, how different is an old-music virtuoso from the current species of big-piano performer, though intrinsic finger and mind ability may be the same. An immensely impressive talent, Schrader is nevertheless very typical, no doubt by his own choice.

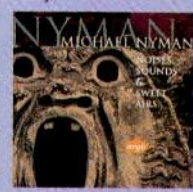
Old-music specialists, notably harpsichordists, tend to be scholarly and didactic, not at all given to flights of romantic fantasy and powerhouse histrionics. Expression in this older music must be in the clarity of the

MICHAEL NYMAN

Noises, Sounds & Sweet Airs

Catherine Bott, soprano; Hilary Summers, alto; Ian Bostridge, tenor; Ensemble Instrumental de Basse-Normandie, Dominique Debart
ARGO 440 842-2, CD; 72:35
Sound: B–, Performance: A (Presumably)

It's hard to know just what to make of this piece. The notes say little about the composer (who is new to me) or the circumstances of composition, except that the present suite is derived from the score for an opera-ballet Nyman has written called *La Princesse de Milan,* based on Shakespeare's *The Tempest.* In most ways, it suggests the so-called minimalist (I'd prefer the term "post-modernist") techniques of, say, Philip Glass: The musical material often is a series of mesmerizing ostinato-like figures. At the same time, the timbres and textures frequently suggest the modern medievalism and obsessive rhythms of Carl Orff's *Carmina Burana.* There are other resonances to the likes of Andrew Lloyd Webber's Requiem.



The performance is all of a piece and seems utterly secure, so I can only assume that this is the way Nyman wants "Noises" performed. It is effective and often powerful done this way, but I consistently get the feeling—or the illusion—that there is more here than meets the ear and that the piece might come across quite differently in other hands. Like Shakespeare's Prospero, Nyman has woven a spell, and only another generation may be able to discern the substance from the beguiling smoke and mirrors he has set before us.

The recording would rate a better grade if it used space as diaphanously as Nyman uses sound. It is good, but with this score it seems static and somewhat boxed in. *Robert Long*

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playing, the registration (choice of tone colors), and especially in the added ornamentation—a vast area of knowledge in itself and a formidable difficulty in actual performance. On these points David Schrader is impeccable, absolutely virtuoso. His playing is ultra-clear and accurate, his registration (notably in the frequent repeat sections) is simple yet perfectly contrasted, and his added ornament—some, but by no means all, indicated by Bach—is the most fluent and complex I have ever heard. No matter how elaborate, however, it should not obscure the basic sense, and here it does not, as those who already know the music will discover.

The French Suites, or overtures, are, for Bach's own reasons, the longest and most complex among his numerous suites (a French-Italian style out of Lully). The so-called English Suites, for reasons that remain obscure to me, are much more relaxed and melodic as well as shorter. We have one of each type in this recording, plus the even more ebullient Italian Concerto (solo and "orchestra" all on one instrument).

Bach was, oddly enough, one of the great proto-Romanticists, an innovator of the utmost profundity. Here Schrader is disappointing, if precise. I did not at all like the Chromatic Fantasy and the moving slow movement of the Italian Concerto, which march dogmatically from start to finish. Schrader simply does not project what is there. But who in Bach's own day could have? It took an outrageously unauthentic Romanticist like Wanda Landowska to show us what depths lie in these movements. *Edward Tatnall Canby*

Brahms: Fantasies, Op. 116; Wagner: Album Leaf for Betty Schott; Arrival at the Black Swans; Steuermann: Sonata for Piano

Bruce Brubaker, piano
VITAL MUSIC VC003, CD; 55:27
Sound: B–, Performance: B–

Here is a new young leader in the U.S. piano world, and I found his CD a problem. I did not like the opening Brahms, some of my favorites from the composer's last years. Why? Is it the recording—the quality of piano sound, the room sound, the hall sound? Or is it intrinsic in the actual playing? Only one way to find out: Play it through, then play it again. And maybe still again. Even for a "short" CD, this takes a lot of time and close attention.

Reviewers face big problems in listening to CDs from anywhere and everywhere: Different recording techniques for very different sounds, drastic and sudden changes of venue from one recording to the next, violent falsities of relative volume (such as a harpsichord suddenly as large as a full orchestra). Many a recording seems awful at first because of these artifacts, which no concertgoer ever hears. So, play it again! The ear does adjust in time.

The basic problem, I judge, is the piano sound. First, it is a bit close, so it tends to be hard and percussive, just enough to roughen up the mellow Brahms. In addition, there is no apparent room sound: All the "reverb" comes from the piano itself.

And now for the music. No, I do not think this young performer pounds unduly—though I did at first—just moderately hard, as is normal today. Bruce Brubaker is a brilliant technician and never mechanical, never unmusical, like too many young keyboard geniuses. But he has things to learn about Brahms. First, you do not "bring out" the melodies, but play them legato and with even rhythm; it is the long line that brings them out, even at low volume. Second, the elaborate inner texture must be subdued, blended seamlessly by the pedal but never obscured. I hear

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too much "insides" in this playing. Third, there should be more emphasis on the big, often dissonant chords: Not louder, but tiny pauses for emphasis. Sounds easy, but it isn't.

I should note the two interesting tidbits by Wagner. How seldom we hear him in piano form! But the Wagner sound is there, and goes well with the Brahms. As for the Steuermann sonata, it is a ghastly programming mistake. I remember this distinguished pianist as a youngish elder statesman of contemporary music. His own composing, though, was at the extreme of twelve-tone dissonance, superimposed on a very Romantic shape: Okay in principle! But after Brahms and Wagner, it is a horrendous shock. *Edward Tatnall Canby*

McCormack & Kreisler in Recital

John McCormack, tenor;
Fritz Kreisler, violin; assisting artists
NIMBUS PRIMA VOCE NI 7868
CD; ADD; 69:07
Sound: A, Performance: A+

Nathan Milstein: The Last Recital

Nathan Milstein, violin;
Georges Pludermacher, piano
TELDEC 4509-95998-2, CD; DDD; 69:01
Sound: B+, Performance: B+

Violinists Fritz Kreisler and Nathan Milstein both recorded acoustically. There is hardly anything else that these two CDs have in common. In fact, it is the contrasts between them that make the comparison interesting.

The idea of combining some of Kreisler's solo discs with some of John McCormack's, and adding numbers the two artists recorded together to create a "recital," is a charming one. The recording dates range from 1912 to 1924, so we're not talking about a live recital here. However, the Nimbus Prima Voce technique—using state-of-the-art *acoustic* playback equipment and capturing the results digitally in a fine acoustic space—brings them to astonishing life. The consistent level of musical charm and grace is utterly disarming, though very little of the musical material has even a nodding acquaintance with the profound. Both artists, in fact, were to make their most serious contributions to the *holde Kunst* only in the early electrical era; McCormack died in 1945, about the same time as Kreisler's head injury, a tragedy from which his playing never recovered.

