Audio

JULY 1984 • $1.75

INTERVIEW: TELARC'S RENNER

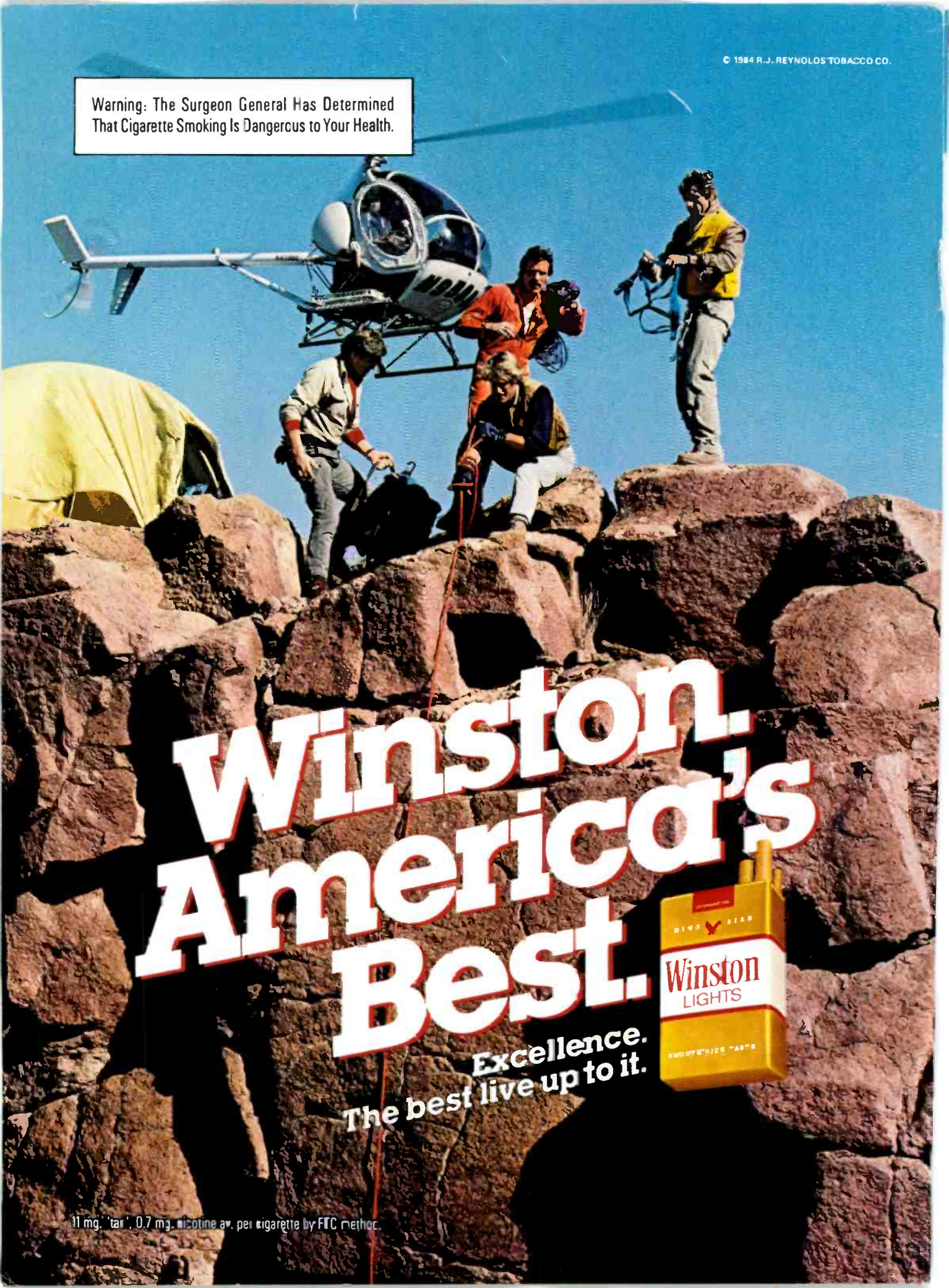
TESTED:
ALPHASONIK A-265 CAR AMP
AR TURNTABLE

PHASE FILTER FOR DIGITAL

EXCLUSIVE!!
SONY'S CAR CD:
ON THE ROAD AHEAD

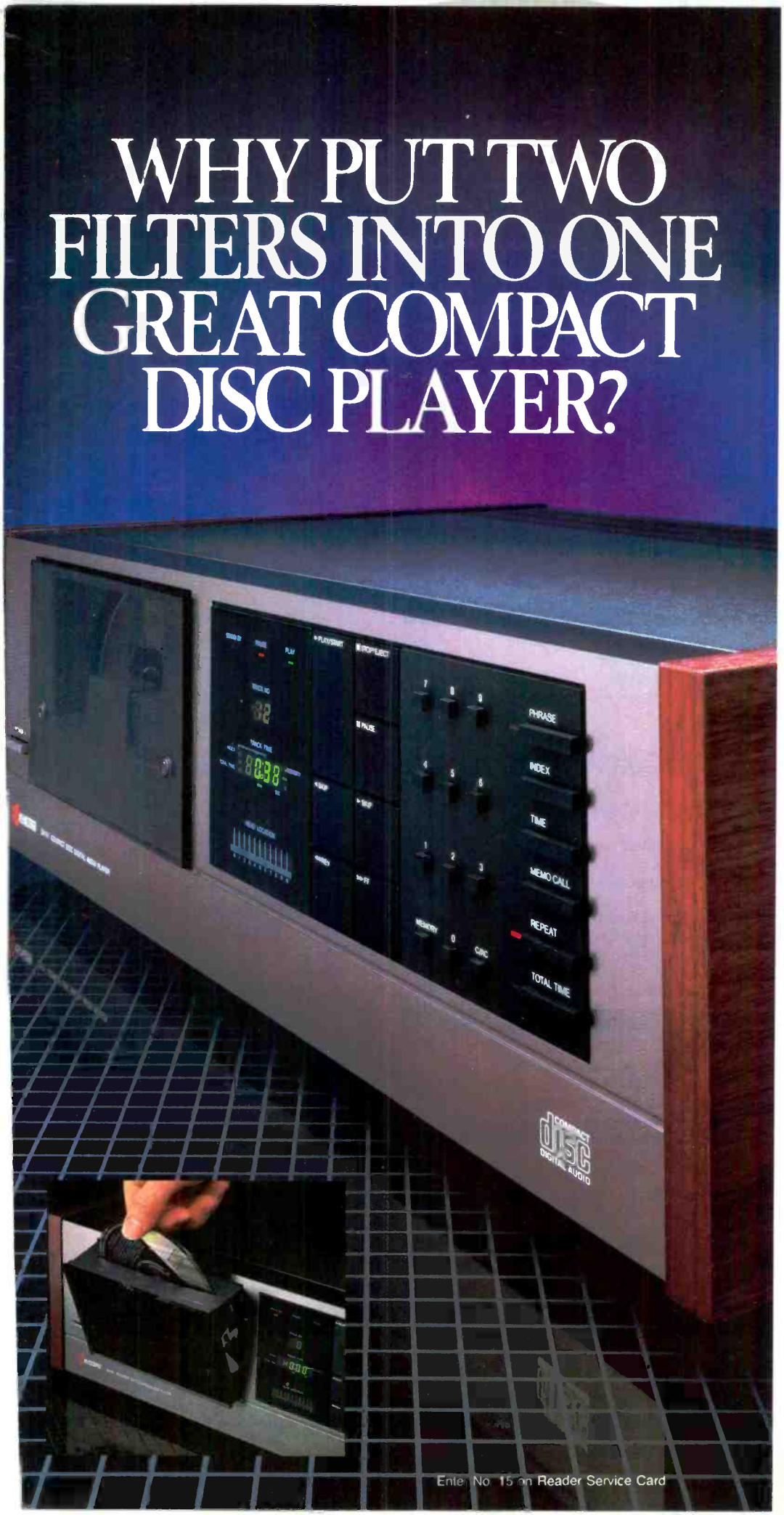
07
270301

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangercus to Your Health.



11 mg. 'tar', 0.7 mg. nicotine av. per cigarette by FTC method.

WHY PUT TWO FILTERS INTO ONE GREAT COMPACT DISC PLAYER?



Kyocera goes to double lengths to make sure there's no distortion in its DA-01 Compact Disc Player. It's got both digital and analog filters—so nobody hears distortion.

The advantage of digital and analog filtering systems.

Modern technology has made analog filters pretty effective. But there can be a problem—analog filters by themselves render limited performance. By combining an analog filter with a digital filter, and precisely applying both types in just the right way, the limitations found with analog filters are not there anymore. Thanks to the unique use of these filters, and an impressive array of very advanced circuitry, the Kyocera CD Player provides accurate, crystal-clear, lifelike sound.

The awesome specs that only digital can provide.

Needless to say, the Kyocera DA-01 comes through with some specs that are mind-boggling: A full 90 dB dynamic range...flat frequency response from 20-20,000 Hz... quiet 90 dB S/N ratio...and total isolation 90 dB channel separation.

And, just in case you didn't realize it, with the fabulous disc player system, as provided in Kyocera's DA-01 Player, there is no contact between disc and playback head. No tics, clicks, pops, scratches or record wear. And the DA-01 plugs right into your present audio system—Kyocera or others—just like a conventional turntable.

Easy to use, but total control of every function.

The DA-01 is easier to use than a modern cassette deck—slide the compact disc into the disc compartment, shut the door and hit the play button. With the DA-01's feather-touch controls, you can play the whole thing (60 minutes a side)...repeat a track...scan... pause...skip... advance...index... and program up to 24 different segments with an electronic memory. A functional LED digital panel tells you program running time and just where the optical scanner is on the disc.

Call (201) 560-0060 for the name of the nearest dealer. Kyocera International, Inc., 7 Powder Horn Drive, Warren, NJ 07060.

KYOCERA

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Audio

JULY 1984 VOL. 68, NO. 7

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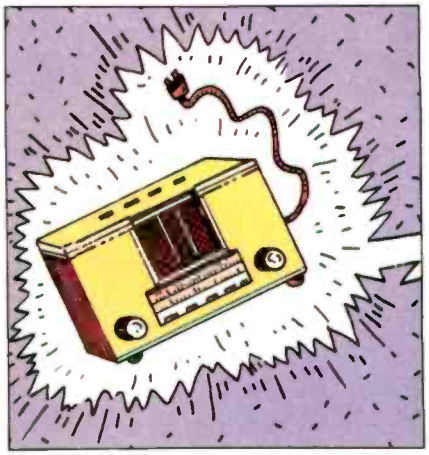

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MUSIC REVIEWS

DEPARTMENTS

The Cover Equipment: Prototype of Sony CDX-R7 car CD player.
The Cover Photographer: Carl Zapp; background photo, © Gill Kenny/Image Bank.

