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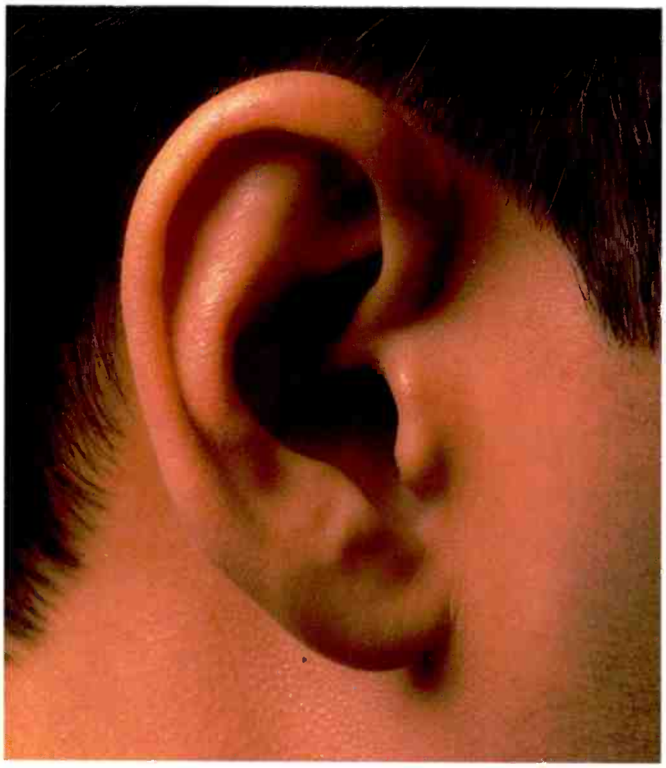

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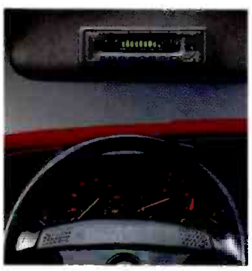

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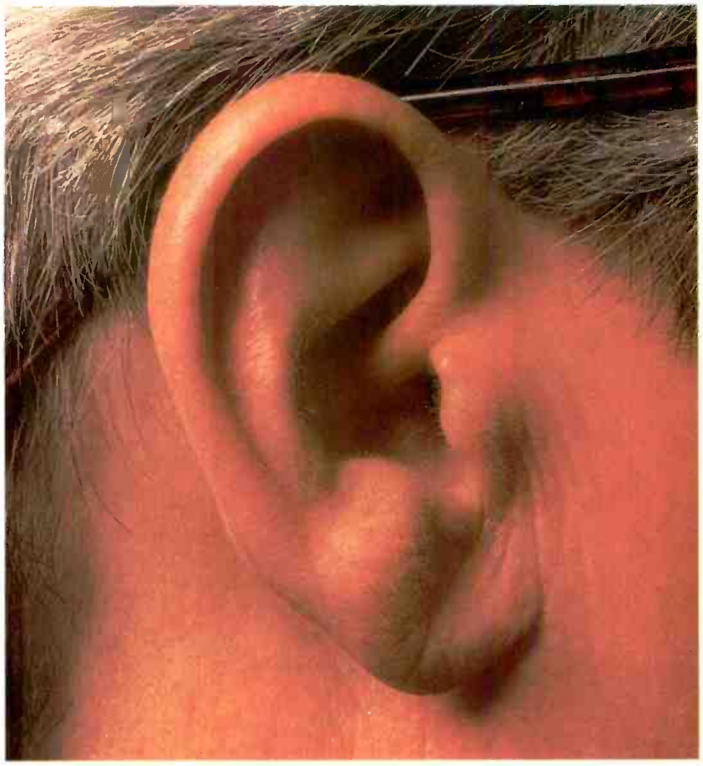

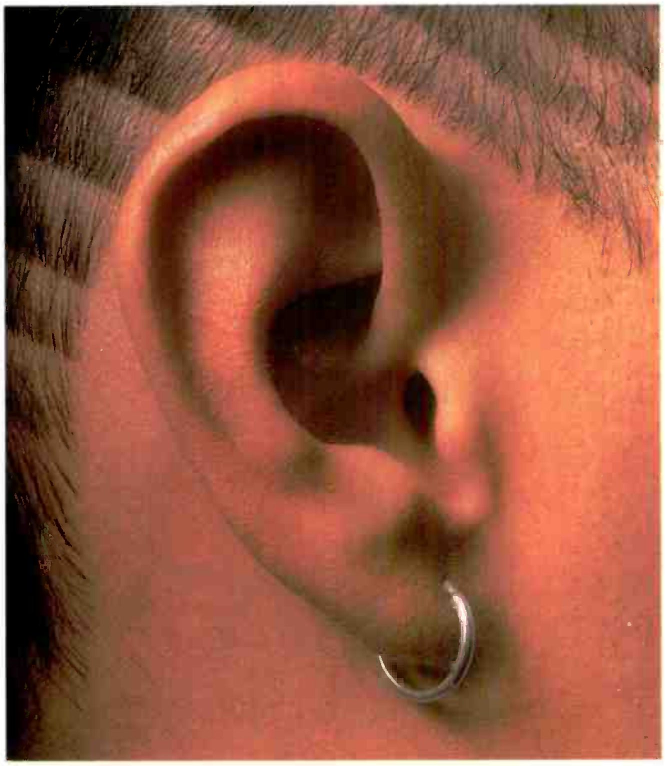

ar of the beholder.

can then use the Listening Position Selector to move the center stage image around your car. So that no matter where you're sitting, it'll always sound like the best seat in the house. Once you've chosen the position you want, you can use the Image Focus Control for ultraprecise imaging and staging, particularly in vocals.

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You can then further fine-tune your sound field, by adjusting the delay time and intensity within each of these particular venue modes.

Of course, while it's nice to sit here and read about the DEQ-7500, it's even better to sit behind the wheel and experience it for yourself. Which reminds us of one final step: visiting your nearest Premier dealer. He's part of a network of expert craftsmen who install and design sound systems with PREMIER the utmost care and attention to detail.

If you'd like more information regarding the DEQ-7500, as well as the name and address of the Premier dealer located closest to you, simply give us a call at 1-800-421-1601, extension 901.

And discover how nice it is to have an audio unit that adapts to your ears. Instead of the other way around.

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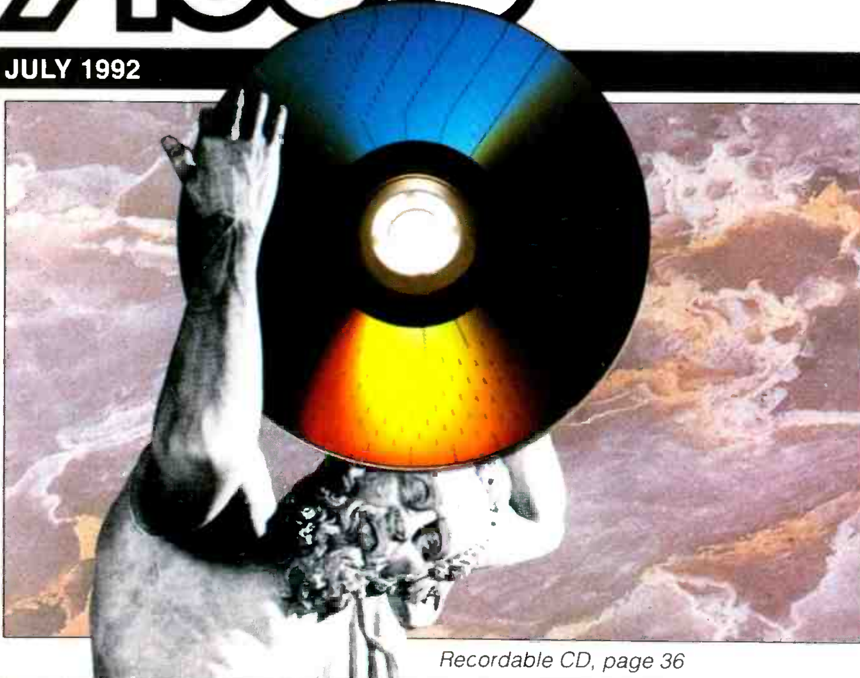

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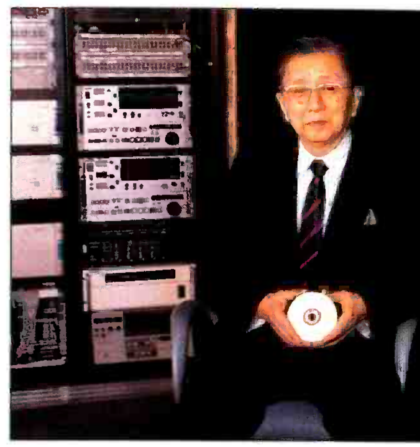

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*Letterbox

SIGNALS & NOISE

Great Scott

Dear Editor:

Thank you for the article in your January issue on the history of the radio electronics industry ("Tuning In to Yesterday"). An article like this can be used as a measuring stick to see just how far we have come over the years.

About three years ago, I acquired an antique radio built by the E. H. Scott Radio Corp. in Chicago and have been restoring it. This model has a unique feature in which the user may adjust the bandwidth on short-wave and the old familiar AM band. On AM, it can be adjusted to a width of 16 kHz, which will give a frequency response from 30 Hz to beyond 15 kHz. Connecting this set, from 1937, to a modern, quality loudspeaker reveals that the quality of AM can be very close to FM's.

This discovery leads me to a question. Why can't companies like Magnum Dynalab and Creek Audio Systems, for example, who are serious about high fidelity, build an AM/FM tuner that has FM quality on *both* bands? I believe a feature like the one on the old E. H. Scott Philharmonic would help snap AM out of the doldrums. If we had the technology in 1937, we must certainly have it now.

Scott Guthrie
Guelph, Ont.

Tuned In, Turned On

Dear Editor:

Just a brief note to say how much I enjoyed the pictures of the old radios ("Tuning In to Yesterday") in your January issue. I was two years old when my father manufactured the first commercial radio in Austria under Siemens license back in 1924, so these things do evoke memories for me. I can still remember tuning the separate circuits in TRF receivers with non-ganged condensers (some were actually tuned with coils) and carefully turning up the filament current to get enough gain—but not high enough to burn out the tube.

I am probably the only one in our business who still remembers all this, which sometimes makes me feel that I belong in a museum myself and should be dusted off from time to time.

Hans Fantel
Syndicated Columnist
Sheffield, Mass.

You Can Bet Your Life on DAT

Dear Editor:

Congratulations on the 34th Annual Equipment Directory (October 1991). As an audio marketing manager (who used to fill out your stinking stack of forms every June for almost 10 years), I can tell you that the "bible" has really established itself as an indispensable reference in my office. The directory issues take up almost half a shelf in my bookcase.

I was a little surprised to see the letter from Danny Blatt, the first in that issue's "Signals & Noise" column. As one of the earliest and staunchest proponents of DAT in our industry, I have grown so weary of the Danny Blatts of the world. While Blatt has astutely observed that CD is an optical process, his inference that CDs won't wear out is absurd. After all, a scratch of less than ⅛ inch presents an obstacle that no CD player can navigate. If this tiny scratch happens to occur somewhere over the table of contents, the entire disc is rendered unplayable.

So how long will a Digital Audio Tape last? As Blatt points out, the tape and transport are quite similar to those used in VCRs. I think it fair to suggest that their effective lives should also be similar. How many times can you watch that favorite dogfight in *Top Gun* before the videotape wears out? When was the last time you replaced a videotape because the picture quality was so degraded from wear that you couldn't take it anymore? I think that in my entire life, I may have worn out one passage of one tape. And, of course, let no one forget that the signal on the videotape is analog.

With its digital signal, sophisticated error correction, and integrated self-defense system (tape shell), I believe that a DAT could last 10 times longer than its analog video brother. And that's a lot longer than the luckiest CD ever pressed.

I ran one DAT cassette 1,100 times and had no problems. If I had to bet my life on the long-term performance of a digital audio carrier, I'd have no qualms with DAT. Unlike CDs, DATs don't care about fingerprints or scratches, and error correction seems to take care of everything else.

Bruce D. Adams
Stockholm, N.J.

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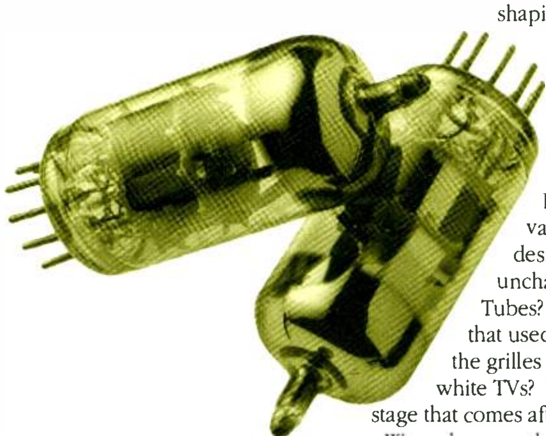
CAN TUBES WARM UP CD SOUND?

How a very old technology can make a brand new compact disc player sound extraordinarily good.



Our new SD/A-490t has a clock that "ticks" 33 million times a second, multi-stage noise shaping, pulse width modulators and enough other edge-of-the-art circuitry to finally qualify us for entry into the hallowed Compact Disc Techno-Jargon Hall of Fame.

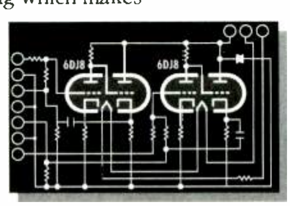
But it also includes two vacuum tubes whose classic design has remained unchanged for over 35 years.

Tubes? Those warm glass things that used to glow cheerily through the grilles of old radios and black & white TVs? Yes. In an important circuit stage that comes after all the digital wizardy.

We and many other critical listeners believe that this anacronistic addition to an already excellent CD player design significantly enhances its sound. Read on and decide for yourself.

THE AMPLIFIER THAT DOESN'T AMPLIFY.

Between a CD player's D/A converter and external outputs is circuitry called a buffer amplifier stage. When you hear the word amplifier, you think of something which makes a signal louder. But that's not a buffer amp's purpose. In fact, contrary to popular lore, a CD player's buffer amplifier doesn't boost the signal strength at all — the final output of a CD player's D/A converter already has sufficient voltage to directly drive a power amplifier!



Instead, the buffer amp is a *unity gain* device which *1) increases output current, and 2) in the process, acts as a sort of electronic shock absorber.

A signal emerging from a CD player's digital-to-analog conversion process has sufficient voltage but insufficient current for proper interaction with a preamplifier or power amp. By acting as a current amplifier, the buffer stage helps lower impedance to a level that's compatible with modern components — about 50 ohms in the case of the SD/A-490t.

At the same time, the buffer stage helps isolate the relatively fragile D/A chip set from the nasty outside world of demanding analog components.

TUBES VERSUS SOLID STATE.

All compact disc players have buffer amplifiers. But more than 98% of them use solid state devices for this stage: either integrated op-amp circuits or discrete transistors.

A handful of hard-to-find, esoteric designs in the $1200 to $2500 range employ one or more tubes instead. As does our readily-available $699 SD/A-490t. For fundamental physical reasons, tubes have different transfer function characteristics than transistors. When used in ultra-expensive, audiophile preamplifiers and power amplifiers, their sound is variously described as "mellower", "warmer", "more open and natural" or simply "less harsh than solid state".

At the heart of these perceived differences are three basic facts:

1. Tubes produce *even*-order distortion (i.e. 2nd, 4th, 6th harmonics, etc.) while transistors create *odd*-order distortion, particularly 3rd harmonics which are less psychoacoustically pleasant.

2. In a buffer stage, a tube acts as a pure Class A device, which is considered the optimal amplifier configuration. Op-amps function as Class A in and Class B out, with potential crossover distortion as voltage swings from positive to negative.

3. Tubes "round off" the waveform when they clip. When over-driven, solid state devices cut off sharply, causing audible distortion.

THE SD/A-490t'S OUTPUT SECTION

Our new CD player uses two 6DJ8 dual triodes (each literally two separate tubes in a single glass envelope) placed between the digital-to-analog converter and a motorized volume control.**

Operated at less than 30% of their maximum capacity, these tubes achieve a highly linear output voltage with very low static and transient distortion while providing very high dynamic headroom.

And because they're "loafing" at 1/3 their rated current capability, the SD/A-490t's tubes are designed to last the life of the CD player without replacement or need for adjustment.

A "LESS IS MORE" DIGITAL APPROACH FOR CLEANER ANALOG SOUND.

It would be pointlesss to have a tube output stage if the digital circuitry which precedes it

The Carver SD/A-490t.
At $699, its suggested retail is $500 less than the nearest competitor with tube output***

wasn't first rate. The SD/A-490t uses Single-Bit D/A circuitry to eliminate a form of exceedingly audible distortion inherent in most current CD player designs, and to provide better signal linearity than ever before.

If you've read current CD player brochures, you've probably stumbled across descriptions of de-glitcher circuits, laser trimming and even 22-bit converters. All these are merely fixes, applied to the same basic kind of D/A converter in an attempt to overcome built-in shortcomings.

In contrast, the SD/A-490t uses a completely new technology which avoids many of the problems that older approaches have struggled to surmount. We'd have to buy a whole section in this magazine to fully explain the differences (if you're interested, call 1-800-443-CAVR for an appropriately long and detailed brochure), but here's a short synopsis.

Traditional converters require 16 separate reference circuits, each of which must be accurate to one part in 65,536 — but, due to the realities of mass production, rarely are. If they're not "dead-on", an unpleasant form of noise called *zero-cross distortion* is produced. Because Carver's Single Bit D/A Converter transforms a 16-bit signal into a 1-bit pulse signal array, the "ladder" of 16 ultra-high-precision reference devices is not required: In effect, the SD/A-490t need only manipulate a stream of varying-width on/off pulses instead of having to accurately create 65,536 different amplitude levels at all times.

Zero-cross distortion is non-existent, and the SD/A-490t's Single Bit converter is able to decode linearity in excess of 115 dB below peak level with exceptionally low noise. You'll particularly notice the difference in the heightened purity and clarity of music during very quiet passages. Every nuance, intonation and harmonic of the original recording is there. Yet "digital" harshness is noticeably absent even before it enters the SD/A-490t's mink-lined tube stage.

AN ARRAY OF FEATURES AS RICH AS ITS SOUND.

We've designed the SD/A-490t to be both useful and easy-to-use. 21-key front panel or remote programming. Fixed and variable output. Programming grid display. Random "shuffle" play. Variable length fade. Automatic song selection to fit any length of tape. Even index programming for classical CD's.

Plus our proprietary Soft EQ circuitry which compensates for variables in spacial (L-R) information and midrange equalization found in many CD's mastered from analog tapes.

BRING YOUR TWO BEST CRITICS TO A CARVER DEALER.

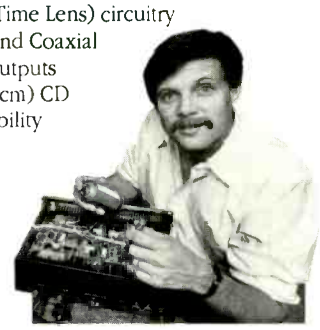
It's tempting to further regale you with how well we think the SD/A-490t's tubes and Single Bit circuitry improve the sound of a compact disc. But your own ears should be the final arbiter of quality.

Thus you are invited to bring a few familiar compact discs down to your local Carver dealer and compare for yourself, hopefully creating your own superlatives in the process.

Suffice it to say that almost all critical listeners not only are able to hear a difference, but prefer the sound of the remarkably affordable SD/A-490t's dual triode transfer function.

THE SD/A-490t

- Dual 6DJ8 Vacuum Tube Output Stage
- Over-sized Disc Stabilizer Transport
- 24-Track Programming with 21-key front panel & remote input
- Music Calendar Display
- Indexing
- Random Play
- Motorized Volume Control
- Time Edit/Fade Taping feature with user-variable time parameters
- 2 to 10 Second Variable Length Fade
- Exclusive Carver Soft EQ (Digital Time Lens) circuitry
- Optical and Coaxial
- Digital Outputs
- 3-Inch (8cm) CD Compatibility



Bob Carver

CARVER

CARVER CORP., LYNNWOOD, WA, U.S.A.
Call 1-800-443-CAVR for information and dealer listings.

***A device which neither amplifies nor attenuates a signal is said to have unity gain. In other words, what goes in comes out unchanged. Or does it?**
****Remote control variable output is a wonderfully convenient feature, but it would be pointless to eliminate solid state circuitry in the buffer amp stage and then use a solid state circuit for the final gain attenuator. So the SD/A-490t changes volume the old fashioned, physical way: a nice, clean carbon potentiometer, in this case, physically rotated by a small motor.**
*****Source: 1990 Audio Magazine Annual Equipment Directory.**

AUDIOCLINIC

JOSEPH GIOVANELLI

Balanced and Unbalanced Circuits

Q. *Please explain balanced and unbalanced inputs and outputs used with amplifiers and preamplifiers. Are there sonic advantages of one over the other?*—Lorenzo Brice, Brooklyn, N.Y.

A. The main advantage balanced circuits have over unbalanced circuits is that balanced circuits tend to reject hum pickup via interconnecting cables. Most of the time, hum is not a problem, even with unbalanced circuits; thus, any additional hum reduction offered by balanced connections is not usually important.

You're already familiar with unbalanced circuits, the kind typically found in home audio equipment. Unbalanced systems have two wires, one of which is "hot" while the other, the shield, is grounded. Balanced systems require three wires: Two signal leads, neither of which is at ground potential, plus a ground. The two signal-carrying conductors are twisted around each other and contained within the shield. Any hum voltage that penetrates the shield will be introduced equally into both signal-carrying leads. Because these leads are of opposite signal polarity and the signal is introduced at the same polarity, the hum is cancelled, or nulled out.

I suppose a case could be made that a preamplifier that used balanced, push-pull circuitry throughout would produce less harmonic distortion than an unbalanced preamplifier would. However, I'm personally not convinced that we could hear the difference.

Video Cables for Audio

Q. *I have a question about interconnecting cables used between different audio devices. I notice that some cables used for video gear have phono plugs on each end—just like those used in home audio gear. The cable is RG59. Are these cables as good as those we usually use? A video cable must carry a wider frequency band than is needed for audio, so it seems to me that video cables should be fine. I tried some video cables, and I can't hear any difference when using them.*—Richard Costa, Houston, Tex.

A. If the video cable has less capacitance per foot than your present audio cable, it will work fine, even giving you less high-frequency loss on long cable runs. There are many varieties of RG59 cable, with capacitances ranging from about 16.5 to over 21 pF per foot, depending on the brand, size, and type of insulation.

In a video setup, the impedance seen by each end of the cable will be 75 ohms. In an audio setup, the impedance at one end of the cable will be rather low, while the impedance at the other end will be high. At the frequency where the capacitive reactance of your cable becomes equal to the output impedance of the audio component feeding it, output will be reduced by 3 dB, and higher frequencies will be attenuated even further. However, as long as your video cable has less capacitance than the audio cable you've been using, the results should be at least as good as you are getting now.

One caution, however: RG59 cables frequently have solid center conductors. If these cables are flexed or moved a lot, that conductor could break. In setups where the cable will not be moved, it will work well.

Intermittent Noise From a Sound System

Q. *My amplifier sends sudden, loud, bursts of noise to my loudspeakers. They seem to be triggered by vibration or by the touch of my hand. I have taken steps that have reduced but not eliminated the problem.*

The noise is produced only after the system has been on for a few minutes. If I strike the floor with my fist just hard enough to make it vibrate a little, the noise is heard. Even a heavy footfall in the room causes the sound.

I don't think the problem resides in either of my program sources—CD player or cassette recorder. Even with these devices turned off and with the volume fully counterclockwise, the noise can still be triggered.

I have experimented with grounding and with tightening up all connections, to no avail. The only change I made that has helped reduce the noise is to plug the equipment directly into the wall outlet rather than into the voltage step-up transformer. (I live in Japan, where house voltage is 100 V a.c., 50 Hz.) The system now must be on for a longer period of time before the noise is produced and the loudness of it is decreased.

Do you suspect, as I do, that the a.c. power is at the root of the problem? Will operating my gear on 100 V rather than its recommended 120 V cause damage? What do I do now?—Stuart T. Foster, FPO Seattle, Wash.

A. No! The transformer or your a.c. wall supply is not the root of the problem, but it does, as we will see, point us to the culprit.

It is not clear as to whether you have an integrated amplifier or have a separate power amplifier and preamplifier. This may matter. You have already done some good trouble-shooting. Let's see how to use what you have written to make a final determination of the location of the problem: We already know that when the volume control is set to its lowest point, the noise can still be triggered even though no signal is reaching the circuits after the volume control. Thus, you are correct in assuming that your program sources are not responsible.

If you have a separate power amplifier, it could be the culprit. To prove it, disconnect the input cables but leave the loudspeaker cables connected. Turn the amp on and wait an appropriate amount of time and see if the noise can be triggered. If it can't, we know that the problem is in the preamplifier. If it can, you know the power amplifier needs some work.

I said that the power-line voltage and frequency were not the root causes. Why, then, did removing the transformer help? The equipment now operates on a lower voltage. This, in turn, means that less heat builds up inside the faulty unit. Somewhere in the unit there is probably a poorly soldered connection which, when heated, becomes less secure and makes the electrical connections intermittent when they are vibrated. There could be a slight crack in a circuit foil, which opens slightly with applied heat, making the electrical path intermittent at this junction. The problem could be really simple. I recently solved a problem like yours when I tightened a screw that held the p.c. board to chassis ground.

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

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George Benson—Big Boss Band (Warner Bros.) 412•478

George Michael—Listen Without Prejudice, Vol. 1 (Columbia) 411•181

L.L. Cool J—Mama Said Knock You Out (Def Jam/Columbia) 411•165

AC/DC—The Razors' Edge (ATCO) 410•662

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Jane's Addiction—Ritual De Lo Habitual (Warner Bros.) 407•098

"Beauty & The Beast"—Orig. Soundtrack (Walt Disney Records) 432•690

Enya—Shepherd Moons (Warner Bros.) 431•718

Larry Carlton—Collection (GRP) 407•825

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Foreigner—Records (Atlantic) 318•055

Squeeze—Singles (A&M) 317•974

Stevie Ray Vaughan & Double Trouble—Sky Is Crying (Epic) 429•258

The Cult—Ceremony (Sire/Reprise) 428•300

Social Distortion—Somewhere Between Heaven And Hell (Epic) 433•631

Mr. Big—Lean Into It (Atlantic) 418•798

MORE SELECTIONS AND COMPLETE DETAILS ON THE OTHER SIDE.

HERMAN BURSTEIN

The Cons of HX Pro

In recent years a number of "Tape Guide" readers have inquired whether they are missing something important if their decks lack HX Pro. This has brought up the question why Nakamichi still eschews it; the company is perhaps just about the only manufacturer of high-quality decks not to use it. My answer has been that there is more than one design path to desired results, and that HX Pro might introduce not only the benefit of extended treble at high signal levels but also the disadvantage of inaccurate variations in bias; such variations could increase distortion and roll off flatness of response at the high end of the audio spectrum.

When I asked, Nakamichi stated that they've chosen to overcome the cassette format's headroom limitations by designing and making their own heads, electronics, and transport mechanisms rather than by adding circuits such as HX Pro. According to Technical Support Coordinator Hyam R. Sosnow, the headroom of Nakamichi's discrete three-head decks has exceeded that of "virtually every other make and model of cassette deck, even those incorporating HX Pro. . . ." He continues: "Unless a deck incorporating HX Pro has been very carefully adjusted for the particular tape formulation being used, the resulting inaccurate variations in bias can actually reduce high-frequency headroom over what the same deck could achieve if HX Pro were not used. Many decks incorporating HX Pro lack the user-calibration facilities for record sensitivity that are essential to its proper operation. . . . Nakamichi would not consider building [a two-head deck with HX Pro] without including the user-calibration facilities necessary to maximize its performance. The resulting two-head deck would be [nearly as expensive as] our least expensive discrete three-head deck yet would not equal the performance of the three-head model."

VCR for Audio

Q. Is it a good idea to use a VCR instead of a high-quality analog cassette deck? In my case, cassette size is unimportant, but uninterrupted recording is important inasmuch as classical music often spans more than 50 minutes [*one side of a C-100 cassette; a C-120, which offers 60 minutes per side, is not recommended for high-quality results.*—H.B.]. *Please advise on the pros and cons of using a VCR for high-quality audio recording, and such considerations as to what Dolby NR system is employed and whether or not metal tape is required.*—M. Grant, Gardena, Cal.

A. My own experience and reports from a number of readers indicate that very good audio recordings can be made with a Hi-Fi VCR. Repeat: With a *Hi-Fi* VCR. In terms of signal-to-noise ratio, frequency response, distortion, and motion (low wow and flutter and accurate speed), a good Hi-Fi VCR can outperform the best of analog cassette decks. Using T-120 videotape at the slowest VCR speed, you can get six hours of recording without interruption. I and others have found little, if any, audible difference between audio recording at the fastest and slowest VCR speeds.

The only important disadvantage I can think of in using a VCR for recording music is that you cannot monitor the tape while it is being recorded, something that can be done when recording with a three-head cassette deck. That is, you cannot simultaneously record and play in order to make certain that the recording is proceeding to your satisfaction.

For Hi-Fi recording, the VCR does not use Dolby noise reduction. However, linear recording, which is performed along the edge of the tape by both conventional and Hi-Fi VCRs in a manner comparable to that of an analog cassette deck, does sometimes employ Dolby noise reduction. Whether in a Hi-Fi VCR or in a conventional one, the quality of linear recording is substantially lower than that of Hi-Fi recording, which makes use of frequency modulation.

So far as I know, videotapes all employ a ferric-oxide coating, which is more or less similar to the coating on Type I analog cassette tapes; that is, metal tape is not used. While you should use good-quality videotape of a reputable manufacturer, you need not go to unusual lengths in this respect. For example, you do not need to purchase one of the special tapes labelled "stereo."

Poor Recording

Q. I have a seven-year-old cassette deck that plays prerecorded music just fine but records poorly. When playing a tape that was just recorded, it exhibits a 5-dB drop relative to the initial recording level, and the left channel is 1 or 2 dB lower than the right one. I have cleaned and demagnetized the heads. And I took the deck to a repair shop but was told nothing is wrong. I'd appreciate some suggestions on what the problem might be.—Jason Cooper, Miami, Fla.

A. Taking your problems in what seems to be the reverse order of importance, the slight difference between left and right channels is rather inconsequential. You can easily adjust in recording or playback for this.

The 5-dB difference between record and playback levels may be due in part to the sensitivity of the tape you are using—that is, the amount of output for a given input. But it is also possible that it may be due to a fault in the recording circuit.

When you say that the deck records poorly, I assume you mean the *quality* of sound and not just the level. Possibly, bias is insufficient. If the sound is too high-pitched and distorted (grainy, coarse), this would indicate too little bias. Also, insufficient bias would reduce the recorded level.

If bias isn't the culprit, there are other things that could have gone wrong with the recording circuit of a seven-year-old deck. Resistors may have changed value, capacitors may have become leaky and/or changed in value, or transistors may not be performing up to specifications. In this event, you need a service shop that is competent and honorable. If the manufacturer of your deck is still in business, it should be able to supply the names of authorized service shops in your area.

On the other hand, a thorough check and repair can cost a tidy sum, perhaps $100. It is probably wiser to put the money into a new deck. Some very nice performers are now available at relatively moderate prices.

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

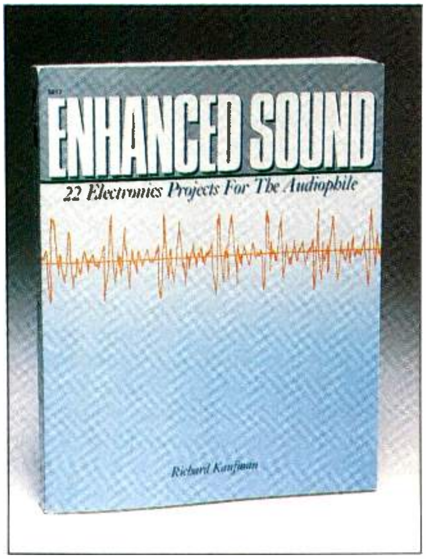
SOLDERING ON

Enhanced Sound: 22 Electronics Construction Projects for the Audiophile by Richard J. Kaufman. TAB Books Division of McGraw-Hill, softcover, 170 pp., $12.60.

Richard J. Kaufman's articles have appeared for years in *Audio* and are popular among those of us who actually take a soldering iron in hand occasionally. Small-scale projects suitable for an evening or weekend have been the subjects of his articles, and now he can add this book to his goal of, in one way or another, improving the sound of our systems. Examples of the *Audio* articles are "Build a Polarity Inverter" and "Build an Op-Amp Power Supply" from December 1987, two quick-build car projects ("Op-Amp Power Supply" and "Subwoofer Crossover") from the May 1989 issue, and more recently, "Build a Simple Surround Decoder" from June 1991. Kaufman's circuits tend to be simple, workable examples of how to achieve a given audio function in a relatively straightforward manner. They also have the strong appeal of using readily available, moderately priced, non-exotic parts. This makes the circuits easy to duplicate, with reasonable confidence that they will function as planned.

I should preface my remarks with the fact that I am reviewing a book dedicated to basic concepts I personally endorse. Quite simply, it is my own feeling that the audio world *needs* more and various such circuits, as examples of how-to, as idea stimulators, or just as continuing reminders that we as creators and builders (albeit on a small scale) can indeed alter and improve our own sonic fortunes. Not only do we need these reminders, we need them on a continuing basis and, at best, with an associated dialog of feedback experiences, application pros and cons, and the generally healthy exchange of ideas.

There could be a tendency to aim a book like this either too low or too high, in terms of the experience level required. *Enhanced Sound* strikes a reasonable balance here, with three introductory chapters on construction and semiconductor basics and then eight more chapters dealing with actual project examples, in some cases several in each. These chapters include such



headings as Projects Without Power Supplies, Power Supplies, Preamps and Amplifiers, Basic Op-Amp Projects, Active Filters, Active Crossover Networks, Speaker Design Programs, and FM Antennas. The 22 project examples within them include passive and active preamps, tone controls, and even a power amplifier design.

At times, the art accompanying the circuits discussed is found lacking. For example, the RIAA response curve (Fig. 6-5) is so crudely drawn as to be almost meaningless (no label for the vertical axis, and the curve itself is not accurate). In other instances, there are missed connections or component values, or ambiguities in schematics (Figs. 5-5 and 6-3).

For parts callouts, Kaufman suggests relatively commonplace parts, which is generally fine for the overall context of the book. For example, TL072 op-amps are standard items, acceptable for general purposes, but some lower noise alternates should also be mentioned. Dedicated p.c. layouts or boards are not available for the projects, but a functional alternate in the form of stuffing guides for Radio Shack boards can be purchased for every project and are available from Rivera, which also stocks all the individual resistors and capacitors.

The power amplifier presented is not discussed so much as a circuit "ready to build" but more as a typical design example, available from a kit vendor in the Orient (source specified in the appendix). This design, quoted as capable of 100 watts per channel into 8 ohms with proper supply, is strongly reminiscent of a Hafler DH-200 series but with a bipolar output stage. A table of parts is listed for it, however, presumably for those wishing to build the circuit from scratch. I would suggest anyone so inclined should check out the circuit thoroughly, though, as there appears to be a schematic connection dot missing at R14/C7 that should seemingly go to the collectors of Q3-Q5. (I note this apparent error in the hopes that few will actually suffer from it in building the circuit up.)

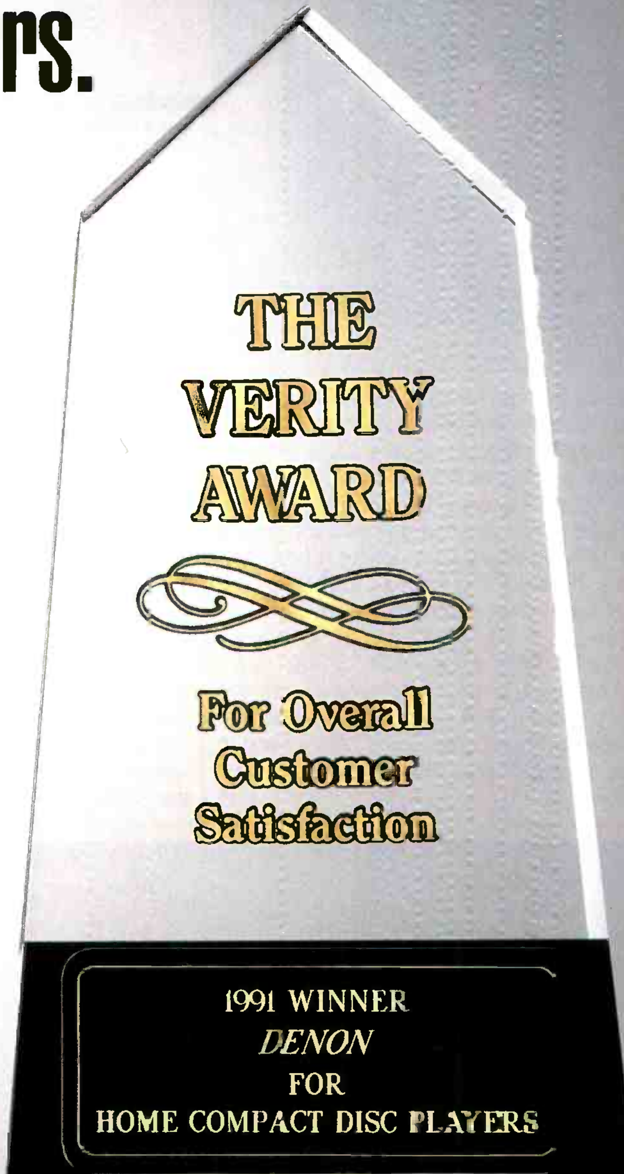
In other chapters, Kaufman gets into examples of active filters, even including BASIC source code for multiple feedback filter circuits. Active crossovers are illustrated by several different types, including constant voltage and fourth-order Linkwitz-Riley styles. Vented-box enclosure arrangements are also shown, with BASIC listings for computer programs to calculate a design using Thiele-Small parameters.