Milstein, some 30 years Kreisler's junior, recorded acoustically as a child prodigy, and

he remained a star almost until his death in 1992, when he was nearing 90. Whereas Kreisler's Viennese charm and unassuming manner made him a superstar, adored wherever he set foot, Milstein's birth and training were Russian. Need one say more? The present recital attests to his seriousness of purpose. Beethoven's "Kreutzer" sonata is followed by the Bach chaconne and another movement from a solo sonata, with a Handel sonata between them. Things lighten up a little with Sarasate's "Introduction et Tarantella," followed by two short pieces by Prokofiev and one by Tchaikovsky. Then come a Paganini caprice and a Liszt transcription. Whew!

This 1986 TV recording evidently was made by Milstein in Stockholm, judging from the notes. I can hear no trace of an audience. It was not planned as a farewell; shortly afterward, Milstein injured a finger, putting an end to his career, which would undoubtedly have continued otherwise. He certainly is in fine form here. This CD is a fitting memorial to a great musician. In its very different way, so is the Nimbus disc. *Robert Long*

Italian Compositions of the 20th Century
Rota: Concerto for Strings; Malipiero: Sesta Sinfonia for Strings; Porena: "Vivaldi"; Morricone: Esercizi for 10 String Soloists

I Solisti Italiani
DENON CO-78949, CD; DDD; 62:47
Sound: A, Performance: A

I have to admit that, until recently, I winced when seeing a CD of a string ensemble or solo violin come across my desk. Such source material is perfect for pointing out the steely harshness that some of us have dubbed "digititus."

But painful string tone seems to be finally fading from the scene. Part of my own solution has been switching to a D/A converter with tubes in the analog section, but many recording engineers are now working with greatly improved A/D converters, such as Denon's 20-bit Mastersonic approach that was used for this recording.

I Solisti Italiani, an 11-member, conductorless ensemble, formerly worked with I Virtuosi di Roma. The brilliant playing is matched with a distinctive program of string music, which results in a disc that should appeal to those who find string orchestra repertory a bit of a bore.

Nino Rota's concert music—that is, the music not created for Federico Fellini's films—is currently finding increasing attention on recordings. The Concerto for Strings, a classically structured work that displays Rota's special harmonic sense and an ironic character that sometimes recalls his film music, is a fine example.

In "Vivaldi," Boris Porena rediscovers "the already perfected cultural complex" of the Venetian composer and links it to the 20th-century idiom, much as did Stravinsky in *Pulcinella*. Its first movement hews close to Vivaldi, but the next two bring us back into this century. Gian Francesco Malipiero's Symphony for Strings employs his own highly individual language couched in the 18th-century concerto grosso style—alternating solo and tutti sections. *John Sunier*

Baroque Inventions: Scarlatti: Sonatas; Bach: French Suite No. 5, BWV 816; Handel: Overture to Rodelinda; Chaconne in G

Julian Gray and Ronald Pearl, guitar duo
DORIAN DOR-90209, CD; DDD; 71:03
Sound: A–, Performance: A

Purists need read no farther: These two solid musicians (who also have made all the transcriptions) take music written for harpsichord and play it—charmingly and brilliantly—on two guitars. Pragmatically, a plucked string remains a plucked string, no matter who plucks it, but in fact the guitar's greater richness and resonance make the sound of these baroque gems exceptionally ingratiating.

Purists might take exception to some of the musical interpretations necessitated by the mere logistics of the instruments involved. No matter: I find this CD uncommonly likable and enjoyable, and I imagine that would apply to anyone who doesn't have an out-and-out aversion to this noble, much abused and misused instrument, the guitar. The Handel chaconne stands out especially. *Paul Moor*

Nielsen: Four Works for Violin

Søren Elbæk, violin; Morten Mogensen, piano
KONTRAPUNKT 32200, CD; DDD; 72:17
Sound: A–, Performance: A

Two of these pieces—the Prelude, Theme, and Variations, Op. 48 and the Preludio e Presto, Op. 52—are for unaccompanied violin and are galvanizing. They may make you think of Ravel, Kodály, or Bartók—or all of the above—but they're ultimately pure Carl Nielsen. The earlier of the two accompanied sonatas that fill out the CD, Op. 9, may be a bit overbearing, but the later one, Op. 35, is a solid piece. The vivid, close-up sound suggests superb studio technique but not, alas, a "real" musical venue. *Robert Long*

ROCK~POP RECORDINGS

I Just Wasn't Made for These Times
Brian Wilson
MCA MCAD-11270, 29:32
Sound: A+, Performance: A+

During a chance encounter, Brian Wilson sent punk icon Iggy Pop screaming for the door. Yep, the Iggster was weirded out by the then all-but-washed-up Beach Boy. Check out producer Don Was' new documentary of Wilson's career, and you'll understand why; Wilson's a kook, a nut, a weirdo, but his knack for expressing himself with music is simply fascinating. Often called a genius, he's no doubt bizarre, but your alive and kicking inner child sorta makes you want to give Wilson a big hug, as does his music.

While the soundtrack to *I Just Wasn't Made for These Times* gets you right to the point—music—the film is obviously more, providing a character portrait that's worth observing. Between studio footage are interviews, anecdotes, and casual moments, as when Wilson sings "God Only Knows" while sitting at the piano with his mom and brother Carl. There's mom proudly recalling early musical ability; gushing disciples like Tom Petty and Lindsey Buckingham; gushing contemporaries like Van Dyke Parks, Graham Nash, and David Crosby; a gushing music conservatory professor, and record moguls who gush, too, but with less emotion. All extol Wilson's genius while also debating it: Is he indeed a genius or just really, really brilliant? His eccentricities: Are they the result of inherent hypercreativity, an abusive father, chemical dependency, or all of the above? And on and on.

At one point, Wilson chimes in with "I guess I've got a few phobias" after everyone else (daughters, ex-wife, et al.) reveals more than a few forgivable quirks. Anecdote after anecdote paints him as a survivor, more at home in front of his 88 best friends than anyplace else, yet it's his own ability to laugh at himself that provides comic relief at a necessary juncture. Seconds later, we're with him in a studio. He's flapping his arms like a dodo bird trying to take flight while a roomful of recognizable studio hacks, maybe oblivious to all but the groove, don't seem at all fazed by the man/child having a party at the piano.

For his documentary, Was took his legendary subject into a studio and recorded him doing several Beach Boys and solo songs. The result is stunning, and it's largely because of the good old *vox humana*; the voices here are enough to make you cry—especially "Caroline, No" and "The Warmth of the Sun." All has pretty much been said about Wilson's gorgeous sense of melody, harmony, and studio inventiveness—the stuff that ranks him as a demigod, debated genius and all of that. This recording, like its celluloid counterpoint, is a reaffirmation of who and what Wilson is, and *I Just Wasn't Made for These Times* makes its point with immediacy. After seeing it and hearing it, you just gotta believe all the hype.