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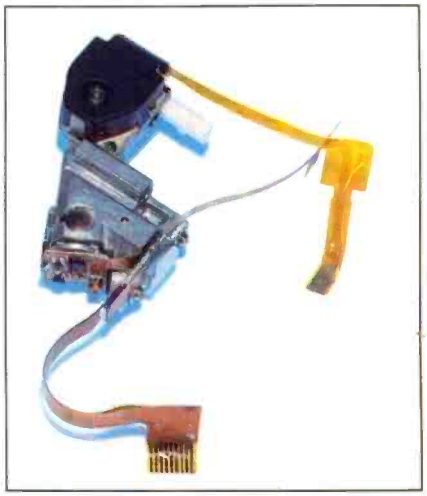
MPA ABC

Subscription Inquiries, (800) 525-9511; in Colorado (303) 447-9330.



See page 26.

See page 80.

FROM

HITACHI

the sight and sound of

QUALITY

COMPACT DISC DIGITAL AUDIO PLAYER

Hitachi's laser based sound reproduction system challenges the limitations of the finest analog stereo system. There is greater dynamic range. Virtually no distortion. No wow and flutter. No acoustic feedback. No record wear. The result is the purest, cleanest sound, faithful to the original recording. Until you own Hitachi's Compact Disc Player, you've yet to hear the true sound of quality.

New

PORTADECK™ VIDEO CASSETTE RECORDER

If you're still looking for a portable VCR that truly is one—here it is. The PORTADECK™ VCR is the smallest, lightest, most versatile video system Hitachi has ever created. A single cable disconnect and your PORTADECK™ is ready to go anywhere you are. At home, it becomes the perfect table model. Stacked or side-by-side, the PORTADECK™ VCR features 5 heads, Hitachi's exclusive four corner access control, "customized" tuner and a myriad of special effects. It's the video system only a leader like Hitachi can offer.

One Federal Court has held that recording of copyrighted television programs for in-home non-commercial use is wrongful. copyrighted programs should not be recorded.

CT2000W *Exclusive*

SIGNAL TRACKER™ COMPONENT TV

Hitachi's new 20" diagonal flat screen receiver/monitor integrates all your home entertainment functions. VCR, VideoDisc Player, Stereo System, games, computer and total TV reception. The flat screen picture tube gives you more on-screen picture, less distortion and minimal reflection of room light. And only Hitachi has SIGNAL TRACKER™ control, the most advanced color control system ever.

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The Year of the Champion

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Not for the meek

There are some people who simply can't appreciate all that Sanyo's new FT-E25 car stereo system has to offer.

With 2 or 3 times the power of most car stereos, and hardly a trace of distortion, Sanyo gives automotive sound the clarity and "sock" it's always lacked. Of course, you get bass, treble, and loudness controls—plus a built-in fader to make the most of 4-speaker installations.

Our digital electronic tuning and sophisticated FM Optimizer system deliver superb stereo reception without fading or "picket fencing." And besides Dolby B*, it has super-advanced Dolby C* noise reduction to keep tape hiss inaudible.

Fortunately, we've made it easy to use—with auto reverse, automatic tape and radio search, human engineered controls, and clever illumination that eliminates fumbling in the dark.

A Sanyo auto sound dealer will challenge all your preconceived ideas by putting the FT-E25 (or one of our other new masterpieces) through its paces.

Warning: Sanyo car stereo definitely separates the men from the meek.

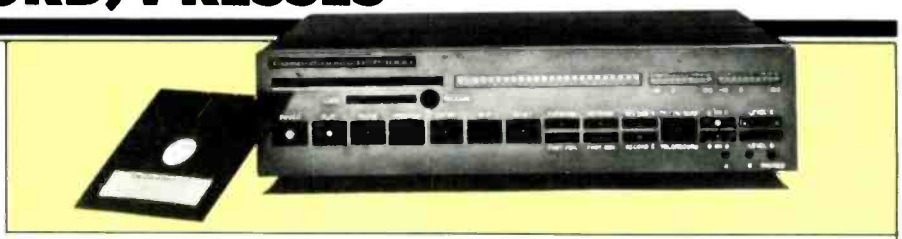
SANYO

The modern art of electronics.

Enter No. 25 on Reader Service Card

IVAN BERGER

STOP THE (RECORD) PRESSES



Home DAD Recording

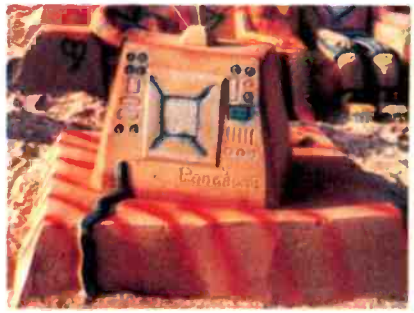
By next spring, you may be able to record digital audio discs at home—not on CDs, but on 5¼-inch floppy disks that hold about an hour of music. CompuSonics, of Cambridge, Mass., showed a prototype of such a recorder, with a planned selling price of $1,200, just as we went to press. The unit will interface with both IBM and Apple home computers for editing and other control functions, and will accept digital recordings over high-speed telephone lines or via cable TV. But it will have no digital output, to prevent digital-to-digital sound pirating. A multi-channel studio version, with digital mixing and equalization, is available now.

Photos: Kay Blumenthal

Hawaiian Eye

At a recent meeting of the Technics/Panasonic sales staff and dealers in Honolulu, Hawaii, the magnificent sand sculptures shown here appeared on Waikiki Beach for one day only (because of local laws). Entitled "New-Wave Family (Harry, Mable & Jr.)," the tableau was created by Joe Maize and Sandman & Associates from Tupperware, Formica, gelatin, sand, and water. If this reporter had been on the scene when the sculptures were being built, she would have requested loudspeakers, an amp, and a decoder to capture stereo-TV sand.

Because of the great distance between Hawaii and the mainland, the only cable movies available for viewing were: *True Grit, Beach Blanket Bingo, Oceans 11, The Story of Vernon and Irene Sandcastle,*



Jaws, The Last Wave, Woman in the Dunes, The Poseidon Adventure, Jaws II, Now Voyager, Jonah Who Will Be 25 in the Year 2000, The Swimmer, South Pacific, 20,000 Colleagues Under the Sea, Lifeboat, Blood and Sand, The Deep, Shell Is for Heroes, Jaws III, Where the Boys Are, From Here to Eternity, The Old Man and the Sea, The Sand Pebbles, Splash, and *Jaws IV.* K.B.

Digital Newsletter

The Digital Recording Report is more a newsletter for audio professionals than for amateurs, but it has some nuggets audiophiles might appreciate. Examples from one recent issue (with my own comments in parentheses):

- Fifteen Japanese manufacturers, plus Philips, are working on an international standard for home digital cassette recorders. (*Audio*'s editors have already seen Matsushita and Sony prototypes.)
- Several Sony 1610 PCM converters (used in making CDs) are in use in Moscow. (Melodiya CDs may appear sooner than you think.)
- Telarc Records and Suma Recording have developed an interface for digitally translating signals between the Sony PCM-1610 professional and Sony PCM-F1 home recording formats. (With CD here and digital cassettes coming, this should open the possibility of CD mastering on home equipment.)
- The American Compact Disc Manufacturing Corporation is shopping for equipment for a new CD plant to be built in Pennsylvania or New Jersey.
- Laser Video, a division of Quixote Corp., Chicago, is working out a process for production of CDs using laser video equipment, with production about a year away. Industry experts imply that the slow video presses will make production costs too high (but reports elsewhere cite Quixote's claim that their process will lower CD costs).

If getting items such as these each month is worth $39 a year to you ($50 overseas), order from *The Digital Recording Report*, 195 Willowbrook Ave., Stamford, Conn. 06902.

One of America's leading performance car magazines wrote those words after they tested the 1983 Dodge Shelby Charger. Other buff books seem to agree. And no wonder. The Shelby Charger's proven 2.2-liter engine takes it from 0-50 in 5.5 seconds.* That same engine also delivers mileage figures of 37 est. hwy., 24 EPA est. mpg.** And the legend will endure. Because that rugged 2.2 is Dodge tough and backed up by a quick, close-ratio 5-speed. Front-wheel drive. Plus tight, power-assisted, rack-and-pinion steering. And the whole engine and power-train are backed by a standard 5/50 Protection Plan.* See your Dodge dealer about buying or leasing* a 1984 Shelby Charger or Charger 2.2. Then you won't have to live the dream. You can live the legend.

OPTIONAL CHARGER 2.2 INTERIOR

DODGE. BEST BUILT, BEST BACKED AMERICAN CARS.†††

"...FURTHER PROOF THAT DODGE'S 2.2 LITER ENGINE IS DESTINED TO BECOME A LEGEND."

—CAR AND DRIVER, April '83

AN AMERICAN REVOLUTION.

BUCKLE UP FOR SAFETY.

*5 years/50,000 miles, whichever comes first. Limited warranty on outer body rust through, engine and powertrain. A deductible applies. Excludes leases. SEE DEALER FOR DETAILS. **Based on acceleration tests performed by NHRA on vehicle with standard engine and transmission. ***Use EPA est. mpg for comparison. Your mileage may vary depending on speed, weather and distance. Actual hwy. mpg lower. †Sticker prices exclude taxes and destination charges. ††Lowest percent of NHTSA safety recalls of any American car division for '82 and '83 cars designed and built in North America. Longest warranty of 1984 American models.

Where's the Dish?
Dear Editor:

Nel Namdlef does a thorough job, in the April issue, of reviewing the Lirpa Si-O_2 Compact Dish Player—except for not telling us where to obtain the Compact Dish of Raoul Duke's "The Saucer's Apprentice." It's not listed in the Schwann catalog, and none of the local household-goods departments stock it. How disappointing!

Frank Pedroja
Wichita, Kans.

Ysae rof Mih ot Yas
Raed Rotide:

Ti saw a erusaelp ot daer Nel Namdlef's etidure dna tnegoc weiver fo eht Lirpa Compact Dish player. Ti si yratnemmoc hcus sa sih taht sekam *Oidua* htrow gnidaer. I kool drawrof ot eht txen Lirpa tnempoleved.

Mailliw A. Rennak
Wen Kroy, Y.N.

East Bests West
Dear Editor:

In the January 1984 "Spectrum" column, you stated in "What's on Stereo TV?" that Japan has had TV with multiplexed soundtracks "for about two years now." That statement is incorrect by at least a factor of two.

I was transferred to Japan in September 1980, and within days of my arrival I rented a Japanese television set with a switch on it that enabled one to receive bilingual broadcasts. A month or so later, I purchased a used multiplex receiver to receive stereo and bilingual broadcasts. There was already in existence a thriving market for the used sets among resident foreigners, and the set I rented was hardly new. I suspect the Japanese have had multiplex broadcasts for at least four or five years, since I heard no comments about it being a recent addition to the broadcast capability. I know that the multiplex broadcasts, both stereo music and bilingual programs, were common in September of 1980 and changed very little in the three years I stayed in Japan.

As for the inexplicable listings you mentioned, almost all shows on Japanese television feature at least one song by a well-known singer, even quiz shows, and believe it or not, wrestling shows. I have seen a singer sing a song before the matches on Japanese television.