The book concludes with a chapter on FM antennas, which includes construction details for basic dipole types, a double-loop circularly polarized unit, and even a relatively exotic helical type. The appendix and index wrap it all up, the former by two pages of parts sources, while the index is three pages long.

As I stated initially, I like the basic idea of what *Enhanced Sound* is about, and I think Kaufman's choices for circuits and projects are good overall. While I have some reservations about the publisher's quality control in letting some of the items mentioned slip through, one must decide individually how much these things get in the way. The thing to bear in mind here is the overall utility and function of this book, as it presents a broad range of useful material. If you have enjoyed Kaufman's *Audio* articles, you may wish to look it over. *Walter G. Jung*

The Down Home Guide to the Blues by Frank Scott and the staff of Down Home Music (6921 Stockton, El Cerrito, Cal. 94530). Softcover, 252 pp., $14.98.

For many years, Down Home has supplied the blues record buyer with



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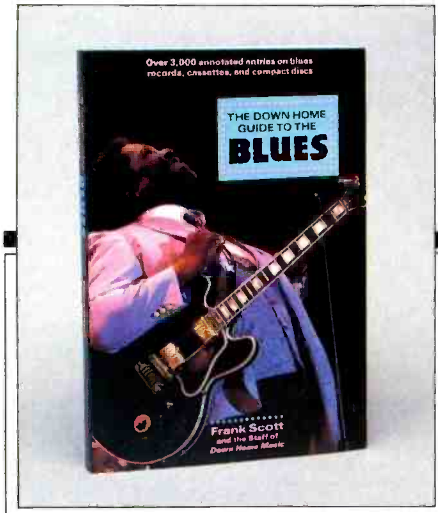
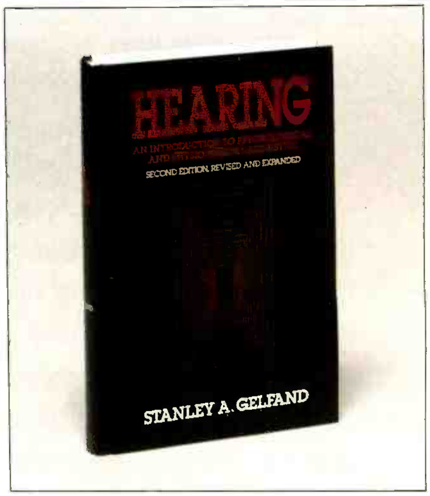


discs that are largely impossible to find elsewhere. While this is their catalog, the text is by no means an unconsidered touting of the records they sell—quite the reverse, and in fact, they include a clip-out coupon entitling you to a 15% discount on an order. For example, here's a line from a Leadbelly disc review: "Overall sound on this collection is a bit muffled but generally good." With more than 3,000 discs covered (I'll take their word for the count) and 100 record "Essential Selections" highlighted, it's pretty hard to go wrong buying this if you're a blues lover. *E.P.*

Hearing: An Introduction to Psychological and Physiological Acoustics, Second Edition by Stanley A. Gelfand, Marcel Dekker, Inc., hardcover, 535 pp., $55.

Despite the statement in Harry Levitt's Foreword that this book is "up to date with respect to new developments in all aspects of the field of hearing science," it falls considerably short of this claim. Stanley A. Gelfand presents a reasonably good view of the state of thinking as it existed 20 to 30 years ago but provides very little information concerning the technological advances, theoretical developments, and experimental approaches that have appeared in the field of hearing science since then.

The book begins with a chapter on the physics of sound. There follow discussions of the anatomy of the ear and the auditory pathways, of the ways in which sound is conducted to the inner ear, and of the functioning of the inner



ear. Further chapters are concerned with the functioning of the auditory nerve and of the higher auditory pathways. These chapters focus on the response of the auditory system to simple signals and do not consider the recent findings showing that the hearing mechanism can respond in highly sophisticated ways to complex sounds and patterns of sound.

There are several chapters on psychoacoustics which deal almost exclusively with simple detection and discrimination tasks. Virtually no mention is made of the perception of auditory and musical patterns, of the processes involved in the identification of musical instrument timbre and other sound qualities, or of the ways in which temporal patterns of sound are perceived. A final chapter addresses speech perceptions, and this again draws almost exclusively on earlier findings.

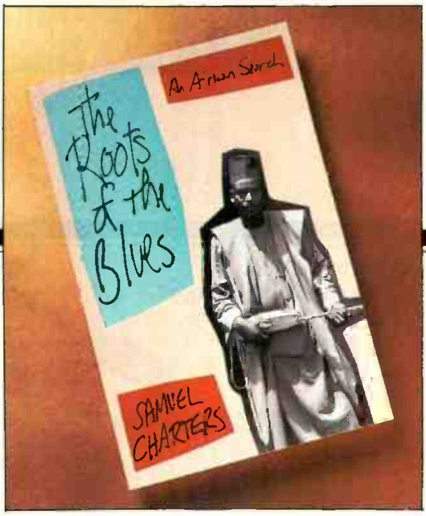
In summary, this book presents a rather depressed account of research and theory concerning the hearing mechanism and does not attempt to consider the exciting new approaches being taken, discoveries being made, and technological capabilities that are available to researchers in the field. Perhaps the third edition will prove more inspiring. *Diana Deutsch*

The Roots of the Blues: An African Search by Samuel Charters. Da Capo Press, softcover, 152 pp., $10.95.

I first came into contact with musicologist/writer Sam Charters' work about a quarter century ago when I discovered a three-LP set, *Chicago/The Blues/Today!* One day, I hope to publish an interview of him.

This little book was originally published in 1981 by Marion Boyars, Inc., and has nine photos and a simple map of West Africa. Properly, it ought to be accompanied by the recordings Charters did during his trips, but they do not seem to be available presently (though similar music is available on Playa Sound's *Senegal: The Griots' Kora* [PLS 65079], distributed by Allegro Imports). I suspect, however, that other later recordings, using more modern equipment, particularly DATs, will be more satisfactory.

Unhappily, Charters didn't find the source of the blues, but let him tell it:



> I had come to Africa to find a kind of song, to find a kind of music and the people who performed it. . . . I'd come looking for a kind of song, and even if I hadn't really found it, I'd found the people who sang it. The journey I'd begun had taken me to places I hadn't expected, and the ideas and attitudes I had at the end of it were different from where I'd started.

It would have been nice if Charters had found the roots, but at the end of the book my ideas and attitudes were different . . . and that made it a nice journey. *E.P.*

Esoteric Sound Six-Speed Turntable

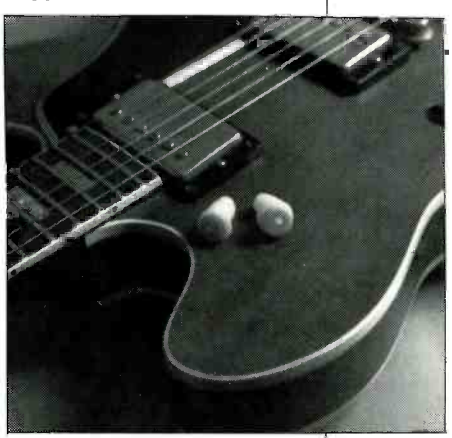
Collectors of old records know that "78-rpm" records were not always recorded at that actual speed. Esoteric Sound's V-2 turntable therefore provides not only the contemporary speeds of 33 and 45 rpm but speeds of 71.29, 76.59, 78.26, and 80 rpm as well; a pitch control allows for fine-tuning the speed. The direct-drive unit operates from 120 or 240 V a.c., and its tonearm accepts standard headshells. A polarity inversion switch is available for use in playing vertically cut (hill-and-dale) records. Prices: V-2, $375; vertical/lateral switch, $22.50; gooseneck lamp, $26.

For literature, circle No. 101

Westone Hearing Protectors

Designed for musicians and others who frequently attend loud concerts, the ER-15 Musician's Earplug filter attenuates sound levels without blocking any frequencies, according to Westone Laboratories. The plugs, which were developed by Etymōtic Research, are also designed to avoid occlusion, the effect which makes earplug wearers feel as if they're talking in a barrel or have a cold. Plugs are custom-molded to the wearer's ear by local professionals in the field of hearing health care. Price: Under $140, fitting included.

For literature, circle No. 100



Cramolin Contact Conditioner

ProGold 100 is a conditioner and protector for gold and base-metal contacts. According to the manufacturer, Caig Laboratories, it coats contact surfaces, enhancing their conductivity and protecting them from wear and atmospheric contamination. It is available as a spray or liquid and in dispenser pens or presoaked wipes. Prices: Spray, $15.95; 4-oz. bottle of liquid, $38 in 5% concentration; wipes, $18.95 per pack of 50; pen applicator, $19.95.

For literature, circle No. 102

Legacy Speaker System

The driver array of the Legacy Focus speaker system, available through Reel to Real Designs, is designed to control directivity in order to improve imaging and minimize colorations caused by floor and ceiling reflections. The driver array consists of three 12-inch woofers (two in front, one in back) in a vented enclosure tuned to 20 Hz, two 7-inch honeycomb-cone midrange drivers, a 1¼-inch dome tweeter with a 48-ounce magnet, and a 3-inch ribbon supertweeter that operates above 12 kHz. Frequency response is rated at 16 Hz to 28 kHz. The 4-ohm speaker's sensitivity is 96.5 dB, and its power handling is more than 500 watts per channel. Finishes available include walnut, oak, rosewood, black lacquer, teak, and ribbon mahogany. Price: $4,450 per pair.

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BERT WHYTE

READ ALL ABOUT IT

During these times of economic recession, the audio industry, like so many others, has seen sales revenues drop significantly, research and development projects curtailed, and venture capital practically dry up. All of this has led to dreadful "restructuring" by many companies, with an attendant fallout of reduced staffs, production cutbacks, drastically restricted outlays for advertising and promotion, and myriad other unpleasantries.

Well, friends, the audio industry—be it the professional world of recording, broadcasting, or communications or the consumer world of the audiophile and music lover—has weathered other recessions. Audio is a technology-driven business, and every advance in the reproduction of sound has resulted in the introduction of desirable new products that create entirely new markets. Surely the best examples of this are digital audio and the Compact Disc.

Thus, in spite of financial constraints and the need for companies to run a tight ship, audio engineers and scientists in audio-related disciplines continue to toil in the research laboratories. They are bringing new understanding to audio and acoustic phenomena, developing new technologies and significant new products of ever-increasing sophistication.

Since the first Audio Engineering Society Convention in 1949, the AES has showcased the developments and products of its members and has provided a forum for the presentation of scientific papers covering their investigations. The AES alternates conventions each year between New York City and Los Angeles or San Francisco. Every spring, a European convention is usually held in London, Hamburg, Paris, or Montreux. For the first time, this year's (92nd) AES Convention was held in Vienna in March, and it enjoyed great success, producing a record number of papers covering a broad range of audio technology.

The AES papers, or preprints, as they are known, provide a fascinating glimpse into the cutting edge of audio research and developments. Some of these preprints cover very arcane subjects indeed, but there are quite a few that I feel would be of interest to the audiophiles and music lovers who read *Audio*. There is information in these preprints that is simply unavailable elsewhere.

On a very practical note, AES Preprint No. 3237, "Study of Corrosion Stability on DAT Metal Tape," written by F. Hayama et al. of Hitachi Maxell, Ltd., addresses a story that has been making the rounds since the introduction of R-DAT. This story purports that DAT metal tape is quite unstable and that in as little as three or four months, and most certainly within a year, some loss of signal can be expected due to corrosion of the tape coating. If tape is stored at high levels of temperature and humidity (60° C and 90% relative humidity) for one week, it is equivalent to four years of normal room storage at 25° C and 60% relative humidity! High humidity apparently can cause more destabilization than high temperature. The conclusion of the Maxell engineers was:

> As long as DAT cassettes were stored under a nominal environmental condition of 25° C and 60% RH for four years, the DAT tape was very stable and did not show any change in electrical performance. Even though under the conditions of high temperature and high humidity of 60° C/80% RH for one month, the degradation of RF output level and C/N were less than 0.5 dB and had few changes in audio performance.
>
> However, in general, the lifetime of magnetic tape also depends on the decompositions of chemical components, such as polymer binder and base film on the sticky phenomena on the magnetic tape caused by water between the tape layers.
>
> Therefore, it is better for users to store the magnetic tapes in the temperature range of 15° to 25° C (59° to 77° F) and humidity range of 40% to 60% RH.

If you use planar-type loudspeakers from such manufacturers as Quad, Magnepan, Martin-Logan, or Apogee, you know that the placement of these dipole speakers in a room is of critical importance for optimum sound quality and is a matter of considerable controversy. AES Preprint No. 3327, "Dipole Source Placement in a Room," by Jorma Salmi of Gradient, Ltd., provides invaluable information on the subject from both practical and experimental viewpoints. (Incidentally, Gradient, Ltd. is a Finnish company that manufactures an approved subwoofer for the Quad ESL-63US speaker.) Salmi concludes by saying that his

> . . . recommendation to follow the 1/3 rule . . . is based mainly on minimizing the back wall effects at the midrange, assuming that this wall is highly reflec-

Illustration: © Courtney Granner

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For virtual reality to be successful, we must have sound quality that rivals the visual stimuli.

tive. The speaker can be placed closer to the wall if the wall is absorbent at middle frequencies. In practice, the minimum distance to the back wall is relative to the speaker's physical size. However, we must keep in mind what will happen to the bass output.

If a dipole is weak in bass, positioning it close to the side wall will give some help but at the expense of the midrange quality.

A dipole source having a very light diaphragm (e.g., most electrostatic designs) is generally more sensitive to the back wall effects and less sensitive to side wall effects than those having heavier membranes.

The position of the listener in the room relative to the speakers and boundaries is as important as the position of the speakers.

The influence of absorption is not discussed in this paper. The measurements were done in an empty room with highly reflective boundaries, so the results are presenting the worst case situation.

For recording engineers and dedicated audiophile recording enthusiasts alike, AES Preprint No. 3255, "Microphone Arrays Optimized for Music Recording," by R. W. Woszczyk of McGill University, is a veritable goldmine of information on various mike arrays for stereo music recording. It has large, clear layout charts of patterns, polar plots, frequency response plots, and more on such setups as four coincident KM84s in line, four coincident KM84s in block, the famous Decca tree stereo array, various spaced arrays, X-Y, and ORTF. Three other papers on mikes and stereo recording are also worthwhile: Preprint No. 3252, "Frequency Dependent Hybrid Microphone Arrays for Stereophonic Sound Recording" by Michael Williams of Paris; Preprint No. 3254, "A Matrixed Pressure Triplet for Full Surround Stereophonic Pickup" by Andre L.G. Defossez of Brussels, and Preprint No. 3313, "Standard Stereo Recording Techniques in Non-Standard Situations" by Albert G. Swanson of Location Recording in Seattle.

By now most readers are aware of the concept of virtual reality, an exciting prospect for the not-too-distant future. Through manipulation of high-power, ultra-sophisticated computer graphics, a person wearing special electrooptical equipment would enter a three-dimensional space that he perceives as being a real environment. The environment could be whatever suits one's fancy, providing the computer graphics processor is programmed to simulate it. No doubt, a Walter Mitty-type could become an ace Grand Prix driver, zipping his racer through the streets of Monte Carlo! This is the ultimate step beyond video games! However, a problem must be solved before virtual reality can more closely simulate the sensory inputs of a real event or environment. As one would expect, to accompany the visual stimuli we must have sound of "virtual reality" quality. Binaural sound might seem the obvious solution, but it has always been plagued by the "sound inside the head" phenomenon and, worse yet, the inability to perceive frontal localization. There have been attempts to rectify this by using special dummy heads coupled with equalization processing. I have heard quite a few of these special recordings, but none of them really provided me with a convincing sense of frontal localization.

Much work is in progress to solve the problem of frontal localization and sound externalization, most of which involves digital signal processing, and five fascinating AES preprints cover various approaches to binaural recording problems. An offshoot of this research—and a very important thing for the many people who listen to stereophonic music through headphones—is digital processing that can simulate loudspeaker listening while listening through headphones. The preprints on binaural sound are: No. 3291, "Improved Externalization and Frontal Perception of Headphone Signals," by Søren Gert Weinrich of Oticon A/S Research Unit in Snekkersten, Denmark; No. 3323, "BAP Binaural Audio Processor," by F. Richter of AKG Akustische in Vienna; No. 3289, "Head-Related Transfer Functions: Measurements on 24 Human Subjects," by Dorte Hammershøi et al. of the Institute for Electronic Systems at Aalborg University in Denmark; No. 3290, "Transfer Characteristics of Headphones," by Henrik Møller et al., also of the Institute for Electronic Systems, and No. 3332, "Improved Possibilities of Binaural Recording and Playback Techniques," by K. Genuit et al. of HEAD Acoustics in Herzogenrath, Germany.

Preprint No. 3343, "The Sound of the Orchestra," by Jürgen Meyer of Physikalisch-Technische Bundesanstalt in Braunschweig, Germany, explores the physics and acoustics of the instruments in a symphony orchestra and the qualities that determine the characteristic orchestral sound. The various instruments' transit and decay times, resonances, sound power output, and dynamic expression are analyzed. Meyer used the orchestra of the Vienna Technical University for his research, and his sound examples are from their performances of the Overture to *Die Freischütz* by C. M. von Weber and Joseph Haydn's Symphony No. 89. The examples illustrate:

> . . . the chorus effects produced by the groups of the strings, tone mixture in unison and in octaves, location-related tonal balance between upper and lower voices, seat arrangement of the strings —motif separation and blending [and] loudness level balance between instrument groups—masking in fortissimo, dynamics and space impression [and] time structure of the onset of tutti sounds.

This is, indeed, a fascinating and instructive paper.

In the March issue, I reported on Ambisonic sound. Michael Gerzon and Geoffrey Barton of the U.K. are major proponents of this technology. Their AES preprint, No. 3345, "Ambisonic Decoders for HDTV," offers very persuasive arguments for Ambisonics as the multi-channel sound that will complement HDTV. However, it will have to compete against the new Dolby SR-D digital stereo film format. As I noted in the February issue, Dolby SR-D follows the SMPTE layout for six discrete channels of sound. Time will tell which format will predominate, but at least owners of typical home surround theaters will be able to play either one.

There are many other preprints from the Vienna AES Convention that would be useful to audiophiles, but I've tried to pick the plums. Each preprint costs $5 and can be ordered from the Audio Engineering Society, 60 East 42nd St., New York, N.Y. 10165.

INTRODUCING SPEAKERS THE EXPERTS SAID WOULDN'T WORK.

When Museatex engineers started working on a speaker using a single pulsating sphere to reproduce perfectly time aligned sound, the experts agreed that this was theoretically an ideal solution, but impractical to implement. Now, after five years of research, Museatex engineers have perfected the most revolutionary speaker to be introduced in over three decades — **Real-Time Ripple-Effect (RTRE) speakers.** The Melior RTRE speaker uses a single point source to drive a flat diaphragm to propagate sound with naturally perfect time-aligned signals. In addition to near perfect reproduction, this speaker has several other unique advantages. It is less than 3" deep and can be integrated into any decor. It operates as a pulsating sphere with di-polar characteristics and is less critical to room placement than any other high quality speaker. The speaker has no cross-overs or transformers and presents a uniform load to amplifiers. Virtually any amplifier can drive these speakers although they reveal the fine nuances of the best in electronics. As the speaker is naturally flat, it can be designed as an in-wall speaker without sacrificing performance. The RTRE speakers by Museatex are available in a variety of finishes, including lacquered mahogany and piano black.

THE EXPERTS ARE NOW SINGING A DIFFERENT TUNE ABOUT THE REVOLUTIONARY 'REAL-TIME RIPPLE-EFFECT' SPEAKER BY MUSEATEX. "...FOR THE FIRST TIME IN HI-FI HISTORY, A FULL RANGE SPEAKER WITHOUT CROSSOVERS AND ELECTRONIC GADGETS HAS BEEN ABLE TO DEMONSTRATE NEAR PERFECT REPRODUCTION..." HANS JÜRG, SOUND, SWITZERLAND.

REAL-TIME RIPPLE-EFFECT LOUDSPEAKER
RTRE
MUSEATEX

EDWARD TATNALL CANBY

TELL-TAIL SINES

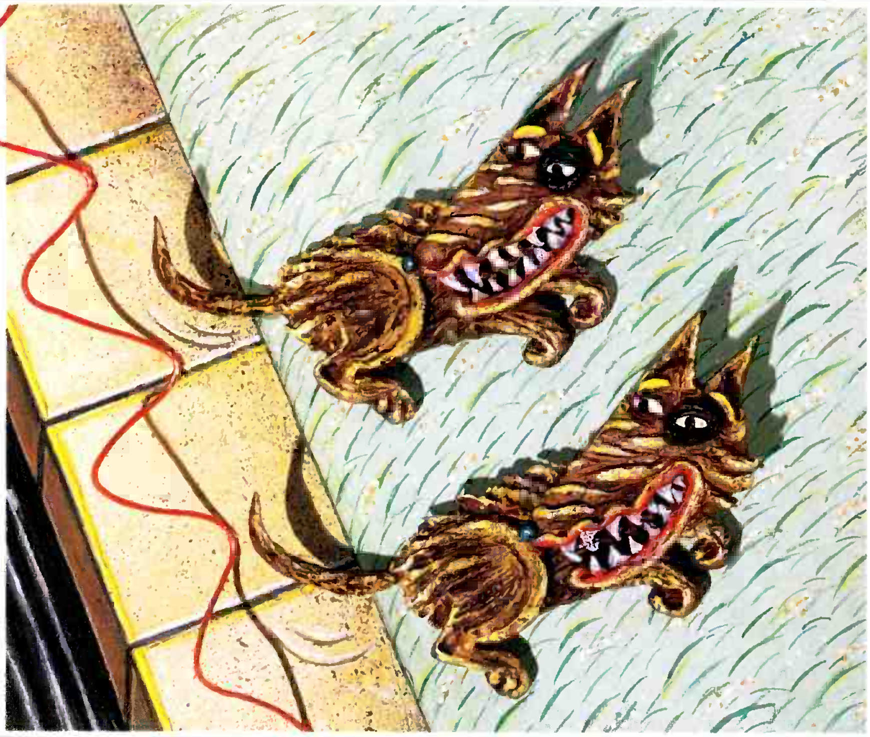


Illustration: Victoria Raymond

As I look forth on today's world, including audio, I find myself pondering upon, of all things, the sine wave. Literal and figurative. It's everywhere, in the most astonishing places, once you look—I mean, the *principle* of the thing. It rules a large part of audio, quite aside from the test equipment that generates the electronic sine wave. It rules the rest of the world too, if you will stop to notice.

The sine principle is one of nature's most elegant patterns. It's a dynamic, undulating, ongoing cluster of force that swings back and forth as it goes around an invisible central vector that does not exist. Yet that vector contains the very meaning and sense of the whole. A dynamic balance of continuous, seamless change and no stopping points anywhere. A conjunction of opposite thrusts, opposed excursions, first this way and then that way. Sine and cosine! Complementary in trig, balancing forces everywhere else, even when these are merely the forces of strong argument. Plenty of *that* in audio! But sometimes the sine is merely a physical change in taste, placid enough and even pleasing.

Ladies' skirt lengths in the '20s and '30s, for instance—long, short, long, short. Titillating but never an all-out battle. House-building styles, from the two-story house with dormer windows to the one-floor ranch house or split level—and back to the two-story. That's where we are now, a cycle that is very long in the wave.

Then there is music, and the multiple sines that are the base of most music, if not always the bass. The fundamental sine wave is the dullest of all sounds in music. The accretions are what count—everything from overtones to sawtooth and IM and, the most useful of all, the percussive transients.

Finally we have audio, with figurative sines and cosines by the dozens and enormous, oscillating, even furious arguments, one side or the other and in the middle. We swing and we sway. All sorts of interesting sine waves, like the 78 versus the LP, followed by the LP versus the CD. And, of course, the disc versus the cassette. Sometimes these sines become entangled. We've also had mono versus stereo and tubes versus transistors, once hot arguments, and recently, analog versus digital.

There are even sines within sines, little ones along with the big. Williamson-circuit amplifiers versus—what was that other one? I forget. Ah yes, also triodes versus pentodes, and maybe it would have been back again there too, but the larger sine wave eclipsed all the tubes and subdued the little undulation. You can think of dozens more of these—anything that wags back and forth like a puppy dog's tail.

Now I don't mean to go off on a tangent here, nor do I need a cosigner for this column to witness my remarks and help you believe. (*Editor's Note: You can see, can't you?—D.H.*) What matters is that all-important median validity, the nonexistent *center of dynamic balance* in the sine, whether it is a balance of fierce argument or of electronics. Of course there are mountains, whole worlds of audio detail along the way, the whole area of audio activity. But paradoxically, it is just this ongoing enormity of complexity that hides the essential, the sine pattern so dimly perceived yet so significant.

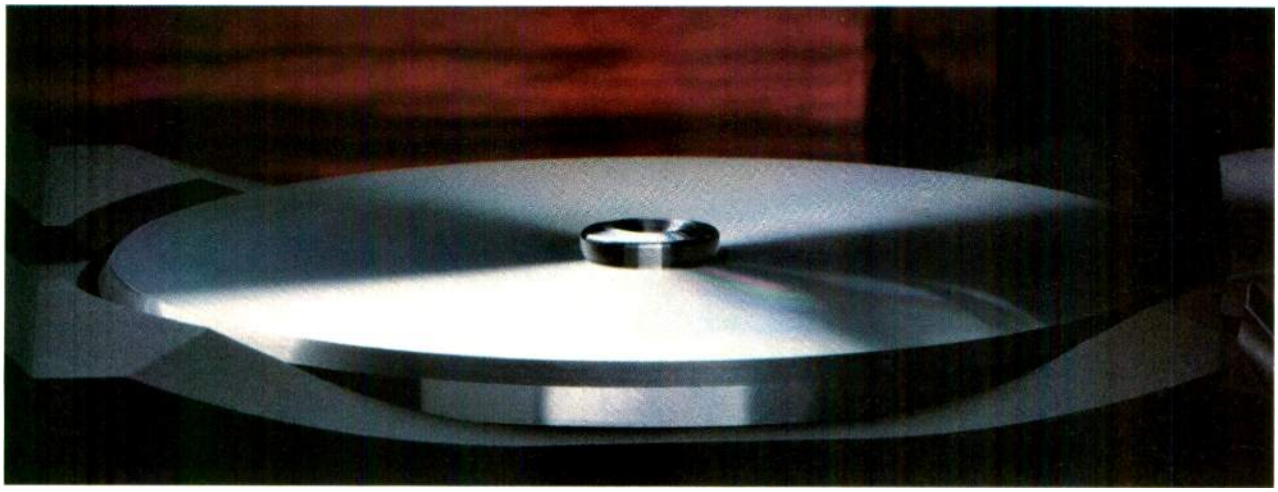
In theory the sine wave is as pure as the driven snow. I'm a snow lover too. In practice, in the real world, sines aren't so pure, and just as well.

Sines do not stand still, even electronically. All our sines are progressive. They never stay put. They always come back at a different point from where they were. Sines mean *progress*, movement, from somewhere to somewhere else. That's the pattern. Oddly, this implies impurity, doesn't it? Changes in detail, additions, subtractions, aberrations. Or, figuratively, new arguments, new discoveries.

Nice contradiction. Even the purest electronic sine wave has a finite series of sine curves, which, if in nothing else, are different in *time*. That's a meaningful difference. But the sines that are more figurative are absolutely loaded with impurities! That is the point. And the paradox.

In music, again, the impurities are virtually the art. Harmony, tone color, rhythmic patterns, even the perception of pitch. Why do musicians like me use a pitch pipe to set the tone for singing? Because it is loaded with coloration, overtones, designed to accentuate the fundamental. A tuning fork is more difficult, accurate but with the wrong "distortions"; a pure tone or near-pure, as in a cheap electronic keyboard, is deadly. Too close to a sine.

Continued on page 29



How A Concept Called The Stable Platter Turned The CD Upside Down.

Professional type, balanced output jacks are grounded, and shield the signal against noise.

In airline pilots, brain surgeons, and CD players, steadiness is a pretty fundamental requirement.

In the case of the Elite® line of CD players and the uncompromising Elite transport, their rock-solid stability has rocked the world of music lovers and audio critics. It's apparent from the reviews and the awards that Elite has advanced CD standards dramatically.

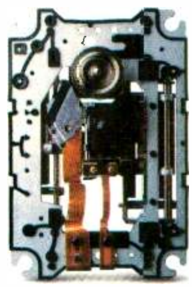
At the very apex of CD technology today is our PD-S95 transport. To insure optimum sound quality, it mobilizes an unprecedented array of mechanical and electrical isolation techniques, including rigid acoustic shell construction and discrete power supplies.

But its most significant innovation – incorporated throughout the Elite line – is the stable platter.

The Elite PD-75 Compact Disc Player. Its elegant urushi finish reflects technical elegance within.

Two basics of physics – mass and inertia – combine to make the stable platter an obviously superior platform to support a disc spinning at high velocity. Next, the stable platter, by supporting the entire area of the CD disc, minimizes wobble and chatter. A wobbling disc presents a difficult target for the laser, while a chattering disc creates resonance, distorting the signal, which distorts the sound.

The stable platter, with its great mass and driven with precision by a new transport mechanism, spins solidly in place generating no vibration. The result is sound that is perceptibly superior.



An advanced linear drive motor moves the laser pickup with smooth speed and precision.

Another problem for conventional CDs is gravity. Spinning above the laser pickup and supported only in the center, the disc sags microscopically. Which to a laser beam is significant. But on the Elite CD platter, the disc is turned upside down and lies firmly clamped to a solid surface. Meanwhile, the laser pickup reads the disc's digital code from above, where it is immune to dust settling on the laser optics.

We invite you to visit an Elite dealer and audition the entire line of Elite CD players.

And usher in a new era of stability.

ELITE
BY PIONEER

JOHN EARGLE

SCANNING THE NAB

Illustration: Betsy Everitt

This may be the first overview of a National Association of Broadcasters (NAB) Convention to appear in *Audio*—at least in recent decades. There is much to report, and it all has implications for readers of this magazine.

The NAB is primarily a trade organization that promotes the business, legal, technical, and regulatory interests of the radio and television industries in the United States. In recent years, the exhibits at the convention have expanded to such a degree that they now cover just about every aspect of radio/TV production, syndication, trouble-shooting, facilities design, and construction. Away from the exhibition floor are seminars which, over four days, cover emerging technologies as well as business opportunities and problems. What we see on TV and hear on radio is largely shaped by events and opportunities fostered by these conventions.

Consider the scope of the exhibits themselves. At one end of this spectrum are manufacturers of heavy transmitting equipment; at the other end you will find the latest in digital work stations for editing music and video. Between these extremes falls an interesting array of services and equipment.

For example, assume that you want to build a broadcast facility. Some exhibitors at the NAB convention specialize in designing from the ground up, and then they simply give you the key to the front door on completion. Such matters as allocation of work space, equipment choice and interface, utility requirements, layout of the production area, and the like are all part of the service these companies provide. Suppose you are already on the air and have what appears to be a coverage problem, possibly due to terrain. There are engineering companies that provide surveys of signal strength, indicating the magnitude of the problems and possible solutions to some of them. And have you ever wondered about the high-tech graphics used in TV weather reports? These services can be bought and tailored to a local station's needs.

In the competitive world of radio, it has always been felt that the louder station has an advantage over the softer one, so in-line signal compression and limiting have always played an important part in program processing. The latest in dynamic-range processing was displayed at this show, much of it tailored specifically to the modulation processes involved.

Satellite communications are an important part of today's broadcast signal distribution, so it was no surprise to see that technology represented as well. As a corollary to this, a number of data-reduction systems were exhibited—appropriate, since satellite-channel capacity will at some future point be limited. Some form of this technology will become the basis of future digital broadcast transmission.

The largest exhibitors at NAB were Sony, Ampex, Panasonic, and Philips. The three foreign-based companies are noted for their wide range of video cameras, monitors, and processing equipment. Ampex, which perfected video recording in the '50s, is primarily known for its tape and for video recording and editing gear. This company may be the world's leader in digital-effects generation for video. Those of you over 40 will likely remember when Ampex audio recorders were just about the only game in town. This is now a memory, and today, open-reel analog recording is largely in the hands of Studer and Otari.

The NAB takes a great interest in the development of high-definition television (HDTV), and a special exhibition area was set up for that purpose. What we think of as HDTV is not just a single standard but a broad array of both analog and digital technologies converging on a common goal. The big questions have always involved compatibility with existing transmission and reception methods, channel allocation, and, of course, commercial interests. Suffice it to say that whatever solutions may be acceptable in Japan or Europe may not be suitable in the United States because of vast geographical and business differences.

While the exhibits were underway, many seminars and update sessions were offered to attendees. These always fall basically into two areas, business and technology. The subject matter ranged far and wide, and I will comment on only a few of the topics which were discussed.

On the business side, the sessions covered competition with newer media (such as cable) for advertising dollars,

What we see on TV and hear on radio is largely shaped by events and opportunities fostered by NAB conventions.

the partnership between networks and affiliates, programming and advertising for special-interest and demographic markets, and problems of legal liability.

On the technical side, primary emphasis was on digital audio and television broadcasting. Other sessions dealt with improving AM and FM and reducing station operating costs. Interactive television and pay-per-view were also discussed.

In keeping with the special emphasis on HDTV, a large number of presentations were made on behalf of the various proposed systems as well as on general aspects of HDTV programming and production. HDTV is about 10 years old, and the Japanese MUSE system is the one that has been demonstrated most frequently at trade shows. This system is now available to a limited extent in Japan but at great expense to the consumer. It requires a very large transmission bandwidth and thus is not a likely candidate for application here. One proposed HDTV system, DigiCipher, jointly developed by MIT and General Instrument Corp., was actually broadcast at the NAB via a standard TV channel, demonstrating that normal terrestrial broadcast technology and channel capacity are compatible with HDTV requirements. I did not see the demonstration, but I understand that all worked well.

HDTV is some years away, and costs are going to be high. The interim step of improved NTSC (standard TV) performance remains very attractive, even though it may increase the cost of TV sets by as much as $200. The ultimate performance of these enhanced sets is dependent on line doubling (see "Currents," April 1992), and the cost of that technology is still rather high. By the time HDTV comes to pass, there will likely be a version of the LaserDisc that operates at a shorter laser wavelength and that can accommodate the necessary wider bandwidth signal for HDTV. This will make motion pictures available for wide-screen home HDTV playback, long before there's much wide-screen HDTV programming available on broadcast or cable television. I believe that we are looking at mid-decade, at the earliest, for the first consumer products in this exciting field. ▲

The sine principle is one of nature's most elegant patterns, and it contains the very sense of the whole.

AUDIO ETC/*Continued from page 24*

The musical sine wave by itself, the musical driven snow, if you will, is all too much like the "pure" acoustics of the anechoic chamber, which can make you feel faint or even nauseous, it is so UN-natural. Our senses are inherently tuned to "distortion" in every area, not to the pure mathematically simple pattern.

And yet, beneath so much, the powerful sine wave lies dimly. An elemental natural force.

Enough! I hereby sign off the generalities and move to the phenomenon that started me on all this. It came through the mail. I couldn't believe it. A large package containing two *LP records!* What, back to the LP again? But yes. New and improved, of course.

Moreover, these were not like the last LPs I received some years back and more, the late-late digital sort. These were *analog* LPs, and boasted themselves as being so. If the fanciest CDs carried the cachet of DDD—all digital in the now-extinct SPARS code—then these LPs would be flamboyantly AAA. Analog, analog, ANALOG. How's that for a swing?

Not only that. There was another boast as well. These neo-LPs are *all-tube*. From the beginning, which happened to be around 1961 or '62, to the end, the present-day rerelease. The original tapes, played on the kind of good old Ampex I worked with for so many years. Nostalgia—for me. Sine wave for audio. Back to our earlier selves—only improved.

For me, another wave. I knew both of these LPs from the original and probably wrote about them at the time. I spotted the covers instantly, just as they were except for a new label name, Analogue Productions. I remember the recordings, the performances. Vanguard Records! Talk about *déjà vu*. More of these have been coming in on CD, from a label called Omega. Hmmm. First letter of the Greek alphabet is Alpha. Does that relate to Vanguard, i.e., out in front, the first? If so, then Omega, the last letter of that alphabet, means not only the end, but the ultimate. Do I infer a subtle relationship between Vanguard and Omega? (*Editor's Note:* Not so subtle, as Seymour Solomon founded both.—*I.B.*)

I am not going to make comparisons in this return of the LP and the tube, not to mention the Ampex. I have not the slightest doubt that these are superb LPs, technically state of the art as of now and well ahead of the originals. Vanguard, in its own quiet way, was one of the most consistent classical labels for high-quality recording back in the '60s. I know the performances too, and they are okay. But the technical improvements in Analogue Productions' LPs can best be judged by others. As a puppy dog's tail to this article, I'll give you the dope so you can acquire them for yourself.