Audiophiles, take note: This album is *sonic deluxe*. Meaning, it lives up to stringent "audiophile recording" demands without being labelled as such.

Mike Bieber

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Sleepy Eyed

Buffalo Tom
EAST/WEST 61782 2
Sound: B+, Performance: B–

Buffalo Tom has come a long way from their feedbacked, anti-pop roots. This trio, from Amherst, Massachusetts, remains loud but increasingly accessibile, with occasional cloying sentimentality and overbudget melodies. Sounds familiar? If George Wendt shows up in their video, Buffalo Tom is probably on the road to trapping their own "big brown beaver."

Like Soul Asylum's, Buffalo Tom's back catalog is more interesting than their current album, where the band shifts between a good loud-and-fast song such as "Your Stripes" and the maudlin "Clobbered." Such peaks and valleys give the album an untethered feel, hastening its arrival on my shelf, where it'll gather dust for a few years before I'll trade it in toward a Kinks bootleg or something. Singer/guitarist Bill Janovitz plays some great guitar, ranging from a big, double-tracked sound to Leslie cabinet effects, but it gradually becomes overshadowed by his plaintive, over-aching voice. So do a handful of really good, potentially excellent songs. Oh, well . . . *Mike Bieber*

Lovers in the City

Tanita Tikaram
REPRISE 9 45883-2, 52:08
Sound: A, Performance: B+

Tanita Tikaram burst out of England in 1988 with a debut album that was hyped and praised to the skies. Her subsequent albums have failed to generate a similar response. With *Lovers in the City*, her fifth recording, she delivers a colorful and offbeat collection of songs, all enthusiastically performed.

Produced by Thomas Newman along with Tikaram, this album is deliberately unfashionable. Its musical backing includes some strange couplings, such as Middle Eastern percussion with Dusty Springfield-like horn arrangements and string quartets melded with a rhythm track by guitarist David Lindley and drummer Jim Keltner. The album's most immediate songs are "I Might Be Crying," which features an infectious vocal chant by Jennifer Warnes, and "The Yodelling Song," which, strangely enough, rocks.

Other women artists whose debuts are met with critical adoration or mega sales or both (Sheryl, Sinead, and Tracy, anyone?) should note that there's life after hype, and it is possible to overcome the sophomore jinx. Sometimes, however, it takes half a decade.

Jon & Sally Tiven

Last Train to Lhasa

Banco de Gaia
PLANET DOG BARK CD 0118
Two CDs; 2:01:03
Sound: A–, Performance: B+

Through the wonders of digital sampling technology, the wailing chants of Arabic singers, the rubber rhythms of Indian tablas, and the breathy voices of panpipes have become the stuff of modern electronic music-making. I don't know if Banco de Gaia, the recording persona of Toby Marks, takes this technology further, but he certainly does it better than most.

Marks is an activist in the Tibetan freedom movement, and *Last Train to Lhasa* takes its

DUBLIN BLUES

Guy Clark is one of country music's most respected and admired songwriters. He's also one of its most reclusive. Yet between his 1992 *Boats to Build* (a clue to what he does when he's not making music?) and his new *Dublin Blues*, he's been gigging more than usual. Hence, Clark's performance on this CD has a relaxed confidence that wasn't there before, no matter how fine his albums.

Guy Clark
ASYLUM 61725-2, 41:47
Sound: A, Performance: A

With *Dublin Blues*, Clark's typically superb songwriting is highlighted by some excellent backup musicians. There are three guitarists—Verlon Thompson, Darrell Scott, and Rodney Crowell—Sam Bush on mandolin, Jonathan Yudkin on fiddle, as well as the Kenny Malone/Travis Clark rhythm section. Vocal help comes from Crowell, Nanci Griffith, Emmylou Harris, Kathy Mattea, and Suzi Ragsdale. Highlights? This album is exclusively highlights, from beginning to end. There are no weak links anywhere. *Michael Tearson*

title from the Tibetan capital. His music sources are drawn from Tibet, as well as from India, the Middle East, the techno dance floor, and old music lesson records. He mixes them into kinetic, rhythmically delineated landscapes where the beat isn't just a dance groove: It's a lifeline in a surreal landscape, shifting from the languorous, slow-motion sitar trance of "China (clouds not mountains)" to the driving techno-dub grooves of "White Paint." It suggests what The Grateful Dead's "Anthem of the Sun" may have sounded like if they'd started up in 1985 rather than 1965. Marks shifts perspective and tone, turning his music into a layered emulsion of tablas, sitars, Middle Eastern ululations, and electronic beats, creating multiple-exposure images.

Also like The Dead, Marks likes to jam, but in an electronic rather than instrumental sense. An additional CD contains ambient remixes of the primary disc's tracks, yet like a Dead jam, this material often overstays its welcome. But the main body of *Last Train to Lhasa* is an exhilarating ride, one you don't want to miss. *John Diliberto*

Maria

Jane Siberry
REPRISE 9 45915-2, 68:48
Sound: A, Performance: A

From her introspective lyrics to her octave-leaping vocals, Joni Mitchell is a touchstone for Jane Siberry. While Siberry transcended that influence long ago, she follows Mitchell onto the jazz track for her latest album, *Maria*. Siberry has always worked with a psychological scat, a verbal stream of consciousness and a jazz angularity that until now has never been couched as jazz. But *Maria*'s title track, sung by Siberry with an acoustic quintet, will sit comfortably next to the latest by singers Cassandra Wilson or Patricia Barber. However, this is far removed from most rock artists' attempts at jazz, à la Sinead O'Connor.

While Joni Mitchell's jazz forays on her 1979 album, *Mingus*, always sounded forced, Siberry doesn't alter her style so much as free it with a film-noir impressionism that recalls mid-'60s Miles Davis. Trumpeter David Travers-Smith shadows Siberry's every turn, commenting on and framing her lines with a muted sound similar to Miles's. Pianist Tim Ray recalls an early Keith Jarrett, with an impressionistic sense of melody.

The free association of jazz is a perfect match for Siberry, whose lyrics often map the synapses between the conscious and unconscious worlds. She sings of lost innocence, transforming non sequiturs into psychological scat on "See the Child." On "Begar, Begat," she intones a Hebraic litany of freedom, promise, hope, and joy.

Set off from the body of the album is a dreamy, surreal modal tune that builds relentlessly over its 20 minutes. "Oh My My" is a harrowing and sardonic comment on life in the real world, with an elegiac mix of reality clichés and dream relationships interspersed

with nursery rhymes and innocent tunes like "Puff the Magic Dragon." It's the kind of brilliant juxtaposition that has made Siberry's music so fulfilling, and even in this moody jazz setting it remains just as rewarding.