I would like to add that I find the American audio and video markets very disappointing after living in Japan, where one store sells both. And all releases, American as well as Japanese, of Laserdiscs, Compact Discs, videotapes, CEDs and VHDs, as well as audio records, are available in one store. Shinseido's Shinjuku store, or Yamano's Ginza store, are media delights and stock everything released.

As in automobiles, the Japanese are way ahead of their American counterparts by light years.

Rodney L. Thacker
Omaha, Nebr.

Digital Humor
Dear Editor:

In your interview of Doug Sax (January) he says, "If the whole world goes to Compact Disc, I will be first-generation live-to-digital." I appreciate the broad humor here. But for the sake of the readers, it should be made clear that one of the advantages of digital recording is that there is no information lost during transfer from digital tape to digital disc, so nothing is gained by direct-to-digital disc. In analog recording, there is a loss with each transfer, as there would be in the tracing of a copy of a copy of a drawing, and thus the value of direct-to-(analog) disc. In digital recording there should be no transfer loss, just as a copy of a copy of the sequence 001011 should be exactly the same sequence of zeros and ones as in the original.

Sam Craig
Berkeley, Cal.

Pen Pal Request
Dear Editor:

I am an audio fan in Japan. I found *Audio* at a bookstore in Tokyo, and that is why I am writing to you now. I am looking for an American friend of any age who likes audio, and I want to correspond with him or her.

I am a 23-year-old man and go to college in Tokyo. My other hobby is amateur radio (ham). I like almost all kinds of music, but mostly I listen to pop and beautiful music. In 1981, I travelled alone through America for 45 days with a radio-cassette-recorder and I listened to many FM stations. I was very excited to hear the American FM because we don't have so many FM stations or such exciting ones.

Masaaki Arai
3-3-4 Minami-cho
Tanashi-city, Tokyo, 188
Japan

Clubbing in Atlanta & Mamaroneck
Dear Editor:

In the hope that your list of audio clubs and societies ("Where & When," December 1983) is an ongoing enterprise, I would like to add our name and address: Atlanta Audio Society, P.O. Box 92130, Atlanta, Ga. 30314. We formed last October, and our president is Howard Royal of Newnan, Ga. We generally meet on the third Sunday of each month, and dues are $25 a year. Anyone can call (404) 253-6419 or send an SASE for more information.

David L. Passler
Atlanta, Ga.

Dear Editor:

Audio listed audio clubs in the December 1983 issue. One group listed was The Audiophile Society, a Westchester-based organization, but our official mailing address is: Box 312, Mamaroneck, N.Y. 10543. Membership in our 70-member group costs $25 a year and includes a subscription to our quarterly magazine, *Format Minutes*.

Larry Greenhill, M.D.
Mamaroneck, N.Y.

Thanks for the Memories
Dear Editor:

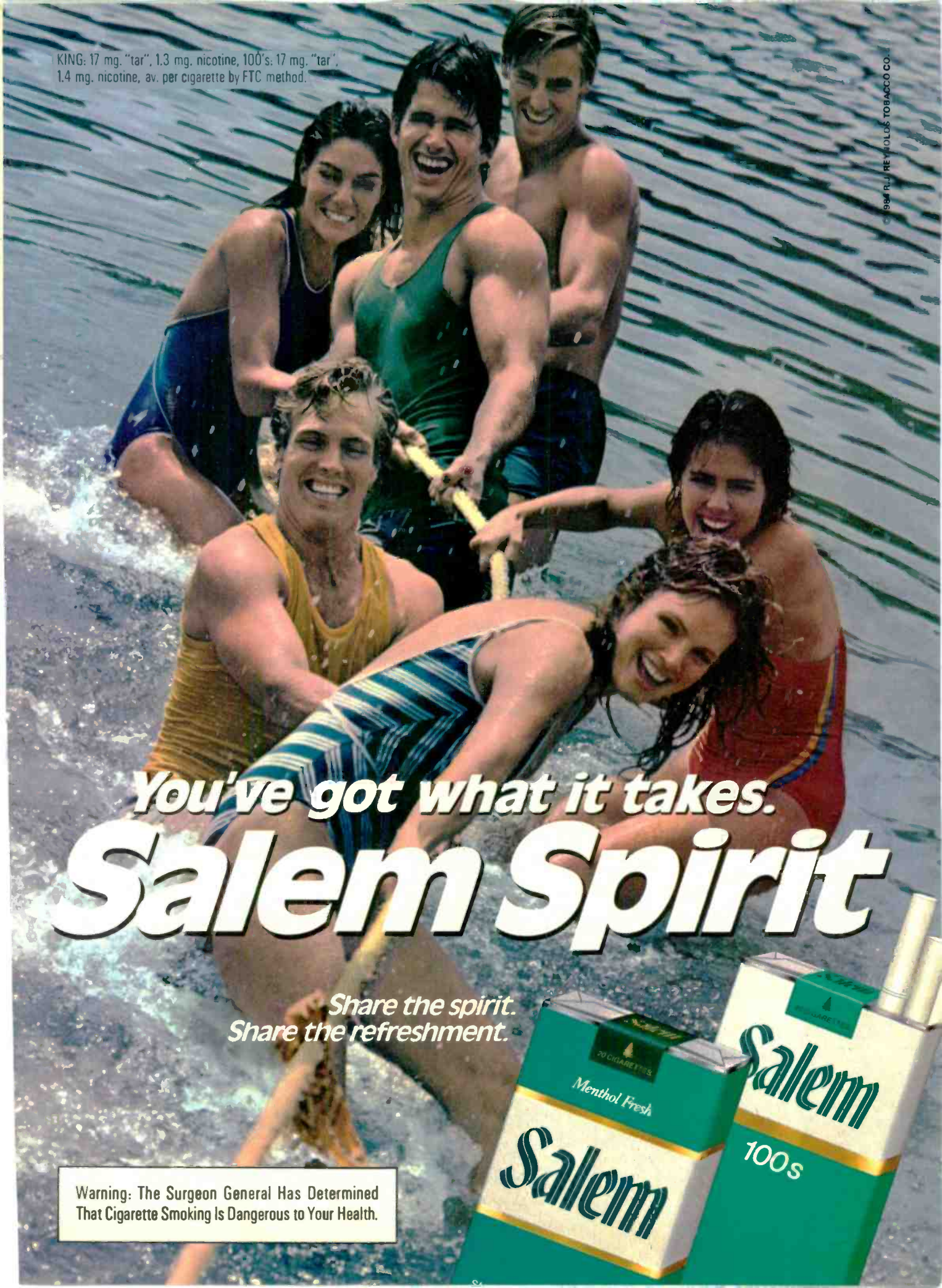
For an intellectual and business history of the Boston-area consumer audio industry from the 1950s to the present, I would be grateful for anecdotes, reminiscences, and the like.

David Moran
Farrar Rd.
Lincoln, Mass. 01773

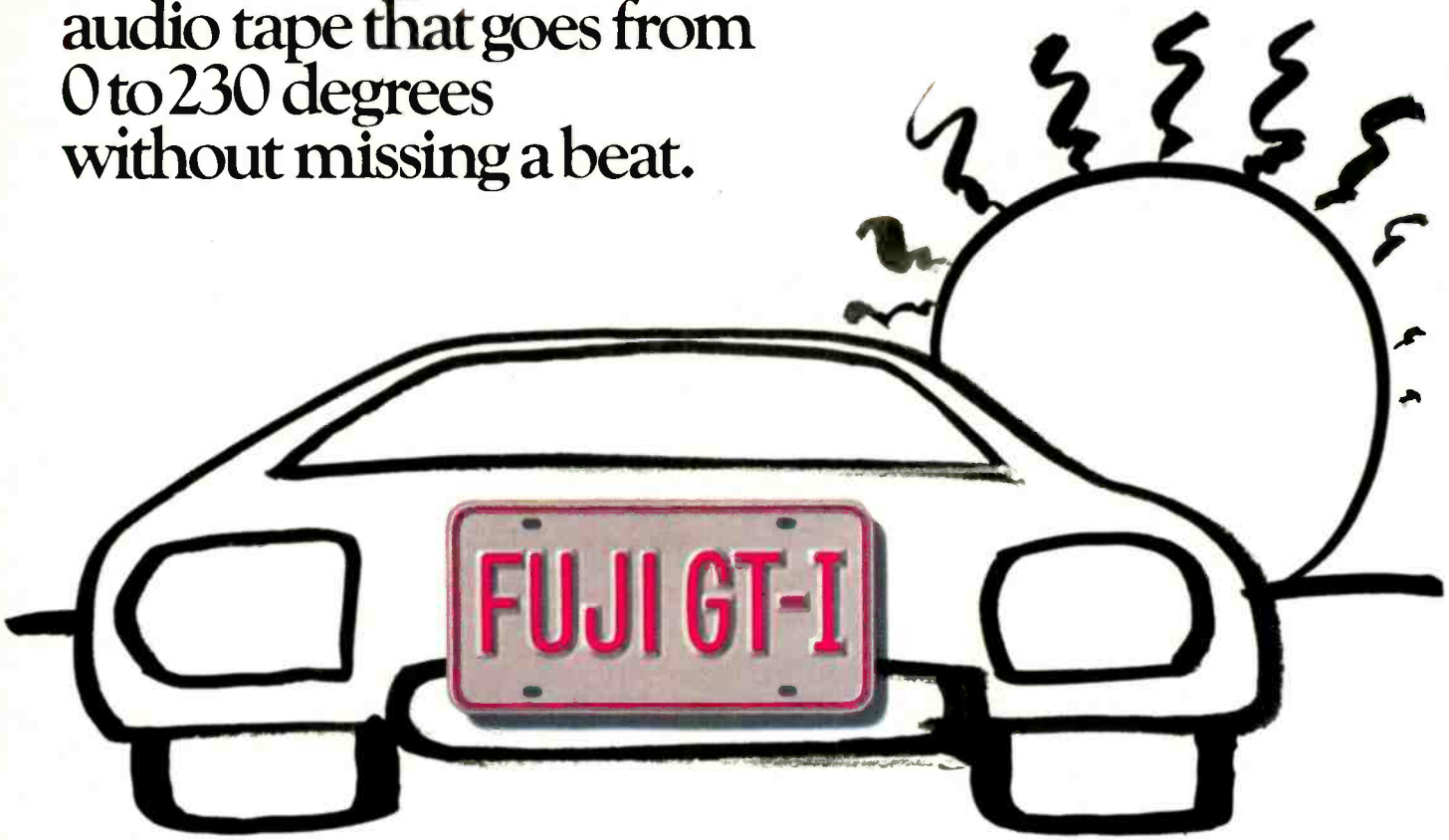
Errata

The Sony Book of Digital Audio Technology, referred to in "Error Correction in the Compact Disc System" in the April issue, is available in an updated version only from Sony Digital Book, P.O. Box 166, Lowell, Mass. 01852.

The price of the Akai CD-D1 CD player was incorrectly listed on page 76 of the June issue; the unit costs $1,000.00.