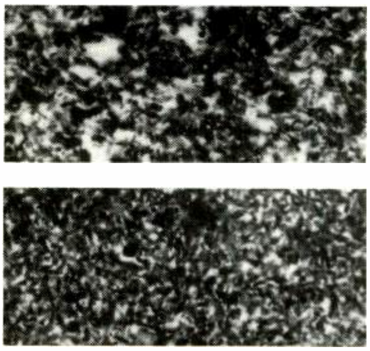
Have to make one more point of sine-ish paradox. As you may remember if you are 21 or over, the last years of the LP were decorated by a grand new recording feature, namely, DIGITAL. This was inaugurated far, far back by dauntless Denon, Japanese Columbia, which introduced a new type of recording that at first had me baffled—digits? I knew nothing of digital audio at the time. Turned out to be 14-bit PCM digital, later upgraded to the present standards. But in time, digital recording jumped the gun, before CD, and became the rage. Nobody would buy an LP that was not marked DIGITAL in large letters. Of course, the LP itself was entirely analog, not a bit or a byte to be found on its vinyl! But the idea took off and sold. A great swing of the sine in one direction, culminating in the true digital disc, the CD.

So you now can easily understand this particular twist of a number of sine waves, going back. True, figuratively, the returned LP is in the minority, but (and this *is* a point) low volume is made up for by high dedication. Like a low current with high voltage. These new LP folks are fanatics.

The joke on them is that for semantic reasons and because of their creed, these people really can't reissue the very best of the old LPs, from the first digital era Every LP cover said DIGITAL on it, as loudly as possible. Now it must say ANALOG. A pretty pickle, that. So we return to the '60s, when all was safely analog. And all-tube.

For more analog LPs, both reissues and oldie originals (also lots of CDs), write for *Acoustic Sounds*, Analogue Productions' catalog (P.O. Box 2043, Salina, Kans. 67402; $3 in the U.S., $5 for Canada). You'll find all the sines of the times in it. *A*

A warning to those with toupees, small vulnerable house pets, and a fear of flying: Maxell has taken high bias tapes to an even higher level of performance.

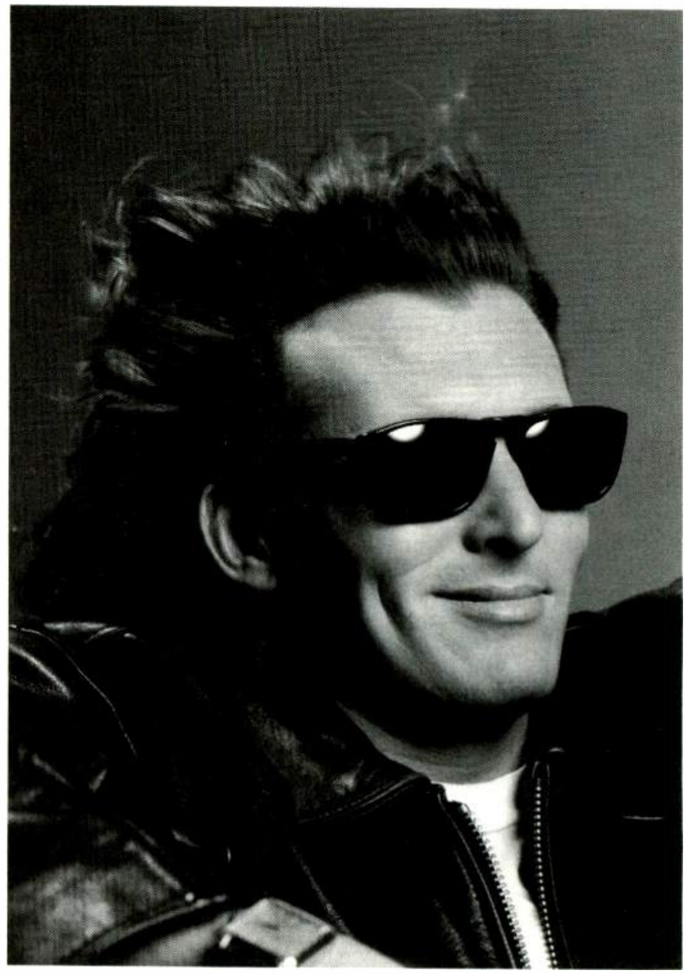


Compared to other tapes, XLII-S has a higher density of magnetic particles.

The tape is XLII-S. The power behind it is Black Magnetite—a unique magnetic material recently harnessed by Maxell engineers.

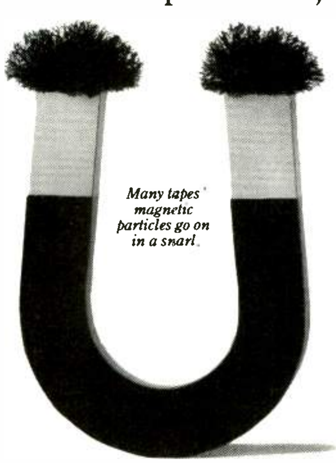
With 13% greater power than the magnetic coating on all other high bias tapes, Black Magnetite helps XLII-S deliver higher maximum output levels and wider dynamic range.

Black Magnetite's tiny magnetic particles are not only more powerful than conventional gamma ferric oxide particles, they're smaller and more uniform in shape. This enables us to pack more particles more densely onto the surface of the tape.

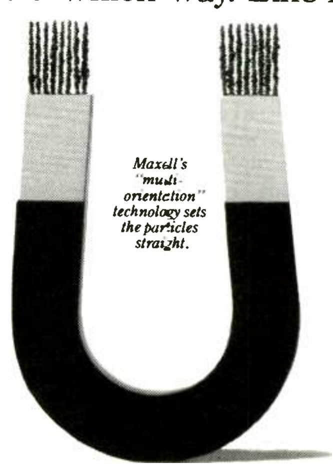


HIGH BIAS

During manufacture, conventional tapes run through a magnetic field where many of the magnetic particles adhere any-old-which-way. Like flies on flypaper.

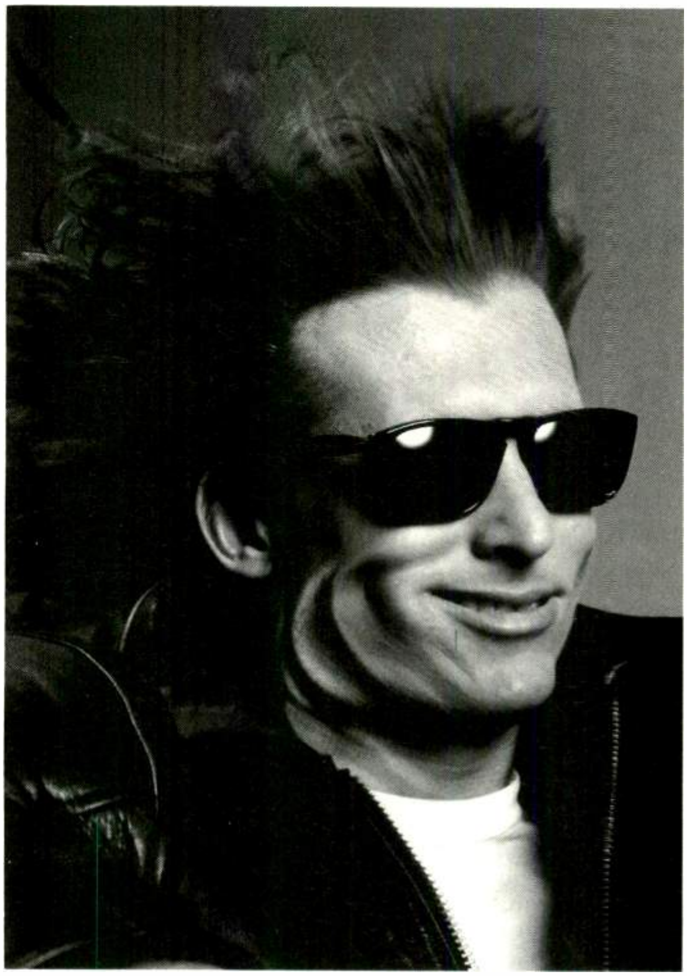


Many tapes' magnetic particles go on in a snarl.



Maxell's "multi-orientation" technology sets the particles straight.

But at Maxell, we employ a complex process called *"multi-orientation"* to set the particles straight. The result is a



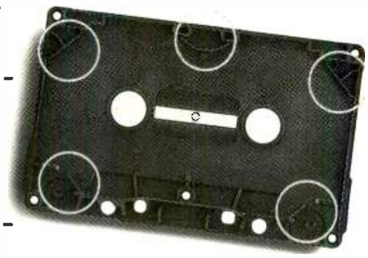
BLACK MAGNETITE

smoother magnetic coating, which produces less AC bias noise.

Unwanted noise is further reduced by our patented *dual-surface base film.* One side of the film is super-smooth for closer tape-to-head contact. The other is rough, deliberately so, for a stable ride through your transport mechanism with the least possible friction and tape jitter.

These innovations, however, are no more remarkable than the cassette shell that houses them.

More rigid and weightier than standard cassettes, the XLII-S *high resonance-damping cassette* has been precision engineered to reduce modulation noise. By making the window smaller, for instance, we were able to build in more anti-resonant material and five support points instead of three.



XLII-S vibration-damping cassette shell has five support points for increased rigidity and durability.

All of which helps XLII-S maintain phase accuracy as well as an extremely low noise threshold.

You can feel a difference in XLII-S just by picking up the cassette. Of course, it's nothing compared to what you'll feel the moment you press 'play'.

TAKE YOUR MUSIC
TO THE MAX.

Heitaro Nakajima
Digital Pathfinder

David Ranada

Dr. Heitaro Nakajima is one of the founding fathers of digital audio, having been a member of the team responsible for the development—amid formidable technical and bureaucratic difficulties—of the first digital audio recorder at the Japanese Broadcasting Corp. (NHK) in 1967. That machine was a 12-bit monster with a 30-kHz sampling rate, a far cry from today's DAT recorders with their single-chip, 16-bit oversampled converters and 48-kHz basic sampling rate. From that first recorder through Sony's work on the CD system and DAT, Nakajima has seen it all and reminisces about his long career in digital audio in this interview. *D.R.*

Tell us how you started your career.
After my graduation from college in 1947, I joined NHK, the Japanese Broadcasting Corporation, where I began my initial research with microphone and loudspeaker design for broadcast use.

I take it that your background in these areas is quite scientific and technical?
That is correct. In fact, as an outgrowth of this research, NHK introduced a reference studio monitor speaker, and later this initial research also led to Sony's development of the C37 and C39 microphones.

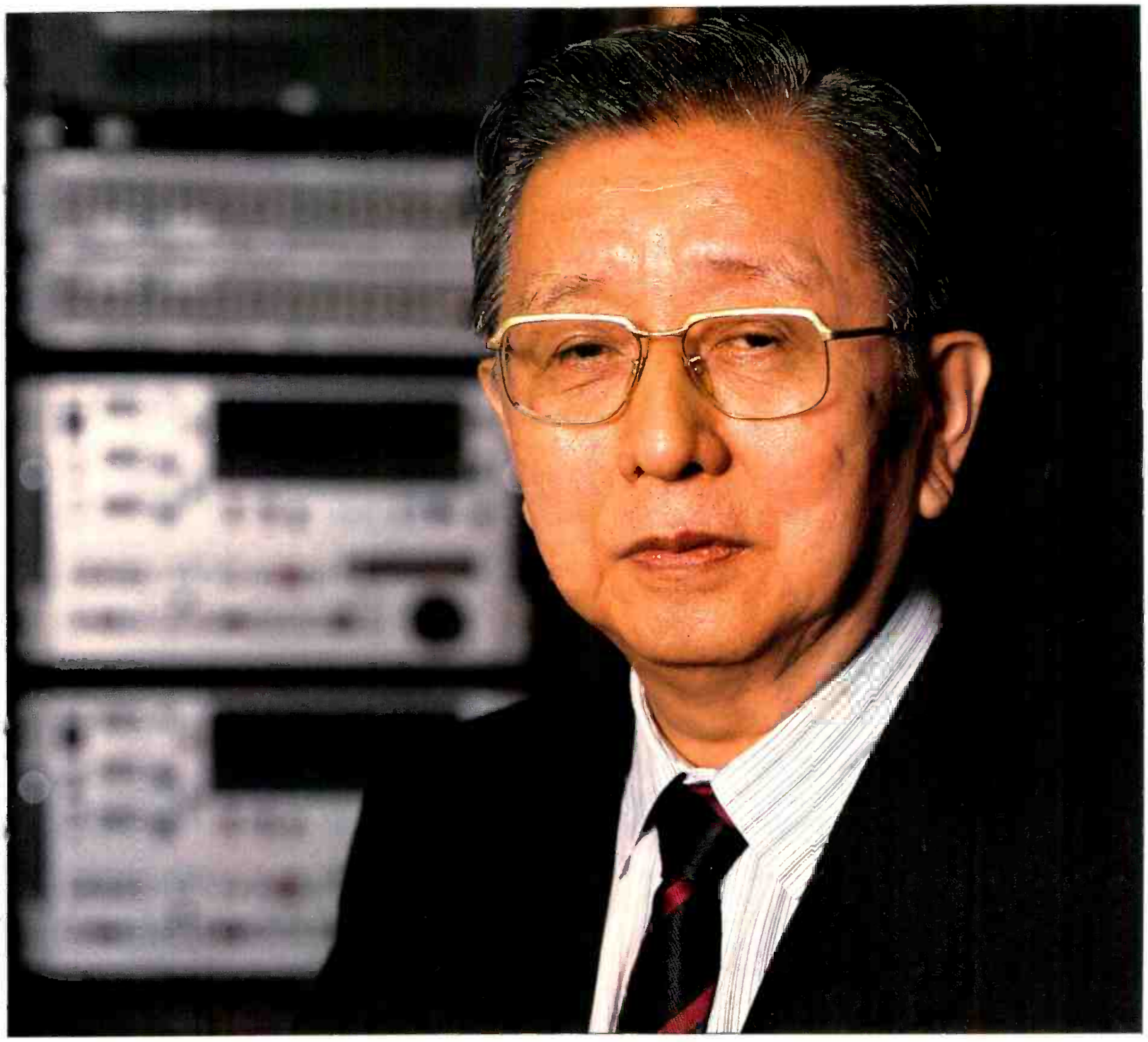
I also understand that you were involved with the very first digital recordings done by NHK. How were these conducted?
We began our work with digital recording at NHK in 1965, just after the conclusion of the Tokyo Olympics. My group was actually responsible for developing the world's first digital tape recorder, which was introduced in Tokyo in 1967. It operated at a sampling rate of 30 kHz, with 12-bit quantization.

This seems to be a very early period in the development of digital audio technology.
In retrospect, our work in digital audio was very advanced compared to the rest of the industry. Because, frankly speaking, at that time our team had already completed our transducer research, so we were quite ready for a much more formidable challenge.

What motivated NHK to get involved in digital audio at that time?
You must first understand that in 1964, the Japanese broadcast industry considered the Tokyo Olympics to be a true milestone in our country's history. Therefore, much research and development work was focused on making the broadcasts of these Olympics as memorable an experience as possible.

In addition, we had recently achieved another milestone with the introduction of FM stereo broadcasting. So by this time, we had already realized that the quality of our analog master recorders was not good enough to serve as a reference source for high-quality FM transmissions. These were the factors behind NHK's early involvement in digital.

It goes without saying that moving from analog to digital recording was a fairly radical change in the way that broadcasters approach their business. In this regard, do you specifically remember any other experiments in other parts of the world that coincided with NHK's efforts?
As far as I can remember, there were no other activities in digital recording anywhere else at that time. In fact, the only other group interested in digital audio at all was the BBC, who, if I



correctly recall, began experimenting with it around 1969.

Did you really expect digital audio to come so far in such a relatively short time?

Not at all. When you consider that our first digital recorder was large and cumbersome, cost at least five times more than conventional analog tape recorders, and didn't even include a provision for editing, many people were extremely curious as to why NHK was interested in digital audio at all at this time.

If this was the prevailing opinion, why indeed did NHK move in this direction? Was it the quality of digital audio sound?

In some ways, significantly so. For although much research still remained to be done, even with our first recordings I was immediately taken by the incredible improvements in dynamic range and surface noise versus analog. Without this initial impression, I'm afraid I could not have been motivated to continue my research in digital audio for another 20 years.

In 1971, approximately five years after your initial work in digital audio with NHK, you joined Sony. Is this when it first occurred to you that it would be possible to bring digital audio sound to the consumer?

Yes. By the time my first anniversary at Sony had passed, there were already 40 research and development engineers in my division. It was at that time that I decided to assign two of these engineers the task of beginning applied research into the fundamentals of digital audio. Yet I did this without establishing any ultimate purpose or specific product goal.

This was primarily based on my belief that digital technology would ultimately prove to be the foundation for some type of new recording system that was then unavailable for use with any analog product. And it is this belief that ultimately became the motivation for our original group of digital engineers.

I take it, then, that as your engineers continued to refine their work in digital audio, the impetus

PHOTOGRAPHS: DAVE KING

THE AUDIO INTERVIEW

for new Sony product developments naturally began to follow.

Yes, that's correct. For example, we discovered initially that a conventional stationary-head recorder did not offer quite enough bandwidth to record digital information efficiently. Therefore, we decided to redesign a helical-scanning head to record the data instead. As a result of this development, we invented dedicated pulse-code modulation [PCM] processors like the PCM-1600 and PCM-1, which were designed to be used with already existing U-matic or Betamax video recorders.

Just as the 78-rpm record and the LP lasted 25 years each, Nakajima expects the Compact Disc will last for 25 years as well.

When I joined the industry in 1979, technology was also under development to bring digital audio to the consumer via optical disc. How did your work in this area begin?

Our work in this area began with our preliminary research into optical videodisc technology. This was followed by successfully recording high-density digital audio data onto a videodisc. All of this led us to conclude that virtually any optical format that could record video could be easily modified to store digital audio instead.

I remember that an early Sony prototype for an optical digital audio disc was 30 centimeters in diameter and provided many hours of digital audio music. Was it Sony's co-developer of the Compact Disc format, Philips, that actually proposed a very small digital disc?

We began our research from the traditional analog perspective of a 12-inch format that would store up to one hour of recorded music. However, as our digital research continued, we realized that we could actually achieve up to 13 hours of recording time on an optical disc of this diameter.

My conclusion was that since 13 hours of prerecorded music would not be necessary, a one-hour music playback format could be achieved on a disc only 9 centimeters in diameter. Later we learned through our discussions with Philips that their initial proposal for the Compact Disc format called for a disc 11.5 centimeters in diameter.

So Philips' first proposal for the CD standard was larger than 9 centimeters but smaller than the present CD?

That is correct. The current CD format specifies a disc that is 12 centimeters in diameter, while Philips' original proposal called for an 11.5-centimeter disc.

It is also my understanding that Philips' initial proposal provided a shorter playing time as well as a different signal resolution and error-correction system than is specified in the final CD standard. How did all of this finally evolve into the present Compact Disc system?

The key to the Philips proposal was that they based their approach primarily on their extensive experience in optical videodisc technology rather than their experience in digital audio processing. This is why they recommended a digital converter system that only provided 14-bit music resolution.

On the other hand, our Sony team approached CD from a totally different perspective and therefore based our recommendations on our developments in PCM digital audio.

If Philips recommended a 14-bit system, how did the two companies finally agree on the 16-bit CD format?

As a matter of fact, Philips insisted on 14-bit quite strongly. However, I had two responses: First, from a technical point of view, although a 16-bit D/A converter was not available at that time except for professional use, I believed that in the future it would not be that much more difficult to produce a 16-bit LSI than a 14-bit converter. Even more important, from a musical point of view, once CD listeners would become accustomed to the limitations of 14-bit sound quality, they would demand even higher resolution than a 16-bit system. Today, high resolution still remains an issue in the music industry, with engineers now insisting on 20-bit systems for professional use.

There is a story circulating that the playing time on a CD was increased to accommodate Beethoven's Ninth Symphony. Is this true?

Well, Sony believed that if we could accommodate Beethoven's Ninth Symphony, there was enough room to store other long musical works as well. This was another way that we helped to convince Philips to expand the diameter of the CD to 12 centimeters.

Another way we convinced them was to measure the size of a person's coat pocket. We studied a wide variety of pockets and found that most of them measured about 14 centimeters in width, so we concluded that a 12-centimeter CD in a jewel box would not be a problem.

This is a difficult question, but what do you think are the CD's weak points now that the system has evolved? And are there any technical "loose ends" that you had wished had been resolved in another manner?

Taken as a whole, I believe that Compact Disc is a remarkably convenient, high-quality consumer digital audio format, particularly in regards to other current music configurations.

But with the recent development of solid-state memory devices at far lower prices, isn't it possible to design far more powerful error-correction systems for more consistent playback performance?

At one time, the development of such devices was looked upon as a viable option. However, today's higher quality CD replication and laser pickup designs generally ensure more uniform performance, without additional manufacturing or LSI production expenses.

As you pointed out, there are now a number of 20-bit systems in the professional audio market. Some people say that the CD should become an 18-bit format. What is your opinion?

While I technically acknowledge these opinions, at the same time, if CD is to truly remain a viable consumer music format, it should last until at least the end of this century. In other words, just as the 78-rpm record lasted 25 years and the LP lasted 25 years, so I expect the CD to last for 25 years as well. Maybe by the year 2007, we should expect the next generation of music enthusiasts to develop another revolutionary digital audio format.

Speaking of advancements, DAT was big news in this country for a while because of the controversy surrounding its introduction. Was DAT intended to ultimately replace analog cassette, or was it truly meant to be a product for the high-end music enthusiast?

Although this might not be a direct answer to your question, according to my philosophy a recording version of a prevailing technology must be designed to coexist with the technology's prerecorded software. In the case of Compact Disc, which follows a 44.1-kHz, 16-bit format, there must also be a recorder that operates at the same parameters. By the same token, if there is a 48-kHz, 16-bit digital broadcast, there must also be a 48-kHz, 16-bit recording system.

Taking this point of view, it's quite easy to see that DAT was designed to serve a variety of music enthusiast applications.

The Digital Compact Cassette and Mini Disc are now being touted as the ultimate replacement for the analog cassette. Do you think consumers will be confused with these new formats, since their development so closely follows the introduction of DAT?

Both MD and DCC offer suitable digital performance to meet the requirements for portable or mobile music reproduction. Therefore, since these applications do not require full 16-bit linear digital processing, we can make the media both smaller and less expensive.

This difference in intended use is the primary distinction between MD and DCC, versus CD and DAT.

Mini Disc seems to be a very radical departure in signal processing compared to everything that has come before. Given your strong feelings on linear 16-bit encoding, do you feel that data compression is destined only for portable audio or those applications that only require limited dynamic range?

Personally, I believe that these data-compression encoding algorithms will continue to be improved in the future. However, if there is an obvious difference between 20-bit linear and 16-bit linear systems, can you imagine the difference between 16-bit linear encoding and data encoded with only one-fourth to one-fifth the amount of information?

Therefore, for the critical listeners, despite the likelihood of expected improvements in data-compression schemes in the future, there will always be some audible difference between data-compressed encoding and properly designed linear encoding systems.

So you believe that 16-bit or 20-bit linear systems will continue to be used for high-quality recording?

Yes. I believe that linear digital formats must continue to exist, in order to ensure the highest quality master recordings possible. So at the very least, professional digital recording will continue to improve, based on additional refinements in the linear encoding process.

Digital audio has certainly come a long way in eliminating almost all of the major problems traditionally associated with analog recording and playback. Are there any aspects of digital sound reproduction that you feel still need improvement?

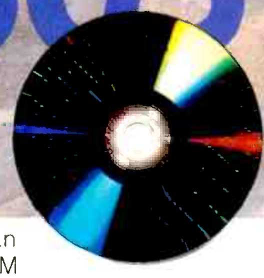
Although digital audio solves many problems inherent in analog signal processing, many people still believe that Compact Disc sound is too analytical or "cold." Therefore, I believe that there is still room to subjectively improve overall digital sound quality in such critical areas as the design of the A/D converter, the Compact Disc player's drive mechanism, and the player's power-supply circuitry.

But in the future, most of my research will center on new discoveries in the field of psychoacoustics, with particular emphasis on the way human beings interact in the listening room environment.

Do you think audio technology will ever improve in its ability to convey the live music experience?

I believe it will remain quite difficult for us to ever achieve this so-called "musical reality." For although we are improving our ability to simulate key sound-field characteristics with more sophisticated digital signal-processing techniques, it must always be remembered that these are only simulations, with far fewer aural cues than the actual live musical experience. While we may be getting closer, we're nowhere close to actually "being" there.

RECORDABLE ● CD promises



Magneto-optical recording, discussed last month, is hardly the only recordable CD system being investigated: Phase-change and dye-polymer technologies are also in the running.

Phase-change materials are those which, when heated, change from amorphous, non-crystalline molecular arrangements to organized crystalline structures or vice versa. In thin layers of metallic phase-change materials, such as alloys of antimony and selenium, the change from the amorphous to the crystalline phase causes a change in reflectivity. This change is triggered when the layer is heated to about 170° C (338° F). It is irreversible and can therefore be applied to WORM media. If a disc coated with a thin layer of antimony-selenium is heated by a modulated recording laser, data can be recorded as spots of differing reflectivity. When a recorded disc is read by a playback laser, the variation in reflected light permits the data to be recovered.

Other materials have the property of reversible phase change, making them suitable for erasable media. Complex combinations of rare earths and elements, including layers of gallium antimonide with indium antimonide and tellurium alloyed with elements such as germanium and indium, have been developed. In their neutral state, these compounds are usually in the stable crystal phase, but when heated to a temperature a little above their melting point, the heated spot solidifies in the amorphous state. Because the crystalline phase is more stable than the amorphous, the coating will tend to return to this form; thus, erasure can be achieved by heating the recording layer to a temperature just below the melting point, which triggers a return to the crystalline phase and erases the data. Erasable phase-change media can be used as WORM or archive systems by increasing the power of the recording laser to the point where a hole is melted in the coating, thereby creating a permanent record.

Michael B. Martin is a retired electroacoustics engineer who spent approximately half of his 40-year career designing consumer and professional recorders (analog and digital) and the other half in the field of magnetic recording tape. The last three years of his career were devoted to optical recording.

The difference in reflectivity between a crystalline and an amorphous surface is typically 30% or less. The specification for a commercially produced CD calls for a reflectance between 70% and 90%. The overall reflectance of a phase-change surface does not reach 70%; therefore, reliable playback of a phase-change recording will require CD players to be more sensitive to low levels of reflectance and to the relatively small changes in this reflectance generated by data. This does not create any major technical difficulty, but it is probable that many players now in the field will not be capable of satisfactory performance; therefore, phase-change recording can only realistically be considered a forward-compatible system. Another difficulty with phase change appears to be with volume production at an economical cost: Years of work by several technically powerful companies have not yet yielded a completely satisfactory process. Both private and public demonstrations of prototype systems have been made, but there has been no announcement of a system at consumer prices.

The materials used for the active coatings of phase-change discs are somewhat similar chemically to those of MO discs; therefore, it is not surprising that the corrosion problems can be similar. As with MO, the maximum information density that can be recorded is a function of the wavelength of the recording laser, and it is diffraction-limited.

The recording systems known as dye polymer rely on the use of optical dyes as absorption filters. All dye-polymer media use the principle of energy absorption by an optical dye loaded into a layer of normally clear polymer that has the same refractive index

& problems

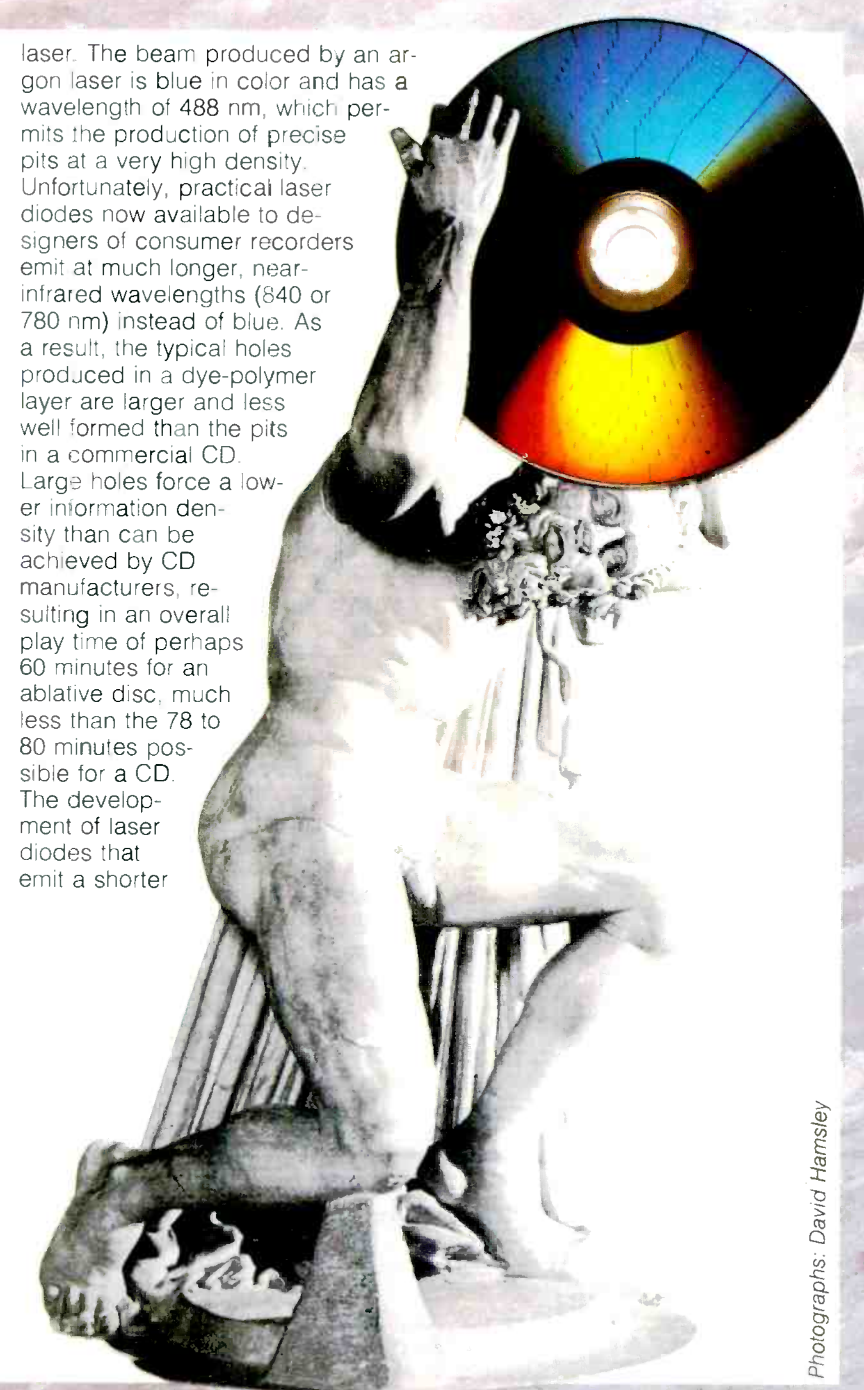
PART II

Michael B. Martin

as the plastic or glass substrate of a disc. When a laser beam passes through a plastic layer containing a dye that absorbs at the wavelength of the laser, the layer is heated very rapidly (hundreds of degrees per microsecond). A dye-polymer medium can be designed to achieve one of several possible results. The heat generated can be used to burn a hole in the dyed layer, bleach the dye, locally vaporize the surface of the substrate (thus forming a pit in the substrate surface), or cause rapid local expansion of the dyed layer to create a bump or pit.

The majority of dyes in existence were developed for applications such as textile coloring and photography; few are suitable for the dye-polymer field. Suitable dyes can be and have been synthesized in small quantities; some dyes designed for other applications have been used for experimental studies but have less than desirable efficiencies. It is a drawback of all dye-polymer systems that even if all the media used the same dye and the annual production were to be in the tens of millions of discs, the dye requirement would still be insufficient to justify even a small manufacturing unit for this special dye. The established dye manufacturers are conditioned to producing vast quantities for traditional applications such as textiles and photographic products. They do not become enthusiastic about producing annual quantities in the 1-ton region; they only begin to get interested at 1,000 tons! As a result, dyes for optical recording will be produced with laboratory-scale equipment at very high cost. Fortunately, because of the minuscule amount of dye used in a disc coating, the impact on the final cost of the media will be very small.

Systems that burn holes in the active coating are known as ablative systems. Obviously, an ablative disc is a WORM medium, but it has the advantage that, by coating the polymer with a reflective layer that is burned off with the polymer, the disc can support a CD-compatible recording. The master discs for a commercial CD are made by an ablative system, i.e., a photo-resist coating on a glass substrate is burned off using an argon-gas laser. The beam produced by an argon laser is blue in color and has a wavelength of 488 nm, which permits the production of precise pits at a very high density. Unfortunately, practical laser diodes now available to designers of consumer recorders emit at much longer, near-infrared wavelengths (840 or 780 nm) instead of blue. As a result, the typical holes produced in a dye-polymer layer are larger and less well formed than the pits in a commercial CD. Large holes force a lower information density than can be achieved by CD manufacturers, resulting in an overall play time of perhaps 60 minutes for an ablative disc, much less than the 78 to 80 minutes possible for a CD. The development of laser diodes that emit a shorter



Photographs: David Hamsley

wavelength of light will definitely improve this situation because they will permit proportionally smaller holes to be burned into the coating of the disc.

A dye-polymer approach to making an erasable and compatible CDR disc is the multi-layered layer-distortion or bump-forming system. A laboratory sample was demonstrated early in 1988, but there have been no public demonstrations since then. As with all dye-polymer approaches, the bump-forming system depends on optical dyes absorbing energy from a laser beam, with the difference that there are two layers that absorb at wavelengths different from each other. Two possible configurations for bump-forming media are shown in Fig. 5. The bumps produced by the upper structure (the system demonstrated in 1988) will project away from the substrate. This allows the recording, play, and erase lasers all to operate from the substrate side. The bumps produced by the lower structure will project towards the substrate, and the record and erase lasers will operate from the coated side, opposite the play laser on the substrate side. With the first type, the recorded media will be fully compatible with all CD players that have three-beam tracking. A two-laser recorder will be possible because one of the lasers can be dual-purpose, used in a high-power mode for erase or recording and at much reduced power for playback. With the second type, the recorded media will be compatible with CD players that have either single-beam push-pull or three-beam tracking, but the recorder will be more complicated. Also, the recorder will require three lasers—one each for recording, playing, and erasing.

TO DATE, ONLY DISCS USING BUMP-FORMING TECHNOLOGY HAVE A CHANCE OF BEING FULLY COMPATIBLE WITH COMMERCIAL CDs.

The principle of operation is exactly the same for both structures. The dye in the expansion layer absorbs energy from the recording laser and appears transparent to both the play and erase laser beams. The dye in the retention layer soaks up energy from the erase laser and is transparent to the other two beams. At normal temperatures, the retention layer is rigid compared to the expansion layer, which is relatively elastic. When the recording laser is energized, the expansion layer is heated to very high temperatures in picoseconds and expands locally with explosive force. The retention layer is thus heated by conduction to its softening point and deformed into a bump by the swollen expansion layer. The reflective layer is in turn deformed by the retention layer. When the recording laser is de-energized, the retention layer becomes rigid before the expansion layer is fully contracted and the bump becomes permanent, with the expansion layer in a state of tension. Erasure is achieved by heating the retention layer to its softening temperature with the erase laser, which allows the tension in the expansion layer to relax. The relaxing expansion layer pulls the bump flat in all three layers, thus erasing the information.

The principal attraction of the bump-forming technology is that presently it is the only one which has a chance of being fully compatible with commercial CDs. Unfortunately, several difficult problems must be solved before bump-forming discs can be considered fully developed and out of the laboratory. Some of these problems are:

- The number of times the disc can be erased is limited by fatigue in simple reflective-layer materials or the formation of small artifacts in the polymer layers. Both of these phenomena worsen the signal-to-noise ratio and decrease the response to the shorter information pits.
- Unusual eutectic alloys of metals with low melting points are needed to overcome the reflective layer fatigue problem and will also require the development of new coating techniques.
- Disc-controlled tracking during the recording process is difficult, because the refractive indices of the polymer layers and polycarbonate are the same.
- Existing dyes are far from ideal, and the close proximity of the wavelengths of available diodes (780 and 840 nm) makes the development of special dyes very difficult. The introduction of 640-nm laser diodes will simplify the development of dyes whose absorption spectra do not overlap; they will also improve the recorded information density. (See Fig. 6.)

Interrelationships of Hardware and Software

As a product for home recording, recordable CD will have unique relationships with commercially produced software. Unlike any other home recording medium, either audio or video, when CDR is introduced into the consumer market a huge library of program material will already exist on a nonerasable medium—the commercial CD. CDR will have a structure different from that of the CD, unlike magnetic tape systems where both the blank media and the prerecorded product have identical structures and are recorded by essentially the same process. With the cassette and DAT systems, the prerecorded library came after the blank media system was launched; DCC will fit into this pattern. In all probability, CDR will also have quite a different appearance from the well-known shiny CD. For example, a dye-polymer disc will have a blue or cyan color because its polymer layers absorb red light. The relatively high cost of CDR discs, coupled with the difficulty of high-speed duplication, is likely to make CDR an uneconomical system for high-volume commercial applications, including piracy.

As with other memory systems, CDR must be developed with an eye towards both the price of the media and the price of the recorder. Many blank tapes or discs are purchased for each recorder. Thus, a small increment in the cost of the media to the consumer can result in a much higher total operating cost over the life of a recorder than will a larger addition to the recorder's initial cost. An important consideration is whether to have tracking during the recording process controlled by the disc itself, by a head-positioning mechanism in the recorder, or by a combination of the two. In addition to cost considerations concerning the tracking method, there are significant technical problems to be solved with any technique. Currently, the general opinion is that recorder-controlled tracking is not cost-effective.