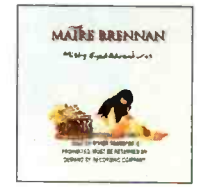
John Diliberto

Misty Eyed Adventures
Maire Brennan
ATLANTIC 82701-2, 51:04
Sound: B+, Performance: B–

Maire Brennan is the lead singer of the Celtic-rock/New Age group Clannad, but left to her own devices, she always seems to take a much more exuberant, world-music approach.

Brennan's voice is a warm, dusky instrument, with an earthier sound than her younger sibling Enya. Like Enya, she favors big choral arrangements; unlike Enya, those arrangements aren't dubbed into infinity. Instead, Brennan uses additional singers whose voices echo and contrast with hers rather than reflecting it—they create a chant on "Heroes" and surging refrains on the album's title track.

Occasionally, Brennan gets uncomfortably close to MOR soft rock, with harmonies reminiscent of The Carpenters. Her lead single, a cover of Joni Mitchell's "Big Yellow Taxi," is



commercially savvy but doesn't add much irony to this slimmest of Mitchell songs, despite funky backing from The Blue Nile. And with *Misty Eyed Adventures* only her second solo album, Brennan has already begun to pillage her own music: "The Watchman" could be a simple redo of "Land of Youth" from her first album. However, on the haunting "Eirign Suas a Stoirin" and "The Might One" (the latter sounding like a hybrid of Balinese and Celtic music), Maire Brennan bares her Irish soul, revealing one of the most entrancing voices in contemporary music.

John Diliberto

Glow
The Innocence Mission
A&M 31454 0332 2, 40:31
Sound: A–, Performance: A–

The Innocence Mission has been holding onto the fringes of jangly modern rock for over seven years. After a four-year hiatus, they haven't abandoned their sound on *Glow*, but it has an earthier, almost country-folk mood that opens up like the rolling farmlands of their native Lancaster County, the Amish lands of Pennsylvania.

Writer and vocalist Karen Peris' voice sounds like a more innocent version of Sam Phillips, a childlike waif gilded by grit. It works well in the ringing guitar filigree cast by her husband, Don Peris. Producer Dennis Herring offers the same textural sensibilities he brought to Throwing Muses and their CD, *The Real Ramona*.

From the anthemic tones of the radio-friendly "Bright As Yellow" to the rolling reminiscence of "Everything's Different Now," Karen Peris brings a sense of personal small-town detail to her lyrics.

Whether singing of love or spirituality, the images of iron bridges, Aunts Ruth and Mary, or taking blankets to the bay, Peris brings her songs to an intimate and revealing level. It makes *Glow* a beautifully constructed album, providing a sense of place and time that will make you think that Karen Peris' stories are your own.

John Diliberto

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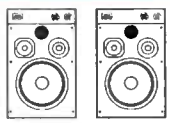

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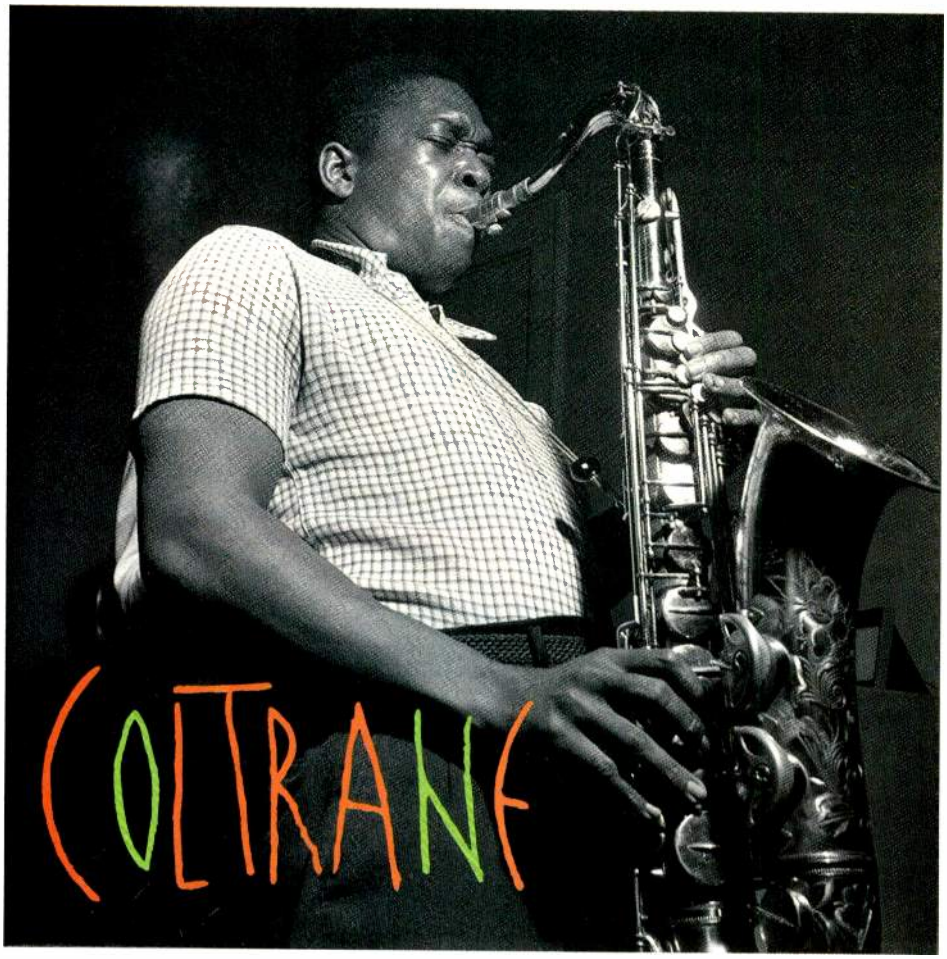

Photograph: Francis Wolff ©Mosaic Images

The Heavyweight Champion: The Complete Atlantic Recordings
John Coltrane
RHINO/ATLANTIC R2 71984
Seven CDs; 7:59:14
Sound: A, Performance: A+

The competition among CD box sets has been stiff recently. With each year, it seems like the packaging becomes more ingenious, the liner notes more thorough and illuminating, and the tracks more thoughtfully chosen and comprehensive. In 1992, Verve set a new standard of excellence in this area with its magnificent 10-CD Billie Holiday box. More recently, Blue Note scored a triumph with its Bud Powell box. And the folks at Rhino have been consistently issuing classy, superbly designed box sets since the initiation of its Atlantic Jazz Gallery collection in June of 1993. Rhino's crowning achievement, up to this point, was the fabulous Ornette Coleman box, *Beauty Is a Rare Thing*. Now comes John Coltrane's *The Heavyweight Champion* to blow away the competition.