KING: 17 mg. "tar", 1.3 mg. nicotine, 100's: 17 mg. "tar", 1.4 mg. nicotine, av. per cigarette by FTC method.
© 1984 R.J. REYNOLDS TOBACCO CO.
You've got what it takes.
Salem Spirit
Share the spirit.
Share the refreshment.
Menthol Fresh
Salem
100s
Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

Announcing audio tape that goes from 0 to 230 degrees without missing a beat.



Fuji GT-I audio tape is specifically engineered to handle the hazards of the road.

We built the GT-I to survive the icy depths of winter and the searing heat of summer. In fact, the GT-I can even withstand the harsh environmental extremes of your dashboard. We designed the GT-I with a shock absorber to maintain good vibrations on the toughest roads. And because you demand peak performance, we made sure the GT-I delivers the highest fidelity, even under your car's less than ideal accoustical conditions.

So take the Fuji GT-I for a spin. And see how much smoother the road can be when you drive with a tape that's built to give you more treble and less trouble.

FUJI.

Nobody gives you better performance.

Enter No. 13 on Reader Service Card

TAPE GUIDE

HERMAN BURSTEIN

Bulk Erasing

Q. I have a good bulk eraser, and it wipes out all *recorded sounds on my tapes. With a bulk-erased tape do I have, in essence, a "virgin" tape? Will it capture high frequencies as well as a new tape? Have I degraded the tape in any manner?*—Gary Tillery, Tulsa, Okla.

A. Bulk erasing the tape with an eraser of good quality does no harm to it and leaves you with the equivalent of virgin tape, except for physical wear (such as oxide shedding) which may have occurred due to repeated use of the tape, and provided that you use the eraser properly. By proper use I mean turning on the device while several feet from the tape, bringing it slowly to the tape, describing a circular motion about the tape for several seconds, gradually withdrawing the eraser, and only then turning it off.

Balancing Act

Q. I have a collection of about 200 country music discs that I plan to put on tape. I find that most of these records are heavy on the right channel (some are heavy on the left channel and some are equal), so I have been increasing the left input when taping. The problem is that this seems *to muddy the recording a little, although this could be my imagination. Should I attempt to find an exact balance between channels, or should I copy the record the way it was recorded? In other words, should I always make the channels equal by means of the record-level indicators, or should I only resort to this when there is extreme unbalance?*—Gary Tillery, Tulsa, Okla.

A. You should balance the channels according to the dictates of your ears or of the record-level indicators. In the case of your discs that appear to be heavy on the right channel, instead of raising the level of the left channel to the full extent necessary for balance, try a combination of partly raising the left channel and lowering the right one. However, use the combination only if you are convinced that raising the left channel truly muddies the sound a bit.

Slow Down, Please

Q. Recently, there was a letter asking why open-reel deck manufacturers don't bring back the 1⅞-ips speed. You said most manufacturers feel that those who want 1⅞ ips will simply turn to cassette decks. That response "ain't quite it." You want the slow speed in order to permit a long unattended recording, or to provide long playback time of noncritical material, or to use a minimum amount of tape for such material. Cassette only gives you 45 or 60 minutes per side unless you have an auto-reverse deck that reverses in recording. But I can put a 2,400-foot tape on my open-reel deck and go about my business while the deck tapes a 4-hour radio program at 1⅞ ips. Not every recording is of superquality music. The slow speed is darned handy for talk shows, background music, old radio, dubbing old LPs and 78s, etc. The main consideration is fairly good transport stability so that wow and flutter are acceptable.

I think all home open-reel decks should have the 1⅞-ips speed. Along the same lines, I also wish that cassette decks would have a half-speed setting (15/16 ips) for noncritical recordings. Consumers want not only maximum fidelity but also versatility.—Jack Burke, Chicago, Ill.

A. I agree with you, but economics is economics. The fact remains that nearly all makers of open-reel decks have judged that the market for 1⅞ ips is not large enough to warrant the extra cost of providing this speed. Along these lines, the company that used to make a 15/16-ips cassette deck (Nakamichi) decided to abandon this speed.

Let me add that one of the reasons for such abandonment is the difficulty of maintaining correct azimuth alignment. A given amount of azimuth error produces ever-greater treble loss as tape speed is decreased and as track width is increased. In open reel, track width is nearly 80% greater than in cassette, so azimuth loss is a good deal more pronounced for open reel at a given speed and a given azimuth error. Within the cassette format, as one goes from 1⅞ down to 15/16 ips, azimuth loss similarly grows much more severe.

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

AUDIOCLINIC

JOSEPH GIOVANELLI

Individual Channel EQs and Controls

Q. I cannot understand why the makers of equalizers find it necessary or desirable to separate the controls for the left and the right channels. Every time an adjustment is to be made, it requires that much longer to insure that the left and right channels are balanced as well as equalized.—Jim Quaderer, Palo Alto, Cal.

A. If you're using your equalizer as a more elaborate tone control, then it's more convenient to have both channels ganged. Five-band equalizers, which are mostly used for this, almost invariably have ganged controls.

If you're using it to correct for room or system problems, then you need to be able to equalize each channel separately, since the acoustical properties of the left side of a listening room may be quite different from those of its right side. Third-octave and half-octave equalizers, which are mostly used for this, invariably have individual controls for each channel.

The common 10-band equalizers may be used for either of these applications. Consequently, some manufacturers build them with ganged controls, while other firms make units with separate controls for right and left.

If you frequently re-use the same settings, you might take a tip from Soundcraftsmen and cut a cardboard template for the slider positions. This lets you restore all your slider settings in seconds, by moving them till they are stopped by the template's edge.

Switched Outlets

Q. Is it safe to plug my amplifier's power cord into the switched outlet on the rear of my preamplifier? My preamplifier's instruction manual says this outlet can handle 800 watts maximum. The instruction manual for the power amplifier states that it can draw up to 1,000 watts. Also, the power cord has a three-prong plug. How can this be plugged into my switched (2-prong) outlet?—Greg Bower, Fremont, Ohio

A. The connections you wish to make are *marginally* acceptable. Most of the time your power amplifier will not draw the 800 watts allowed by your switched outlet's wiring. The 1,000 watts will only be drawn on extreme peaks. From this standpoint, you can get away with the hookup. My only reservations have to do with the fact that if the power amplifier is capable of such a high, peak current, it must possess a low d.c. resistance. What this means is that *sometimes* (depending on the instantaneous line voltage at the time of turn-on) the current will be very high for an instant—before the back EMF of the power transformer stabilizes the current drain. Repeated surges will cause the on/off switch on your preamp to fail because of arcing.

The matter of the 3-prong plug is readily solved. You need an adaptor made to connect a 3-prong plug into a 2-prong socket. This adaptor contains a pigtail lead which represents the ground wire. This ground should be screwed to the most convenient ground on the preamplifier's chassis.

CD Players, Tape Recorders and Acoustic Feedback

Q. Can acoustic feedback affect CD players or tape recorders having wide dynamic range?—Dennis A. Millage, Evergreen, Colo.

A. Although I have heard of a case of acoustic feedback which involved a CD player, I have been unable to recreate it myself. I experimented with several players, selecting a quiet musical passage and turning up the volume, bass and treble controls on my amplifier. I never noticed even a tendency toward feedback.

As for this phenomenon's taking place with a tape deck, I have been able to produce that condition in some older machines, with microphonic heads and tubes. I have not been able to produce acoustic feedback with any recent tape recorders and players, cassette or open reel.

When to Replace a Cartridge

Q. How does one determine when a cartridge loses its magnetic strength and, hence, when it's time to purchase another one?—Robert Hirose, Los Angeles, Cal.

A. It is unlikely that the magnetic flux in your cartridge will drop to a point which will produce changes in performance. Even if there was a loss of flux, the result would be a lowering of overall sound level, but the rest of the parameters for that cartridge would be unaffected. If the signal level dropped below the point where the background noise from your preamplifier became a problem, it would then be time to replace the cartridge.

Digital Audio

Q. Please explain to me what digital audio really is. In this connection, how does a CD player know when to slow down from 500 to 200 rpm?—Tony Perkins, Los Angeles, Cal.

A. Sound consists of continuous waves in air, which older recording and transmission systems carry as continuous models, or "analogs" of the original waves. Digital systems record a series of discontinuous "samples," representing the signal voltage at each sampling point, in numerical (digital) form. Recording and transmission (whether analog or digital) are never perfect, but digital data can include extra signals which allow most of the errors that do occur to be corrected, so less of the music is lost due to these imperfections.

The CD player "knows" when to slow down by reading the signals on the recording and comparing them to its internal "clock." Because the slowdown is gradual, matched to the changing diameters of successive tracks, the *linear* speed of the recorded track past the laser pickup remains constant, even as the circumference of each track increases (the disc is scanned by the laser from the inside out). The phonograph disc, by contrast, has a constant *angular* speed, which means that its information is crammed together at the inner grooves and wastefully spread out at the outer ones.

Typo Trouble

Due to a typographical error, Ohm's Law was partially misstated in "Reader Response: Power Amps and Speaker Impedance," in the March 1984 column. The relationship between power and voltage is: $P = E^2/R$ (not E^2R, as we had printed it). Thanks to reader Bruce Rorem of St. Paul, Minn., for pointing this out.

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

BERT WHYTE

UNREEL

A sad and shocking announcement has come from Ampex: After 38 years of production, they will no longer manufacture analog audio magnetic tape recorders. They will continue to manufacture various types of professional video recorders, a field in which they are pre-eminent. Parts for the many thousands of Ampex Models 350, 300, 440, ATR-100, and their 16- and 24-track magnetic recorders—in use in every corner of the world—will be available for 8 to 10 years.

Thus, an era which began in 1946, with the introduction of the Ampex Model 200, has come to a rather abrupt end. The Model 200 was a refined, but nonetheless direct descendant of the German Magnetophon, and it had to run at 30 ips to achieve wide frequency response.

In 1950, although I was a sales executive and music director of Magnecord, arch-rival of Ampex, I had quite a few friends at Ampex and always had a very good relationship with the company. Over the years I have either owned or used just about every model of Ampex magnetic tape recorder except the big multi-trackers. Some of the Ampex recorders I used were quite unusual, as you will see from the following.

The 350 (1953) and AG-350 (1965) were popular workhorses.

To combat the growing menace of that upstart, television (which by 1953 had precipitated the closing of many movie theaters), the movie industry came up with Cinemascope, which used a wide-aspect-ratio screen and, in its original embodiment, honest-to-God, real, three-channel stereophonic sound. In fact, there even was a fourth channel available for occasional special effects from the rear of the theater. A notable example was the thunder and earthquake effects during the crucifixion scene in *Ben Hur*. The original Cinemascope film used stripes of magnetic oxide for each channel, and Ampex made the magnetic heads fitted to the projector to reproduce these channels. Now, friends, make no mistake, under optimum conditions this system was capable of exceptional high-fidelity stereophonic sound. In fact, in using three discrete channels of sound, it followed the ideas of the famous Bell Telephone/Stokowski stereo experiments of 1933, in which they concluded that three-channel stereophonic sound afforded the most realistic reproduction of music.