The reasons for the strong bias towards disc-controlled tracking are to be found in the physical dimensions of CD tracks and the data recorded on them. (These dimensions were given last month in Table I.) At a pitch of 1.6 μm, there are over 15,000 tracks per inch, and the information pits are comparable in size to smoke particles. The accuracy required of any mechanism that must work to these dimensions is almost beyond comprehension. It is believed that the pits in a CD are the smallest artifacts produced in a controlled manner by any manufacturing process. The lathe used for mastering a CD is built like the proverbial battleship, the motion of the head carrying the argon laser is totally computer-controlled, and the position of the sled carrying the head is controlled by an elaborate feedback system which constantly refers to the pits just cut by the laser. The sled is mounted to the lathe on air bearings in order to eliminate any irregular motion generated by mechanical imperfections in the supporting unit. In addition, the lathe is mounted on a massive steel plate or granite block which is isolated from outside vibration by complex shock absorbers. Within the limitations of a consumer-oriented recorder, isolation of this order is impossible to achieve.

Consumer CD players track satisfactorily by virtue of the fact that they follow the information recorded on the disc. Therefore, it is logical to believe that recorders can be designed to track to the necessary tolerances if tracking information is buried in the blank discs. The favored means of providing guidance for the recording head is to mold a spiral groove into the disc's transparent substrate on the side to be coated with the recording material.

The molding die used to produce a grooved substrate is made in a manner similar to the way a CD mold is fabricated, and the master groove is cut on a CD mastering lathe. The dimensions of the groove are chosen so that interference takes place at the

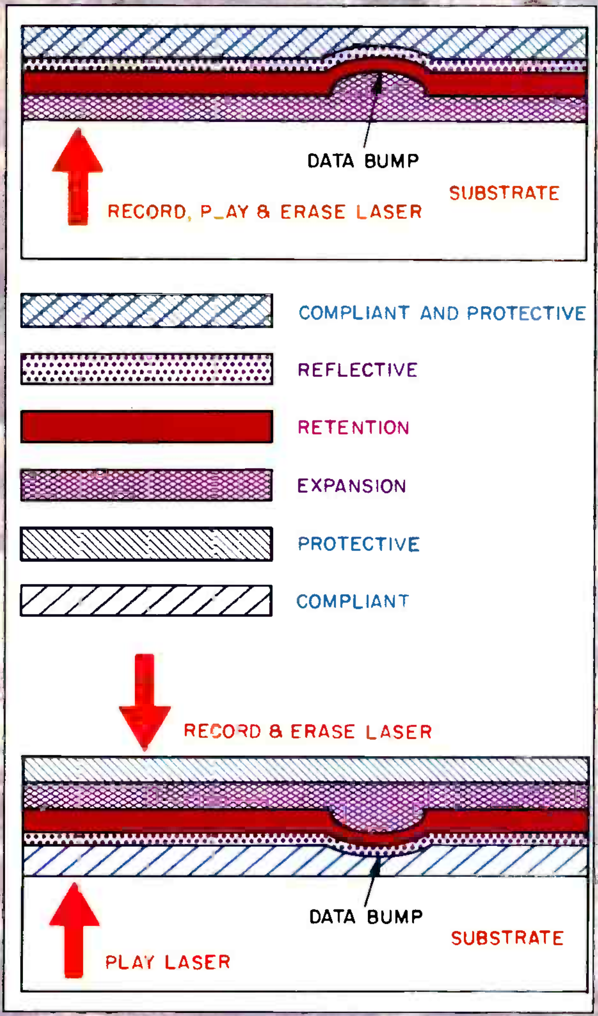


Fig. 5—Cross section of two types of bump-forming media. Note how each dictates a different laser layout in the recorder.

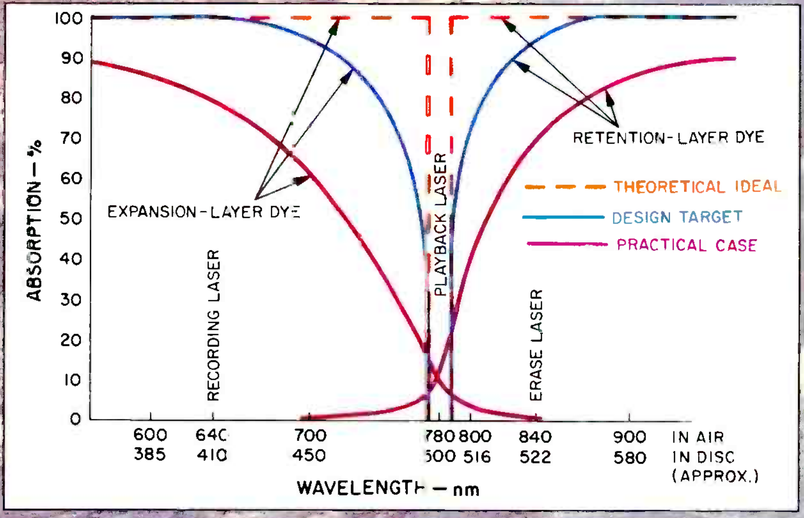


Fig. 6—Dye-polymer absorption and laser wavelengths; see text.

wavelength of the recording laser. Similarly, the tracking servo is designed to position the recording head in the area of minimum interference, in other words, between the grooves. When the recording is played back, there is no interference from the grooves because the playback head tracks on the recorded information and does not see the grooves in the substrate. A problem arises with this particular system if the refractive index of the active coating is the same as that of the substrate and the coating flows into the tracking channels. If this happens, the grooves become invisible to the recorder. A solution to this difficulty is to add a primer coating which fills the grooves and makes them visible to the recorder's laser. In dye-polymer systems, the primer may have an adverse impact on the overall performance of the media.

The recorder's servo system must be tolerant to the errors created by disc run-out created by the interface between the mounting chuck and the disc's center hole, flatness errors in the disc itself, and molding errors in the groove. These errors can add up to eccentricities that are equal to several times the pitch of the groove and take place at least once per disc revolution. Some disc-controlled tracking systems use a more complicated guide than a simple groove, such as having recorder-control information embedded in the pilot channel.

RECORDABLE CD WILL BE THE FIRST RECORDABLE MEDIUM TO BE GREETED ON ARRIVAL BY A HUGE LIBRARY OF COMPATIBLE PRERECORDED MATERIAL.

All tracking controls embedded in the disc substrate increase the manufacturing cost of what is already an expensive piece of plastic. The substrate blank for a CDR must be free from optical and mechanical flaws which can cause errors, such as dropouts, during the recording process. The tight specifications for substrates result in a higher manufacturing cost than that of a finished CD. When the costs for coating materials and processing are added, the result is a high basic cost. This generates a retail price for a blank CDR greater than that of a commercial CD that already includes music.

The high costs associated with the blank discs cause the developers of the media to pressure the designers of recorders to consider ways of having the recorders control the tracking. No recorder designer has yet developed a cost-effective tracking system. Also, as discussed above, the technical difficulties are such that unless a brilliantly conceived floating-point servo is designed, which automatically isolates the focused light beam from outside influence, a recorder-controlled tracking system will never appear on a consumer machine.

Conclusion

The audio community has been allowed to believe that the principal block to CDR is opposition by the music industry to digital recording equipment for the consumer market. The release of Digital Audio Tape recorders to the stores suggests that the music industry's objection is no longer the overriding problem facing home digital media such as the recordable CD, especially since the Serial Copy Management System now built into consumer-level DAT recorders to prevent multiple copying can also be included in a DAD machine. It is far more likely that the important reasons why consumer CDR has not appeared are that the systems the engineers are offering to the marketeers have too high a level of projected costs and that they lack compatibility with CD. Without CD compatibility, rapid random access to recorded programs is the only advantage CDR has over such less costly alternatives as DAT and DCC. Quick random access may well be important to the professional user, but it may not weigh very heavily in a consumer's decision to buy when DCC is available at a much lower price. If the only compatible CDR available is a WORM system, it is questionable whether the ability to play the recordings on standard CD players will outweigh the severe disadvantage of not being able to correct mistakes and erase and reuse the media.

The CD is a remarkable and successful product, one of those rare developments that is a technical success, a commercial success, and a revolutionary product. The CD has caused rapid and permanent change in the audio industry as a whole because the convenience in use and the matchless quality of the reproduced sound proved to be irresistible to the public. Nevertheless, there is a definite possibility that a commercially successful CDR will never exist. A

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For further information, the following books are recommended. They were of great assistance to me in the preparation of this article and are very valuable for the extensive reference bibliographies given in each.—*M.B.M.*

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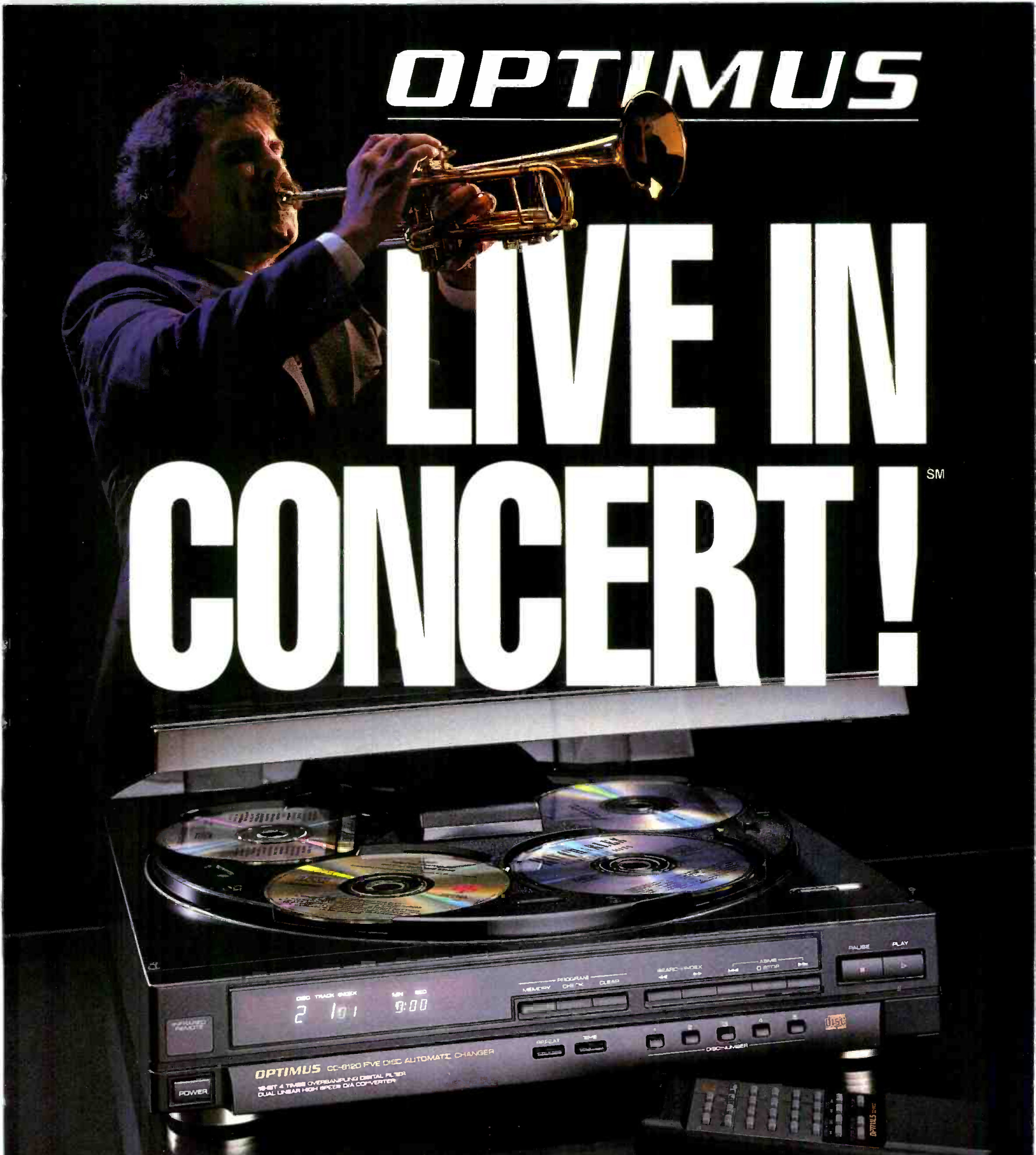

Tonight, enjoy the performance that continues where others end. The Optimus® CD-6120 changer plays up to five compact discs in sequence, up to 32 selections in any order, even random selections for a different concert every time. You get remote control convenience plus a design that lets you view titles and add or remove discs during play. Most importantly, the sound is superb—pure digital stereo with all the energy of the live performance.

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1

TECHNICS SA-GX910 A/V RECEIVER

Manufacturer's Specifications

FM Tuner Section

Mono Usable Sensitivity: 11.2 dBf.
50-dB Quieting: Mono, 20.2 dBf; stereo, 40.2 dBf.
S/N: Mono, 75 dB; stereo, 70 dB.
THD: Mono, 0.2%; stereo, 0.3%.
Frequency Response: 20 Hz to 15 kHz, +1.0, −2.0 dB.
Alternate-Channel Selectivity: 65 dB.
Capture Ratio: 1.0 dB.
Image Rejection: 50 dB at 98 MHz.
I.f. Rejection: 90 dB at 98 MHz.
Spurious-Response Rejection: 80 dB at 98 MHz.
AM Suppression: 50 dB.
Channel Separation: At 1 kHz, 40 dB; at 10 kHz, 30 dB.
Carrier Leakage: At 19 kHz, −35 dB; at 38 kHz, −50 dB.

AM Tuner Section

Sensitivity: 20 µV; 330 µV/m.
Selectivity: 55 dB.
Image Rejection: 40 dB at 1 MHz.
I.f. Rejection: 60 dB at 1 MHz.

Video Section

Composite Video Output Voltage: 1.0 V peak to peak, ±0.1 V, for 1 V input.
Maximum Input Voltage: 1.5 V peak to peak.
Input and Output Impedance: 75 ohms, unbalanced.
S-Video Input and Output Voltages: Y (luminance), 1 V peak to peak; C (chrominance), 0.286 V peak to peak.

Digital Section

Harmonic Distortion: 0.005% at 1 kHz.
Frequency Response: 2 Hz to 20 kHz, ±0.3 dB.

Amplifier Section

Rated Power: Front channels, 125 watts/channel into 8 ohms, 20 Hz to 20 kHz; rear channels, 30 watts/channel into 8 ohms at 1 kHz; center channel, 60 watts at 1 kHz.
Rated THD: Front, 0.008%; rear and center, 0.8% at 1 kHz.
Dynamic Headroom, Front Channels: 1.2 dB.
SMPTE-IM Distortion, Front Channels: 0.01%.
Frequency Response, Front Channels: High-level inputs, 7 Hz to 70 kHz, ±3.0 dB; phono, RIAA standard curve, ±0.8 dB.
Input Sensitivity for 1 Watt Out: High level, 27 mV; phono, 0.4 mV.
S/N (re: 1 Watt): High level, 70 dBA; phono, 70 dBA.
Maximum Phono Input Voltage: 160 mV at 1 kHz.
Tone Control Range: Bass, ±10 dB at 50 Hz; treble, ±10 dB at 20 kHz.
Four-Band Parametric Equalizer Range: ±10 dB.
Loudness Compensation at −30 dB: +9 dB at 50 Hz.
Damping Factor, 8 Ohms: 30.

General Specifications

Power Requirements: 120 V a.c., 60 Hz, 500 watts, 650 VA.
Dimensions: 16 15/16 in. W × 6¼ in. H × 16⅞ in. D (43 cm × 15.8 cm × 42.9 cm).
Weight: 33½ lbs. (15.2 kg).
Price: $899.95.
Company Address: One Panasonic Way, Secaucus, N.J. 07094.
For literature, circle No. 90

More than an audio receiver, the Technics SA-GX910 is designed to serve as a complete control center for home A/V entertainment systems. It therefore has such features as Dolby Pro-Logic surround sound decoding, digital signal processing (DSP), one-bit D/A signal conversion, and a four-band parametric equalizer that can be used as an alternative to the receiver's conventional tone controls.

The receiver contains five power amplifiers: Front-channel amps rated at 125 watts per channel, rear-channel amps delivering 30 watts per channel, and a center-channel amplifier that can pump out up to 50 watts. The built-in Dolby Pro-Logic circuitry utilizes all five of these outputs for three-dimensional reproduction of stereo audio tracks on videotapes or LaserDiscs.

The receiver's MASH one-bit D/A converter and digital interface allow digital input from, and output to, CD players or DAT recorders. The unit's DSP circuits can simulate the acoustics of a concert hall, jazz club, or stadium, and the DSP's adjustable time delay enables you to vary the apparent size of these simulated environments.

The four-band parametric equalizer lets you choose from among 28 center frequencies and select bandwidth and the amount of boost or cut. Three EQ curves have been preset at the factory, and the user can set three more for one-button recall. Conventional bass and treble tone controls are also included. And settings can be checked with the 11-element, 15-band spectrum-analyzer display.

The tuner section of the SA-GX910 offers *rotary* digital tuning, with memories for up to 30 AM and FM stations and a choice between manual and automatic tuning modes. As for other signal sources, the receiver has two more analog audio inputs and two analog tape loops, one optical digital input and tape loop, A/V loops for two VCRs, and two A/V inputs. All of the unit's video connections, including the front-panel camcorder input, have both composite and S-video jacks. The front-panel A/V and headphone jacks are gold-plated.

The infrared remote control can learn command codes from the remote controls of other components, even if those components are made by other companies. The receiver has a fan to prevent heat buildup during extended periods of high-power operation. I might mention that at no time during my tests (including those involving full power output) did the fan operate.

Photograph: Michael Groen

Control Layout

This receiver's versatility necessitated the design of a control-laden and perhaps intimidating front panel. Even the most experienced audio enthusiast will need to spend some time consulting the owner's manual—at least during the first week or so of use. That owner's manual, incidentally, contains 75 pages of text and diagrams!

A "Power" switch, a pair of speaker pushbuttons, and a stereo 'phone jack are at the extreme left of the panel. Buttons associated with the parametric equalizer and a button for varying the display mode are arranged to the right of the speaker buttons. The "Display Mode" control selects either bar-graphs or dot outlines of the spectrum-analysis or equalization curves; pressing it for more than 3 S starts a demonstration of the parametric equalizer's capabilities. Additional buttons further down on the panel take care of turning the parametric EQ feature on or off, fine-tuning the center frequency of each EQ band, adjusting the slope or Q of each filter, and, finally, switching from the parametric EQ to conventional tone controls. Two rotary controls adjust boost or cut levels in either the EQ or the tone-control mode. A graphic display shows the selected response curve whenever these controls' settings are changed, reverting to a spectrum analysis of the signal at other times. In addition, the display tells the user the status of just about every control and function of the receiver.

Directly below the display are 10 numbered buttons used in memorizing and selecting AM and FM station frequencies. For presets with double-digit numbers (10 through 30), two buttons must be pressed in sequence—i.e., "1" and "6" for station 16.

Another row of buttons below the presets takes care of various surround functions. These include selecting Dolby 3 Stereo (a three-speaker setup for those who do not wish to employ all five speakers needed for Dolby Pro-Logic), adjusting "Delay Times," and activating a Dolby test signal for adjusting the relative levels of all five speakers for uniform surround.

Larger pushbuttons along the lower portion of the panel take care of program source selection and tape monitoring. The upper right corner of the front panel sports a large, calibrated "Volume" control, a rotary "Tuning" knob, and a "Tuning Mode" pushbutton that selects manual, automatic, or "locked" tuning. This last-named mode prevents acci-

Technics quotes all their amplifier specifications in accordance with IHF/EIA Standards. Would that more companies did so!

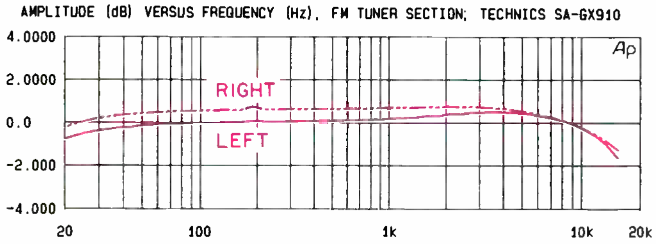

Fig. 1—FM tuner frequency response.

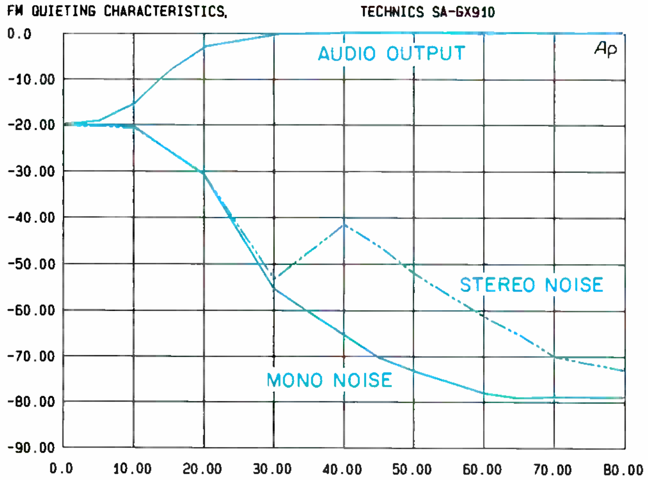

Fig. 2—FM quieting characteristics. Quieting and sensitivity are actually better than shown; see text.

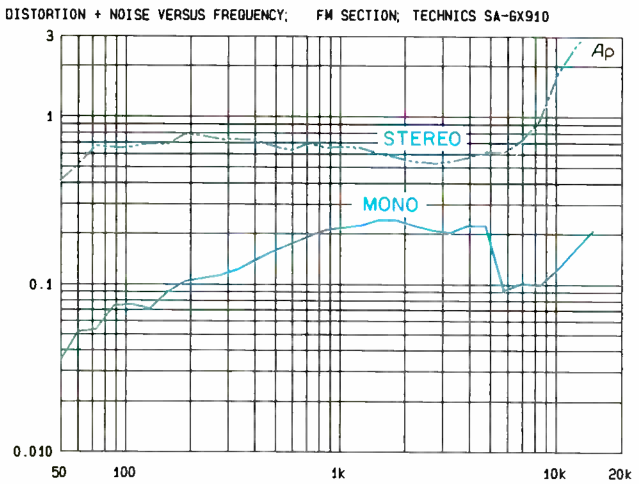

Fig. 3—FM section THD + N vs. frequency.

dental detuning of the current station if the rotary tuning knob is inadvertently turned. The AM and FM band selector buttons, an FM stereo mode button, a "Memory Scan" button, and a button for presetting station frequencies are all beneath the volume knob. Further down, at the lower right-hand corner, are a "Loudness On/Off" button, a Dolby "Surround Input Balance" control (to minimize dialog leakage in the surround channel), the "Balance" control, and a set of audio and video input jacks.

The rear panel of the SA-GX910 receiver is almost as densely populated as the front panel. Here are found the optical digital, analog audio, composite video, and S-video jacks corresponding to the inputs and outputs mentioned earlier plus a center-channel preamp-level output, front-channel preamp-out/main-in jacks (normally strapped together), and the speaker outputs—40 jacks in all. Binding posts are provided for the front and center speakers; terminals for the rear speakers are the smaller, spring-loaded type. A coaxial FM antenna connector and AM antenna terminals are at the left end of the rear panel, along with a ground terminal. Also on the rear are a pair of switched a.c. outlets, a speaker impedance-matching switch, the receptacle for the detachable line cord, and a "Remote Control Out" jack. The circular opening for the exhaust fan completes the panel layout.

Measurements

As with all receivers that I test, I measured the FM tuner section's performance first. All measurements were made at the front speaker outputs, which listeners use most, rather than at the record outputs. Figure 1 shows the frequency response of the FM tuner section. Response is down 0.6 dB at 20 Hz and 1.7 dB at 15 kHz. There is a marginal difference in level between channels, no more than 0.4 dB at any frequency, with the balance control centered.

Measuring the quieting characteristics of this tuner proved to be something of a problem, because the antenna input's coaxial connector is not the standard U.S. type and I lacked an exact adaptor for it. Technics supplies a 300/75-ohm transformer to fit that connector, but using it also meant that I had to use a second transformer that comes with my 75-ohm signal generator. The two transformers in series introduced a signal loss that I estimate at about 6 dB. Accordingly, in examining Fig. 2, it is appropriate to subtract 6 dBf from the readings. Thus, while it appears that the 50-dB quieting point for mono occurs at 27 dBf, the correct figure is more like 21 dBf; for stereo reception, the 50-dB quieting point is about 42 dBf rather than the 48 dBf shown on the graph. Ultimate quieting, however, needs no such correction factor: The signal is strong enough at 65 dBf so that no further quieting takes place with stronger signals applied. Best S/N in mono for strong signals is truly around 78 dB, better than claimed by Technics. For stereo reception, S/N reaches the specified 70 dB at an input level of 70 dBf, then increases a bit more, as shown.

Figure 3 shows how THD + N varies with frequency. For mono reception, THD + N at 1 kHz is a bit more than 0.2%, dropping to about 0.1% at 6 kHz and about 0.075% at 100 Hz. Stereo THD + N measures 0.65% over much of the frequency range. Figure 4 shows how THD + N varies with

I can't think of another high-powered receiver that offers as much control and flexibility as the SA-GX910.

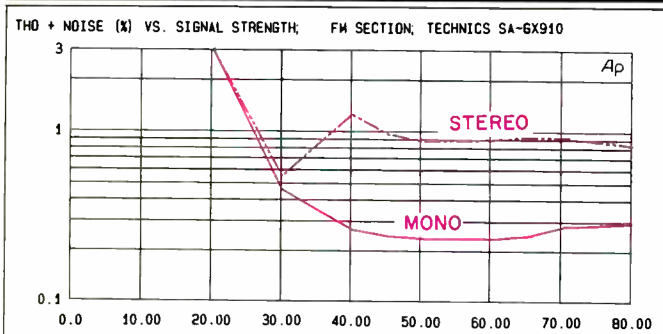

Fig. 4—FM section THD + N vs. signal input level. Usable sensitivity is actually better than shown; see text.

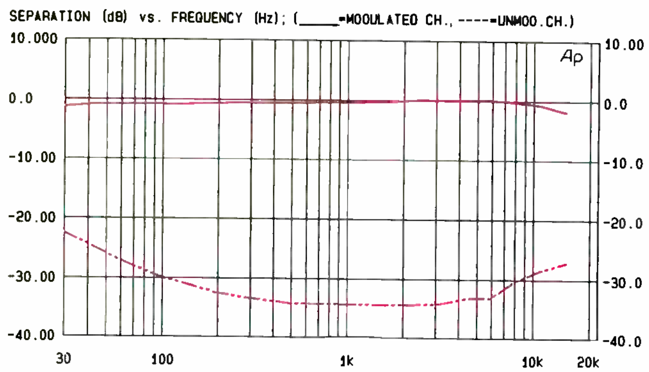

Fig. 5—Channel separation for 65-dBf FM signal.

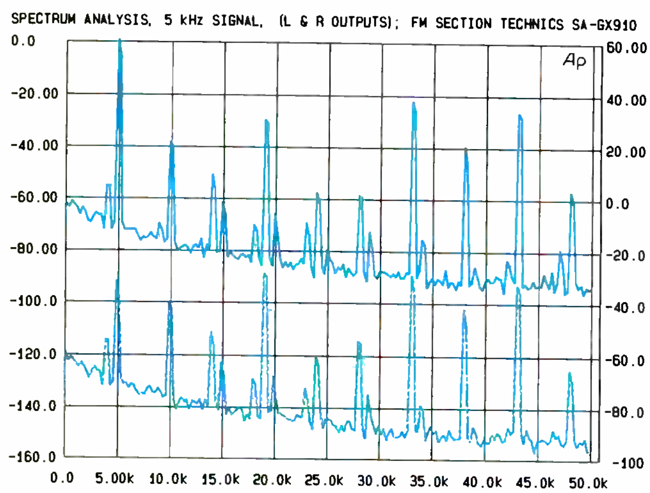

Fig. 6—Spectrum analysis, FM stereo mode, one channel modulated with 5 kHz (top), other channel unmodulated (bottom). Use the right-hand scale for the bottom curve.

input signal strength. Here again, the losses incurred by my having to use a pair of impedance transformers in series must be taken into account. So, usable mono sensitivity is really around 14 dBf as opposed to the 20 dBf shown.

Channel separation falls somewhat short of published specifications but is adequate for creating a satisfactory stereo image (Fig. 5). Separation is 34.5 dB at 1 kHz, 30 dB at 100 Hz, and 28.5 dB at 10 kHz. However, I soon discovered that this seemingly reduced separation was due to the high level of subcarrier products in the output signals rather than to actual crosstalk of the modulating signals. Consider, for example, the spectrum analysis of a 5-kHz signal that was used to modulate only the left channel. As shown in Fig. 6, the 5-kHz "spike" has an amplitude of 0 dB (the reference level), while the crosstalk at that frequency is at a level of −37 dB, at least 3 dB lower than would be implied by referring to the graph of Fig. 5. Note, too, that the 19-kHz component, in both the modulated and unmodulated channels, is down by only about 30 dB from reference level, and the sidebands at 33 and 43 kHz (5 kHz to either side of the suppressed 38-kHz subcarrier) are also quite large in amplitude. Although all of these subcarrier components are generally inaudible, the high level of 19-kHz output might well have an adverse effect on tape recordings made using Dolby B or Dolby C noise reduction. I was somewhat surprised to see that these high-frequency components had not been effectively attenuated as they are in many other tuners and receivers. On the other hand, I commend Technics for at least specifying the level of 19-kHz carrier leakage pretty realistically as −35 dB. Other measurements made for the FM section include capture ratio, which was 1.5 dB; selectivity, which was 67 dB; image rejection of 55 dB, and AM suppression of 52 dB.

The less said about the performance of this receiver's AM section the better. With so much effort on the part of AM broadcasters to improve their signals (if not their program content) and to comply with recent NRSC standards, it is surprising to me that makers of superb receivers such as this one still pay virtually no attention to AM performance. Figure 7 shows how poor the AM frequency response is; the −6 dB attenuation points occur at 80 Hz and 3.3 kHz. The NRSC standards dictate that response should be within ±3 dB of flat out to 7.5 kHz! Enough said.

Preamplifier and amplifier measurements for this receiver were made via the CD inputs (with the exception of phono and direct digital input measurements). Figure 8A shows the frequency response obtained using the analog CD inputs. Response is down by barely 0.5 dB at 20 Hz and by 0.4 dB at 20 kHz. At 50 kHz, response is down by 1.5 dB. Frequency response was also measured by feeding digital signals from my test system to the SA-GX910's optical digital input. The results, shown in Fig. 8B, do not differ in any great respect from those obtained via the analog inputs.

Using the equalizer's tone-control mode, I next plotted the range of the bass and treble controls, and results are shown in Fig. 9. Note that midrange frequencies are only minimally affected even when the bass and treble controls are turned to their extreme boost or cut positions. This, to my mind, has always been the preferred approach to tone-control design. Switching to the parametric equalization mode, I set up an

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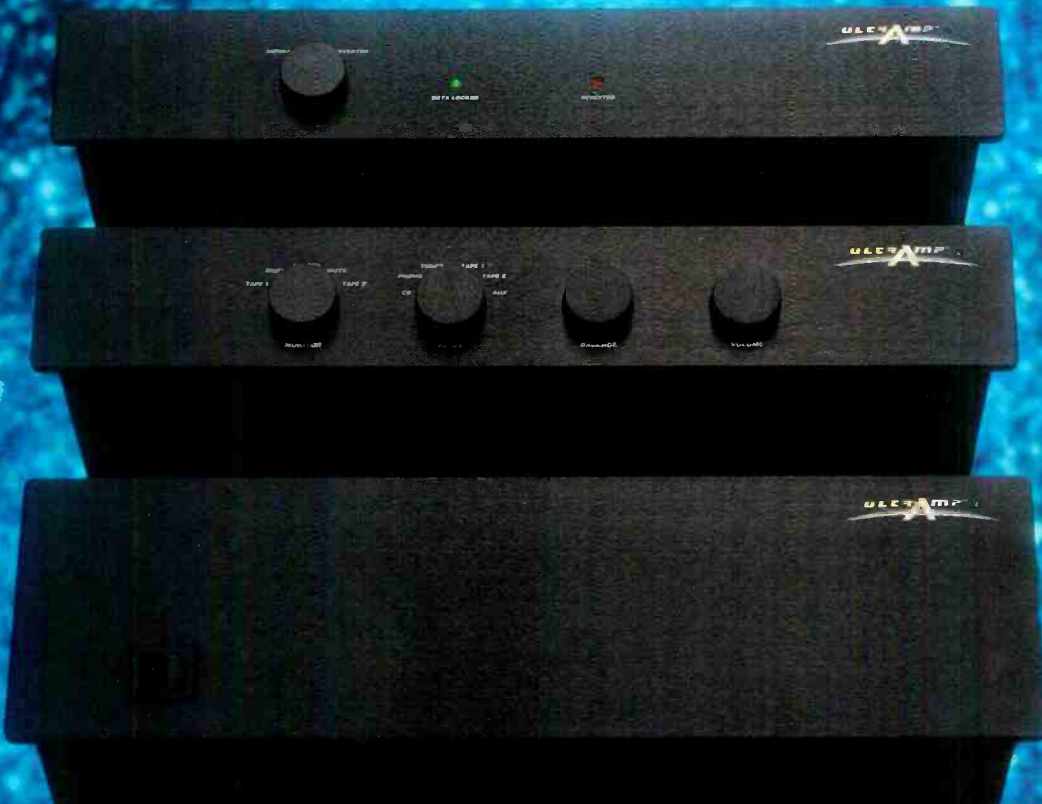

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Being able to tweak the response with the top band of the parametric equalizer tamed my room's high end as no treble control could.

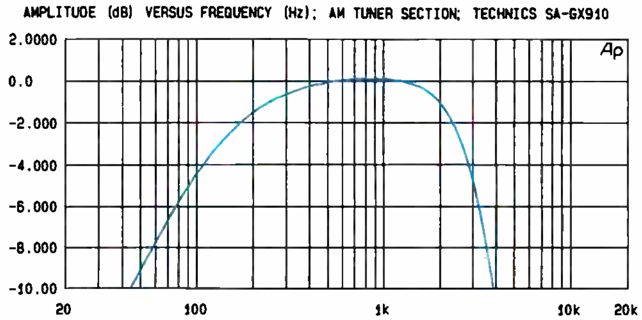


Fig. 7—AM section frequency response, using 75-µS pre-emphasis and de-emphasis.

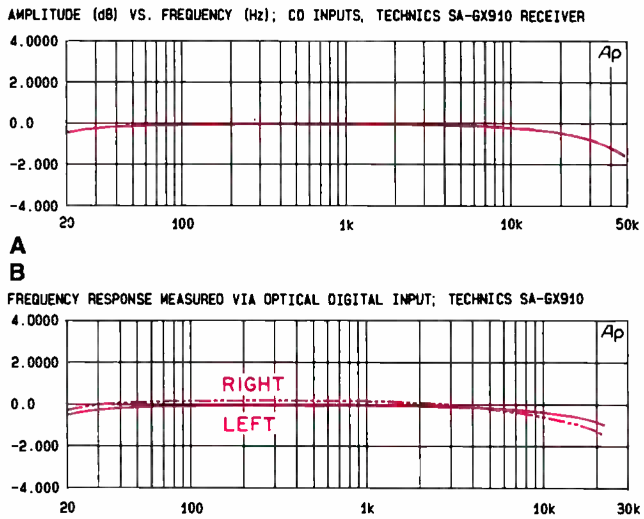


Fig. 8—Frequency response, at front speaker outputs, for analog signal via CD inputs (A) and digital signal via optical input and receiver's internal D/A converter (B).

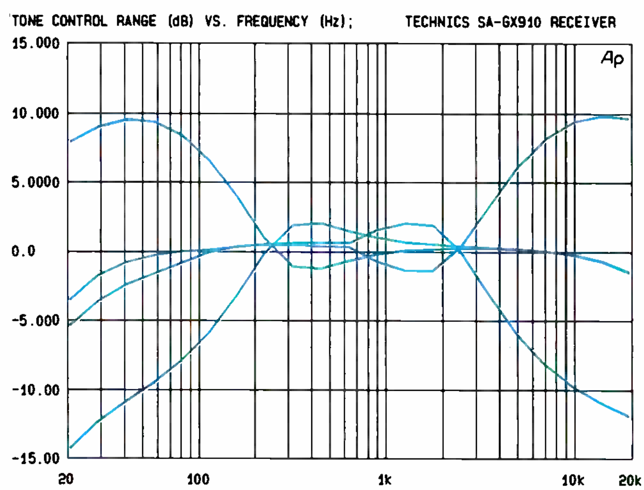


Fig. 9—Bass and treble control range.

admittedly arbitrary (and no doubt exaggerated) response curve just to see how flexible the parametric EQ circuitry is. My test curve (not shown) had a sharp peak at 100 Hz, a sharp dip at about 1.6 kHz, and a broad peak from 10 to about 17 kHz, followed by a slope that was down to –15 dB at 80 kHz.

Checking the loudness compensation next, I saw that Technics has wisely confined the action to the bass region only. The amount of bass boost varied smoothly, from just a couple of dB at volume settings of –10 dB to the full +9 dB at settings of –30 dB and lower.

Turning to the power amplifier sections for the front speakers, I next measured THD + N versus frequency for the rated output of 125 watts/channel into 8-ohm loads (Fig. 10). Over much of the frequency spectrum, THD + N is around 0.01% at this high power output level, but at low frequencies, THD tends to rise, reaching a still insignificant level of 0.068% at 20 Hz. Good correlation with these results was obtained when I plotted THD + N versus power at 20 Hz, 1 kHz, and 20 kHz. The results (Fig. 11) are nearly identical for the 1- and 20-kHz test frequencies but show a higher level of distortion at 20 Hz.