In terms of sheer heft alone, this seven-CD set is indeed the undisputed heavyweight champ. But the inclusion of rare photos of John Coltrane, a brilliant essay by 'Trane expert Lewis Porter, and a complete CD of never-before-heard outtakes from the *Giant Steps* sessions of March 1959 truly make *The Heavyweight Champion* the ultimate jazz box for collectors.

In making this project completely comprehensive and chock-full of rarities, Rhino may have been trying to make amends for its rather sketchy two-CD Coltrane set from 1993, *The Last Giant*, which was roundly criticized for being subtitled *The John Coltrane Anthology*. Indeed, it would take far more than two CDs to compile a true anthology of Coltrane's recorded output with Atlantic Records, which lasted from March 1959 to May 1961. And now, under the guidance of Joel Dorn and Patrick Milligan (with kudos to remastering ace Gene Paul and art director Geoff Gans for another sonically and visually striking package), Rhino has finally done justice to the Atlantic era of the Coltrane legacy.

By the time John Coltrane signed with Atlantic, he was already widely regarded as a great saxophone player and improvisor. His commanding voice—marked by a full-bodied and dark tone, phenomenal speed, and searing intensity—was firmly rooted in the styles of Lester Young, Charlie Parker, Dexter Gordon, and Johnny Hodges, yet it contained an awesome, penetrating power that was truly unique. He had developed this bold style by the time he joined The Miles Davis Quintet in 1955 and continued to expand his emotional range, captured on several of Miles' Prestige classics: *Workin'*, *Steamin'*, and *Relaxin'* and culminating in the 1959 masterwork for Columbia, *Kind of Blue*. Coltrane appeared on the Prestige label as a sideman with Sonny Rollins, Kenny Burrell, Elmo Hope, Tadd Dameron, Red Garland, and Gene Ammons and was a leader in his own right, all of which was documented on a sprawling 16-CD box set, *The Prestige Recordings*. Coltrane's excellent Blue Note album (*Blue Train*, recorded in 1957) showed further growth and development as a composer and player. But it was during his fertile period on Atlantic that Coltrane began to fully integrate his distinctive tenor voice into a composerly vision that was intensely personal and ever-searching.

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Disc one of *The Heavyweight Champion* contains material from Coltrane's very first Atlantic session, a January 1959 quintet date with vibist Milt Jackson, pianist Hank Jones, drummer Connie Kay, and bassist Paul Chambers, originally released in December 1961 as *Bags & Trane*. These recordings—strictly covers, like Harry "Sweets" Edison's "Centerpiece," Dizzy Gillespie's "Be-Bop," and Harry Ruby's "Three Little Words"—show Coltrane in fine form within a fairly conservative, albeit swinging, context. But the real treats on disc one are the first takes of "Giant Steps," "Naima," and "Like Sonny," recorded in March 1959 with pianist Cedar Walton, drummer Lex Humphries, and bassist Chambers and originally released in January 1975 as *Alternate Takes*.

The hard-driving *Giant Steps* album, originally released in January 1960, is represented on disc two along with material from *Coltrane Jazz*, released in February the following year. 'Trane displays a more searching side on disc three, which contains material from *The Avant Garde*, his great collaboration with trumpeter Don Cherry, drummer Ed Blackwell, and bassists Charlie Haden and Percy Heath. This was recorded in June 1960 but not released by Atlantic until April 1966. Disc four contains 'Trane's classic, soaring rendition of "My Favorite Things," his first serious investigation of the soprano sax. Both discs four and five draw on material from *My Favorite Things*, *Coltrane's Sound*, and *Coltrane Plays the Blues*, the earliest documents of Coltrane's chemistry with drummer Elvin Jones and pianist McCoy Tyner.

Disc six covers the expanded group concept of *Olé Coltrane*, while disc seven (cleverly packaged in a mini recording tape box) contains previously unissued alternate takes, false starts, and incomplete takes showing the genesis of such Coltrane classics as "Giant Steps," "Naima," "Like Sonny," and "Blues to You." For serious Coltrane scholars and devotees, this disc of rarities is a treasure trove.

The Heavyweight Champion documents a jazz giant in full stride. It represents some of the most powerful music in jazz while laying a foundation for the spiritual search that John Coltrane would continue into the mid-'60s on the Impulse label. *Bill Milkowski*

Soccer Land

Ivo Perelman
IBEJI IBJ 0959-2, 46:03
Sound: B, Performance: A

Whenever I hear a drum kit and saxophone combination, my first thoughts are of John Coltrane and Rashied Ali's *Interstellar Space* and the Anthony Braxton/Max Roach duets. Brazilian saxophonist Ivo Perelman utilizes this combination, but brings something different to the table. Instead of emulating the vortex of Ali or the precision swing of Roach, Perelman's drummer, José Eduardo Nazario, shows off a veritable encyclopedia of traditional Brazilian rhythms. These two musicians lock into Brazilian folk songs and *candamble* chants, expanding them into frenzies of passion and ecstasy.

Perelman is a woefully underrated player. If São Paulo had a Knitting Factory, there's no doubt he'd be an international figure—and deservedly so. His playing is passionate and exuberant, but never facile or glib. On tracks like "Lampião de Gas," he spurs on Nazario with staccato phrases and chanting cries. But usually Perelman is riding the carnival grooves, bouncing off the *candamble* chant of "Samba de Ogum" or lolling sensuously across the pulsating rhythms of "Tristeza do Jeca."

The soccer metaphors go over my head, but hopefully Perelman's musical success in America will be much greater than that most international of sports. (Ibeji Records, 111 East 14th St., Suite 167, New York, N.Y. 10003.) *John Diliberto*

Song for the Beautiful Woman

Marcus Printup

BLUE NOTE CDP 7243 8 30790 2 5, 59:40

Sound: A–, Performance: B+

A "quintet with a twist" may best describe trumpeter Marcus Printup's debut record. The "twist" comes via the included six well-crafted originals, which combine the best of '60s hard bop with the quirky jazz of the '90s. Lately, numerous composers have been using odd-bar phrases and deceptive changes to inspire cliché-free improvisations, and Printup's compositions show exemplary technique. Never is the listener aware of Printup's writing per se. What you hear is solid, aggressive jazz played with quantitative individuality and feeling.

Great players seem to be coming out of the woodwork these days. Pianist Eric Reed and tenor saxophonist Walter Blanding, for example, exhibit styles worthy of serious note. Printup, who has done road time with Marcus Roberts and The Lincoln Center Jazz Orchestra, delivers crisp, decisive lines on the uptempo burners, and expressively lays back—often using a mute—on several luscious ballads.