Unfortunately, the repetitive screenings of the films imposed severe wear on the magnetic stripes. Careless projectionists would not clean the heads that were clogged with powdery oxides, which, of course, severely degraded the sound quality.

Another problem with the use of true stereophonic sound in Cinemascope pictures was the extreme difficulty of maintaining a realistic ratio of visual and audio perspectives. This was especially problematic in shifting from close-ups to distant scenes and all variations on this theme. Now that the FCC has approved stereo TV, the same problems could crop up, exacerbated by the small TV screen. However, it is doubtful that any attempt will be made to correlate the dynamics of motion with sound. Maybe with the advent of wall-size, flat-TV screens this could come to pass . . .?

In its heyday, when Cinemascope still employed three-channel stereophonic sound, a purely symphonic mini-concert film was presented before the main feature was run. This was done to impress audiences with the sound quality, and most of the time Johnny Green (conductor on many Academy Award shows) and the MGM Symphony Orchestra were shown playing such pieces as "Capriccio Italien." Believe me, through the widespread left, center and right big-theater loudspeaker systems, it was a mighty impressive sound!

The revolutionary ATR-100 (1976) had no pinch roller.

Needless to say, these filmed concerts had to have real three-channel stereophonic master recordings, which would ultimately be transferred to the Cinemascope film. Enter Ampex again. They supplied a special Model 300, equipped with one of the few three-channel, quarter-inch heads ever made. Through some finagling, I managed to acquire that Ampex three-channel Cinemascope recorder, complete with the "Capriccio Italien" and other tapes, including a Wurlitzer organ recital. I set up three Bozak loudspeakers with three McIntosh amplifiers, and *wow!*—I was absolutely blown away and became an immediate and everlasting champion of three-channel stereophonic sound.

I know you have all heard two-channel stereo systems, with a phantom center channel between your speakers, but when you hear three discrete channels of stereophonic sound, it is simply no contest. With the three channels, you perceive the entire panorama of the symphony orchestra in front of

Analog tape recorders will continue to be used for many years, but don't ignore the increasing use of digital recording technology.

you. There is simply no ambiguity of instrumental positioning; everything is in its proper musical perspective. There is layered depth and a three-dimensional image that is almost palpable.

By 1953, I had been recording two-channnel stereo and binaural sound for over three years. I had met the late Bob Fine, and when he was making his famous Mercury Olympian Series of monophonic recordings, I was in on those sessions, experimentally recording the music in stereophonic sound.

When Bob decided to convert to stereo recording in 1954, he insisted that it be in the three-channel format. Now, you must remember that in those days there was no such thing as Dolby A or any other kind of noise reduction. In order to maintain good signal-to-noise ratio, Bob wanted to use the three channels on 1-inch-wide tape. One-inch tape was strictly nonstandard, and, try as they might, the several tape manufacturers who furnished the experimental reels had trouble slitting the tape so it would run smoothly over the tape guides and heads. When Bob reduced the tape width to half-inch, all was well, and Ampex began to produce Model 300s with three-channel, half-inch heads. This format quickly became standard in the recording industry, and today thousands of three-channel, half-inch master tapes are in the vaults of the record companies—vast repositories of musical treasures. Perhaps with further development of the digital processing system, devised by Roger Lagadec of Studer to remove noise from analog recordings without degradation of the music (described in the January issue of *Audio*), many of these great recordings could offer new musical riches.

Ampex made thousands of the three-channel, half-inch recorders. In 1958, when Harry Belock and I founded Everest Records, we ordered three and modified them with special low-noise electronics. I made many recordings with the London Symphony Orchestra and the London Philharmonic Orchestra and used these Ampex recorders until we pioneered the use of 35-mm, three-channel magnetic film. (Several years later, we sold this 35-mm equipment to Bob Fine.)

I have a number of copies of some of my Everest three-channel, half-inch masters and a three-channel, half-inch head for my Ampex 440C. A few years ago, I invited my good friend Lee Kuby (a very keen-eared tape and music enthusiast who was product development manager for Harman/Kardon for many years and now is with Infinity/JBL) to come to my home for a listening session. I set up the three-channel heads on the Ampex, with B & W 801s on the left and the right and a B & W 802 in the center. I drove the left and right 801s with a Levinson ML-3 amplifier and the 802 with one channel of another ML-3. Then I threaded the Ampex with a three-channel, half-inch tape of Rachmaninoff's "Symphonic Dances," which I had recorded with the London Symphony Orchestra conducted by Sir Eugene Goossens. Lee had never heard three-channel stereo, and he reacted as I knew he would—with amazement and delight. Of course, he became a new convert. But then I went a step further and added in the side and rear speakers in my Benchmark delay system. The three channels up front plus the delay system reproduced music with what can only be described as mind-boggling realism! Just think, friends—the Compact Disc could conceivably be formatted to provide three channels of totally discrete stereo sound! If any enterprising record company wants to engineer three-channel stereo digital recordings, I am, in a modest way, available.

The MM-1000 (1968) came in 8-, 16-, and 24-track versions.

Through the years, Ampex built an enviable reputation for the high quality and reliability of their magnetic tape recorders. The MM-1000, a 16-channel recorder, really pioneered the concepts behind today's multi-track technology. Alas, in the past several years, rising parts and labor costs and a decline in reliability has not helped matters. Combine this with the failure of Ampex to launch a contender into the digital derby, and it spelled trouble.

Undoubtedly, with the availability of parts and some tender loving care, most Ampex recorders still have many years of useful life. However, the demise of the Ampex audio tape-recorder division may be the handwriting on the wall. Is the Ampex failure the first nail in the analog magnetic-tape coffin? Professionally, analog tape machines are available from Studer, Sony/MCI, Telefunken, Magnetophon, Otari, Lyrec, Schlumberger and Philips. In the consumer area, open-reel tape recorders are still available from Akai, Nagra, Revox, Teac, Technics, Otari and several other Japanese companies. John Crocker and Tony Barclay, those two indefatigable champions of prerecorded open-reel tapes, continue to issue excellent dupes from their Barclay-Crocker Laboratories, newly located in Poughkeepsie, N.Y.

No doubt, analog tape recorders will continue to be used for many years. But it would be foolish to ignore the signs and portents pointing to ever-increasing use of digital recording technology. Except for some independent engineers and smaller record companies, virtually all classical-music recording by the major labels is now digitally mastered. A great deal of pop recording is also digitally mastered, although, here, the multi-track analog recorder is still very strong.

It is in the consumer market that open-reel analog recorders must be considered to be in great peril. The pressures from high-quality cassette recorders (and the vast catalog of prerecorded cassettes), plus the availability of low-cost digital processors and VCRs and the possibility of recordable Compact Discs a few years down the road, all point to hard times for open-reel analog tape recorders.

No conventional turntable delivers the accuracy and control of this one: Technics SL-6 Programmable Linear Tracking Turntable.

The problem with a conventional turntable tonearm is that it arcs across the record surface. So it is capable of true accuracy at only two points in its arc. Where the stylus is precisely aligned with the record groove.

The Technics SL-6 Linear Tracking Turntable goes beyond that. It actually duplicates the straight-line motion of the cutting arm that originally mastered the record. This enables the Technics SL-6 to deliver true accuracy at every point on the record. First note to last. There is none of the tracking error, skating force error or distortion that accompanies a traditional tonearm.

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Our patented P-Mount plug-in cartridge system delivers optimum tonearm/cartridge compatibility along with simplified cartridge installation.

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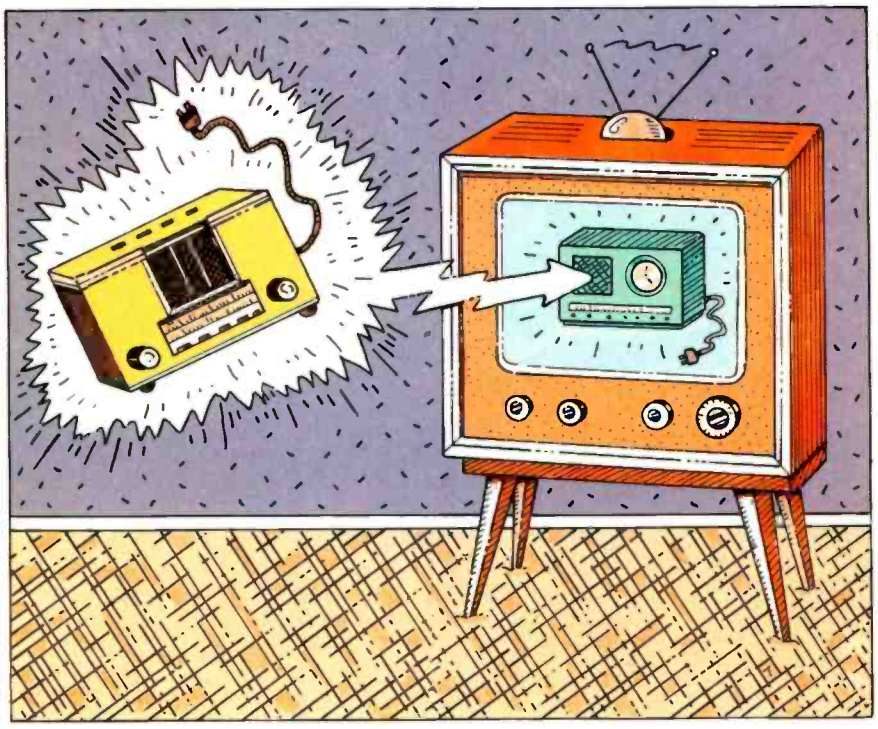


Illustration: Teresa Anderko

Not too many people today remember old-band FM radio, broadcast on a relatively low frequency band in the 41 to 50 MHz range, far from our present, familiar 88 to 108. This was the original and first public appearance of Major Edwin Armstrong's great invention after the years of experimental broadcasting—notably from that high, skeletal tower with the big crossbars which the Major built in Alpine, N.J., diagonally across the Hudson from New York City. Old-band FM flourished, if that is the word for it, just before and during WW II, and I was there. Then, almost overnight, it vanished, and all its equipment with it. A real disaster for hi-fi, but not the last, nor the first, for this, our original and earliest quality-sound medium.

For years after its invention in 1932, FM was in a stalemate, held up by vicious infighting—a long story. But by the '40s, it was at last on the air, officially, for you and me. There were working FM stations, looking to the future. A goodly number of receiver models were on the market, with an appreciative, expanding audience for this absolutely startling new species of radio—wide-range, noise-free, static-free, and beautiful in its sound. I'm not describing FM as an engineer might; this is the way we on the outside felt and spoke about it. The FM sound was awesome.

FM on this low band (then considered pretty high) was one of the great audio miracles. It was not to be believed. When you first hear digital today, on tape or CD, you have an inkling of what we felt almost a half-century ago. This was *hi-fi*, though the term was scarcely known—the very first of it for the general public.

It is in old-band FM, let me say loudly and clearly, that we will find our own origins, back well before our present audio hi-fi (and this magazine) began operations.