In order to isolate actual distortion components from residual noise, I used the FFT spectrum-analysis facilities of my Audio Precision test equipment to display the harmonic components associated with a 1-kHz signal at rated output of 125 watts. The significant harmonic components were at 2 and 3 kHz, with much smaller harmonic components visible at 4, 5, 6, and 7 kHz. The most significant component (3 kHz) was 81.9 dB below reference level, which corresponds to a true THD value of 0.008%, precisely the value specified by Technics. As to SMPTE-IM distortion at rated output, it was 0.023% for the left channel and 0.025% for the right channel.

Signal-to-noise ratio for high-level inputs, referred to 1 watt output with an input of 500 mV, measured –76 dBA for the left channel and –75.1 dBA for the right. These results may be compared directly with the published specifications, since Technics quotes all of their amplifier specifications in accordance with the IHF/EIA Amplifier Measurement Standards adopted in 1978. (Would that more manufacturers would do so!) A third-octave spectrum analysis of residual noise (again referred to 1 watt output) showed noise peaks of about –90 dB at the 60-Hz power-line frequency and its harmonics of 180 and 300 Hz; otherwise, the curve sloped from about –108 dB at 30 Hz up to about –82 dB at 20 kHz. For the phono inputs, for a volume setting that produced 1 watt from a reference input of 5 mV, S/N with the signal removed and input jacks shorted was –75.9 dBA for the left channel and –75.2 dBA for the right.

Sensitivity for the high-level inputs measured 24 mV for 1 watt output, while for the phono inputs, the signal required to produce the same output was 0.29 mV at 1 kHz. Applying an RIAA-equalized signal to the phono inputs produced the frequency response curve shown in Fig. 12. Deviation from correct RIAA playback equalization is negligible from 20 kHz down to around 50 Hz. Below this frequency, Technics elected to use the IEC playback curve (which attenuates response below 50 Hz to reduce the effects of turntable rumble) rather than the RIAA curve.

This receiver should help convince people that they needn't spend $30,000 for a home theater system.

Use and Listening Tests

As I have stated in previous reports; it is difficult to graph frequency response for the center and surround channels because of the time delays in surround and ambience decoding circuitry. Accordingly, the most meaningful evaluation of surround sound circuits lies in listening and in hooking the component up to a complete home entertainment system, including a large-screen TV, a VCR or two, a videodisc player, and the appropriate number of loudspeakers (in this case, five). That's precisely what I did, and the results were extremely satisfying.

The receiver's remote control truly allows you to clear your coffee table of all those other remotes. Just about everything I wanted to do (short of loading my VCR and videodisc player) was accomplished from the comfort of my easy chair. I can't think of another high-powered receiver that offers so much control and flexibility. My "home theater" has always suffered from a bit too much high-end brilliance, owing to wood panelling that was there long before I converted the room to a home theater. Being able to tweak the response with the top band of the SA-GX910's parametric equalizer really tamed that high end in a manner that is not possible with an ordinary treble control. I had a great time just listening to some of my latest CD acquisitions from Telarc, notably the Cleveland Quartet's rendition of Dvořák's Quartet No. 12 (CD-80283) and Mahler's Eighth Symphony, beautifully performed by the Atlanta Symphony Orchestra and Chorus under Robert Shaw's direction (CD-80267). If some CDs are criticized for an overly brilliant high end, such was not the case once I adjusted the parametric equalizer to take the edge off the room's highs.

The real thrill came when I integrated video viewing with listening. A recent limited-edition LaserDisc from Pioneer and *Sports Illustrated*, called *On the Edge*, contains footage shot around the world to provide viewers with the excitement of adventure from the athlete's point of view. There's everything from windsurfing to hang gliding and bobsledding. The thrills are augmented by the Dolby Surround soundtrack, properly reproduced by this receiver and my five loudspeakers. Then, to calm the spirit and come down from the visual and aural "high," I watched and listened to a Sony Classical LaserDisc, *The Loves of Emma Bardac*. This imaginative French Impressionist musical docudrama, originally shot in 1,125-line, 60-frame/S high-definition video, intertwines no less than seventy 19th-century Impressionist paintings with music by the duo pianists Katia and Marielle Labeque. As the music was not recorded in Dolby Surround, I used the receiver's "Hall" surround mode to advantage while watching this enchanting video.

To have created such a complete electronic entertainment package in a single component was, I am sure, no easy task for the engineers at Technics. They have done a remarkable job and produced a receiver at a price that should prompt many audio enthusiasts to go the whole route toward a home theater system. The Electronic Industries Association has been sponsoring a series of exhibits designed to convince consumers that home theater need not involve an investment of $30,000 or more. Technics' SA-GX910 receiver goes a long way toward corroborating the EIA's message. *Leonard Feldman*

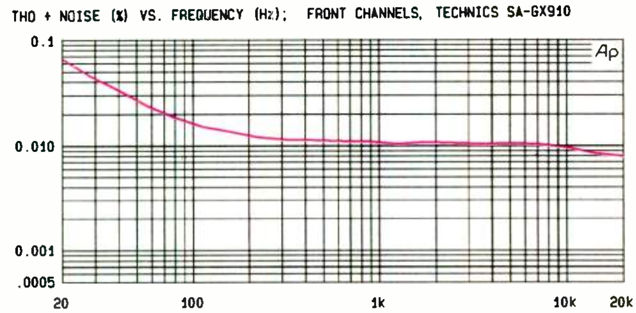


Fig. 10—Front-channel amplifier THD + N vs. frequency, at rated output (125 watts/channel into 8 ohms, both channels driven).

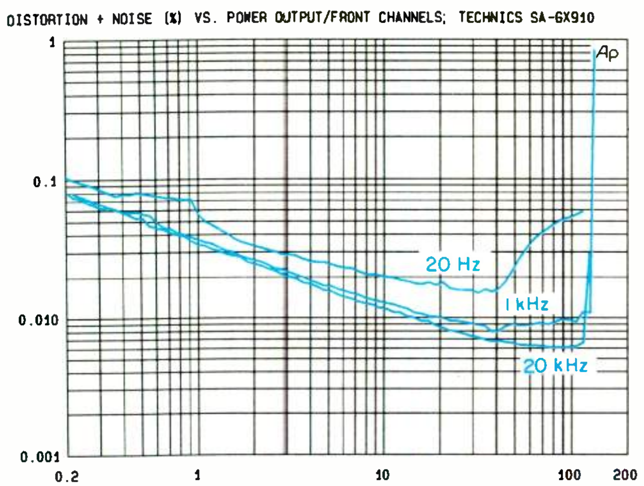


Fig. 11—THD + N vs. power output for front channels.

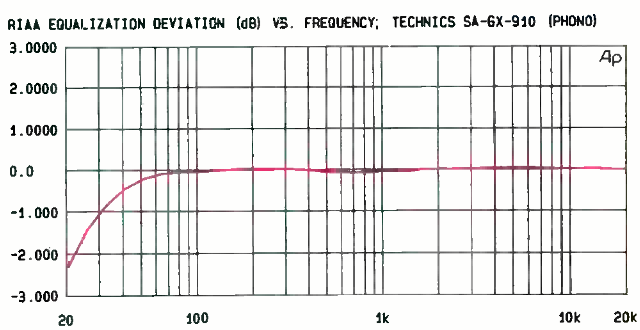


Fig. 12—Deviation from RIAA equalization; see text.

EQUIPMENT PROFILE

2

MAPLENOLL SIGNATURE ARIADNE TURNTABLE AND ARM

Manufacturer's Specifications

Turntable Type: Belt drive, with solid lead platter on air bearing.
Speeds: 33⅓ and 45 rpm.
Speed Accuracy: Within 0.3%.
Wow & Flutter: Less than 0.03%.
Rumble: Less than −80 dB, per DIN 45-529.
Tonearm Type: Linear tracking, with air bearing.
Effective Tonearm Length: 7 in.
Cartridge Weight Range: 3 to 16 grams.
Tracking Force Range: 0 to 6 grams.
Vertical Tracking Angle Adjustment: 1 inch, in 1/200° increments.
Overhang and Anti-Skating: None.
Air Pump Pressure: Nominal, 40 pounds per square inch; maximum, 100 psi.
Dimensions: 14¾ in. W × 17¼ in. D × 7 in. H (37.5 cm × 43.8 cm × 17.8 cm).
Weight: 135 lbs. (61.4 kg) with 50-lb. lead platter.
Prices: With standard 50-lb. lead platter, $4,095; with 70-lb. platter, $4,275; with 30-lb. platter, $3,915.
Company Address: 1095 Bellbrook Ave., Xenia, Ohio 45385.
For literature, circle No. 91

In the past, I have written reports about turntables that had an air-bearing tonearm mounted on them, such as the Eminent Technology and the Goldmund, but Maplenoll's Signature Ariadne goes a step further: It utilizes air-bearing technology for both the main bearing of the turntable and the vertical and lateral bearings of the tonearm. Actually, the Signature tonearm's air bearing combines the vertical and lateral functions into one bearing. If you are not familiar with how air bearings work, you need to know that the bearings are used as the contact area between the load and its support, that is, the air bearing floats the load on a thin film of air. An air compressor is used to supply air that is forced through tiny holes in the fixed part of the bearing; the air spreads out and suspends the moving part of the bearing. Friction, which is present in other types of bearings, is practically nonexistent in an air bearing, but the fact that a compressor is necessary has limited the use of air bearings for most applications.

Bob Dilger, the president of Maplenoll Electronic Co., related some of the history behind the use of air bearings for turntables and tonearms. He told me that Prof. Lew Eckhard developed the air-bearing turntable platter and tonearm.

The Wayne H. Coloney Co., which had the rights to Eckhard's patents, made an air-bearing turntable in 1978, but by 1980 it was no longer being produced. When Dilger retired from the Air Force, he came across Eckhard's original air-bearing designs. He was intrigued with the idea and bought the rights to the air-bearing turntable and tonearm in 1980. The first turntable and tonearm system Dilger produced, the Athena, was introduced in 1981 and remained in production until 1988; it cost $795. The original tonearm was similar to the Eminent Technology arm. Bruce Thigpen, the president of Eminent Technology, had been with the Wayne Coloney Co. before it got out of the hi-fi business. Dilger says that both the Maplenoll and Eminent Technology air-bearing arms have gone through many design changes and refinements. As a result, although conceptually the same, the two arms have many design differences.

The Shure Ultra 500 moving-magnet cartridge (now discontinued) was selected for this report because it was the top of the Shure line and I felt it would be a worthy companion to the Signature tonearm for the technical measurements and listening tests. I used other cartridges which also performed well, but the data in this report was generated using the Shure Ultra 500.

The platter of the Maplenoll turntable is the heaviest that I have ever seen or heard of, and it is made of lead. The standard platter is 50 pounds, and lead platters from 30 to 120 pounds are available. The unit I tested had a 70-pound lead platter, although I would recommend you check out one of the lighter platters, which I think would be more than sufficient. Besides its air bearing, the Signature tonearm is also unusual in having a damping system in front of the cartridge position. A bracket, extending out over the cartridge mount, holds a damping plunger that sits in a plastic trough ahead of the cartridge. Damping is provided by a high-viscosity oil in the trough. Motor oil is used because it is soluble in cleaning solutions for vinyl records. If the oil should happen to drop on a record, it will not irreparably harm it. Maplenoll is not the only maker to use this idea; a turntable produced by Townshend Audio in England, the Elite Rock, used a trough for tonearm damping, as does the Well Tempered, which I have reviewed.

The Signature turntable has no suspension and relies on its mass for stability and isolation from outside vibration. Even with the 70-pound platter removed, it weighed 67 pounds. The heaviness is due mainly to the 40-pound lead stabilizing plate inside the Signature turntable base. The base itself is machined from mottled gray and white DuPont Corian, then polished to a high gloss.

The Maplenoll turntable base is 14¾ inches wide, 17¼ inches deep, and 3¾ inches high. It is made as a sandwich that is held together by special epoxies and clamped during the long curing process. Polishing the base takes about 5 hours and involves many hand operations. The total height, including the tonearm, is about 8¼ inches. The tonearm counterweight rod extends about 3¾ inches beyond the rear of the base, so the actual depth required for the turntable is about 21 inches. A slot, 4½ inches long × 1⅜ inches wide, extends through the base, near the right rear. This slot allows free passage of the extremely fine tonearm wires from the arm to a plate on the left rear of the base that holds the phono jacks and the ground terminal. The a.c. power cord and the air hose exit from the left rear of the base.

MEASURED DATA

Maplenoll Signature Ariadne Turntable

PARAMETER	MEASURED	COMMENT
Speed Stability	±0.20%	Very good
Wow, DIN Unwtd.	0.18%	Very good
Wow, DIN Wtd.	0.08%	Excellent
Flutter, DIN Unwtd.	0.10%	Excellent
Flutter, DIN Wtd.	0.04%	Excellent
Wow & Flutter, DIN Unwtd.	0.22%	Very good
Wow & Flutter, DIN Wtd.	0.08%	Excellent
Long-Term Drift	0.14%	Very good
Rumble, Unwtd.	74.6 dB	Excellent
Rumble, Wtd.	89.7 dB	Excellent

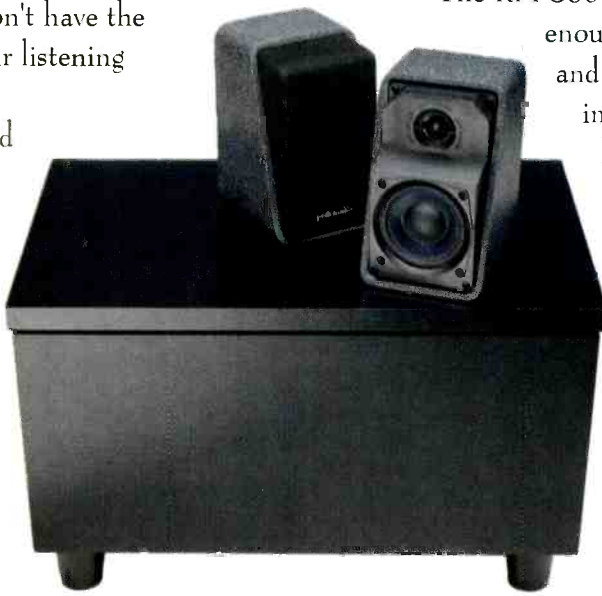
Maplenoll Signature Ariadne Tonearm

Pivot-to-Stylus Distance: 7.375 in. (187 mm).
Pivot-to-Rear-of-Arm Distance: 7.3125 in. (185.7 mm).
Tracking-Force Adjustment: Adjustable counterweight.
Tracking-Force Calibration: None.
Cartridge Weight Range: 5 to 12 grams.
Low-Frequency Resonance: 6.3 Hz with Shure Ultra 500 cartridge.
Counterweights: Three, 12.8 grams each.
Counterweight Mounting: Direct to threaded rod.
Sidethrust Correction: None needed.
Pivot Damping: Special oil-filled trough located in front of cartridge.
Lifting Device: Finger lift.
Headshell Offset: Not needed.
Overhang Adjustment: Slots in headshell.
Bearing Type: Air.
Bearing Alignment: Excellent.
Bearing Friction: Extremely low.
Lead Torque: Very low.
Arm Lead Capacitance: Left, 14 pF; right, 16 pF.
Arm Lead Resistance: 0.8 ohm, each channel.
External Lead Length: None.
Mounting: Integral with turntable.

Listing in the 90's

Today people have become more and more space conscious. Many apartment dwellers don't want to give up valuable floor space for large speaker systems. Others who are planning a surround sound or home theatre system simply don't have the room for more speakers in their listening rooms or hesitate to commit the floor or wall space to a good sounding pair of speakers.

Until now, serious music lovers have had little, if anything, to choose from that would produce a large, bigger-than-life sound in a small, compact size. Systems that fit one's space requirements have been woefully disappointing in sound quality.



The RM 3000's satellites measure 7"H x 4 1/4"W "x 5 3/8"D and are available in black matrix, gloss black piano or paintable white. The subwoofer is 12 1/2"H x 20"W x 12 1/2"D and is available with black wood grain sides and a black, mar-resistant top.

The RM 3000 Three Piece System

Polk's engineers had determined long ago that there were indeed certain technical advantages in small speaker systems. Both high and mid frequencies could be faithfully reproduced with superior transient response and dispersion characteristics, and the convenient, more flexible placement of small enclosures within the listening area could create an ideal sound stage. Unfortunately, reproducing the life-like, full body of the lower frequencies could not be achieved in a truly compact enclosure.

Polk's RM 3000 replaces the traditional pair of speakers with three elements, two compact midrange/tweeter satellites and one low frequency subwoofer system. This configuration makes it easy to properly and inconspicuously place the system within your listening room while offering superior sonic performance.

The small satellites can be located on shelves, mounted on a wall or placed on their own floor stands. They are very attractive and yet small enough to be hidden from view if desired.

The RM 3000 subwoofer is also small enough to sit behind your furniture and can be used on its side to fit into tight spaces. And since it is beautifully finished, it can be used as a piece of furniture.

The Legendary Sound of Polk

In the tradition of Polk Audio, Matthew Polk and his team of engineers were determined to make the RM 3000 sound better than any other speaker of its type.

Initial reactions have been filled with superlatives including Julian Hirsch of *Stereo Review* magazine who says, "...they sound excellent...spectral balance was excellent—smooth and seamless."

Sound as big as life from speakers

Behind these accolades is an impressive technical story.

The Technical Side

The big sound of the RM 3000 is due, in part, to the unique arrangement of the tweeter and midrange elements. This "time aligned system" delivers the high and mid frequencies at precisely the same instant. The result is a clear, lifelike and expansive presentation.

The cabinet materials selected for the satellites are over four times as dense as typical enclosures. The black matrix finish is a non-resonant polymer aggregate (FOUNTAINHEAD®). The gloss black piano and paintable white finishes are rigid ABS

small enough to live with.

surrounding a mineral filled polypropylene inner cabinet. Polk engineers have all but eliminated any "singing" or resonating of the satellite enclosure. You hear the effortless, free sound of a much larger system.

Most subwoofer systems look alike on the outside, but the Polk is worlds apart on the inside. Utilizing twin 6 1/2" drivers coupled to a 10 inch sub-bass radiator, the bass is tight and well defined. There is no tuned port to create "whistling" or "boominess" of the bass frequencies.

For deep, well defined bass, Polk uses twin drivers coupled to a sub-bass radiator. Normally, one sub-woofer system is used for both channels. For those desiring even greater low frequency performance, a second subwoofer can be added, one fed by the left channel, the other by the right channel.

You Have To Hear It To Believe It

You really won't believe how good the RM 3000 sounds until you hear it. We invite you to your nearest authorized Polk dealer for a demonstration. You'll hear sound as big as life...from a speaker you can live with.

You'll hear the next generation of loudspeakers.

polk audio

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Air-bearing tonearms are unusual enough; however, Maplenoll applies this principle to a heavy lead turntable platter as well.

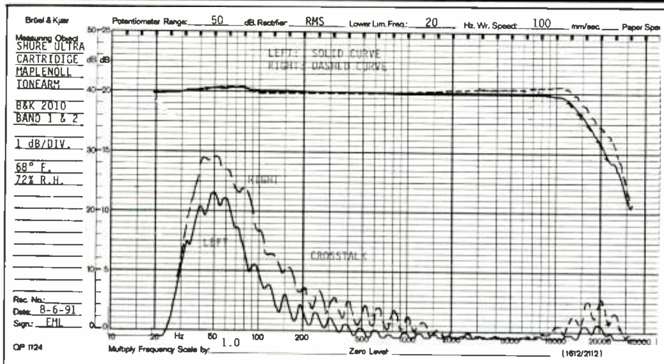

Fig. 1—Frequency response and crosstalk of Shure Ultra 500 cartridge in Maplenoll Signature Ariadne arm.

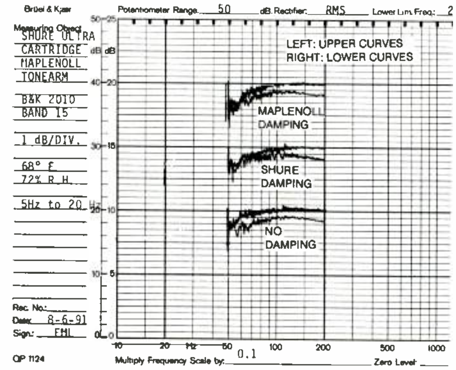

Fig. 2—Low-frequency (5 to 20 Hz) arm/cartridge resonance with arm's viscous damping, cartridge's damper, and no damping; see text.

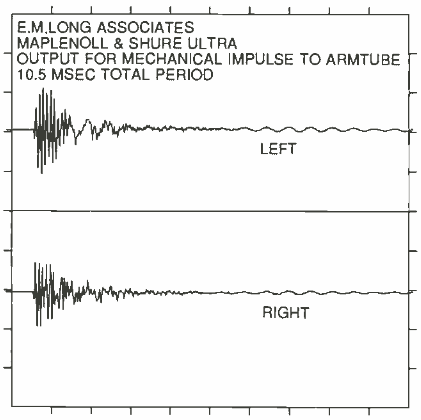

Fig. 3—Output vs. time from an impulse applied to armtube.

The motor is mounted directly to the left rear of the base. The dual-diameter pulley on the motor shaft is easily accessible, so the drive belt can be shifted from one diameter to the other to change between the 33⅓- and 45-rpm speeds.

The Signature turntable's three mounting feet are made from threaded rods and ground to a point. I wouldn't recommend mounting the turntable on anything that you wouldn't mind marking with three indentations, but you can place a quarter under each foot to prevent this. The feet at the right front and center rear are adjusted first, to level the turntable from front to back. This is done by lifting the turntable, turning the bolts, and then locking them into position against the bottom of the base with a hex nut. The left front foot's threaded rod extends through the base and is topped by a knob that allows the final levelling of the turntable to be set very accurately. This adjustment is critical because the air-bearing tonearm will drift to the right or left if it isn't exactly level.

There is a separate switch for the air compressor and the turntable motor; the compressor should be turned on first because it takes a few minutes for a thin film of air to build up between the bearing surfaces. The platter sits on the upper bearing plate and rotates with it. The bearing plates are 8 inches in diameter, and their surfaces are machined to 0.0002 inch. While the bearing could have been smaller, an 8-inch diameter was chosen to improve rigidity and resistance to rocking. The system is preset to provide 50 pounds of air pressure. Since the surface area of the bearing is 50 square inches, the net result is a uniform pressure across the bearing surface of 1 pound per square inch. You can tell if the air bearing is working because the platter turns freely; if the platter doesn't turn at all, then the compressor has not been turned on.

The motor can be turned on next. Because of the high inertial mass of the platter, it takes about 5 or 6 S to come up to speed at 33⅓ rpm and even longer at 45 rpm; in fact, at the faster speed, a gentle push by hand is useful to give the motor an assist. You might wonder why the platter has to be so massive; the high mass provides a flywheel action to smooth out any variation in speed, and even more important, according to Dilger, record vibrations are damped by the direct contact between the record surface and the mass of the lead platter.

The air compressor is housed in a wooden box made, appropriately enough, from maple. It measures 14¼ inches × 13¼ inches, is 11 inches high (including its rubber feet), and weighs 40 pounds. The plastic air hose and the power cord, which has an in-line power switch, exit from the bottom of the box. The turntable comes with long hoses that will allow the compressor to be placed far from the listening area. This is important because the compressor, while reasonably quiet, does make a certain amount of noise. My sample also emitted an odor that would not be appreciated in a listening room, but Maplenoll now provides a charcoal filter to prevent this.

As mentioned, the Signature tonearm uses a single air bearing to do the job performed by the vertical and horizontal bearings of a conventional tonearm. A large polished aluminum block serves as the housing for the fixed part of the air bearing; a black polished aluminum rod, ⅝ inch in

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Even with the damping turned off, low-frequency resonance is well damped by the air bearing.

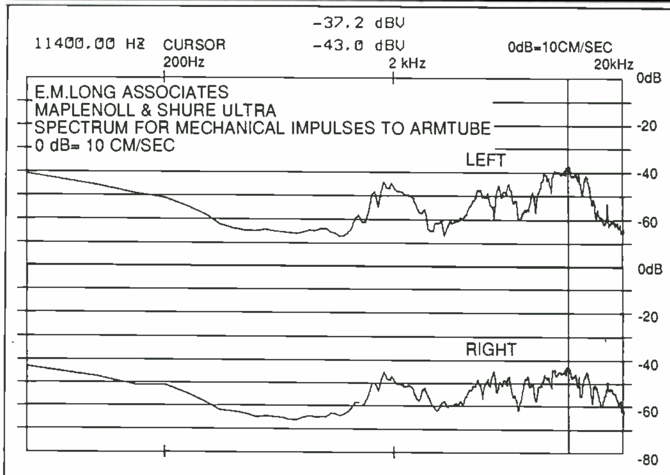

Fig. 4—Spectral output (averaged) from 16 impulses applied to armtube.

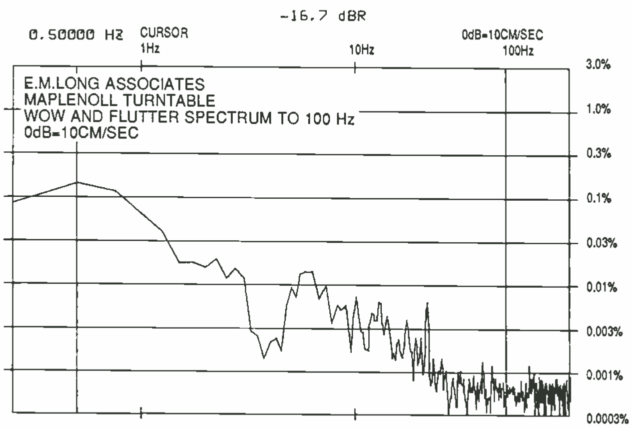

Fig. 5—Wow and flutter.

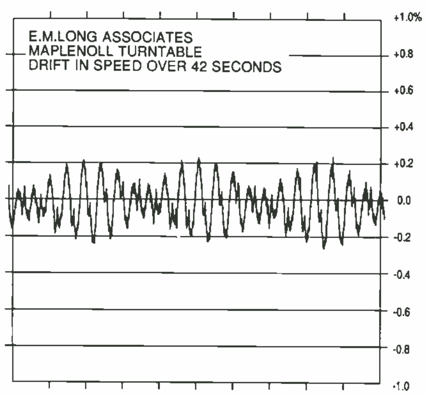

Fig. 6—Speed drift over a 42-S period.

diameter, passes through a slightly oversized hole in the aluminum block. The inside surface of the block and this surface of the rod are machined to 0.0002 of an inch. The rod, which is free to rotate, provides the vertical bearing action, and it moves laterally as well. A bracket is fastened to the left side of this rod, to which the main tonearm tube is attached; the right side of the rod has a bracket to which the threaded counterweight rod is bolted. The counterweights are three round leaden nuts and a locking plastic hex nut. The armtube bracket has adjustments for the cartridge azimuth and height above the record surface. The other end of the armtube has a mounting bracket with slots for mounting the cartridge and adjusting its position; as mentioned, the tonearm extends past the cartridge mounting bracket to provide a mounting for the damping plunger. The plunger interacts with the viscous fluid in the trough to provide the damping for the tonearm.

Measurements and Listening Tests

The setup adjustments and technical measurements were made before the listening evaluations so that I could be certain that everything was functioning correctly. The absolute polarity of the reference system and the Maplenoll/Shure system was also checked, and the recorded selections were marked for correct absolute polarity. The members of my listening panel were given a form to rate the reference system and the Maplenoll/Shure system from zero (perfect) to −5 for each musical selection. Panel members are encouraged to write comments about the perceived quality of the sound, but they are asked not to talk or make any outward sign during the playing of a selection. I put the Signature Ariadne's air compressor in a separate location so it would not distract them.

Figure 1 shows the crosstalk and frequency response of the Maplenoll/Shure combination. The output of the left channel is very uniform all the way up to 9 kHz. There is no "sway-backed" depression in the range from 2 to 5 kHz, which has been the case with so many moving-magnet cartridges. The listening panel wrote such comments as "detailed," "articulate," and "sonorous" and gave the Maplenoll/Shure system a "−1" for the sound of voice and strings, very close to perfection. The crosstalk is exceptionally low and should remain so across a record because the tonearm tracks linearly across the record and holds the lateral tracking angle constant. The increase in crosstalk in the low-frequency range is an artifact of the B & K 2010 test record.

Figure 2 shows something very interesting. The low-frequency resonance, caused by the interaction of the Signature tonearm's effective mass (including the cartridge's 9.45-gram mass) and the Ultra 500 cartridge's compliance, was tested under three different modes of damping operation: With only the tonearm's damping trough, with only the cartridge's integral damping brush, and with no damping system. The curves are almost identical, which is amazing! It appears that the damping provided by the air bearing is sufficient to control the low-frequency resonance of this tonearm/cartridge combination. I did use the Signature damping system during the listening evaluations. Comments that the sounds of double bass and drums were

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The tonearm's smooth energy absorption allows each note of a rapid series to be distinguished clearly.

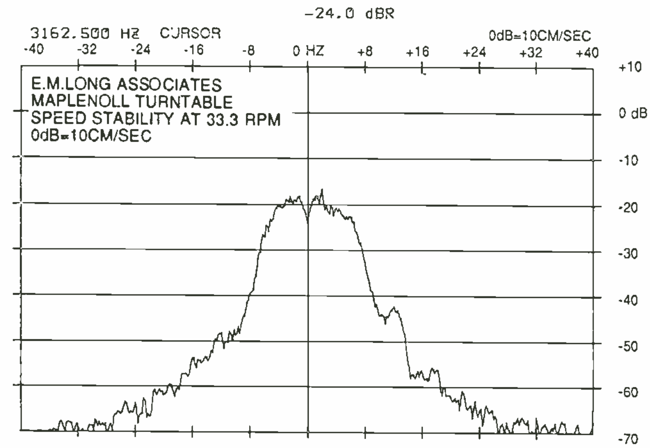


Fig. 7—Speed stability at 33⅓ rpm, which is excellent.

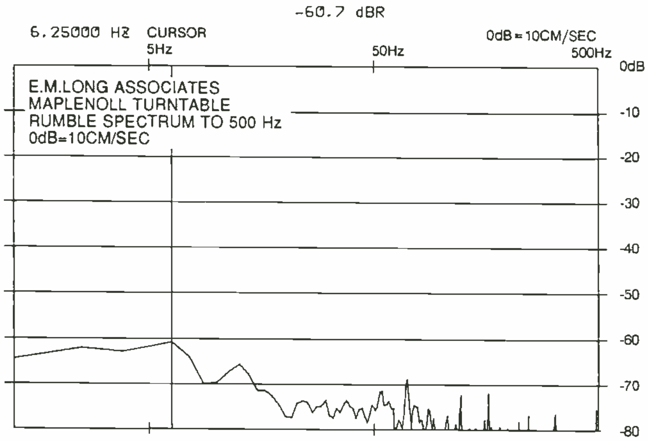


Fig. 8—Rumble spectrum.

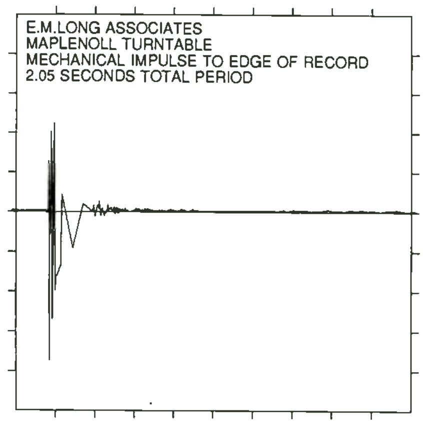


Fig. 9—Output vs. time from a shock applied to the edge of a stationary record.

"deeper," "tighter," and "more realistic" from the Maplenoll/Shure than from the reference system can be directly correlated to the excellent damping.

I checked for resonances in the range from 20 to 1,000 Hz (not shown) by using the slow sweep on band 6 of the B & K 2011 test record. I found a minor glitch at about 65 Hz that I couldn't correlate with any listener comments. I used the slow sweep on bands 1 and 2 of the CBS CTC-300 test record to check for resonances in the vertical and lateral planes of the system; the curves were virtually identical from 10 to 100 Hz and showed a slight increase in the vertical mode at about 6 Hz.

Figure 3 shows the output for a mechanical impulse applied to the Signature armtube, and Fig. 4 shows the spectrum of the output for a series of 16 such mechanical impulses. The output in the range from 2 to 3 kHz may correlate with a panel member's comment about the sound of brass being "brighter."

The Shure Ultra 500 cartridge's phase response was almost perfectly matched between channels—as good as any cartridge I have ever measured and better than most. Interestingly, this can sometimes produce a negative reaction to the reproduced sound from recordings whose spread of reverberance is less than ideal. Comparing the Maplenoll/Shure system's sound to that of the reference system, some panel members found it "less spacious" and "more confined" on certain orchestral recordings. This seeming problem was due to the reference system's less than perfect interchannel phase response, which added a false spaciousness. The clue to determining this was another comment from the panel that the Maplenoll/Shure system had "less spattering of the sound of cymbals." These comments and the explanation for them might help you when you are trying to decide between any two systems you may want to purchase.

Figure 5 shows the spectrum of the wow and flutter of the Signature Ariadne turntable. The major output is at 0.5 Hz, which is close to the turntable's 0.56-revolution/S rotational speed; if the resolution of my spectrum analyzer were greater, it would show that the maximum output is, indeed, at 0.56 Hz. The increase in output at the rotational frequency is caused by the fact that the test record is not perfectly centered. Normally, the high Q of most tonearm/cartridge combinations' low-frequency resonances causes a peak in the wow and flutter spectrum, but the Maplenoll/Shure's output at the 6.3-Hz resonance is very low, which verifies the low Q of its arm/cartridge resonance.

Figure 6 shows the drift in speed of the Signature turntable over a 42-S period. This indicates very good performance and that the Signature provides stable speed, with very little drift over a long period. Figure 7 shows speed stability another way; it is a graph of the variation in the frequency of the 3,162.5-Hz wow and flutter test tone of the B & K 2010 record, averaged over 16 samples. (The test tone is supposed to be 3,150 Hz, but it appears that the turntable which cut the 2010 test record was running about 0.4% slow.) The deviation, ±6.33 Hz, represents a variation of only ±0.20%, which is excellent. No adverse comments were made by any panel members that would correlate with this slight speed variation.

My overall impression was that the Maplenoll/Shure provided very clear and precise sound.

In Fig. 8, the spectrum of the rumble for the Signature turntable, the rumble is most pronounced at the 6.3-Hz arm/cartridge resonance. However, because the Q is so low at this resonance, the measured rumble is extremely low. Some panel members commented that the rumble seemed slightly lower from the Maplenoll turntable than from the reference system.

Figure 9 shows the output versus time for a mechanical impulse applied to the edge of a stationary record, with the stylus of the cartridge resting in a groove near the middle of the record. The mechanical energy is well damped and dissipates quickly. The spectrum produced by a series of 16 mechanical impulses, applied to the edge of the record and averaged, is shown in Figure 10. The spectrum above 75 Hz slopes very smoothly downward as the frequency increases, and there are no peaks or dips that would color the perceived sound. Such smooth energy absorption allows each note of a rapid series of musical notes to be distinguished clearly. The listening panel rated the Maplenoll/Shure system very high for this and indicated by their comments that it exceeded the performance of the reference system, which has consistently been rated very high.

The output from the Maplenoll/Shure system, with the stylus resting in a stationary groove near the middle of the record when a mechanical shock was applied to the solid platform on which the turntable rested, is shown in Fig. 11. The spectrum of this output, for 16 shocks applied and averaged, is shown in Figure 12. There is a decrease in energy transfer for most of the range above 100 Hz except for peaks at around 2.8 and 4.0 kHz. Despite the lack of a suspension system, the high mass of the turntable, the stability and low Q of the tonearm/cartridge resonance, and probably the small transmission path of the pointed turntable mounting feet give the Maplenoll/Shure system very good isolation from outside mechanical vibration.

Conclusions

The panel members rated the Maplenoll/Shure system slightly better than the reference system for voice, strings, brass, acoustic guitar, drums, and piano. The systems were rated as being equal when reproducing the sound of a double bass and complex orchestral works. The Maplenoll/Shure caused the sound of solo violin to be perceived as being "sweeter" and "a little smoother," the sounds of an acoustic guitar were more "precise," and drums were tighter sounding. Ambience was reproduced more faithfully; however, this can sometimes cause a perceived lack of spaciousness that should rightfully be blamed on the recording technique and not on these components. On well-recorded material, there was a real sense of openness and space. Both systems were rated equal in presenting a stereo image that allowed panel members to point at the location of specific instruments. My overall impression of the Maplenoll/Shure was that it provided a very clear and precise sound while being very "polite and subdued" compared to the reference system. If you are considering the purchase of a high-quality record playing system, you should consider the Maplenoll Signature Ariadne turntable and (if you can still find one) the Shure Ultra 500 cartridge.

Edward M. Long

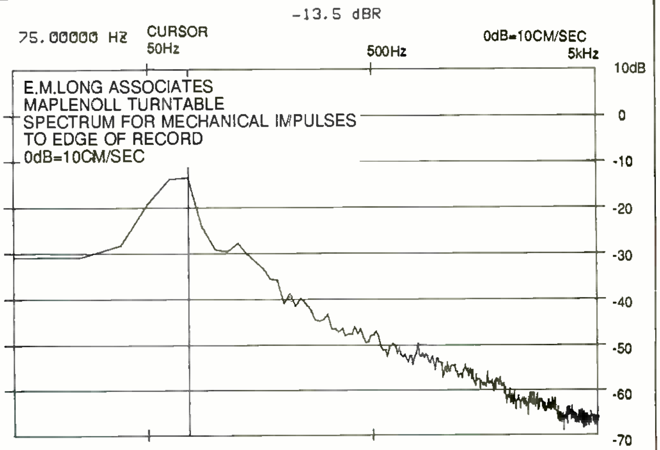


Fig. 10—Averaged spectrum of 16 shocks.