If there are any questions regarding the group's handling of standard repertoire,"I Remember April," "Speak Low," and several blues tunes demonstrate knowledgeable taste for the past while setting loftier standards for the future. *James Rozzi*

20th Anniversary Set

The Phil Woods Quartet/Quintet

MOSAIC MD5-159

Five CDs; 4:32:46

Sound: A, Performance: A

Phil Woods is arguably the greatest jazz alto saxophonist alive. Possessing a warm, full-bodied sound capable of filling a large nightclub without amplification, and chops out the yin yang, Woods epitomizes the true essence of be-bop and post-bop jazz with his passionate, singing style. Often copied but never matched, Woods is referred to as the master by several generations of inspired students of the saxophone.

With that in mind, it is perplexing to think that Woods and his combo of 20 years so seldom have released new material, even though they have recorded quite often. Three hundred meticulously arranged tunes constitute the band's book, and performances both in and out of the studio have maintained the highest degree of artistry. The few changes in personnel on the piano and brass chairs have managed only to enhance the group's evolution. Whether it was bad business or bad luck, this five-CD set—Mosaic's only non-reissue package—is what it takes to set the record straight, with 31 tracks of previously unreleased, hard-driving jams.

Personnel consists of pianists Mike Mellilo, Hal Galper, and Jim McNeely; guitarist Harry Leahey; trumpeters Tom Harrell and Brian Lynch, and trombonist Hal Crook, with bassist Steve Gilmore and drummer/producer Bill Goodwin as the two constant sidemen. Repertoire covers the gamut from numerous examples of blazing bop to the most lyrical of ballads, from gutsy blues to playful funk. Some compositions are familiar standards, while others are obscure originals.

With tracks moving chronologically between live performances and studio recordings, this box set provides a fine cross section, spanning the years 1976 to 1992. Woods and his groups have consistently provided the high-water mark for their genre. To have such a fine compendium available—neatly packaged by Mosaic, with excellent liner notes—is every saxophone and jazz lover's dream come true. *James Rozzi*

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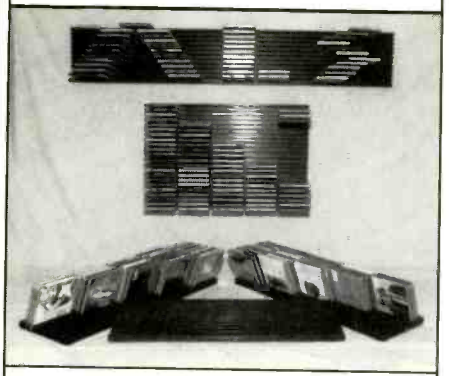

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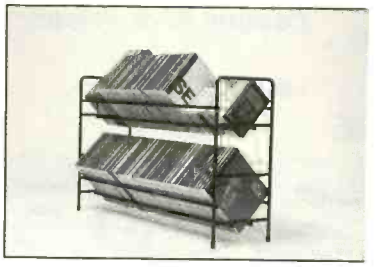

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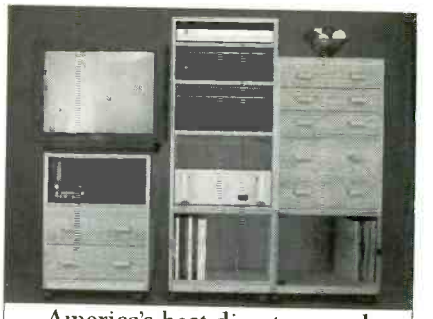

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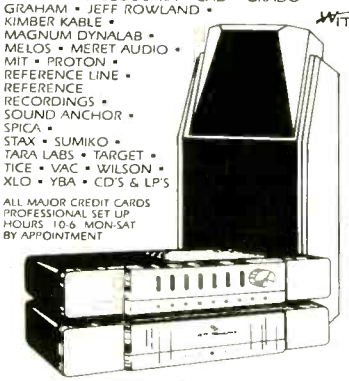

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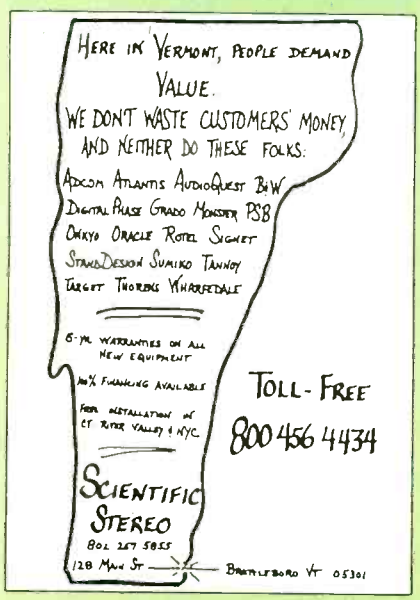

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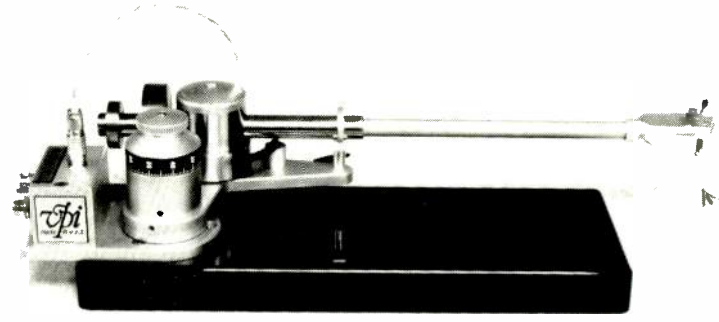

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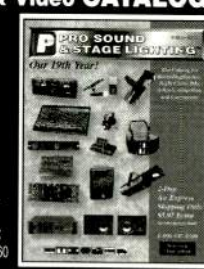

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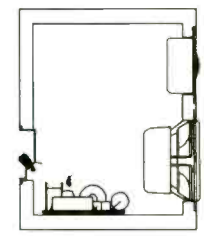

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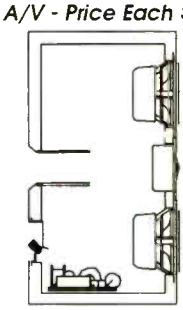

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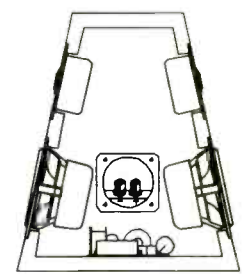

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Nominal Impedance: 8 ohms
Frequency range ±3dB: 80 Hz to 35 KHz - Sealed

The preceding designs were developed using **Madisound's** anechoic chamber, **Audio Precision** measurement and **Leap** analysis. All three systems use the **Vifa** M13SG09 woofer. This is a 13cm paper cone cast frame woofer. The tweeter is the D25ASG05, which is also shielded and has a 25mm aluminum dome. The cabinets are oak veneered 19mm fiber board, with solid rounded oak corners and a black assembled grill. You may choose between black stained or clear oak finishes. Everything you need to complete the system is included. The crossovers are assembled and the cabinets are precut for easy assembly. You can expect to assemble a pair of speakers in one evening. As with all **Madisound** kits, your satisfaction is guaranteed.