Imagine it. We already had years of radio history behind us—the great prewar days. But, in all that time, we had come simply to accept, as a matter of course, the built-in sonic limitations of AM or "standard" radio in our listening, not to mention the same limitations for a billion shellac 78 discs and steel-needle pickups. Then, suddenly, at that late date, there was a radio sound so advanced that it had the potential for quality that only digital has offered us today, and not far behind digital, either. Old-band FM was a quality medium from the beginning. I was in the middle of it, and we knew very well where we wanted to go. It was simply that the sheer perfection of the FM broadcast signal just had to allow for a matching state-of-the-art audio in the reproduction for home use. And in quality programming as well. Before FM, this sort of effort would have been wasted, on both radio and records as they had been known for so long. Now—the sky was suddenly the limit. Hi-fi! The first.

That new sound, even before the war, was easily what we would now call hi-fi. The signal on the air was good to 15 kHz, or, as we put it, 15,000 cycles, in contrast to the impoverished range and plenteous distortions of prevailing AM. It was clean—there was no limit to its cleanliness. For the first time we could hear natural speech reproduction with clear, smooth sibilants—we had never heard them before. The same ability, in contrast to the effective 4 kHz or so, tops, on AM radio and most shellac, gave us lifelike, musical tone colors—common enough today but a thing to marvel at in those times. And, somehow, the prewar FM people came up with reproducing equipment to do justice to this amazing quality in their chosen amplifiers and speakers. I can't tell you how, but I heard it—it was the sound of FM that mattered. Maybe not perfect, but pretty darn good, is all I can say. That kind of transmission would make any speaker system sound beautiful.

But the most astonishing thing about FM was *silence*. Absolute, complete silence—except for signal. Like that which we have now discovered in digital. (Our present stereo FM is *not* totally silent.) You turned on your set, the lights lit—and nothing happened. It seemed dead, until suddenly a very real voice came out at you, or a loud passage of music. How history repeats! We are merely reflecting that experience today with the new CD technology.

It was this silence, above all, that knocked me for a loop, as we would have said, in a time when reproduced sound was so much noisier than now! More important still, FM in daytime was uncanny, but at night it *remained the same*, velvety-silent, where AM, especially in summer, degenerated from

AUDIOPHILE FILE™ XL-S

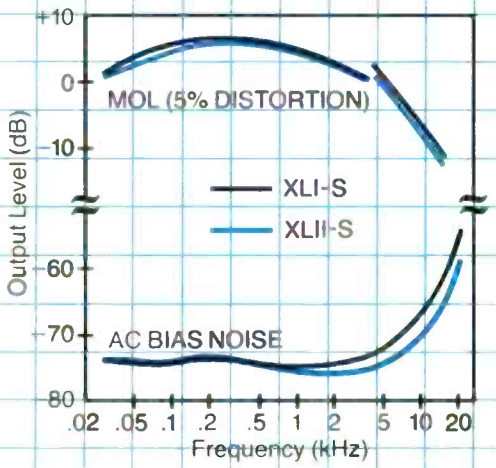
COMPACT DISC COMPATIBLE

Maxell introduces the new XL-S audio cassettes; a series of ferric oxide tapes which deliver a level of performance that can capture the sound nuances found on Compact Discs more faithfully than other ferric oxide cassettes on the market.

There are a number of areas where this achievement is apparent.

GREATER DYNAMIC RANGE.

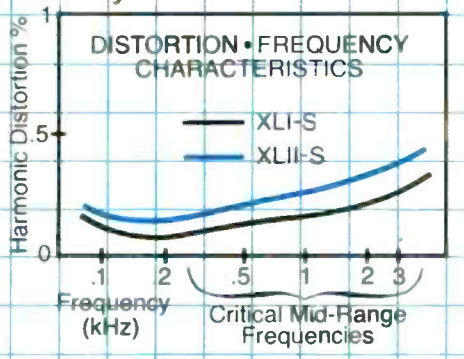
Through a new formulation of our magnetic particles, we were able to reduce the perceived residual AC bias noise level by 1 dB in the critical 2 kHz to 10 kHz mid-frequency range. And simultaneously increase sensitivity and maximum output levels by as much as 2 dB.



As a result, the dynamic range of each tape has been significantly expanded. So you get a better signal to noise ratio and a fuller impact of the dynamic transients exclusively inherent to digital CD recordings.

LOWER DISTORTION.

The newly formulated particles also contribute considerably to XL-S's low output fluctuation, as well as its virtual distortion-free reproduction, especially in the critical mid-range frequencies. This, in turn, accounts for our XL-S tape's enhanced sound clarity.

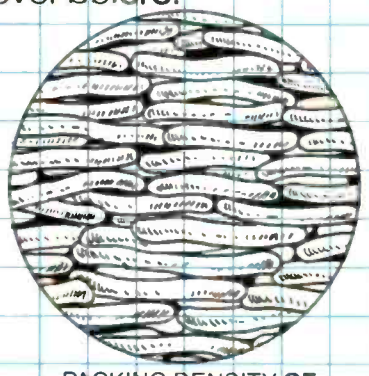


IMPROVED MAGNETIC PARTICLES.

Our refined particle crystallization process is the basis for all of these accomplishments. Maxell engineers are now able to produce a more compact needle-shaped Epitaxial magnetic particle of extremely high uniformity.

This allows us to create a greater ratio of total surface area to unit weight of magnetic particles.

As a result, our XL-S tapes now have the ability to record more information per unit area than ever before.



PACKING DENSITY OF UNIFORM PARTICLES.

Which is why Maxell high bias XLII-S and normal bias XLI-S are unsurpassed at reproducing the sound qualities found on today's finest recordings. Regardless of whether your frame of reference is analog or digital audio discs.

For technical specifications on the XL-S series, write to: Audiophile File, Maxell Corp. of America, 60 Oxford Drive, Moonachie, New Jersey 07074.

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*Based on 1983 versus 1982 calendar year sales.

Some Chevrolets are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your dealer for details.

Let's get it together...
buckle up.

GM

Old-band FM flourished, if that is the word for it, just before and during WW II, and I was there.

mere hiss to the familiar roars and pulsing jargons of station interference that made most night listening all but impossible. This was just overwhelming. And it all came (at least for us) so suddenly. Super-fi in one giant step.

I feel as though I am rewriting a familiar script, for these are the words I so often used then in my enthusiastic accounts of what I had discovered in FM, which as usual I had managed to run into, by sheer luck and happenstance, even before old-band FM officially began. I ended up working full-time in an FM station.

Meanwhile, sad to say, a distant war had begun in Europe. We were worried, but for two long years we kept ourselves fiercely out of that war. And business, including FM, went on somewhat as usual. Then came that hideous shock, Pearl Harbor, Sunday, Dec. 7, 1941. (I was listening to the New York Philharmonic AM broadcast and even remember the ugly, blonde-veneer radio/phonograph console.) In minutes, almost, we were at war. FM was frozen in its track, just as auto production and a million other things were—out for the duration. No more FM equipment. This was the end, so soon after the glorious beginning.

Not quite. The existing FM stations were graciously allowed to continue broadcasting to their new audiences (500,000 sets), and most did, on a hold basis, desperately looking forward to the Big Break that might come "after the duration," when and if the war ever ended. And so it came about that we had excellent FM, remarkably commercial-free(!), throughout the war years. A few of us, that is. Enough to keep the spark very much alive. In July of 1943, I bungled into the station where I was to remain—more or less by accident. I was there, straight through until the final disaster, some three years-plus.

So, oddly, the FM medium flourished both technically and artistically during the years we were on hold, when the old FM band still was in use. There must have been financial disaster around every corner, with no income coming in, but even so we began to understand through daily hours of working experience what really could be done in a hi-fi medium like this. For that's what old-band FM was, and no two ways about it. Hi-fi.

There was, of course, cooperation (mostly) between artistic talent and professional engineering. Both sides were learning together. For instance, we found new mike techniques for voices, out at an easy distance instead of close. No need for exaggerated punch to counter noise and lacking highs. (This presaged much, as you can see, in present microphone technique.) We discovered the dismal limitations of our shellac records, and also some rare and unexpected glories among them. We put on dramatic

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OH, S.A.E. CAN YOU SEE

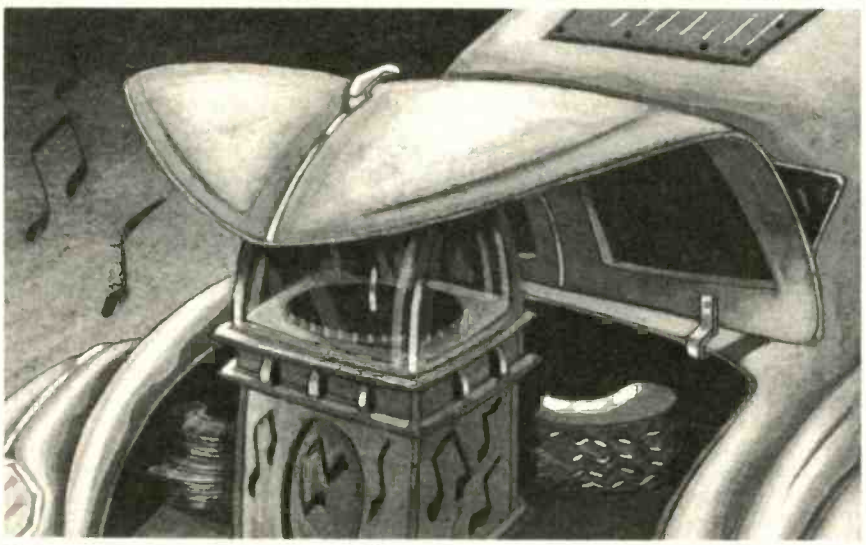

Illustration: Michael A. Donato

Herewith, a guest column by David L. Clark of DLC Design and a contributor to *Audio*:

Every year the Automotive Engineer's Convention is held in Detroit, Michigan, because most of the engineers are there already. This year's International Congress and Exposition of the Society of Automotive Engineers (S.A.E.) was billed as the largest ever. Of interest to auto-audiophiles is the fact that, for the first time, the organizers allotted Audio Systems its own papers category rather than having it exist as a subset of the instrument panel. With its own identity, 30 technical papers were submitted, making this new category the largest at the Convention. That also makes the S.A.E. Audio Systems about one-fourth of the size of an Audio Engineering Society Convention.

Most of the papers were from vendors who apparently were out to impress their clients—the manufacturers. There have been two major influences in automotive sound systems in recent years, custom aftermarket installations and the Delco-GM/Bose system (see *Audio*, December 1982). Many of the papers seemed to offer opportunities to catch up with these systems. Panasonic described an automatic equalizer which measures the system acoustical response to ⅓-octave resolution. It then uses a microprocessor to adjust center frequency, peak or notch depth, and bandwidth of multiple equalizer sections to achieve flat response. Harman-Motive, Toyota, and Panasonic again each addressed sound-field control, localization and ambience enhancement. Bose has relied heavily on computers for synthesis and analysis of audio test signals since the company's founding. In a paper on equalizing automobile acoustics, John Carter of Bose showed us just how advanced they are in utilizing digital signal processing. Dolby Labs gave a highly polished paper on their B and C noise-reduction systems. A good argument was made for tape noise reduction even in the noisy car environment.