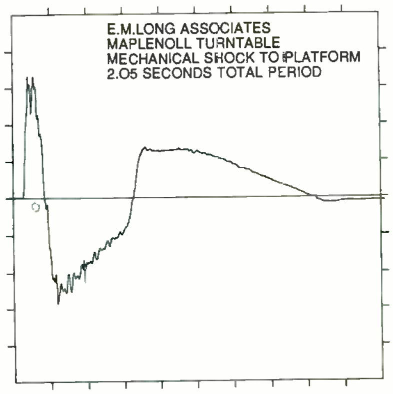


Fig. 11—Output vs. time for a shock applied to the platform on which the turntable was resting, with stylus in a stationary groove.

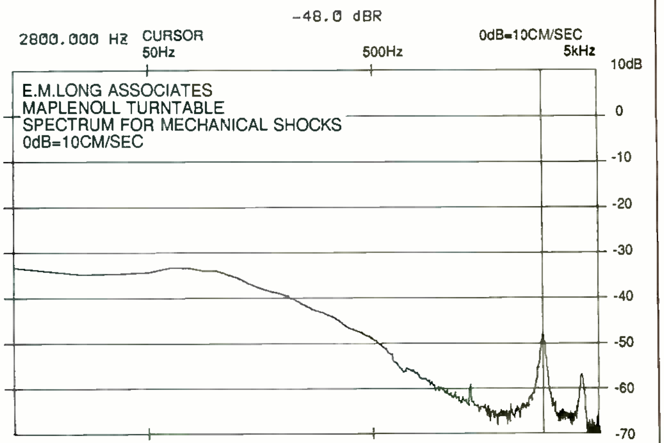


Fig. 12—Averaged spectrum of 16 shocks to platform.

3

BRIGHT STAR ALTAIR SPEAKER

Manufacturer's Specifications
System Type: Three-way, aligned-driver, floor-standing, dynamic dipole system.
Drivers: 10-in. carbon-polypropylene cone woofer, 5-in. open-back cone midrange, 1-in. polymer-dome front tweeter, and ¾-in. dome piezo rear tweeter.
Frequency Range: 44 Hz to 24 kHz.
Sensitivity: 88 dB at 1 meter with 2.83 V rms applied.
Crossover Frequencies and Filter Slopes: 450 Hz (12-dB/octave low pass, 6-dB/octave high pass) and 3.15 kHz (6 dB/octave).
Impedance: Nominal, 6 ohms; minimum, 4 ohms.
Recommended Amplifier Power: 20 to 300 watts per channel.
Dimensions: 27¾ in. H × 20¼ in. W × 12 in. D (70.5 cm × 51.4 cm × 30.5 cm) without stand; stand, 8 in. H × 21 in. W × 12 in. D (20.3 cm × 53.3 cm × 30.5 cm).
Weight: 40 lbs. (18.2 kg) each without stand.
Finish: Natural granite; black, white, or dark granite; high-gloss black or white granite.
Prices: $999 to $1,145 per pair, depending on finish; stands, $159 to $199 per pair, depending on finish; Electronic Foundation Control stereo equalizer, $319.
Company Address: 2363 Teller Rd., #115, Newbury Park, Cal. 91320.
For literature, circle No. 92

Bright Star Audio, a relative newcomer to the high-end loudspeaker market, was founded in 1989 by Barry Kohan, who, after 14 years managing a chain of high-end audio salons in the Los Angeles area, decided to go into business for himself. Kohan's previous background as a professional musician and part-time loudspeaker designer prepared him well for this endeavor. His early love of the involving sound produced by dipole-based speakers such as the old ESS AMT 1, which utilized the Heil Air Motion Transformer, challenged him to design a reasonable size, moderate-price, direct-radiator dipole system that would exhibit some of the excellent qualities he remembered.

Kohan started out by selecting a good midrange driver and then working out a unique hidden behind-the-panel mounting scheme that provides a rounded sound-radiating aperture to minimize interference and diffraction. The desired dipole nature of the system dictated that the back of the midrange be open to radiate freely to the rear. To provide dipole radiation at the highest frequencies, and knowing that no high-quality bidirectional direct-radiator tweeters were available, he added a rear-mounted tweeter, wired with reversed polarity. To keep the system of reasonable size, true dipole radiation was sacrificed at the low end, where a quasi-closed-box system with a highly damped rear port was used. To acoustically align the drivers for coherent time response, the baffle was tilted back.

This process eventually lead to the unusual design of the Altair system. On first sight it looks like none that you have seen before. It is a tall, truncated pyramid coated with a granite-like material. The three circular shapes on the front panel locate the system's drivers, but closer examination reveals no obvious means of driver attachment, only gentle rounded surfaces. The lower two drivers, the woofer and midrange, are protected by rigid metal-screen grilles. The tapering enclosure minimizes the baffle area around each driver, improving dispersion.

A large section of the enclosure is open at the rear, exposing the backs of the tweeter and midrange. However, the sides continue upward, forming slanted wings that direct the signal radiated from the midrange straight back. An additional small dome tweeter is mounted on the sloping top of the woofer enclosure, aimed upward and slightly back.

All exposed surfaces, including the bottom and inside top rear of the cabinet, are covered with a quite good-looking granite-like material that leaves no evidence of the underlying wooden construction. In addition, all corners and edges of the structure are rounded to minimize diffraction. The shape of the enclosure means that *none* of the walls are parallel to each other, which reduces the effect of internal standing waves and strengthens the assembly. The exposed wiring of the tweeter and midrange is dressed and treated very tastefully, with shrink-wrap tubing over the soldered driver terminals and tie-downs.

The bottom rear of the cabinet had separate input terminal cups for the woofer and midrange/tweeter connections, with short pairs of heavy Tara Labs cable provided to link the cups for single wiring. Units now in production have all the connections in a single cup, with heavy gold-plated straps instead of cable links. A fiberglass-filled Scan-Speak aperiodic loading chamber (a type of vent active only when cabinet pressure exceeds a preset level), 4 inches in diameter, is mounted above the terminal cups.

Bright Star offers a separate line-level equalizer, the Electronic Foundation Control (EFC), which is said to extend the response of the Altair down to 32 Hz and to smooth the low-frequency response. The speaker system is designed to be used with an optional metal stand, which raises it to the proper height for a seated listener.

The enclosure is constructed from medium-density fiberboard, ¾ inch thick, and covered on all sides with multiple applications of Bright Star's granite-like spray coating. Multiple coats of a flexible rubber-like damping material that Bright Star calls "flexible borosilicate" have been applied to the open areas at the rear of the enclosure (under the granite-like coating), and to the inside of the woofer cabinet, to damp vibrations and control surface resonances. No internal bracing was evident (or needed) in the low-frequency enclosure, which is completely stuffed with a white polyester batting material.

The crossover of the Altair is wired point-to-point on a piece of ⅜-inch-thick particleboard mounted to the bottom of the enclosure. It contains 16 parts (two inductors, nine capacitors, and five resistors), though paralleling reduces the effective capacitor count to four. Both inductors are air-core types and are well separated. All capacitors are bypassed with small-value, 600-V polystyrene capacitors. All signal-path capacitors are high-quality, high-voltage Mylar, polypropylene, or metallized polypropylene units. The 205-μF capacitor in parallel with the woofer is actually composed of three parts: A large electrolytic, with smaller value Mylar and polystyrene units in parallel. All internal wiring consists of paired Tara Labs Space and Time 18-gauge wires, paralleled to form roughly 16-gauge cable. All connections to and inside the Altair's crossover, and to the drivers, are soldered (using silver-based solder, according to Bright Star).

The design of the crossover consists of all first-order, 6-dB/octave networks for the midrange and tweeters plus a second-order, 12-dB/octave low-pass filter for the woofer. The midrange is connected via a second-order, series-connected LC bandpass filter, which functions as a 6-dB/octave cascaded high-pass/low-pass combination. Bright Star states that they hand-match the crossover components between right and left speakers to within 1%. The piezo rear tweeter is driven through a series RC network that serves both to set level and provide protective high-frequency current limitation. The connections to the woofer part of the crossover and the midrange/tweeter portion are brought out separately to the rear of the cabinet to allow bi-wiring.

Measurements

Figure 1 shows 1-meter anechoic frequency responses of the Bright Star Audio Altair. In addition to the usual on-axis curve, the figure shows curves taken directly behind the system and 1 meter overhead, which is on the axis of the upward-facing tweeter. The front and rear measurements were taken at a distance of 2 meters, 36 inches from the bottom of the system (including stand), with 2.83 V rms applied and then referenced back to 1 meter. All curves except the overhead one were smoothed with a tenth-octave filter.

The on-axis curve is shown with and without the equalization provided by the Electronic Foundation Control equalizer, whose frequency response is shown in Fig. 2. With equalization, the on-axis curve fits within a tight, ± 2 dB tolerance from 60 Hz to 20 kHz. The main effects of the equalizer are to pull down a woofer response peak in the range from 80 to 300 Hz and to extend the response below 50 Hz. The effect on frequency response of the Altair's metal grilles, which cover only the woofer and midrange, was minimal, less than ± 0.2 dB over the whole range. All the following measurements, except for distortion, were made with the grilles in place. The right/left matching of the systems was quite good, about ± 0.8 dB.

The rear on-axis output between 400 Hz and 1.6 kHz is actually 3 to 6 dB greater than the front output. The increased output in the rear is presumably due to the directivity of the midrange's rear radiation, channelled by the enclosure's side wings. The polarity of the rear output is reversed in this range, because this signal comes from the back of the midrange cone.

Because the rear tweeter is essentially aimed upward, it contributes little output directly to the rear. The curve labelled "Above" in Fig. 1, measured directly on axis and 1 meter away from this tweeter, shows that the rear tweeter's output is about 6 to 10 dB below the level of the front tweeter Its response is quite ragged due to numerous close reflections from the rear structure of the system.

Harmonic distortion at 41.2 and 110 Hz proved quite low for such a system, and distortion at 440 Hz was unmeasurable.

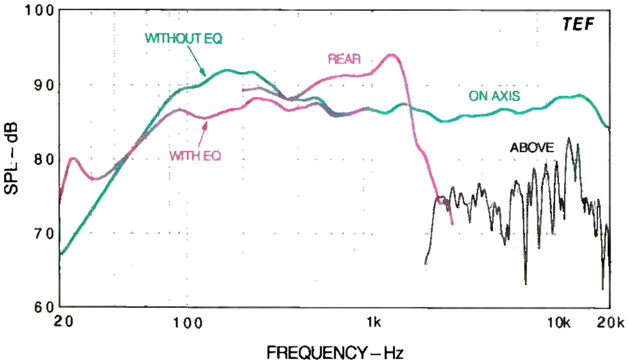


Fig. 1—One-meter, on-axis frequency response, with and without equalizer. Also shown are 1-meter responses taken at the rear and above the system; see text.

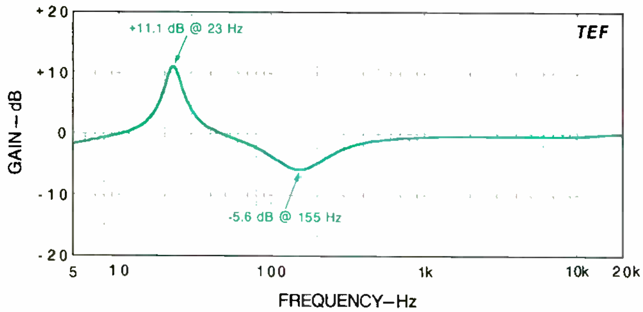


Fig. 2—Frequency response of the EFC equalizer.

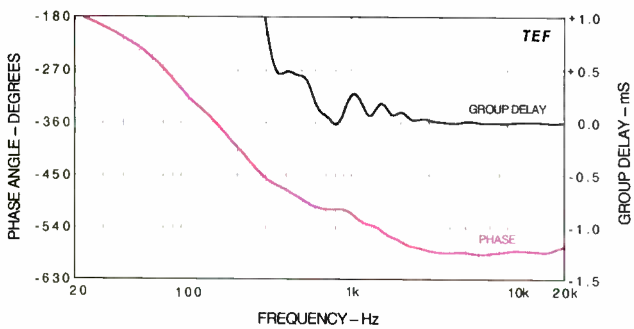


Fig. 3—On-axis phase response and group delay.

The Electronic Foundation Control equalizer Bright Star supplied me was just a preproduction prototype, so I tested only its frequency response, impedance, and overload characteristics. Figure 2 shows a flat unity-gain response except for a relatively narrow, 11-dB peak at 23 Hz and a broader, 5.6-dB dip at 155 Hz. Below 3 Hz (not shown), the equalizer's response rolled off at 6 dB/octave. The EFC's audible frequency response is roughly reciprocal to the speaker's low-frequency response. I say roughly because, although the 155-Hz dip is a good match to the Altair's hump in this region, the 23-Hz peak is somewhat mismatched to the speaker's response and actually overcompensates, resulting in a narrow peak in the equalized response at 23 Hz (see Fig. 1).

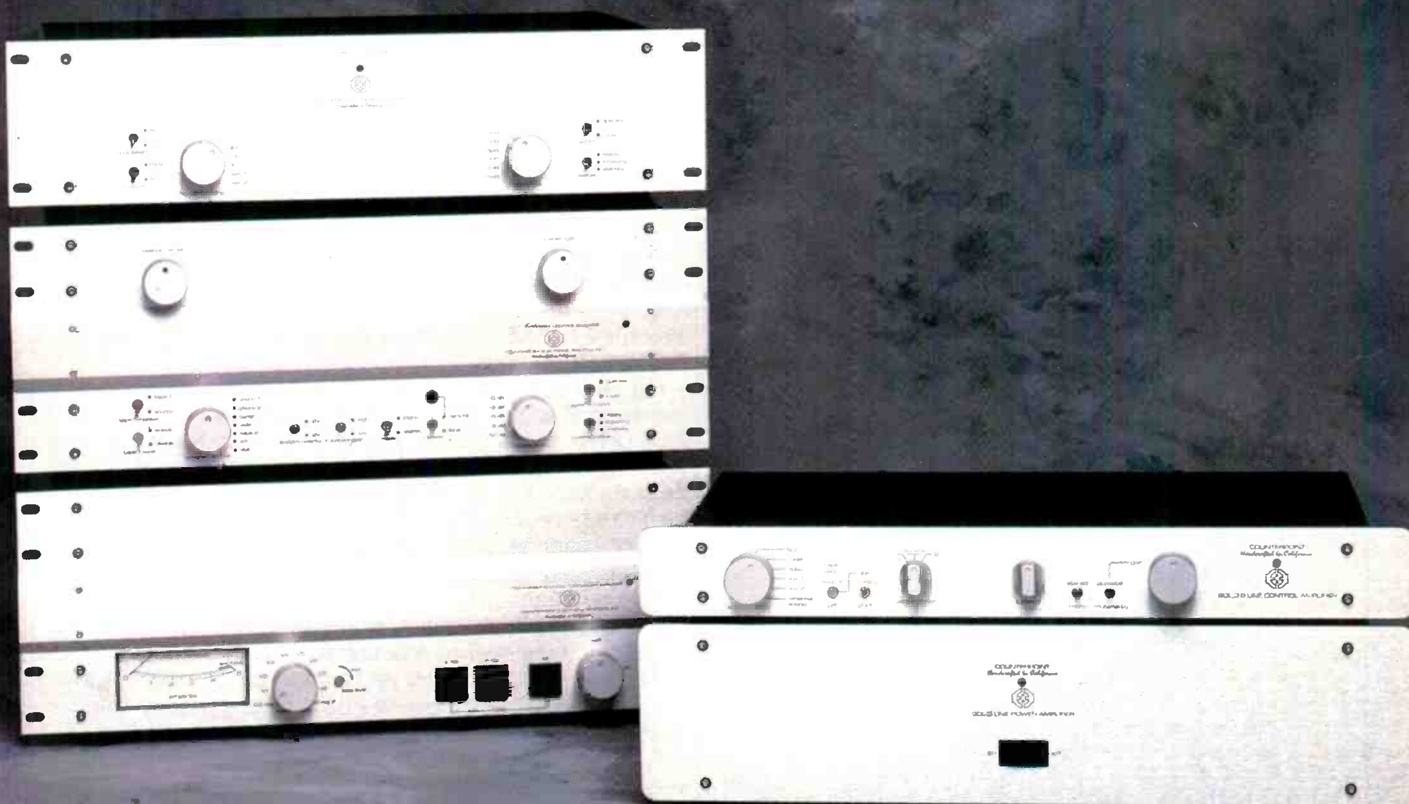
The schematic of the equalizer disclosed the use of high-speed AD712JN op-amps and all 1% tolerance resistors and 2% tolerance capacitors in the signal path. The EQ's input impedance measured about 330 kilohms, and the output impedance was about 100 ohms.

The equalizer's overload (clipping) point occurred at an output level of 10.5 V rms, about ±15 V peak, though the unit did not overload gracefully. When the lower −15 V supply rail was reached, during the negative part of the sine wave, the output voltage would switch very rapidly to the +15 V supply rail, then return rapidly to the negative rail when the negative portion of the wave came out of overload. This essentially created a sharp-edged square wave at twice the input frequency for only slight sine-wave overloads. Fortunately, normal program material never attains levels that would trigger this overload. Only a situation where the equalizer was inserted between a preamp and power amplifier, and the power amplifier gain was turned down quite far (thus forcing the preamp and equalizer to operate at high levels for reasonable playback levels), might this occur.

Figure 3 shows the phase and group delay responses of the speaker, referenced to the tweeter arrival time. The phase curve is nearly flat, only rotating about 67° between 1 and 20 kHz. The group delay is also quite flat from 600 Hz to 20 kHz, a result of the careful alignment and positioning of the system's drivers. The fluctuations in group delay between 600 Hz and 2 kHz correspond mostly to minimum-phase deviations in the Altair's frequency response.

Figure 4 displays the system's excellent energy/time curve (ETC) for a test signal swept from 1 to 10 kHz. The Altair's alignment results in a very tight main arrival at 3 mS with only some minor late arrivals, 25 dB down.

The horizontal off-axis responses of the Altair are shown in Fig. 5. On-axis response is shown by the bold curve at the rear. The horizontal coverage is very good, as the off-axis curves uniformly carry over the irregularities of the on-axis response. High-frequency coverage is maintained to beyond 15 kHz for angles out to about ±40°. The 180° rear curve (seen in the front of the display) shows that the system's output actually exceeds the on-axis output by several dB in the range from 400 Hz to 1.6 kHz; as noted, this is due to the rear radiation of the speaker's midrange. The high rear curve obscures the off-axis dip in the midrange's response toward the sides, caused by the bidirectional midrange radiation.



The Altair could handle more than 150 watts below 30 Hz without generating any unacceptable noises!

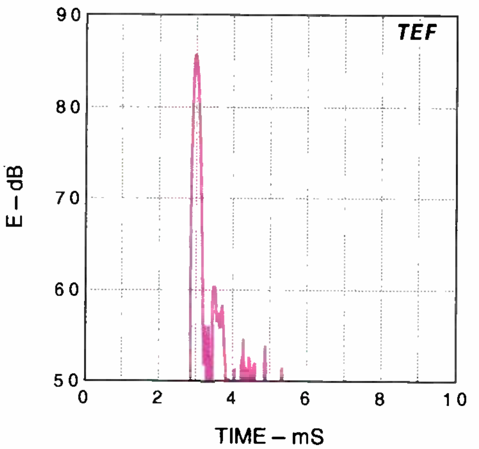


Fig. 4—Energy/time curve.

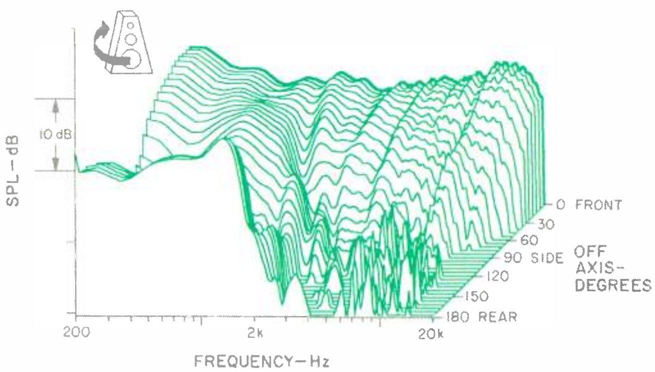


Fig. 5—Horizontal off-axis frequency responses.

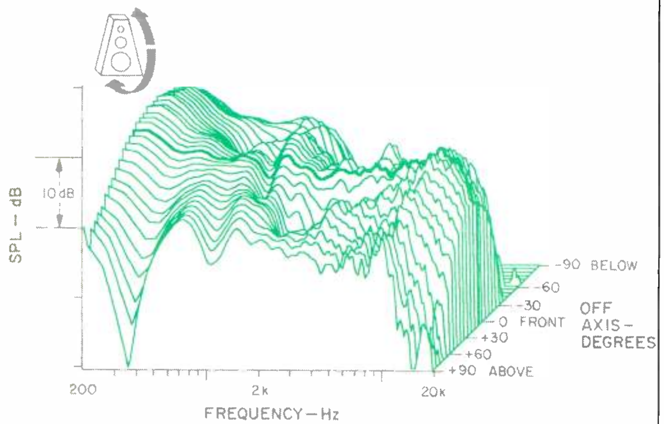


Fig. 6—Vertical off-axis responses.

The vertical off-axis curves are shown in Fig. 6, with the on-axis response curve shown in bold. Fortunately, within the main ±15° listening window, the above-axis curves are the flattest. Only below axis do the expected off-axis dips occur in the response (not clearly shown in the graph because of the above-axis viewpoint). These up/down response asymmetries are the primary indication of lobing, indicating that there is a significant difference in acoustic phase between the midrange and tweeter outputs through the crossover region.

The mean axial (+15° to −15°) horizontal response curve in Fig. 7 is quite smooth and essentially the same as the on-axis response. The 30° to 45° off-axis response is also close to the axial curve but is somewhat rougher and lower in level above 1 kHz, coupled with rapid roll-off above 13 kHz. The 60° to 75° off-axis response is two-tiered, shelved down above 1.4 kHz by about 8 dB. Rapid roll-off above 11 kHz is also noted. The individual horizontal curves, averaged to yield the mean curves, all grouped quite close together.

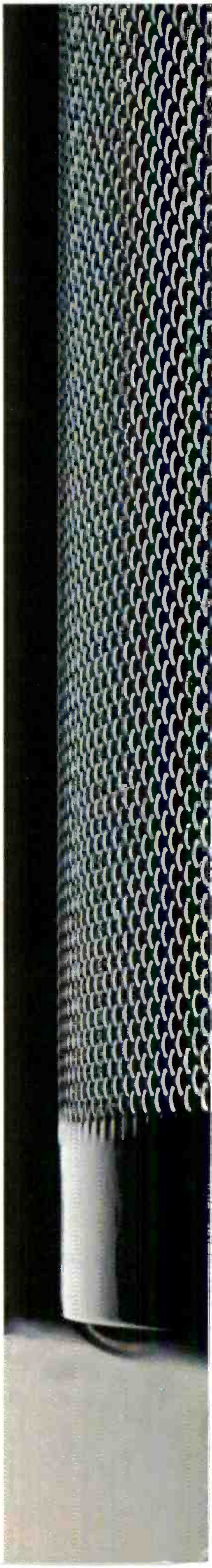
The mean vertical axial curve (Fig. 8) reflects the increased directivity of the system in the vertical plane. Response is generally uneven, with a dip at 3.6 kHz. Examination of the individual curves averaged to make the ±15° mean axial curve (not shown) revealed that the up curves (+5° to +15°) were significantly flatter than the down curves (−5° to −15°). The 3.6-kHz dip in the mean axial curve is a result of interference at crossover in the downward direction. Fortunately, the response in the upward direction, which is heard by standing listeners, exhibits the smoothest responses. The 30° to 45° and 60° to 75° mean curves are more uneven than the mean axial curve and have greater high-frequency roll-off above 11 kHz. As before, considering the individual curves that make up the averaged curves, the up curves are significantly smoother than the down ones.

Figure 9 shows the Altair's impedance. Three low points are evident, with the lowest, 3.6 ohms, at 150 Hz. A peak of 24.4 ohms is reached at 4.3 kHz. This corresponds to a fairly high max/min variation of 6.8 to 1, so the systems will be quite sensitive to series cable resistance, which should be limited to a maximum of about 50 milliohms to keep from causing response peaks and dips greater than 0.1 dB. For a standard run of about 10 feet, 14-gauge or larger wire should be used.

The complex impedance is shown in Fig. 10. The phase angle of the impedance (not shown) reached a maximum of +41° (inductive) at 300 Hz and a minimum of −39° (capacitive) at 71 Hz. The system will be a relatively easy load for most amplifiers.

A high-level low-frequency sine-wave sweep revealed a very solid enclosure with no significant cabinet resonances. The grille over the woofer did resonate slightly at about 180 or 190 Hz. The woofer did not exhibit any dynamic offset effects, a rare characteristic. Some whistling and air-rush noises from the damped rear port were evident at high bass input levels. The woofer enclosure was quite well sealed; it took about 1 S for the woofer to return to its rest position when manually depressed. This also shows that the flow resistance of the rear port is very high, so the port output should not contribute much to the total system output.

Near-field curves run on the Altair's woofer and rear port (not shown) indicated that the rear port's output was at least 10 dB lower than the woofer's through most of the low-frequency range. Essentially, the low-frequency portion of the Bright Star system operates as a closed box. In this situation, however, the high port losses do somewhat re-



THE MONOLITH III

The Monolith III stands alone. Powerful. Imposing. Thrusting you into a world of harmony and purity that both caresses and assaults you in its beauty, truth and timelessness.

The challenge was to maintain the famous Martin-Logan electrostatic purity and still deliver uncompromised levels of power and frequency response. This was achieved by incorporating a massless transducer in a perfectly linear field with no crossovers in the critical music range, yet dispersing energy in a controlled wavepath.

By seamlessly integrating this advanced ESL technology to a tailored superfast subwoofer, a new standard has been achieved.

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The Altairs' sound was spacious, with precise imaging and a revealing sense of depth.

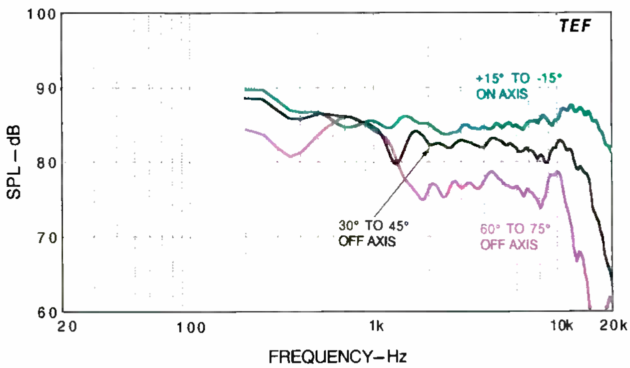

Fig. 7—Mean horizontal responses from Fig. 5 data.

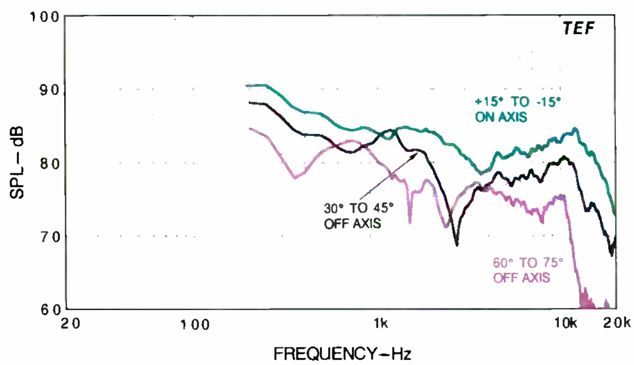

Fig. 8—Mean vertical responses from Fig. 6 data.

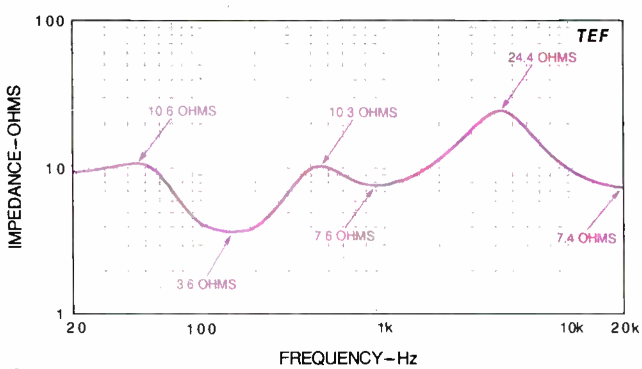

Fig. 9—Impedance.

duce the hump in the low-frequency response caused by the woofer's somewhat small enclosure. Displacement measurements of the woofer cone with high input levels, with the port open and closed, did show that the port reduced cone displacement somewhat in the range from 30 to 60 Hz when the port was open.

Happily, the Altair could handle voltages in excess of 30 V rms (150 watts into 6 ohms), below 30 Hz, without generating any unacceptable noises! This is higher than any system I have measured. The woofer's linear excursion capability was a healthy 0.5 inch, peak to peak, with additional capacity to 0.75 inch before hard limits were reached. The system's high low-frequency power handling is partly due to the woofer's excursion capability and to the added stiffness provided by the somewhat small enclosure.

Figure 11 shows the 3-meter room curve of the Altair with both raw and sixth-octave smoothed responses. The system was in the right-hand stereo position, aimed at the listening location, and the test microphone was placed at ear height (36 inches), at the listener's position on the sofa. The system was driven with a swept sine-wave signal of 2.83 V rms (corresponding to 1.33 watts into the rated 6-ohm load). The direct sound plus 13 mS of the room's reverberation are included. Between 2 and 18 kHz, the smoothed curve is quite flat, with a slight high-frequency emphasis, and fits a tight envelope of ±2.0 dB. Including the room dips below 1 kHz, the complete curve fits within a ±6.3 dB window from 100 Hz to 20 kHz.

Figures 12 and 13 show single-frequency harmonic distortion versus power for the musical notes E_1 (41.2 Hz) and A_2 (110 Hz). Distortion for our usual 440-Hz tone is not shown because the harmonics were below the detection floor of my test gear. The power levels were computed using the rated impedance of 6 ohms.

At full power, the second and third harmonics of E_1 (41.2 Hz) reach only 2.8%, quite low for this kind of speaker system. Higher order harmonics are only significant above 10 watts. At 100 watts, the system generates about 98 dB SPL at 1 meter at 41.2 Hz.

The second and third harmonics of A_2 (110 Hz) reach only about 1% at full power. The higher order harmonics are not significant. At 110 Hz, the system generates a loud 110 dB SPL at 1 meter, for 100 watts input.

Figure 14 shows the IM created by tones of 440 Hz (A_4) and 41.2 Hz (E_1) of equal input level. At 100 watts, the IM distortion reaches only 4.5%, a relatively low value due to the three-way system configuration. Overall, the Altair exhibited respectably low values of harmonic and IM distortion.

The short-term peak-power input and output capabilities of the system, as a function of frequency, measured using a 6.5-cycle tone burst with third-octave bandwidth, are shown in Fig. 15. The peak input power (calculated by assuming that the measured peak voltage was applied across the rated 6-ohm impedance) rises smoothly with frequency, reaching about 5,100 watts above 1.25 kHz (175 peak volts across the rated 6-ohm load). Between 100 and 250 Hz, the Altair actually taxed the output of my test amplifier because of its low impedance through this region. At 200 Hz and below, the speaker's power handling was excellent.

The upper curve in Fig. 15 shows the maximum sound pressure levels the system can generate at 1 meter on axis for the input levels shown in the lower curve. Also shown is the "room gain" of a typical listening room at low frequencies, which adds about 3 dB to the response at 80 Hz and 9 dB at 20 Hz. The peak acoustic output rises rapidly with frequency up to 160 Hz and then levels out at about 124 dB SPL. With room gain, the system exceeds 110 dB SPL above 40 Hz and 120 dB SPL above 90 Hz.

"Krell... Threshold... Madrigal... Rowland... Research... Coda... Parasound. What!!!

Parasound?

How does Parasound manage a mention with the above said heavy hitters of the transistor amplifier world? Easy, the new 2200 power amplifier from Parasound has the type of power and performance that would be expected from the big guys, were they to build an amplifier at the two grand mark. The fact that the 2200 only costs $1,585 certainly sweetens the deal, making it a ridiculously great bargain.

RAVE REVIEW ***RAVE REVIEW*** ***RAVE REVIEW***

HCA-2200 Power Amplifier

Designed by John Curl

But why Parasound?

Actually, this is the amplifier that I had been expecting to see from PS Audio, Superphon or Aragon; a real high calibre audio product that reeks of power, engineering savvy, and bang for the buck. Instead, **a small firm from northern California had the sense to recruit one of the best minds in the business — John Curl — to design for them a product capable of superior performance without a typically prohibitive price tag** to go along with it. John brought with him a full suitcase of engineering and design experience that few others in the industry could match or even dream of. Remember the "JC" designation on some of the Mark Levinson designs of the 1970's — that's John Curl. More recently, John has enjoyed great critical success with his Vendetta phono section electronics, it being declared "State of the Art" by several of the glossy mags...

THE AMP. The 2200 weighs in at 58 lbs., that's 6 lbs. more than the Krell KST-100 ($2,700), and only 2 lbs. less than the Madrigal No. 29 ($2,800)... It has balanced and single ended inputs (XLR & RCA), with a switch to convert to mono operation. The rear of the amp also has two sets of speaker terminals for those who desire to bi-wire... Both sides of the amp are flanked by an impressive array of "Rowland-like" heatsinks... to dissipate the considerable heat generated by the 12 high-bias (over 6 wpc in pure class A) bi-polar output devices per channel. Considering that nearly all listening is done at one or two watts per channel, **the 2200 delivers a lot of class A-biased power.** Inside you'll find two 1.2 kva toroidal transformers (one per channel) and 100,000 mfd of filtered power storage...bypassed by smaller film caps for improved performance... the first amplifier I have seen in a long time that goes so far as to even bypass the larger filter caps in the power supply... **Parts quality throughout is good... the transformers, filtering caps, chassis, output devices and resistors are just about as good as you can get.**

OPERATION. ...Preamps that worked great with the amp included the Cary SLP-70, the Muse Model One and the Counterpoint Solid 8... However, the 2200 was quite capable of driving, with ease, any speaker tied to its outputs. **I have operated this amplifier under grueling and strenuous conditions for almost three months without so much as a hint of trouble or breakdown.** ...

THE SOUND. It sounds balanced. No aspect of its operation unduly draws attention to itself. The highs aren't grainy or smeared; the bass isn't bloated; the midrange isn't recessed, or forward for that matter; the stage isn't cramped; and dynamics aren't compressed. **What we have here is an amplifier that flat out refuses to do much wrong, while doing almost everything right.** ...

The 2200 is one of the most powerful amplifiers you will ever come across, controlling loudspeakers with such aplomb so as to seem effortless. Transients with the 2200 can be awesome... Without seeming forward (remember the balance referred to), the 2200 extends into the bass region with incredible authority. Combining this amp with the Chapman T-7 loudspeaker, I was able to shake loose the neighbors fillings and send the dog running for cover under one of the kids beds... but the bass wasn't there unless it was supposed to be...

Clarity and the sense of space on a three dimensional stage were very good. Without effort I could pick out the location of instruments and vocals. Saxophone on "Jazz at the Pawnshop" had an excellent sense of presence, the sax standing clearly apart from the other instruments on the stage. Drums at right rear had perfect placement, and there was a nice feeling of left and right, up and down, as the drummer worked his way around the drum kit ... **this amp has some pretty remarkable abilities when it comes to reproducing the feeling of a live event in the listening room. Resolution of inner detail was natural and very revealing, without seeming hyped or exaggerated. Images at the back of the stage were crisp and easy to locate...**

CONCLUSION. When I first listened to the Parasound 2200 I got a funny feeling... regarding how to evaluate it. I'm sitting here with the Allegro Cantata and the Krell KST-100 thinking how *they* defined high-end performance at prices that were starting to be accessible to "Blue Collar Audiophiles", even if it was still a stretch dollar-wise... I will continue looking for and examining products of quality and value so that we can talk about them on these pages, and yes, I prefer talking about Parasound and Fried products... because the Parasound and Fried are **not aimed at people with more money than brains.**

So this is how I'm going to approach the review of the Parasound 2200 power amplifier. I want you to add it to the list of truly fine products that have something special to offer in terms of value regardless of what it's compared to or what anyone else says about it. It stands on its own in terms of build and performance, being basically as good (accurate) **as any amplifier that I am aware of, and better** (more accurate) **than most...**

– Martin DeWulf –
Excerpted with permission from
Bound For Sound, November, 1991.

Thanks to the systems' rear output, you can walk between them without having the sound collapse.

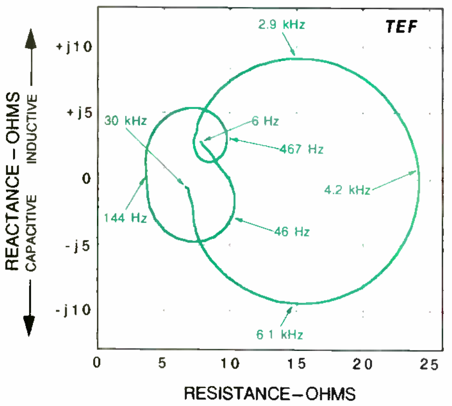

Fig. 10—Complex impedance.