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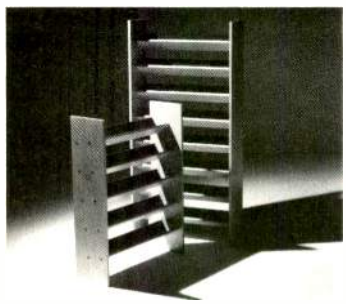

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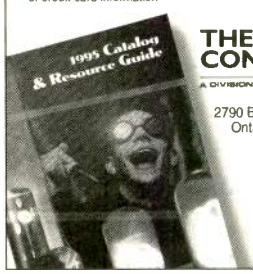

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OmniMount Systems
Models 53 RST-UMK and 53 RWX-UMK Universal Speaker-Mounting Kits

Some things are truly useful; count these gadgets among them. OmniMount's clever, adjustable ball-and-socket joint allows you to orient loudspeakers in almost any direction your room, mood, or wild imagination calls for. The RST version keeps speakers close to the wall (or ceiling, shelf, etc.), while the RWX's longer angled shaft adds a bit of potentially beneficial breathing room between the speaker and adjacent surfaces. Both versions cost $79.95 per pair.

While I had trouble getting the mounts out of the complex packaging, I have to admit that the packaging is designed to keep small parts in. The directions are thorough, but if you're a certified "10 thumbs" klutz, you may need help getting the socket plate anchored to a supporting surface. However, if you've successfully hung anything weighty, you should have little trouble. There's enough hardware supplied to hang your mother-in-law.

GRADE: A-

Note that the stated loudspeaker weight limit for the "53" series is 15 pounds. This can be stretched, but not too far. Although these brackets are particularly useful for surround speakers (I'd suggest the RST version for dipoles and the RWX for direct radiators), they may not be rugged enough for heavy full-range main speakers. (OmniMount has commercial-grade brackets for these.)

The "53" series mounting kits are clear winners. They're utilitarian in the best sense of the word, and they look good, too! **Len Schneider**

For literature, circle No. 120

Allsop
58200 CD Repair Kit

Have you ever experienced "skipping" on a CD, and simply cleaning it didn't do the job? Allsop's 58200 CD Repair Kit, priced at $11.99, may be what you need. To check it out, I purposely scratched a CD with a knife, but it didn't skip. I made some more scratches. No use; even the error-correction system in a $110 portable wasn't fazed! It seemed that narrow scratches weren't enough. Then I made a wide scuff with my knife blade, and this did cause the disc to skip. So I applied a drop of Allsop's water-based, biodegradable repair solution from the 1-ounce dispenser bottle, placed the CD on the DiscGrip Application Base (which keeps the disc from slipping), and polished it with one of the four supplied washable cotton cloths. After about 10 seconds of polishing, I tried the CD in two different players; *voilà*, no skipping. **E.M.L.**

GRADE: B+

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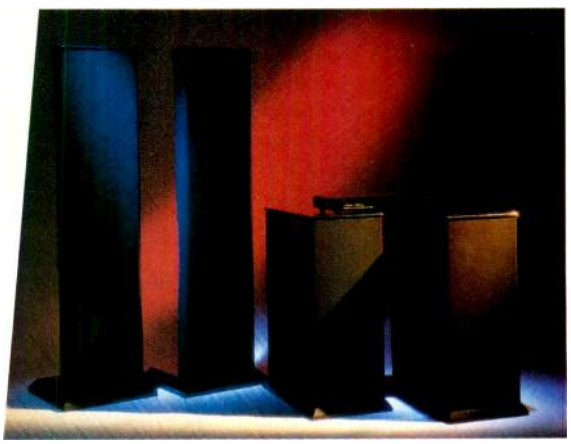
Audio Artistry
Dvorak Speaker System

Renowned speaker crossover pioneer Siegfried Linkwitz leads a design team at Audio Artistry, which offers the five-piece Dvorak system. The main speakers are quasi-dipole towers (54 inches high x 12 inches wide x 4½ inches deep) priced at $3,995 per pair. These units cover the range from 40 Hz to 25 kHz, if used solely, or from 100 Hz to 25 kHz if used in conjunction with matching subwoofers (27½ inches high x 11 inches wide x 20 inches deep), costing $1,995 per pair. The subs respond down to a rumbling 20 Hz. A dedicated active crossover/equalizer (supplied with the towers) is inserted between your preamp and amplifier (or amplifiers), as use of the subwoofers requires separate power sources. Black knit cloth covers the front, rear, and sides of the towers and subs.

GRADE: A-



The nominally 8-ohm Dvorak system throws a huge soundstage, full of depth and rife with the true character of the musical performance. And, given the relative complexity of this five-piece system, I consider the smoothly integrated tonal balance a major achievement. Excellent overall results are maintained with vacuum tube or solid-state gear, more good news for the audiophile with a collection of hardware. The subs are lively and tuneful, with stunning impact, and yet without the muddy, lagging quality that flaws many competitors. The only thing, in my opinion, that keeps the Dvorak from a place in the uppermost rank of cost-no-object speakers is that it is missing that last scintilla of midrange transparency. **John Hallenborg**

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PlayBack

RoomTune Justarack

There are a number of good hi-fi equipment racks and cabinets on the market, but you should look hard at RoomTune's Justarack, particularly the Series 2 Deluxe rack with the recessed-top option. It is one of the only products on the market with infinitely adjustable shelf spacing, and with shelves wide and deep enough—and thick and strong enough—to hold virtually all audio equipment, even high-end heavyweights or large turntables. Perhaps better, the finish is durable enough to take even a reviewer's constant mishandling. Equally important, the system is both rigid and strong enough to allow equipment to be clamped between shelves, which will not resonate or add to room vibration and acoustic breakthrough problems. The feet are cones shaped to transfer mechanical energy without ripping carpets apart.