Within the bandwidth allotted to every FM station, there is an "unused" area around 57 kHz. This is above the band for stereo broadcast and below the auxiliary SCA channel at 67 kHz. A number of papers were concerned with utilizing this band for data or voice transmission. The Blaupunkt Automatic Radio Information (ARI) system is the best known and has been in use in Europe for 10 years. The primary purpose is to interrupt a radio or tape program for local traffic-information announcements. In its most sophisticated form (which adds only about $40 to the price of the radio), it senses the ARI transmission, stops the tape if necessary, adjusts volume to a preset level, allows the announcement to be made and returns to the previous program. ARI is just beginning service in several areas of the United States.

Philips clearly sees the Compact Disc as part of the car of the future, and in one paper they described a car information and navigation system wherein the vast information-storage capability of the CD would be used for data instead of music. The 4,400 megabits available on one disc could, for instance, map every street in a large part of the U.S. Another Philips paper, essentially a designer's guide to adapting the CD to the automotive environment, discussed a prototype system that included a compressor.

A number of papers addressed refinements to today's dominant player technology, the cassette. The most interesting and innovative was a Mitsubishi paper on an experimental cassette jukebox. A car-battery-sized box containing a 10-cassette carrier is located in the trunk of the car so that the tapes are well protected from theft. The cassettes are then easily switched, without taking ones eyes off the road, via a small dash-mounted selector which programs title and track selection. The cassette carrier is removable, so an alternate batch of 10 tapes can just be plugged in.

Car radio is where car audio started, and radios are here to stay, in ever-improving form. An exciting product from SRI International is a diversity antenna system to combat multipath interference. This 50-year-old idea switches to whichever of two antennas is most effective at the moment. Slight fades are eliminated and medium problems are reduced, but, of course, no signal is still no signal. Another antenna idea presented is to use the rear-window demister wires as an antenna by means of a crossover network and small r.f. amplifier. Much work on radio circuitry to combat the problems of front-end overload was also presented by Motorola, Clarion, National Semiconductor and Ford.

This Convention made it obvious that all auto manufacturers and suppliers are taking automotive entertainment systems seriously. Large-scale integrated circuits and digital processing are the key technologies which allow car audio systems to develop in complexity and features while holding costs down. *D.L.C.*

(Mr. Clark, modestly, failed to mention that he gave a paper, too, on "Double-Blind Testing of Automotive Sound Systems.")

4 out of 5 Sony car stereo owners would go down the same road again.

It seems there is one road that most Sony owners would gladly travel again. The road to a Sony car stereo.

In a recent survey, an overwhelming majority of Sony car stereo owners contacted gave Sony the ultimate testimonial. They said they would be more than willing to buy a Sony again*. As one Sony owner, Ronald Dokken of Minneapolis, Minnesota, volunteered, "When there's a car stereo that sounds as good and works as well as a Sony, why would you want another one?"

In fact, most Sony car stereo owners when asked went so far as to say that they would keep their car stereos longer than they'd keep their cars. Or, in the words of Valerie Roussel of New Orleans, Louisiana: "My car was in the shop for a few weeks. I missed my car stereo a lot more than my car." And Mark Share of Tempe, Arizona, added, "I have two cars and two kinds of car stereos. I find myself driving the car with the better sounding one—the Sony."

Which is not at all surprising, considering the fact that Sony car stereos are not just engineered to perform reliably. They are also engineered to deliver brilliant high-fidelity stereo sound. Because they take advantage of the same experience and innovative technology that goes into Sony's home stereos.

So if you're in the market for a car stereo, it makes sense to go down the same road that 4 out of 5 Sony owners would travel.

Buy the Sony.

SONY.
THE ONE AND ONLY.

*In an independent survey of 200 recent Sony car stereo purchasers who sent in warranty cards, 85% said they'd buy a Sony again.

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Created by the world-famous craftsmen of The Franklin Mint.

THE NATIONAL HISTORICAL SOCIETY is dedicated to bringing the excitement and power of American history—as well as its significance—to people in every part of the land.

It is in keeping with this purpose that the Society is about to issue its own Civil War Chess Set. A dramatic tribute to the heroes of both North and South—and a work all the more intriguing because the playing pieces include richly detailed three-dimensional *portrait sculptures* of the great Generals of Union and Confederacy, captured for the ages in solid pewter, solid brass and fine enamels.

This extraordinary new chess set will be crafted to the highest standards of quality and historical authenticity. The National Historical Society has appointed The Franklin Mint to create the sculptures, each of which will be a new and original design. Some figures will be shown standing, some seated, some kneeling, some mounted on horseback. And each figure will be painstakingly crafted of solid pewter, hand-finished, then set atop a solid brass pedestal base embellished with a circular band of richly colored enamel—*blue* for the soldiers of the North, *gray* for those of the South.

Every sculpture, moreover, will be so rich with authentic detail that only the artists and master craftsmen of The Franklin Mint, steeped as they are in the tradition of *precision coinage*, could have achieved it. Indeed, every nuance of facial expression, uniform and weaponry—right down to the buttons, braiding, sabers and carbines—will be depicted with meticulous accuracy.

Thus, The National Historical Society Civil War Chess Set is also a magnificent *collection*. A triumphant achievement of portrait sculpture—and the ultimate in micro-detailed miniaturization.

ALL FIGURES SHOWN ACTUAL SIZE.

Major General
William Tecumseh Sherman
BISHOP

General in Chief
Ulysses S. Grant
KING

General in Chief
Robert E. Lee
KING

Major General
J.E.B. Stuart
KNIGHT

Available only by direct subscription. Issue Price: $17.50 per sculptured chess piece.
Limit: One complete set per subscriber. Please enter your subscription by July 31, 1984.

This handsome pewter-finished chessboard and fitted presentation case will be provided as part of the set.

A dramatic showpiece for your home or office

The chessmen themselves are scaled so that each one will suit the function assigned to it in the game of chess. And the handsomely crafted, pewter-finished playing board has been sized with equal care. Specially fitted, to also serve as the cover for the case which will house all 32 playing pieces, the board completes a presentation so attractive that the chess set will be played and displayed with pride and satisfaction. A Certificate of Authenticity, and specially written reference materials, will also be provided.

Exhibited on a table or cabinet in your living room, family room, den or office, this is a possession certain to evoke both admiration and respect from all who see it. A unique tribute to unique Americans. A work of heirloom quality, that will bring you endless pleasure through the years. And a chess set eminently worthy of being passed on from generation to generation.

The subscription rolls are now open. The work may be obtained *only* by direct subscription, with a limit of one complete set per subscriber.

The chessmen will be issued to you at the attractive price of $17.50 each, with the specially designed playing board and protective case provided at no additional charge. As a subscriber, you will receive two sculptured pieces every *other* month. You will, however, be billed for only *one* chessman at a time—a total of just $17.50 per month. In addition, you will have the option to complete your set earlier, if you wish—but you will be under no obligation to do so.

Here, then, is a work that will bring lasting pleasure to chess enthusiasts, history buffs, collectors of military miniatures—to anyone who appreciates our nation's heritage. Indeed, it is an unmistakably American chess set, that will make a dramatic addition to any room. And an exciting showpiece that will be displayed, enjoyed and treasured by each succeeding generation.

To acquire The National Historical Society Civil War Chess Set, no advance payment is required. But please note that the accompanying Subscription Application is dated and should be returned postmarked by July 31, 1984.

SUBSCRIPTION APPLICATION

The National Historical Society

CIVIL WAR CHESS SET

Please mail by July 31, 1984.

The National Historical Society
c/o The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for The National Historical Society Civil War Chess Set, consisting of 32 chessmen.

I need send no money now. I will receive two new playing pieces every *other* month, but will be billed for just one piece at a time—$17.50* per month—beginning when my first shipment is ready to be sent. I will receive the fitted presentation case and pewter-finished chess board at no additional charge.

**Plus my state sales tax and $.50 per chessman for shipping and handling.*

Signature_____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE.

Mr./Mrs./Miss_____
PLEASE PRINT CLEARLY

Address_____

City_____

State, Zip_____

Limit: One complete set per subscriber.

280

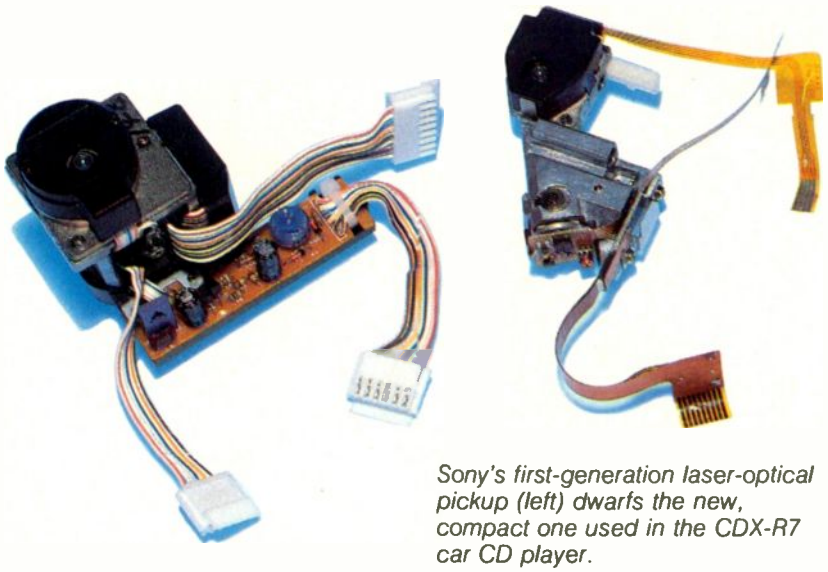
SONY CAR CD PLAYER: On The Road Ahead

LEONARD FELDMAN

It's been more than 18 months since I first laid eyes (and hands, and ears) upon the first CD player that I could operate in my own home and lab. Since then, I must have tested at least two dozen or more players, and I've collected over 100 Compact Discs to play on them. All the while, I've been hearing tales from various manufacturers about the ease with which CD players could be designed for use in moving vehicles. I had no doubts in my own mind about the coming of car CD players. After all, more than a year ago, when several members of the audio press toured the facilities of Philips and Polygram Records in Holland and West Germany, our hosts transported us from one factory to another aboard a mini-bus. And there, perched atop the dashboard of that vehicle, was a *standard home* CD player, sitting on a cushion of sponge-like plastic. The only thing that had been done to it, I was told, was to convert its power supply to work at 12 V instead of at the standard European 220 V. As I recall, the CD player actually functioned quite well—so long as we traveled at constant speeds along Holland's generally fine superhighways. Riding along city cobblestone-paved roads, however, I heard several instances of mistracking and momentary muting. We were assured that it was only a matter of time before such problems, as well as possible problems of temperature extremes and miniaturization, would be solved.