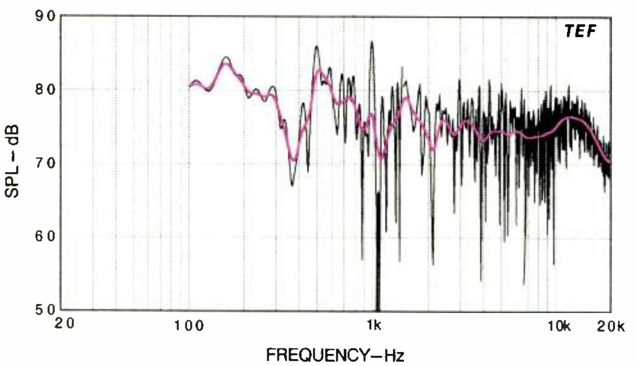

Fig. 11—Three-meter room response.

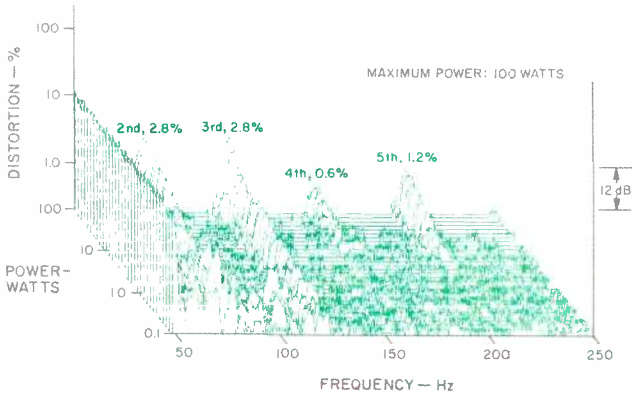

Fig. 12—Harmonic distortion of the musical tone E_1 (41.2 Hz).

Use and Listening Tests

Visually, the Altairs are very striking, quite modern and contemporary. The granite-like coating on the speakers fits quite well their modernistic high-tech look. Their pyramidal smooth-cornered contours are quite distinctive and create a very memorable appearance.

I was quite impressed with the printed documentation that came with the Altair. The eight-page owner's manual is quite complete and was supplied with several information sheets covering such topics as bi-wiring, power handling, and protection. The manual even starts out with the recommendation "that you always wash and dry your hands before handling the speakers," good advice for any systems! The last two pages contain a list of 60 recommended audiophile-quality recordings for use in auditioning the Altairs. In addition, a four-page manual was supplied with the Electronic Foundation Control equalizer.

The Altairs' optional stands are substantial, sand-filled, metal units with attached spikes. When the speakers are mounted on them, the tweeters are slightly above the ears of a listener seated 3 meters away. The 15° tilt of the systems' front panels means that the listener's ears are about 14° below the tweeter's axis.

Connections to the Altair are through multi-way binding posts on the bottom rear of the cabinet. The separate input terminals allow for bi-wiring or biamping. As noted, conventional single connection is accommodated by a set of short jumper links.

Fairly detailed placement instructions were included in the owner's manual. Bright Star recommends a location out from the wall and well away from surrounding objects to minimize early reflections. They emphasize that the speaker's dipole dispersion characteristics may require some experimentation to find the best cabinet position. The systems are supplied with absorptive pads, which Bright Star calls "rear wave controllers," for attenuating the midrange drivers' rear output. These pads allow you to fine-tune the proportion between the midrange's front and rear output levels. Bright Star does not recommend using the Altairs in so-called live-end/dead-end listening setups, where the region behind the speakers is highly absorptive. They recommend a reflective-diffusive environment behind the systems to properly handle the rear radiation.

I listened to the Altairs driven by Jeff Rowland amps and preamp and Onkyo and Rotel CD players with Straight Wire cables and interconnects. The systems were placed 10 feet from my sofa and separated by 8 feet—my usual source positions, and in agreement with Bright Star's recommendations. I found that the sound was best with the systems toed in toward my listening position but with their axes crossing a bit behind me. Most listening was done before the measurements, using both bi-wire and single-wire connections and with all grilles on.

On first listening, the Altairs presented a very spacious sound coupled with precise imaging and a revealing sense of depth. There were some problems in the upper bass, however, where the systems exhibited some excess fullness and a tendency towards tubbiness on male voice. The upper bass emphasis was also quite evident on pink noise, as the systems took on a moderate one-note tonal quality in

These Bright Star speakers offer super-modern good looks, low distortion, high power handling, and an impressive sonic performance.

this range. Subsequent use of the Electronic Foundation Control equalizer completely eliminated this emphasis. With the equalizer, the speakers' tonal balance was quite close to that of my reference B & W 801s. The Altairs' and B & Ws' sensitivity was also very close.

The EFC unit provided additional weight in the very low-frequency region, where the unaided system was somewhat deficient. The high boost of the EFC at low frequencies (+11 dB at 23 Hz) did not seem to restrict the speaker's power handling with most of the CDs I played. Only CDs that had high energy content from 20 to 25 Hz (such as the 20- and 25-Hz third-octave pink-noise bands on the Brüel & Kjaer CD-4090 Pro Audio test CD) presented headroom problems at high playback levels. The low-frequency power handling of the Altairs was superb on all the material I played. Even my favorite low-frequency test CD, the very demanding organ version of Mussorgksy's *Pictures at an Exhibition* (Dorian DOR-90117), was handled very well, generating clean and very respectable bass levels. The only noticeable problems occurred at high levels below 50 Hz, on the band-limited noise tracks on the B & K test disc, where the Altair's rear vent generated significant chuffing noises. Fortunately, these air-rush noises were attenuated significantly in front of the systems because of the vent's rear mounting.

I investigated the rear radiation characteristics of the loudspeaker by using the supplied rear-wave controller pads. With the midrange's rear output attenuated, there was a subtle but noticeable decrease in the spaciousness of the system's sound. I preferred the sound with the pads removed and left them off for most of the listening tests. At least in my listening room, I could tell no difference with the rear tweeters operating or covered up. Unless I stood directly over the speaker, with my head on the rear tweeter's axis, I couldn't tell the difference.

The Altairs' rear output was most evident when I walked from the front to the rear of the speakers along the center line between them. The sound of a conventional front-radiating system just simply collapses as you walk to the rear, but the sound of the Altairs held up very well in this test. When I listened at the rear, the tonal characteristic of the rear sound radiation was somewhat restricted and sounded quite "mid-rangy" (not unexpected, as it's mostly the midrange that radiates to the rear).

The Altairs exhibited only moderate changes in upper midrange response on the stand-up/sit-down pink-noise test. Unlike other phase-aligned systems, no "phasiness" was evident. Laterally, the Altairs' coverage was even and excellent.

The Bright Star systems are well suited for loud rock music, as authenticated on John Fogerty's *Centerfield* CD (Warner Bros. 25203-2); the percussion and vocals were reproduced very cleanly at high levels. John Bayless' piano playing on *Bach on Abbey Road* (Pro Arte CDD 346, Beatle melodies improvised in the style of J. S. Bach—a super performance and recording!) demonstrated the Altairs' smoothness, clean output, and dynamic range. The spacious nature of the Altairs' soundstage and accuracy of imaging were manifested by the choral movement, and especially the baritone solos, of Beethoven's Symphony No. 9, "Choral," with Otmar Suitner conducting the Berlin State Orchestra (Denon C37-7021).

Everything considerd, the Altairs represent quite good value for the money. Even with optional stands and equalizer, the price is just slightly less than $1,500. These systems offer an excellent combination of super-modern good looks, impressive performance, low distortion and high power handling, and premium audiophile traits. *D. B. Keele, Jr.*

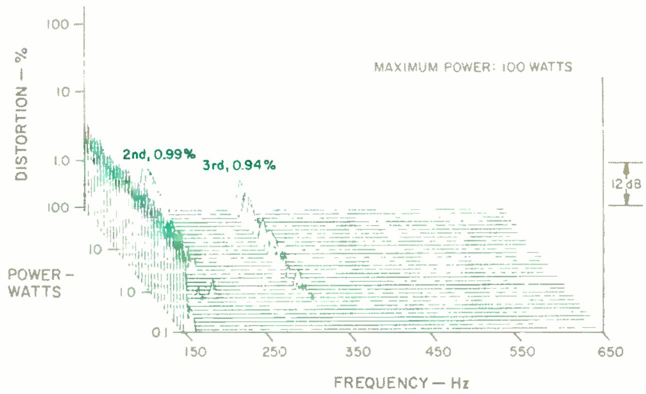

Fig. 13—Harmonic distortion of the musical tone A_2 (110 Hz).

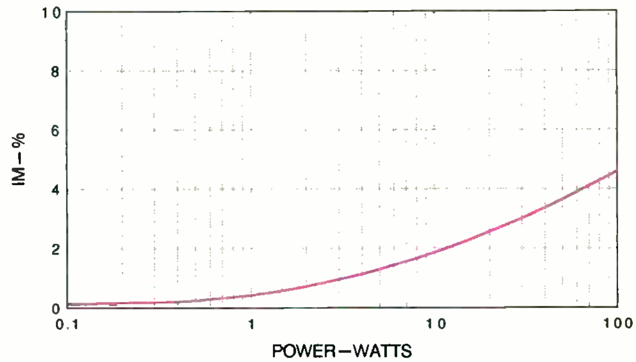

Fig. 14—IM distortion of 440 Hz (A_4) and 41.2 Hz (E_1) mixed in one-to-one proportion.

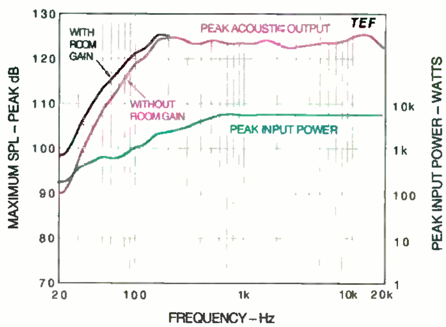

Fig. 15—Maximum input power and peak sound output.

4

PS AUDIO DIGITAL LINK II D/A CONVERTER

Manufacturer's Specifications
Decoding System: 18-bit, with eight-times oversampling.
Analog Filtering: First-order, phase-linear.
Inputs: Coaxial and optical.
Frequency Response: 20 Hz to 20 kHz, ±0.5 dB.
THD: Less than 0.01%.
Dimensions: 17 in. W × 2½ in. H × 9 in. D (43.2 cm × 6.4 cm × 22.9 cm).
Weight: 12 lbs. (5.4 kg).
Price: $799.
Company Address: P.O. Box 1119, Grover City, Cal. 93483.
For literature, circle No. 93

I have known the folks at PS Audio for a number of years and have frequently been impressed by their ingenuity and the timeliness of their new products. The Digital Link II is a good case in point. Here we have a relatively inexpensive digital decoder that can be used with a CD player, satellite receiver, LaserDisc player, or DAT recorder. And it sounds good to boot. There are a lot of people who would like to upgrade to outboard converters but can't afford the prices of most better sounding ones. The Digital Link II could be what these people are looking for.

The Digital Link II is an external processing unit that takes the Sony/Philips Digital Interface Format (SPDIF) serial digital output available from many CD players, CD transports, and other compatible digital sources, in either coaxial or optical form, and converts this signal to the left and right recovered audio outputs. The main reason to use a dedicated device such as this is to get better sound than the circuitry of most CD players and other digital sources can provide. The Digital Link II does the D/A decoding and feeds the audio into the system preamp.

Some of the features of the Digital Link II are automatic adjustment for incoming sampling frequencies from 22 to 50 kHz, automatic signal output muting when there is no suitable digital input signal, and the potential for upgrading to newer, better performing integrated circuit chips as they become available.

The front panel has three touch switches on the left side and a single green LED on the right side. The first switch

Unusual current-to-voltage conversion circuitry is used to reduce the possibility of slewing-induced distortion.

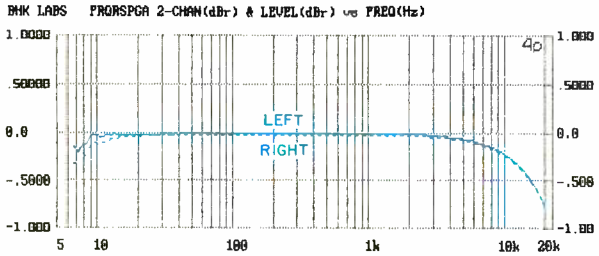

Fig. 1—Frequency response without pre-emphasis.

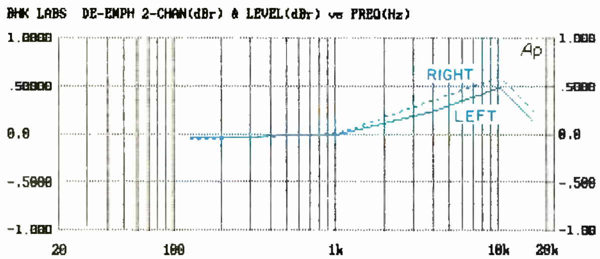

Fig. 2—De-emphasis error.

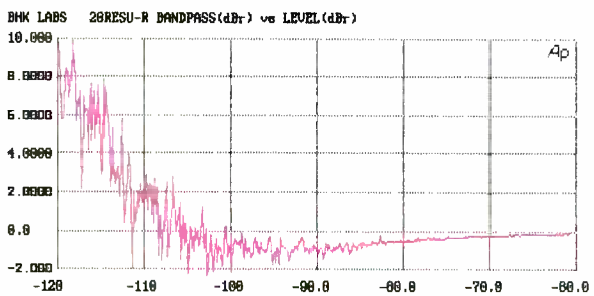

Fig. 3—Fade-to-noise test.

toggles the unit between standby and operation and illuminates the LED when the unit is on. The external power supply should be plugged in all the time to keep the internal circuitry always powered up and running for best sound. The other two switches select coax or optical inputs.

On the rear of the unit are a power input connector, a phono jack for coaxial digital input, a Toslink optical connector for optical digital input, and two audio output phono jacks. All three of the phono jacks are of high quality and are gold plated.

Circuit Description

The incoming digital signal to the coaxial input is terminated with a 75-ohm resistor in the unit to match the presumed characteristic impedance of the interconnect cable. After termination, the signal is fed into a C-MOS logic inverter to amplify and square up the waveform. This inverter is biased into the middle of its linear range by a feedback resistor. Another inverter chip follows and further squares up the signal pulses. The optical input is a neat little circuit module that converts the incoming optical digital signal to TTL logic level. Selection between the conditioned coaxial input and the output of the optical input module is implemented by a combination of three NAND gates controlled by the front panel's switch circuitry.

Next in the signal path is a digital receiver chip that performs many jobs: It locks to the incoming sampling frequency, outputs subcode information (such as presence or absence of pre-emphasis and the status of the copy-enable/prohibit flag), tells whether a suitable digital signal is present or not, and generates timing and data signals.

These timing and data signals then go to an eight-times oversampling, digital low-pass filter with a cutoff frequency of about 21 kHz. This is a steep "brick-wall" filter but still has a desirable linear-phase characteristic. All of this filter action is generated by a fixed, internal digital signal processing (DSP) algorithm.

Following the digital low-pass filter are two Analog Devices 1860N 18-bit D/A converters, one for each audio channel. Converting the D/A circuit's current to an audio signal voltage usually involves the summing junction of an op-amp, but this is done differently in the Digital Link II. Output current from each converter is fed into a low-value resistor. The resulting voltage is then fed into a passive RC low-pass filter followed by a passive de-emphasis network that's switched in when required to play a pre-emphasized disc. Next, a signal amplifier with flat frequency response builds the signal up to the several volts required at full modulation. The rationale for doing the D/A output's current-to-voltage conversion this way is to reduce the likelihood of slew-induced distortion (a possibility with the more common summing-junction approach) by keeping any out-of-band residue of the sampling frequency out of the amplifier circuit. According to PS Audio, this approach produces better sound. A measurement consequence is higher random noise in the final output or signal-to-noise ratios that are not as good as the CD medium is capable of. This increase in noise level is of little practical importance, as the noise is still far enough down to be inaudible in most circumstances. The output amplifier is a Burr-Brown OPA602, chosen for its

The Digital Link II's linearity is very good compared to that of other CD players and external D/A converters.

sound quality. A proprietary circuit is said to force the output stage of this IC op-amp to operate in Class A. This circuit is truly d.c.-coupled, from the D/A converter output to the main output, with no artificial ingredients like servo amps or capacitors in series with the shunt feedback resistor to limit d.c. gain to 1. A trimming arrangement in the output amp is used to adjust d.c. offset in the output to near zero.

The external transformer feeds in a.c. that is then half-wave rectified into two positive and two negative supplies. This rectifier scheme uses a novel approach—two rectifiers in series, with a filter capacitor between them in addition to the final capacitor at the rectifier output. Four three-terminal voltage regulators provide outputs of +12, −12, +5, and −5 V. Four LEDs in series with each 12-V supply drop the voltages to make an additional ±5 V supply.

All in all, the Digital Link II's circuitry has some unusual and interesting features not found in other D/A converters I've studied.

Measurements

For all my measurements, I used a Magnavox CDB-560 CD player as a transport and the CBS CD-1 test disc. The first thing I noticed when measuring the Digital Link II's performance was that its full-scale output was higher than the standard 2 V—closer to 3.4 V, in fact.

Frequency response without pre-emphasis is shown in Fig. 1. I think the slight irregularities below 20 Hz are an artifact of the test since they were not consistent in shape when I did the test at different times. High-frequency roll-off is smooth and is about 0.7 dB down at 20 kHz. Figure 2 is the response with de-emphasis switched in, and it appears to be a bit up in the high end. All other things being equal, this response will be noticeably brighter than if it were flat.

Next I conducted a series of tests for linearity of output level as a function of recorded level. Figure 3 shows the results of the dithered fade-to-noise test, while Figs. 4A and 4B show performance as deviation from perfect linearity. The apparent positive shift below −100 dB in Fig. 3 is actually an increase in noise, the result of hitting the noise floor of the CD player or decoder, and is fairly characteristic of this test. The linearity of the Digital Link II is very good compared to that of other CD players and external converters I have seen measured.

Related to linearity, certainly, are various kinds of steady-state distortions. In Fig. 5, THD + N as a function of recorded level with a 997-Hz tone is shown. The readings here are for THD + N as a percentage of full-scale output rather than as a percentage of actual recorded level. Figure 6 shows how THD + N varies with frequency at full recorded level.

For linearity and distortion, I measured the output spectrum up to 50 kHz with two equal-amplitude tones of 11 and 12 kHz (Fig. 7). Each of these tones is 3 dB below full scale, so their rms sum is 0 dB. The 1-kHz difference tone is about at the level of the noise and therefore doesn't really show on the plot. Second harmonics of the tones can be seen at 22 and 24 kHz, and there is a 23-kHz tone that came creeping in from somewhere. Notably absent is anything at the 44.1-kHz CD sampling frequency. This performance looks pretty good to me.

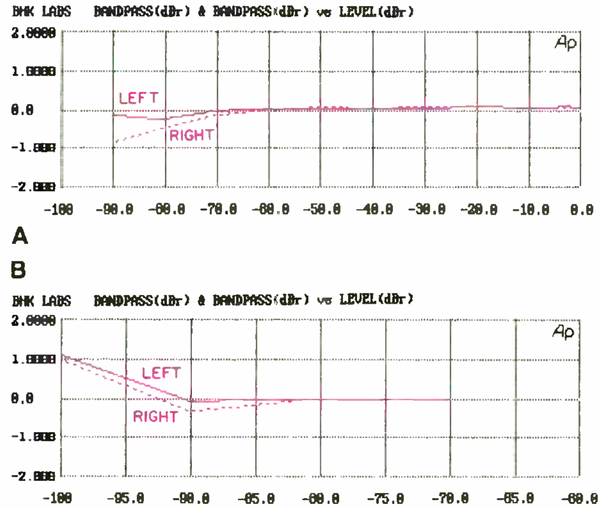

Fig. 4—Deviation from perfect linearity for undithered signals (A) and dithered signals (B).

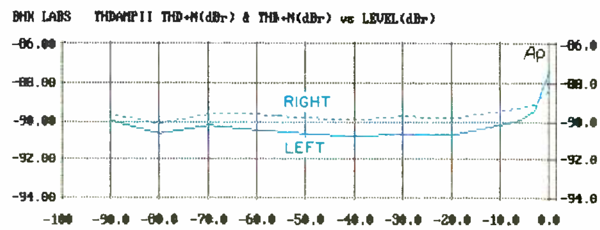

Fig. 5—THD + N vs. recorded level.

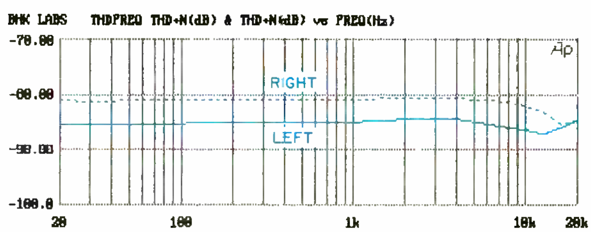

Fig. 6—THD + N vs. frequency.

The sampling frequency and its harmonics are notably absent from the output spectrum, a sign of good performance.

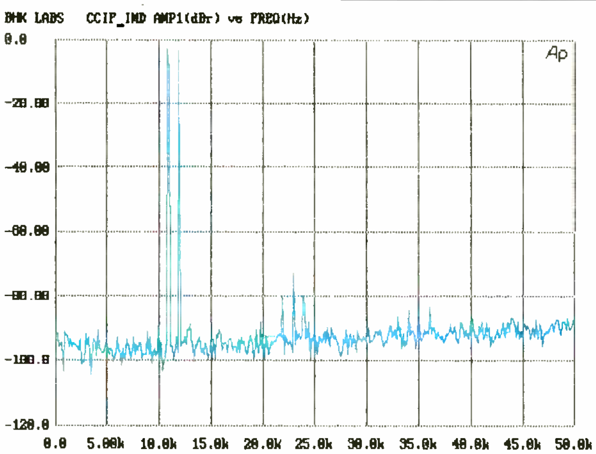

Fig. 7—Output spectrum for 11- and 12-kHz signals at −3 dB.

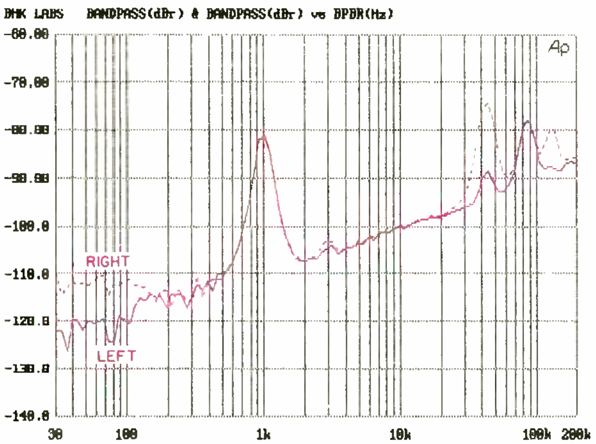

Fig. 8—Third-octave noise vs. frequency for 997-Hz tone at −80 dB.

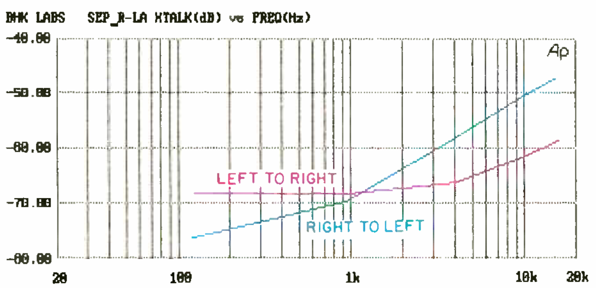

Fig. 9—Separation vs. frequency.

Noise within the bandwidth (approximately one-third octave) of the Audio Precision system's tracking bandpass filter is shown in Fig. 8 as a function of frequency, measured in the presence of a 997-Hz test tone at −80 dB. The noise shown rises at 10 dB per decade because it is closer to white than to pink noise. With a filter of constant percentage bandwidth such as the tracking third-octave filter used here, the density of white, or uniform, noise will rise at this rate. Some leakage at the sampling rate, and the second and third harmonics thereof, are visible. The right channel has more noise below about 200 Hz. Some third-harmonic distortion is just visible at about 3 kHz.

Crosstalk versus frequency is plotted in Fig. 9. Results are not outstanding, but they are probably good enough to avoid affecting stereo imaging and soundstage properties.

The impulse response of the Digital Link II (not shown) indicated that the unit is noninverting, and the nature of the ringing on that impulse showed that the unit's phase behavior is linear. The integral of impulse response is related to the step response, which is shown in Fig. 10 for a 997-Hz square wave. You can see an artifact of the Yamaha digital filter used here (and, I understand, of some Sony filters too): With a full-scale step signal, the filter clips off the natural excursions that go above full-scale. The symmetry of the ringing again shows the filter's phase linearity.

Table I—S/N ratios, referenced to 0 dB.

	S/N, dB	
Bandwidth	LEFT	RIGHT
Wideband	81.0	70.8
22 Hz to 22 kHz	93.4	92.2

Signal-to-noise ratio, relative to a full-scale signal, was measured for several bandwidth conditions (Table I). The sampling frequency and its harmonics were major contributors to the wideband reading in the Table.

My measurements yielded an EIAJ dynamic range of some 94 or 95 dB for the Digital Link II. This figure is arrived at by adding 60 dB to a THD + N measurement (made with A-weighted filtering over the range from 22 Hz to 22 kHz) of a 1-kHz test tone recorded at −60 dB.

I also measured quantization noise in an attempt to assess the noise contribution of the D/A converter when handling a full-scale signal. In this EIAJ test, a full-scale signal at a low frequency (such as 20 Hz) is played, and that signal and its harmonics are removed by a 400-Hz high-pass filter. What remains is random system noise plus the noise from the D/A conversion process—in this instance, 91 or 92 dB. This test does not use the A-weighting filter used for measuring dynamic range, so the results may really show random system noise rather than quantization noise per se; with quieter systems, I would expect to see true quantization artifacts, unmasked by noise, in this test.

Use and Listening Tests

When evaluating the Digital Link II, I used the Magnavox CDB-560 CD player and a Krell MD-1 CD transport plus such D/A converters as a Wadia 2000, a VTL Straight Line

I find the sound quite good, with an excellent sense of space and dimension and well-defined bass.

20-bit model, an Audio Alchemy DDE, and a number of experimental components. The output of whatever D/A converter was in use was fed to the main input of a First Sound Reference II signal selector and attenuator, a passive model that I use in preference to having a preamp output stage in the setup. I also tried such power amplifiers as the Carver Silver Sevens, Quicksilver M135 prototypes, and an excellent switching amp now under development. The speaker systems were the Martin-Logan Monolith III, Spica Angelus, and Win Research SM-10. I had no operational problems except for an occasional mild click or pop heard when muting the Magnavox player.

I find the sound of the Digital Link II to be quite good, with excellent sense of space and dimension and well defined bass. Compared to the better (and certainly more expensive) units I use all the time, the Digital Link II is flatter spatially, and it is a bit more sterile, with more noticeable grain structure but more apparent detail and a bit more irritation. Considering the PS Audio's price and good sound, it would be a worthwhile improvement to many CD systems. In fact, a discriminating friend of mine, who has a terrific-sounding system using Apogee Divas, has been happily listening to CDs through a Digital Link II for months.

In summary, I think the PS Audio Digital Link II is a very good-sounding decoder, and it may well be what you have been waiting for. Go get one and enjoy. *Bascom H. King*

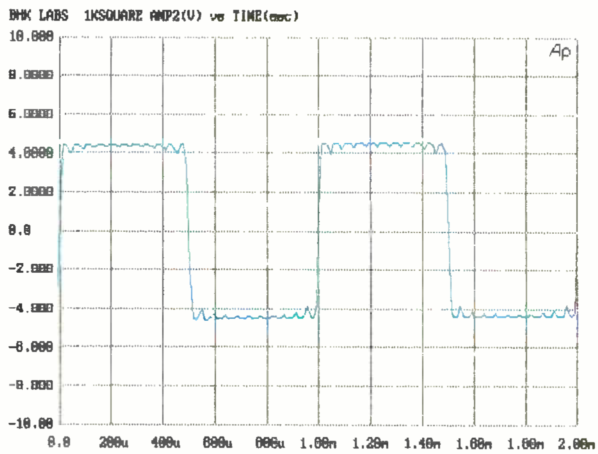

Fig. 10—Square-wave response; see text.

SOUNDAID MODIFICATION KIT FOR REALISTIC MINIMUS 7 SPEAKER

Company Address: P.O. Box 30315, New York, N.Y. 10011.
For literature, circle No. 94

Personal involvement in high-fidelity sound reproduction has diminished over the years. Most audio components have become so sophisticated, with such things as microprocessors, memories, digital signal processors, and infrared remote controls, that even if a listener had the desire to put in time and effort to improve the quality of his system, he would find it difficult to know where to begin. That's too bad, because audio used to be more fun. It has changed from a hobby, where one could actively participate in designing and building audio components and reap the reward of personal satisfaction, to a more passive recreational pursuit. Some people may complain about the lack of science in many of the "tweaks" we hear about, and certainly there are many silly things being promoted, but the reason for their popularity is at least partly due to the fact that many audiophiles want to be actively involved in the pursuit of good sound reproduction.

One of the last components of high-fidelity sound reproduction that is still available for personal input is the loudspeaker system. If you have an interest in getting actively involved in audio, a great way is modifying an inexpensive one. If you have any trepidations, consider the SoundAid Kit.

The SoundAid Kit, which costs $30, contains all the materials and instructions necessary to guide you through some simple modifications intended to improve the sound quality of a pair of Realistic Minimus 7 loudspeakers. The Minimus 7 has enjoyed a long life compared to other speaker models offered by Radio Shack. It is listed on page 19 of the 1992 Radio Shack catalog and is reasonably priced at $49.95 apiece; I have seen it in the company's monthly flyer for as little as $29.95. The Minimus 7 is an 8-ohm, two-way system with a 1-inch dome tweeter and a 4-inch woofer. The enclosure, a die casting with a wall mounting bracket on the rear, measures $7\frac{1}{16}$ inches high × $4\frac{7}{16}$ inches wide × $4\frac{5}{16}$ inches deep. The system weighs $4\frac{1}{2}$ pounds and has a perforated metal grille. Optional mounting brackets are available for $17.95 per pair.

The SoundAid Kit includes eight sheets of damping material that measure $7\frac{3}{4}$ inches long, $\frac{3}{4}$ inch wide, and about $\frac{3}{16}$ inch thick; two 4.7-μF, 150-V Solen capacitors; a small plastic jar (not shown) containing a white liquid to coat the 4-inch bass cone, and a brush to perform this operation. The instructions are clear and the steps easily performed. A Phillips-head screwdriver is needed to remove the bass driver, and a soldering iron and some solder are needed to remove the original gray capacitor and replace it with the new Solen capacitor. Needle-nose pliers might be handy for removing the capacitor leads but aren't essential.

The first step is to remove the grille, which can be pried off easily because it is held in place by small pieces of sticky damping material. Next, the bass driver is removed to give access to the inside of the cabinet. After removing the acoustic material, you apply the slabs of damping material to the inside walls of the cabinet by mere-

KIT EVALUATION

PARAMETER	RATING	COMMENTS
Overall Sound	Good	
Bass	Fair	"No change"
Midrange	Good	"Improved definition"
Treble	Good	"No change"
Value	Very good	

GENERAL COMMENTS: A good way to get involved in improving the sound of a loudspeaker system with minimum expenditure while learning something at the same time.

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Audio has become a passive recreational pursuit, but a great way to be active in audio is to modify an inexpensive speaker.

ly pressing them in place; they are sticky and will adhere quite easily. The next step is the replacement of the capacitor, which is a reasonably easy task. After this is finished, the acoustic material is inserted back into the cabinet, and the woofer is replaced. The last step is to coat the woofer cone with the white liquid. If you want to experiment, you can put on a light coating, listen to the results, and then put on another coating after the first coat has dried. This will allow you to hear the change more gradually.

I asked a number of people to listen and write down their comments while comparing an unmodified Minimus 7 versus a SoundAid modified one. Since I had previously determined that the lowest bass was unaffected by the modification, I saved time by using program material that would allow the actual differences to be heard more clearly. I played recordings that featured brass, strings, and voice. I also used the interstation noise from an FM tuner, because it is an excellent way to hear subtle colorations very easily. Some of the listeners' comments about the sound of the unmodified Minimus 7 were: "Sharper sounding," "more nasal," "unable to listen to it for long periods," "shrill," and "more forward." Comments about the SoundAid modified Minimus 7 included: "Smoother," "more natural," "tolerable," "clearer on voice," and "more definition in middle register." From these comments it is clear that the SoundAid modification improved the sound quality of the Realistic Minimus 7.

I also made a number of technical measurements on the modified and unmodified systems, and the results tended to verify that the SoundAid Kit really does do some good things. The response of the bass driver is better between 1 and 2 kHz because there is less cone breakup. The Solen capacitor improves the sound between 3 and 5 kHz by increasing the tweeter output in this range and making the sound cleaner. The increased tweeter output does increase the level of the baffle reflections in this range, however. You might want to experiment with using some felt or foam material around the tweeter. Because the grille causes some loss of high frequencies above 9 kHz, the sound might be even better with the grille removed if you've added the felt or foam.

I recommend the SoundAid Kit to anyone who has a desire to get more involved in the fun part of audio but feels cautious, inhibited, or even timid about trying something as daring as modifying a speaker cabinet or painting a woofer cone. Try it. Let's bring some fun back to our audio hobby. By the way, as an added incentive to buying the Minimus 7s and modifying them with the SoundAid Kit, these systems make very good rear-channel loudspeakers in surround installations.

Edward M. Long

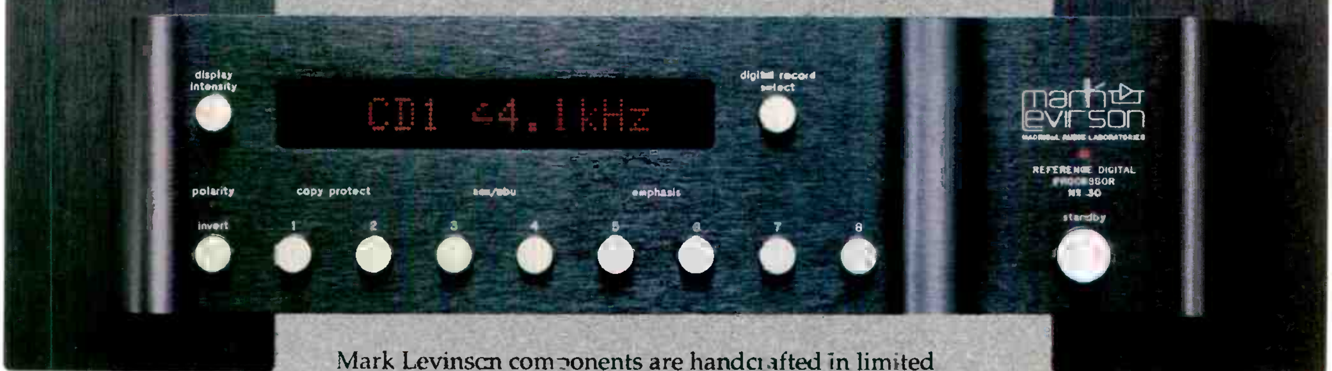
Nº 30

REFERENCE DIGITAL PROCESSOR

PRIDE IN THE DETAILS . . .

Mark Levinson® components have earned a reputation for their rugged reliability, uncompromising fit and finish and, above all, superior sonics. We at Madrigal Audio Laboratories are understandably proud of this reputation.

The presence of "high technology" in our society has, for some, come to mean the absence of craftsmanship. Mass-produced look-alikes are everywhere, even in the realm of so-called high-end audio. The quality that you see and hear in a Mark Levinson component is not the result of automated mass production—rather, it is the result of painstaking attention to the details of design, and of pride in the art of craftsmanship.



Mark Levinson components are handcrafted in limited quantities and to exacting specifications. All who participate in their production share the feeling of pride that comes from knowing that they contribute to a product that defines quality.

It is with great pride, then, that we introduce the Mark Levinson Nº 30 Reference Digital Processor. Five years of exhaustive research into digital audio yielded a processor worth waiting for, deserving of the Levinson marque.

The Nº 30 is a true reference: it neither adds to nor subtracts from the music. It brings to your home the accuracy as well as the essence of the performance. Finally, the promise of digital audio is fulfilled.

The Nº 30 is proof that state-of-the-art digital *and* analog technology can coexist with craftsmanship. The subject here, however, ultimately is music, and the heart of music is in the listening. To fully appreciate the quality of the Nº 30, we recommend that you visit your Mark Levinson dealer for a full audition.

mark levinson®

Mark Levinson® products are designed and manufactured by
MADRIGAL AUDIO LABORATORIES P.O. Box 781, Middletown, CT 06457 FAX (203) 346-1540

WIN RESEARCH SM-10 SPEAKER

Company Address: 7320 Hollister Ave., Goleta, Cal. 93117.
For literature, circle No. 95

I have known Sao Win for a long time, as we both live in the same city and are heavily into audio. About two years ago, I helped him test some of his speaker prototypes. I was taken by the astonishing resolution of his speakers, though it was accompanied by some edginess and irritation when listening with source material and electronics I knew to be good. Further refinement of the diaphragm materials and adjustment of the crossover eliminated the irritation while leaving the resolution and transparency intact.

I've been lucky enough to get a pair of the Win Research Group's final version to listen to for an extended period. I am now getting the most incredibly musical and realistic sound that I have had so far in my home. The SM-10 speakers are so good that although the differences between amplifiers and other electronics are clearly audible, they don't seem to matter as much as with other speakers I have lived with.