GRADE: A-

You may or may not become a fan of using cones and clamping to try to improve the sound of your equipment, but you are almost certain to become a fan of the Justarack. It is a visually striking rack that you can tailor to your own system needs, and it provides excellent ergonomics. The Series 2 Deluxe rack ranges in price from $399 to $759, depending on its height and number of shelves. **A.H.C.**

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"PlayBack" mini-reviews are the result of short, sweet, and sometimes deadly testing by our all-too-experienced editors and writers. These hands-and-ears-only write-ups may look like new product announcements, but the grades and text reflect what the reviewer thought after less than an afternoon's "honeymoon."—*E.P.*

Elite PD-F109
100-Disc CD Changer

Yesterday, you loaded 100 discs into the PD-F109, entered the artist names into memory, and slid the CD booklets into the two binders, writing down all titles on the index label sheet. Today, you want to play R.E.M.—but you can't find the binders! Are you doomed to Remote-Control Hell? Nay, just press the "Search" button, move the cursor to the letter "R," and press the "Enter" button on the user-friendly remote, and the TV-screen graphic user interface is ready to show you, six at a time, every logged artist beginning with that letter. Then move the cursor by pressing the "Down Scroll" button to pass by Bonnie Raitt to get to R.E.M. Now press "Enter," and the changer quietly hunts for the disc and begins play, usually within 10 seconds. It's this kind of flexibility that makes the handsome PD-F109 a joy to use. Additional features include direct access to any track, three "Custom" modes (for grouping discs by artist, music type, etc.), and 32-step programmed playback. You can reload three of the 25-disc racks while the fourth has a disc in play. You cannot, however, remove and shelve racks. Other bummers: The active rack is indicated by a constantly blinking, annoying light, and the soft-plastic binders are rather downscale considering the PD-F109's price tag of $875. (Leather binders are available to PD-F109 owners for a limited time via mail-in coupons.) But these are quibbles in the face of the changer's excellent ergonomics—not to mention its pleasing sound, with a wide, well-balanced soundstage rivalling that of some high-end, single-disc CD players. **Ken Richardson**

GRADE: A-

For literature, circle No. 126

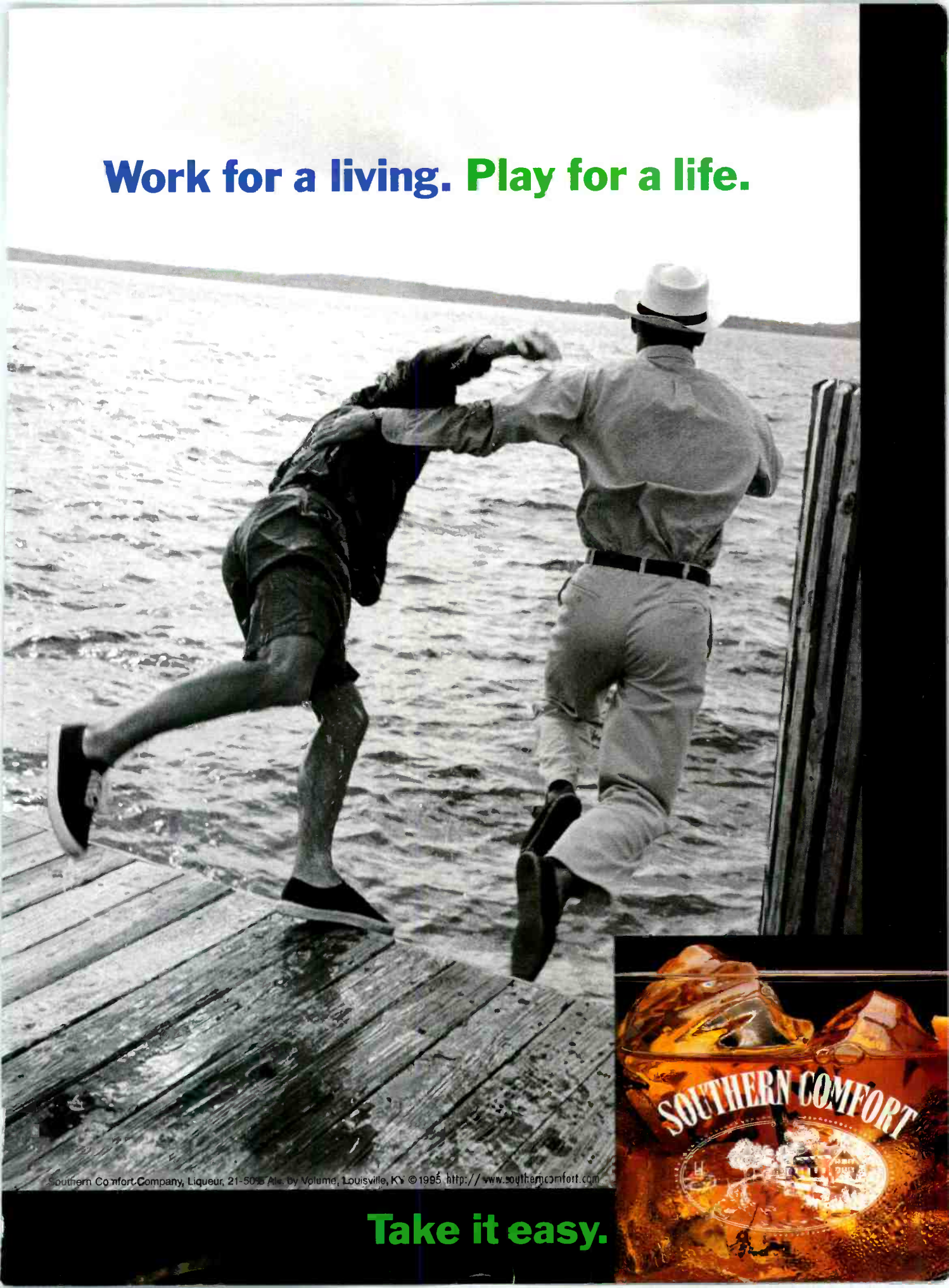
Audio-Technica AT822
ONE-POINT STEREO MICROPHONE

As a recording engineer, I spent years lugging heavy analog recording gear and bulky mikes, but using the Sony TCD-D7 DAT Walkman lightened my load. However, it needed a matching lightweight, compact stereo mike with the same high-quality sound. Audio-Technica designed the AT822 for the occasion. Its trapezoidal head contains two cardioid electret elements configured in coincidental X-Y pattern. A bass roll-off on the body adjusts for subject and acoustics. The mike weighs a mere 5.8 ounces. Numerous adaptors for a variety of inputs, including portables, are supplied. The mike's stand adaptor is even contoured for hand-held use. The mike and all its accessories fit snugly into the supplied pouch. The exceptionally natural stereo stage and pleasing ambience that I captured are harder to achieve with separate mikes. The AT822 also serves well as a stereo room/ambience mike when mixed with a single mike on a soloist. The sound tends toward the bright, crisp end of the spectrum, but remains agreeably honest in tonal balance. It's no Neumann, but what do you want for a list price of $399? **Rich Warren**

GRADE: A-

For literature, circle No. 127

Work for a living. Play for a life.



Take it easy.

Frame Of Reference:

This picture tells you a lot about AudioQuest cables, but without a frame of reference it doesn't tell you whether the boxes (or the viewer) are rising, falling or just floating. Many inferior cables are popular, even though comparison against a proper reference immediately reveals serious flaws. Because AudioQuest cables are referenced against *no* cable (the bypass test), we understand each cable's strengths and weaknesses. We know that AudioQuest cables will give you a performance closer to the original, whether on a mini-system or on a "big rig."

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