Among the CD equipment used to listen to the Win Research SM-10s was a Krell MD-1 transport feeding a VTL Straight Line D/A converter going into the wonderfully transparent First Sound Reference II passive signal selector and attenuator. Records were played with an Oracle turntable fitted with a Well Tempered Arm and Spectral Audio MCR-1 Select pickup feeding an EAR Head step-up transformer and a tube phono preamp. Power amplifiers used were a pair of Quicksilver M135 prototype mono tube amps, the fabulous Carver Silver Sevens, and a very good little switching amplifier designed by my good friend and mentor, Mack Turner.

How realistic is the SM-10's sound? Imaging is wide and deep, and recording spaces and boundaries are revealed with newly perceived precision. Tonal accuracy and resolution of musical details are simply stunning—and all this with very low amounts of harshness and irritation! The only complaint I have is that the bass doesn't go down deeper. Its quality is excellent, however, and is very good down to a perceived 40 or 50 Hz in my room. (I will try various subwoofers in the near future.) After living with the SM-10s, if I had to opt for lesser reproduction above 60 Hz in order to get good low bass, I wouldn't make that trade.

The fit and finish of these speakers is classic Win. Sao Win is such a perfectionist that he worked with the company that finishes the enclosures for months until he was satisfied with the perfection of the black lacquer.

What are some of the technologies that make such an outstanding speaker? First, the transducer unit is a flat-plane coaxial design whose woofer is a ring radiator with an outer diameter of 6½ inches and about a 3-inch inner diameter. The flat-plane tweeter diaphragm is mounted inside that 3-inch circle. By "flat-plane," I mean that the woofer and tweeter membranes are approximately in the plane of the front surface of the enclosure. This arrangement eliminates the tunnelling and diffractive effects of having a tweeter located back at a conventional cone's apex, as in other coaxial designs, and helps to improve the alignment of the two radiators in time.

The woofer diaphragm is driven nodally (about halfway between its center and outer diameter) by a voice-coil of very large diameter, and it is laminated from thin layers of woven carbon fiber and a silica-gel catalyst, compressed under high temperature and pressure. The result is a moving assembly of surprisingly low mass, some 29 grams. Very high damping of breakup modes above the woofer's operating range is another important benefit of this construction technique.

The tweeter diaphragm is also flat and is a disc about 1 inch in diameter. This disc is made out of mica and alumina ceramic and is, like the woofer, compressed under high pressure and temperature. The resulting dia-

The Win SM-10s produced the most incredibly musical and realistic sound I have ever heard in my home.

phragm is nodally driven, like the woofer. This tweeter's suspension has considerably more excursion capability than I have seen in other tweeters. Win Research says that this tweeter diaphragm has 10 times the bending stiffness and twice the internal damping loss of titanium.

Considerable research and computing went into the magnetic design of the drivers. The magnetic material used is Alnico 8. In my experience, the use of Alnico magnets in speakers makes them sound fast and accurate.

Last, but certainly not least, is the die-cast basket and frame assembly of the coaxial driver unit. It is made of an inert aluminum/zinc alloy.

Beneath the enclosure's beauty is design technology as extensive as that used for the drivers, including the use of computerized finite-element analysis to reduce and optimize vibration. The material used in the enclosure is Medex, 1¼ inches thick, with complex internal bracing. The driver assembly is mounted to some of the internal braces rather than the front panel itself. All edges of the enclosure are rounded with a large radius, to eliminate diffraction radiation.

The stands are an integral part of the SM-10 system and were designed especially for these speakers to get the transducer up at listening ear height. Special "Neural rubber" isolation mounts decouple the speaker from the stands.

Mounted on the rear of the stand legs is the passive crossover unit. The crossover is outside of the enclosure to reduce vibration effects on the crossover components and to eliminate any magnetic coupling from the drivers. This crossover has two sets of inputs, for bi-wiring the speakers to amplifiers. The crossover's electrical characteristics and the drivers' electromechanical characteristics yield a net fourth-order low-pass roll-off for the woofer, mated to a second-order high-pass characteristic for the tweeter, at an effective crossover frequency of around 3.5 kHz. The quality of the components in the crossover is first-rate, with Litz-wire inductors used along with all film capacitors. The damping resistors are made in semiconductor TO-220 cases with little finned heat-sinks to dissipate heat!

At $6,250 a pair, these speakers are not cheap, and they certainly won't appeal to all buyers looking at speakers in this price range. For many, however, I firmly believe that the SM-10s' compelling honesty and realism will make the price worth it. For my part, I have not enjoyed reproduced music as much as I have in the recent months with the SM-10s. When my editor asked if I would send the pair that I have to *Audio* for photography, my heart stopped momentarily and I quickly said to myself, "No way, Jose!" I couldn't bear the thought of being without them! *Bascom H. King*

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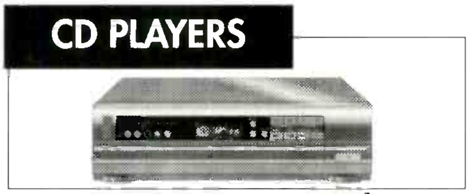

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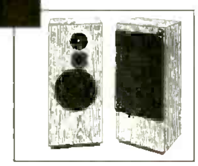

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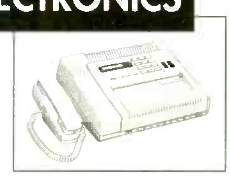

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EXHIBITION PIECES

Illustration: Rick Tulka

Murray Perahia Plays Franck and Liszt.
Sony SK 47180, CD; 60:13.

Murray Perahia, his youth tending now towards early middle age, is without a doubt one of our most intelligent and musical pianists, with a remarkably reliable understanding of many kinds of music as well as the expected super-technique. In the more intellectually difficult works of the Romantic age, this man is outstanding—especially in Liszt.

Everybody knows Liszt as the great Romantic devil-pianist, the greatest ever, whose music for that instrument was the final challenge—and yet so often seemed fussy and hideously over-ornamented. It surely does—when played with mere technique, and without depth. More and more, it seems to me, we can realize the profound and even unsettling profundities that hide behind so much Liszt, the acrid, restless harmonies that seem to tear at his soul as he writes—even in many of the frothiest showpieces. There is no other harmony like Liszt. It is not imitable. Everywhere is the augmented triad, never resolved, moving on to more of the same; he was the earliest to make music of the sort, emphatically before Wagner perfected his musical flotations that went on and on. . . .

Few pianists can fathom these aspects, for they are surrounded in so many works by the finger fireworks that demand all the attention a pianist can muster! Hidden behind a billion tones, like points of flashing light, is the real sense of the music, the harmonies and the melodies. Mostly, they are lost.

Need I say more? Perahia is astonishingly aware of every shade of Lisztian meaning while tossing off the incredible fireworks not only with utter ease but in the right proportion to the "meat" they so easily cover up. I've never heard better Liszt than this—and that means *communicative*. It makes ear sense.

The big Franck at the beginning, a major concert piece, is wonderfully clear and balanced, but not as much an accomplishment as the Liszt. It doesn't have to be. Did I hear B A C H in it? Never noticed it before.

Edward Tatnall Canby

Johann Pachelbel: Music for Organ.
Werner Jacob, organ.
Virgin Classics VC7 91087-2, CD; DDD; 72:58.

About time! Now those who have become familiar with the name Pachelbel via the all-too-well-known Canon may discover the real man, the most eminent of the immediate predecessors of J. S. Bach in Central Germany and a composer whose music is startlingly like that of Bach, out of the same splendid tradition. The Pachelbels were even friends of the Bach family.

The present organist, Werner Jacob, interestingly holds the same position in the same church at Nuremburg that Pachelbel did in his mature years (he died in 1706, 44 years before Bach's death). But this man had to go elsewhere to find an appropriate, present-day organ for Pachelbel's music, the 1833 organ in Alsace. To old Bach organ fans, this organ will sound strikingly like that on which Dr. Albert Schweitzer played his famous organ recordings of Bach, released in 78 rpm, the first lengthy Bach recordings on an instrument appropriate to the music and the playing of Bach himself. That organ, too, was Alsatian.

The music here is Bach-like throughout, including preludes, fugues, a toccata, and two chaconnes (ciaconna). There are also more than a half dozen chorale settings on familiar German tunes, every one of which Bach also set numerous times, not only in his organ music but in his major works such as the Passions and the cantatas. Pachelbel, unlike the somewhat peasant-like and often jolly Buxtehude, out of the north, is as serious as Bach, as elegant and as rigorous, but capable also of lightness and color when it is appropriate. Pachelbel is simply "lower voltage"—Bach was indeed the greater musical mind. But this man nevertheless was a tremendous influence on German music, notably through his numerous pupils (including J. S. Bach's older brother Johann Christoph). And, needless to say, on Bach himself.

This is a fine organ, on the mild and chaste side but very much of the older school in spite of the late date. It was built before the era of the French "Romantic" organ. It is, of course, a mechanically operated "tracker" organ—there was no other kind in 1833. So were the early Romantic instruments. But this one, like Schweitzer's, looks back to a long and sturdy tradition rather than forward to such as Franck, Vidor, and the "symphonic" organ school. *Edward Tatnall Canby*

Romantic Brass: Music of France and Spain. Empire Brass.
Telarc CD-80301, CD; 61:02.

The Empire Brass is much in evidence these days, with their six previous Telarc recordings, world tours, and many broadcast appearances here. The 16 selections on this CD are transcriptions of works seldom or never before heard played by a brass quintet. The Spanish and French composers include Albéniz, Turina, Granados, Rodrigo, Debussy, and Ravel.

When one notes that the quintet is joined by a percussionist and guitarist for many selections, a feeling of hesitation may suggest itself to the purist. But not to worry—all works smoothly, especially the lovely middle movement from Rodrigo's "Concierto de Aranjuez" for brass and guitar. At 11 minutes, it is the major work on this sparkling recording.

The pieces by the same composer are spaced out in the program for variety; thus, a work by one composer can comment on those just before and after by other composers. For example, a short excerpt from Ravel's "Valses Nobles et Sentimentales" serves as an introduction to the also dance-like "Oriental" of Granados, and then a more impressionistic mood is set by Debussy's Sarabande.

The Empire's collective virtuosity is something to hear. On most of these transcriptions, we don't miss the full orchestra at all. Telarc's rich and wide stereo spread places the instruments far enough away that their considerable reflective energy in the hall can be sensed with just a pair of Schoeps tube mikes for the brass. *John Sunier*

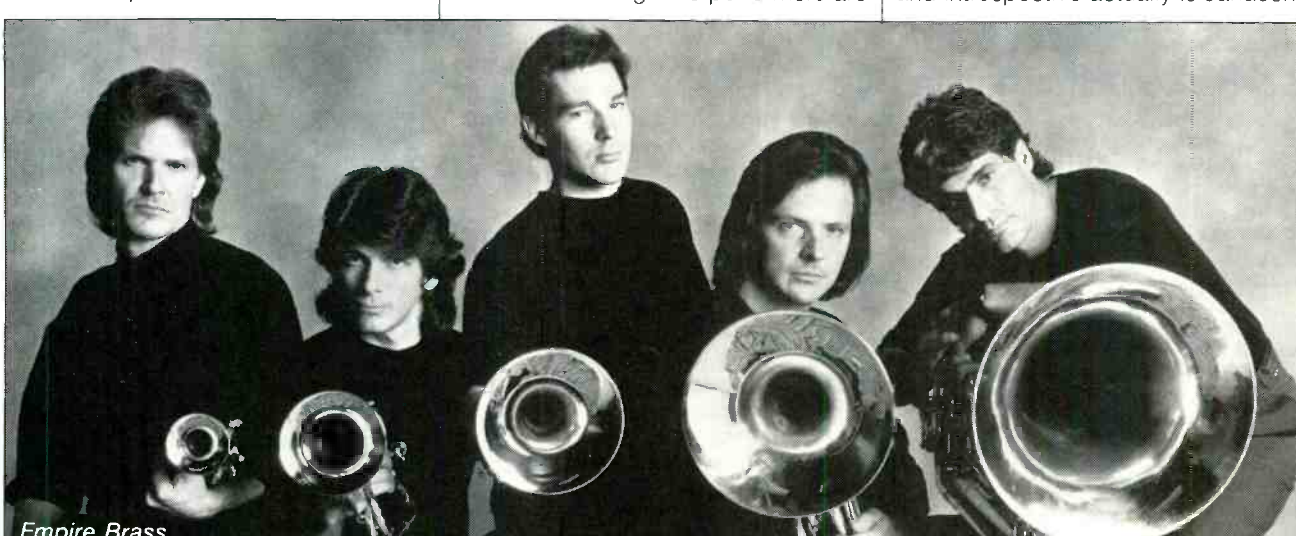
Stravinsky: Suite from Pulcinella and other works for violin and piano; Ernst Toch: Sonata for Violin and Piano. Eudice Shapiro, violin; Ralph Berkowitz, piano.
Crystal CD302, CD; 64:54.

Here is one of Crystal's most effective recordings, a program for violin and piano that has so many interesting facets you forget the "recital" aspect and focus on just the two instruments. For anyone who has been around, so to speak, in Stravinsky, every one of the featured works here is familiar, but not one is in the original form. All are brilliant piano-violin recastings, mostly by Stravinsky himself. This opens up a whole new look and listen, and there is endless interest in what happens in the changed format. To hear ultra-familiar parts of *Firebird* and *Petrouchka* in such a precise and sharply defined form is fascinating. The performers are seasoned pros who themselves knew Stravinsky and the greats involved in so many of his works—the styling is perfection, totally communicative.

That's only half the record. A filler to finish off? I wondered—Ernst Toch? A prominent modernist in the post-WWI period along with Stravinsky, but of a very different nature. This is early prewar Toch and absolutely lovely as a late-Romantic youthful work composed when Toch (1887 to 1964) was 26, perfecting his technique after the music he knew, the grand tradition. No doubt about it, here was a real genius. But could he fit into the violently changing world of the 1920s? I found a peculiar pleasure in this music because it is exactly my own age! Totally irrelevant, but I recommend it and the Stravinsky as ageless CD.
Edward Tatnall Canby

Janacek: Piano Sonata 1.X.1905; In the Mists; On the Overgrown Path, Series I. Leif Ove Andsnes, piano.
Virgin Classics VC 7 91222-2, CD; DDD; 70:47.

From the cover of this CD, Leif Ove Andsnes stares at you with a wary petulance that suggests a self-indulgent teenager. Don't be fooled. Though he may have been just emerging from his teenage years when he recorded this (in 1990), the pianism is mature and poetic: A feast of tonal coloration and rhythmic sophistication. What is moody and introspective actually is Janáček's


Empire Brass

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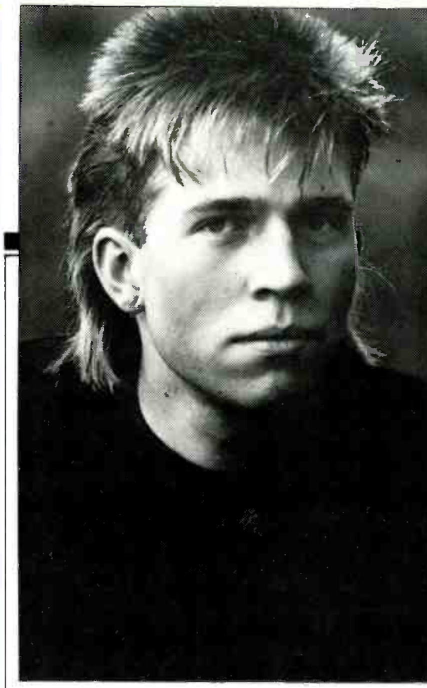

Photograph: ©Morten Krogvoid

subject matter in these frequently moving pieces.

The 1905 date that serves as a title for the sonata memorializes the killing of a Czech worker by Austrian troops for no greater offense than having supported the Brno University. Although the events that helped Janáček shape the rest are generally personal and sometimes very obscure, the tragedy of losing his only daughter played a clear role.

The useful booklet notes (by Mark Audus) make clear that, to Janáček, the piano was "his instrument" and that the more personal quality of the writing (vis-à-vis his operas, which are much better known today) is to be expected. But the pieces are "pictorial" only in the most abstract sense: They gain in impact from our knowing what inspired them, but they deal with patterns and emotions rather than objects or events as such.

The deftness with which Andsnes realizes these works is uncanny. Rubato and color changes seem utterly unstudied—though the control with which he produces them is undeniable—just as though they had been generated by the imagination of the composer himself. The loudest notes are a little hard in sound, but otherwise it is almost impossible to imagine how the performances could be improved.

Virgin Classics used The Maltings at Snape for this CD. Recordings made there demonstrate to those of us who have never attended it why the Aldeburgh Festival has such appeal for those who have. Here, the burnished ambience is a welcome presence that never intrudes on some really exceptional music-making. *Robert Long*

Leif Ove Andsnes performs rubato and color changes in these piano works as if they had been generated by Janáček's own imagination.

Joaquín Rodrigo: The Complete Music for Piano. Gregory Allen, piano; Anton Nel, piano 2. **Bridge 9027 A/B.**

This first recorded collection of Joaquín Rodrigo's works for both two- and four-hand piano is a treasure-trove of fascinating and picturesque pieces. We get to see a different side of the Spanish composer known for his melodic works for guitar and orchestra. The early efforts show an appreciation of Debussy, Ravel, Satie, and Stravinsky. After study with Paul Dukas, Rodrigo began a study of early Spanish art music, and later pieces bear many familiar hallmarks of the culture of Andalusia. Gregory Allen is an exciting performer, captured in clean and resonant sonics. *John Sunier*

Ravel: Piano Works, Vol. 1. André Laplante, piano. **Elan CD 2232.**

This initial CD in a projected complete traversal is beautifully played but somewhat marred by an overly close pickup, which lets you hear the piano's damper action all too clearly. It gives the impression that you're lounging by the piano while a master is playing some of Ravel's most idiomatic music, the piano having been "his instrument." Included are "Gaspard de la Nuit," "Valses Nobles et Sentimentales," "Menuet Antique," and the Sonatine. *Robert Long*

André Laplante.

Photograph: Ken Howard

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TRADING PLACES

Human Touch: Bruce Springsteen
Columbia CK 53000, CD; AAD; 58:51.
Sound: B– Performance: B

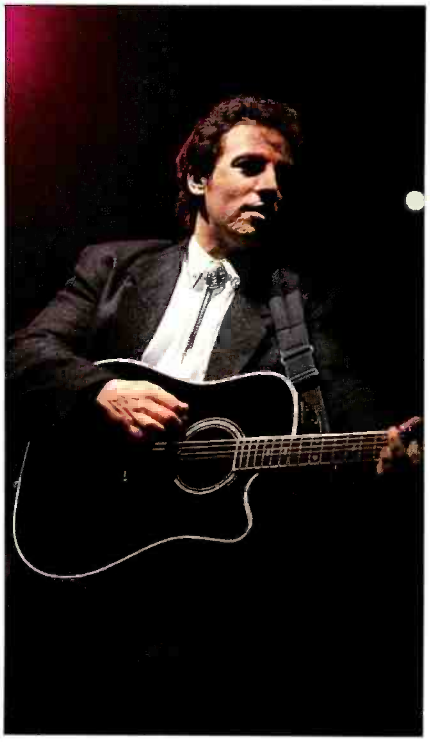
Lucky Town: Bruce Springsteen
Columbia CK 53001, CD; AAD; 39:41.
Sound:C+ Performance: B–

Joshua Judges Ruth: Lyle Lovett
MCA/Curb MCAD-10475, CD; DDD; 57:41.
Sound: A Performance: A

Bruce Springsteen is certainly a long way from "Thunder Road" and its sprawling landscapes. His new albums, *Human Touch* and *Lucky Town*, continue the process of his de-mythification, something he began on *Tunnel of Love* five years ago. *Touch* is fueled by loneliness, while *Town* celebrates acceptance of his new family life.

I find *Touch* to be the stronger album, probably because loneliness motivates the muse better than satisfaction. The yearning tone of the title track is a perfect opener, while the desperate "Gloria's Eyes" and the anthemic "All or Nothing at All" serve as standouts. The moody "With Every Wish," featuring guest vocals by Sam Moore and Bobby Hatfield, is the only song on either album that might be construed as any kind of stylistic reach.

Photograph: Michael Wilson



Photograph: ©Ken Settle

On *Lucky Town*, the opener, "Better Days," sets a tone and theme that carry through the album, with "Local Hero" and "Leap of Faith" the best rockers. However, it is "My Beautiful Reward" that stands out as the most haunting song. Appropriately, Springsteen dedicates this album to his wife and children.

There is a built-in familiarity to the sound of both discs. Recording is adequate, if nothing special. One caveat: On too many of the more raucous songs, Springsteen's voice is submerged in the mix, obscuring his lyrics. In the end, he continues to strip his musical vocabulary down to its basics while his songwriting is more introspective than ever.

In contrast, while Lyle Lovett also refines his musical vocabulary, his sonic presentation on *Joshua Judges Ruth*, his first album in three years, is crystal-clear digital, a very effective means for spotlighting his lyrics.

Joshua is much sparer than Lovett's *Large Band* (1989), but similar elements—bluesy melodies, crisp yet stark arrangements, and his skewed-viewpoint songwriting—exist in both. The key instrument here is Matt Rolling's piano, the only sonic constant.

Lovett's songs make this a dark album, far lonelier than Springsteen's *Human Touch*. They don't come any lonelier than "She's Already Made Up Her Mind" or "She's Leaving Me Because She Really Wanted To" (the only true country song here). Nor are they bleaker than "Baltimore," a song about his grandmother's death. Fortunately, all of this darkness is cushioned by the hopelessly horny "I've Been to Memphis" and "She Makes Me Feel Good," or by "Church," where cornbread and beans prove more sustaining than the long-winded preacher.

It's curious that Springsteen and Lovett are moving in opposite directions, Bruce toward country (whether or not he'd own up to it) and Lyle away from it. Yet the public perception of each is still stuck in first impressions. Artistic growth is often rough on the artist, but maybe even rougher on a public that resists change. *Michael Tearson*

Rise Robots Rise. TVT 3210-2.

Rise Robots Rise is a semi-anonymous 12-piece ensemble (no names appear on the disc) founded by New York University students Joe Mendelson and Ben Nitze. They superimpose rap- and funk-inspired vocals over hip-hop and industrial rhythms supplied by the treble click of a drum machine. With muted Miles Davis-like horns and wailing guitar lines that glide from guns-blazing hard rock to fat jazz and wah-wah'd Jimi Hendrix psychedelia, the songs serve as vehicles for biting social commentary. Yet you have to work hard to cut through the odd juxtaposition of musical styles and the dense, studio-happy mix to get the message. *Michael Wright*

Doppelganger: Curve. **Charisma 92108-2.**

The brainchild of media darlings Toni Haliday and Dean Garcia, Curve offers a dense backdrop of swirling electric guitars and layers of breathy backing vocals that supplement Haliday's coy, throaty lead singing. The fetching Haliday spins alternately between disappointment with some cold-hearted oaf and revenge pacts made of black cotton candy. Though Curve is seductive and enigmatic, they're not really unique, and comparing them to others would be too easy. Yet their success lies in blending elements of style and substance, producing a luscious, compelling sound that keeps you at the edge of your stereo, hitting the repeat button. *Toby Haber*

The Mandolin Man: Marvin. **Restless 72582-2.**

Marvin is actually Marvin Etzioni, the bass player (for one album only) and contributing songwriter for the long-dormant L.A. quartet Lone Justice. *The Mandolin Man*, his debut recording, recalls nobody more than Leonard Cohen, for several reasons: Etzioni's gruff vocals, the arch romanticism of his songs, and the fearlessness of their slow tempos. My particular favorites include the paean to street musicians, "Clarinet Row," as well as the sadly sweet "Rosemary Nobody" and the Guthrie-esque "My Ultimate Home."
Michael Tearson

Inner Revolution: Adrian Belew. **Atlantic 82370-2.**

With *Inner Revolution*, we find the clever ex-Zappa/Bowie/King Crimson guitarist Adrian Belew playing almost every instrument and producing this all-digital set. Belew lets his thoughtful lyrics wander over mature subjects (self-transformation, divorce, and great sex) while his guitar squeaks, squeals, and shimmers through bouncy '60s-cum-'90s pop that more than once brings George Harrison to mind. Great songs, artful arrangement textures, innovative guitar, fine singing, and the feeling of a good time add up to a brilliant record. *Michael Wright*

On Track: Buckwheat Zydeco. **Charisma 91822-2.**

Buckwheat Zydeco, a.k.a. Stanley Dural, has stated in the past that he wants to do for zydeco accordion what Jimi Hendrix did for electric guitar, and in the riveting eight-minute jam on "Hey Joe," he damn near does! Other highlights are "Won't You Let Me Go?" and "The Midnight Special." A whole lot of fun. *Michael Tearson*

Arkansas Traveler: Michelle Shocked. **Mercury 314-512 101-2.**

This is Michelle Shocked's most fascinating album yet, each of the 14 selections recorded in a different location with friends to create a frisky mystery tour. Highlights abound, the very best a duet with fiddler Alison Krauss on "Prodigal Daughter (Cotton Eyed Joe)" that segues into a jam with Alison's hot band, Union Station. Among the other standouts are "33 rpm Soul" with Pops Staples, "Secret to a Long Life" with Levon Helm and Garth Hudson of The Band, "Jump Jim Crow" with Taj Mahal, "Over the Waterfall" with Ireland's Hothouse Flowers, "Blackberry Blossom" with Norman and Nancy Blake's Rising Fawn String Ensemble, and "Strawberry Jam" with Doc Watson, Jerry Douglas, and Mark O'Connor. *Arkansas Traveler*'s diversity reveals a lot about Michelle in a wildly careening ride that will not fit into any radio format. *Michael Tearson*

Michelle Shocked

King's X. Atlantic 82372-2.

The eponymous fourth King's X album shows this hard rock trio at last expanding its vision beyond obscure C. S. Lewis concepts to explore more personal emotions. In spite of the increased accessibility, however, even a rock 'n' roll cliché such as the isolation of the road receives more cerebral expression than found with ordinary bands. These are very talented musicians who stitch together complex structures that please the listener's mind while kicking you-know-what.
Michael Wright

Poison Girl: Chris Whitley. **Columbia 44K 74247.**

We're really not in the business of reviewing CD-5s, but this one deserves serious attention. Leading with "Poison Girl," a great cut from Whitley's *Living with the Law* album, it also includes five solo, live acoustic performances—three from Whitley's living room and two from a concert in Boulder. Whitley takes the blues and bends the genre into something fresh and often startling. *Michael Tearson*

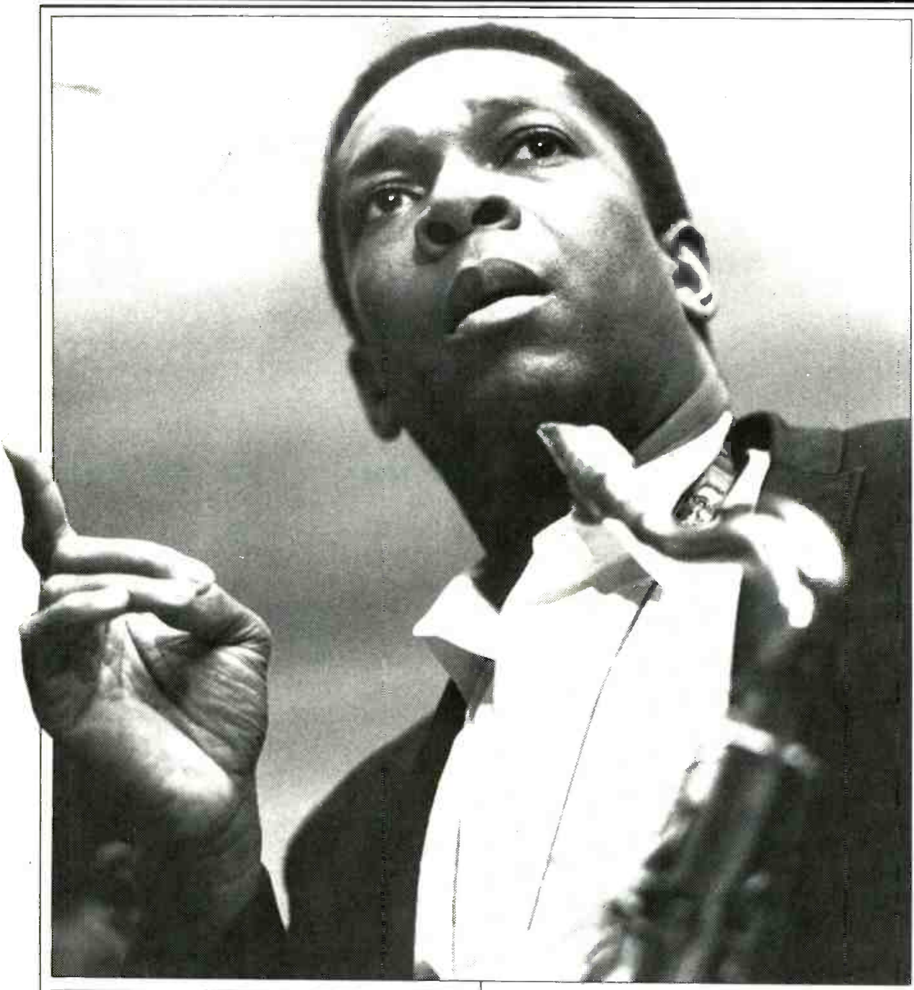
Anything Can Happen: Leon Russell. **Virgin 2-91821.**

After too long an absence, Leon Russell returns with a fine, characteristic album. He sounds as good as ever. Bruce Hornsby co-produced with Leon and also co-wrote five of the 10 selections. The best of these are Leon's own "Black Halos" (about Desert Storm), a goofy and somewhat rappy "Too Much Monkey Business," Hornsby's own "Stranded on Easy Street," and the title track.
Michael Tearson

Remember Me?: Otis Redding. **Stax SCD-8572-2.**

Can you believe it? A full hour—22 cuts in all—of previously unreleased Otis Redding. Some cuts are newly unearthed songs, and some are fascinating alternate takes of "Dock of the Bay," "Try a Little Tenderness," and an early "I've Got Dreams to Remember" with very different lyrics. Superb notes by Rob Bowman, annotator of last year's huge Stax/Volt box and the three-disc *Otis Redding Story* before that, round out this package.
Michael Tearson

SHEETS OF SOUND



Photograph: Charles Stewart

The Prestige Recordings: John Coltrane
Prestige/Fantasy 16 PCD-4405-2, 16 CDs; AAD; 18 hours, 47 minutes.
Sound: B+ Performance: A−/A

The Major Works of John Coltrane
Impulse/GRP GRD-2-113, two CDs; AAD; 2:37:05.
Sound: A− Performance: A−/B+

I have discussed the massive 16-CD John Coltrane set with any number of my colleagues, and some of them don't view it as a "five-star" boxed set. Everyone admits that it's an amazing compilation, but they don't regard it as housing 'Trane's best work.

I don't necessarily quibble with that. Those were Coltrane's "formative" years, the mid-1950s, not necessarily his most formidable. I do, however, feel that, in hindsight, we may be holding the giant among giants up to unfair scrutiny. But why focus on negative aspects? Why not pay attention to the fact that some of the genre's seminal players, particularly Sonny Rollins, are present on these recordings?

The package is overwhelming—as much as, or perhaps more than, any other boxed set I've listened to these past few years. *The Prestige Recordings* spoke to me about a specific spot on the jazz history spectrum. The mid-'50s was such an important time for Coltrane and also for jazz development as a whole, but simply put, I don't know any other collection making that case more strongly than this one.

Also, I'd like to emphasize that the 18+ hours of material were recorded within the span not of three decades, but rather three years. Says a lot. And it places pianists Tommy Flanagan, Red Garland, and Mal Waldron and saxophonists Jackie McLean, Hank Mobley, Gene Ammons, Al Cohn, and Zoot Sims, to name a few, in the same place at virtually the same time.

Furthermore, we have the collaborative work and involvement of Rudy Van Gelder, perhaps jazz's greatest recording engineer, and noted producers Bob Weinstock and Orrin Keepnews. There's something strange about not hearing any Monk/'Trane or Miles/'Trane interaction among 16 CDs, but that's all explained vis-à-vis unwanted boxed-set repetition.

Now, let's jump to the mid-'60s, where we find Coltrane at the height of his final and most spiritual stage. Although *The Major Works of John Coltrane*, a two-CD set recorded in 1965, may be somewhat pretentiously titled, it does successfully and admirably represent some of the saxophonist's most revered, elongated, and percussive works. I find the introductions to pieces such as "Selflessness" continually fascinating, while the dense, two-tenor passages with Pharoah Sanders are intriguing and mystifying.

Indeed, not only "Selflessness" but also each of the compositions here—"Ascension," "Om," and "Kulu Se Mama"—underscore Coltrane's posthumous impact during the '70s. It should be noted that this release arrives on the heels of last year's Impulse/GRP four-CD live set, *Lost in Japan*. Have they been issued too closely together? I don't think so.

Jon W. Poses

Tuskegee Experiments: Don Byron
Elektra Nonesuch 79280-2, CD; AAD; 62:11.
Sound: B Performance: B−

With the death last year of John Carter, Don Byron may be the last great hope for the jazz clarinet. Though not the conceptualist that Carter was, Byron—who spends a lot of time with his Klezmer group—draws deftly from jazz traditions, often recalling the free-form wanderings of flutist/saxophonist Henry Threadgill's trio, Air.

Byron is steeped to a fault in the '60s and '70s art-jazz classicism of Bill Dixon, Leo Smith, and Anthony Braxton. His more impressionistic works, like his tribute to muralist Diego Rivera, have an austere, contemporary classical tone that works against them, creating


Don Byron

a series of half-spoken sentences and unanswered questions. These influences also course through the polemic of the title piece, a poem written and read by Sadiq about vicious medical experiments on blacks.

But most of *Tuskegee Experiments* bristles with quirky compositions negotiated by a rhythm team that alternates bassists Lonnie Plaxico, Kenny Davis, and Reggie Workman and drummers Ralph Peterson, Jr. and Pheeroan ak-Laff. Byron has recruited guitarist Bill Frisell as his foil, and they are well attuned to each other. On "Next Love," Frisell parallels Byron's lines before breaking away in cavorting, graceful arcs through the staccato darts of Byron's solo. Frisell's solos are conceived with the precision of composition but have the burn of spontaneous improvisation. Ellington's "Mainstem" is given a rollicking treatment with ricochet guitar lines and Byron's high-end wail. "Next Love" recalls the modalities of early-'60s Miles Davis with a twisting solo from Byron.

Tuskegee Experiments is an ambitious, if uneven, work from a musician who hasn't tightened his focus but who nevertheless shoots in some interesting directions. *John Diliberto*

Naked Lunch—Music from the Original Soundtrack. Milan/BMG 73138 35614-2.

Any film adaptation of a William S. Burroughs novel deserves a soundtrack as vitriolic as the psychohallucinogenic story. Such is the case with film composer Howard Shore's (*Silence of the Lambs, Dead Ringers*) collaboration with Ornette Coleman on *Naked Lunch.* By combining Coleman's alto sax with a minimalist score, majestically performed by the London Philharmonic Orchestra, Shore has created a near-perfect musical complement for director David Cronenberg's film.

Ornette, the spark and fire of this collaboration, participates in several ways. He not only plays over Shore's score for orchestra but also contributes a 1973 recording with Moroccan musicians, a neo-trance track that appeared on his album *Dancing in Your Head* (1977) and that served as a reference and inspiration for Shore. A "way-out" soundtrack for a very "way-out" movie. *Michael Bieber*

The Cat: Johnny Griffin. **Antilles 422-848-421-2.**

There's something magnificently deceptive about Johnny Griffin's *The Cat.* Although he seems mellower on the surface, he still has the edge in his tone and the bite in his riffs. The only thing missing is input from some of his now-deceased tenor sax colleagues, such as Eddie "Lockjaw" Davis, Sonny Stitt, and Gene Ammons. Nevertheless, *The Cat* is a refreshing, up-to-the-minute date that is good initially and only improves as it goes along.
Jon W. Poses

Skeleton at the Feast: Gary Lucas. **Enemy EMY 126-2.** (Available from Enemy Records, 11-36 31st Ave., Long Island City, N.Y. 11106.)

Skeleton at the Feast is the solo recording debut from former Captain Beefheart guitarist Gary Lucas. He plays unaccompanied guitar while making extensive use of digital delays and other electronic effects, multiplying his sound into a cascading orchestral blitzkrieg. His songs alternate between extraterrestrial rockers and sliding fingerstyle blues-based rambles played on a 1920s National Duolian. *Skeleton at the Feast* is hardly the latest guitar-freak AOR crossover record, but it certainly can open the mind to the interesting possibilities of what a solo guitar and a lot of dexterity can accomplish. *Michael Wright*

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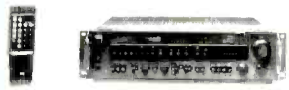

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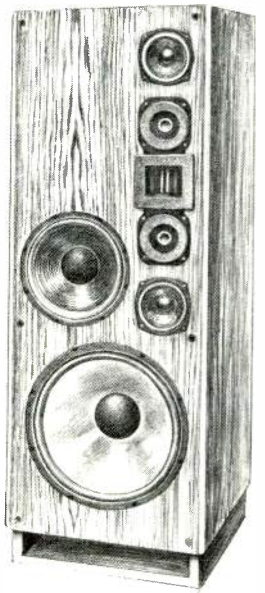

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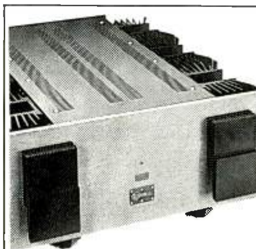

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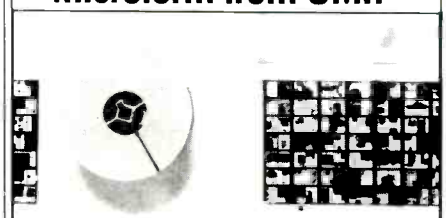

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