Sony, the co-developer of the CD system now universally accepted and endorsed by the audio industry and the hundreds of thousands of music lovers who already own home players, believes that the time for a car CD player has come. Since Sony had given me a sneak preview of their first CD player a year and a half ago (*Audio*, November 1982), I felt it only appropriate that I be given a peek at their first CD player designed for use in moving vehicles, the CDX-R7. Sony was happy to oblige, and here are the details of what I learned and saw:

According to Sony, the two primary designs that were needed to make a car CD player practical were in the areas of the laser-optical pickup (including its driver servos) and in large-scale integrated (LSI) circuitry. Since Sony has its own, in-house IC design and production division, they were able to come up with a new, one-chip digital LSI for all primary functions of the proposed car CD player. As for the need for a smaller, yet stable and reliable laser-optical system, Sony also developed a miniaturized laser optic mechanism which, they tell me, will be applicable not only to car CD players but—and I should have guessed this—to "Walkman"-type CD products in the near future! Having developed these two new major components, Sony was then able to design a car CD player/tuner/preamp component which actually meets European DIN dimensional mounting standards. In other words, it will fit *in-dash*. This means we can foresee the day when CD player/receivers



Sony's first-generation laser-optical pickup (left) dwarfs the new, compact one used in the CDX-R7 car CD player.

Photo: The Image Bank/© Gill C. Kenny

will be offered as factory-built options by car manufacturers, as well as for after-purchase installation in or under the dash.

Front Panel Features

The front panel of the Sony CDX-R7 CD player is no larger than that of any in-dash car stereo front panel. Along its top is a slot into which the Compact Disc is inserted. When you insert a disc partway, the mechanism takes over and draws it into the machine, placing it in position for play. Push the eject button at the far right, and the disc comes out partway, but if you fail to remove it the rest of the way within 15 S, the disc retracts and the system is held in the pause mode—a neat arrangement that protects the disc from dust. If you then fail to release the pause within 15 minutes, the player's power is turned off completely.

The left end of the front panel houses the usual controls you would expect to find on any car stereo front-end component: Concentric volume, fader and balance controls and bass and treble tone controls. A switch beneath the left end of the disc slot determines what indications will be visible in the nearby display area. When playing CDs, touching this switch alters the display from showing time of day (clock function) to showing the track number of the disc being played. Unlike many home CD players, however, this unit does not tell you time played within a given track. When using the built-in AM/FM tuner, the same switch makes the display alternate between showing time of day and frequency of tuned-to stations.

A local/distance switch and an FM mono/stereo switch along the lower edge of the panel are used only when listening to the tuner. Remaining controls and switches located beneath the display area, however, serve different purposes, depending upon whether you are listening to a disc or to the tuner. The button labelled "Memory," used to memorize preset station frequencies when in the tuner mode, controls the laser pickup's return to the beginning of a disc for replay of the first track when listening to CDs. The fast forward/rewind switch, used to scan quickly through the music on a disc (at 10 times normal speed, and at an amplitude which is reduced by about 12 dB), serves as a manual tuning rocker switch in the tuner mode. A second rocker switch allows you to advance to the next (or previous) track of a CD (just as in Sony's home CD players) but becomes a scanning control in the tuner mode. It pauses for 4 S as each station is locked in, allowing you to stay on that station or continue scanning. The "Play/Dir" button at the far right of the small front panel performs

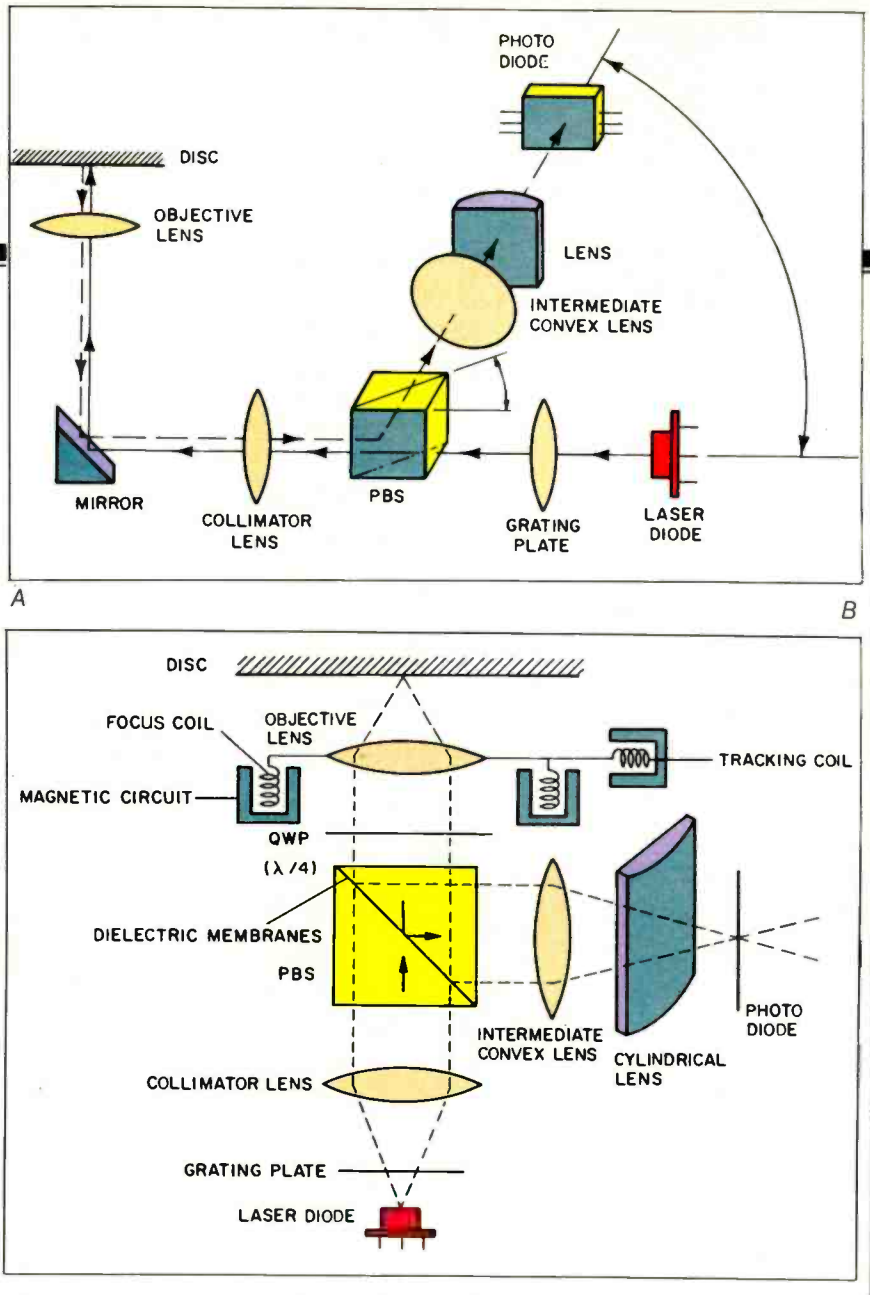


Fig. 1—New laser-optical pickup (A) has a folded light path (note mirror) to make it far more compact than Sony's original home-player pickup (B).

the same play/pause function as on home CD players. Remaining controls relate exclusively to the tuner operation and include an AM/FM band-selector switch, a tuner on/off switch, and six numbered preset buttons. Because there are secondary buttons labelled "FM1," "FM2," and "AM" that work in conjunction with the presets, it is possible for a total of 18 favorite stations (12 FM and 6 AM) to be memorized.

Performance Specifications

Although I have not had a chance to measure the performance of this first car CD player/tuner/preamp in my own lab (I will as soon as I can get my hands on a production unit), published specs for the CD section come close to those found in home units. Harmonic distortion is quoted at 0.007%, while frequency response is rated as flat within 1 dB from 12 Hz to 20 kHz. Dynamic range and signal-to-noise ratio are the usual 90 dB or better, and stereo separation exceeds 80 dB between channels. Line output level is 0.775 V for 0-dB (maximum) recording level, and the entire unit weighs only about 3½ pounds!

FM tuner usable sensitivity is quoted as 15 dBf, and strong-signal signal-to-noise ratios are 70 and 68 dB for mono and stereo respectively. Capture ratio, especially important in a vehicular FM tuner, is only 1.5 dB. Harmonic distortion at 1 kHz is 0.1% for mono and 0.15% for stereo signals; separation at mid-frequencies is 40 dB. Alternate-channel selectivity is rated at 70 dB.

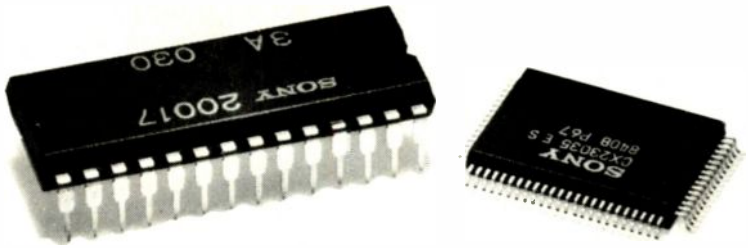
The New Laser-Optical System

As mentioned earlier, the design of this small CD player was made possible by the development of a new, miniature laser-optical pickup mechanism and a new, single-chip LSI. A simplified diagram of the optical pickup is shown in Fig. 1A. Its operation is somewhat similar to earlier, physically larger optical systems used in CD players. An emitted laser beam produced by the laser diode (LD), at the right in the diagram, passes through a grating plate and a collimator lens, after which it is deflected 90° by a 45° mirror and focused by another lens to the reflecting surface of the CD. Between the grating plate and the first lens is a Polarization Beam Splitter (PBS) which incorporates dielectric membranes acting as a sort of prism, directing the laser beam from the diode onward to the 45° mirror, and the reflected beam from the surface of the disc to the photo diode (PD). The cylindrical lens between the PBS and the photo diode focuses the reflected beam of light. The chief difference between this optical pickup and larger ones used in earlier CD players (Fig. 1B) is the fact that this pickup has, in a sense, been folded back on itself to conserve space. This miniaturization has been accomplished without sacrificing any of the elements needed for accurate and stable servo tracking and focusing of the laser beam onto the precise "track" of the CD and at the precise depth required for accurate reading of the digital information embedded below its surface.

The One-Chip LSI

The silicon gate C-MOS LSI developed for digital signal processing of Compact Disc signals combines the functions previously performed by as many as four separate ICs. The functions of this new IC, the CX23035, are shown in Fig. 2, with the functions of the four ICs it replaces indicated.

Some nine separate functions are performed by the one chip. They include bit-clock generation using a phase-lock loop circuit, data decod-



ing, detection protection and insertion of frame-synchronizing signals, detection and correction of serious data errors, interpolation by "mean value" or previous-value holding, decoding and error correction of sub-code signals, constant linear velocity (CLV) servo/spindle motor control, track counter with eight bits, and Central Processing Unit (CPU) interface via a serial bus. The IC itself is configured as an 80-pin flat package, and its maximum power dissipation is 500 mW. It may be safely stored at any temperature from −67° to +302° F (−55° to +150° C) and may be operated at any temperature from −4° to +167° F (−20° to +75° C). The ability to operate over such a wide temperature range is, of course, essential for any device intended for use in the hostile and extreme environment of an automobile.

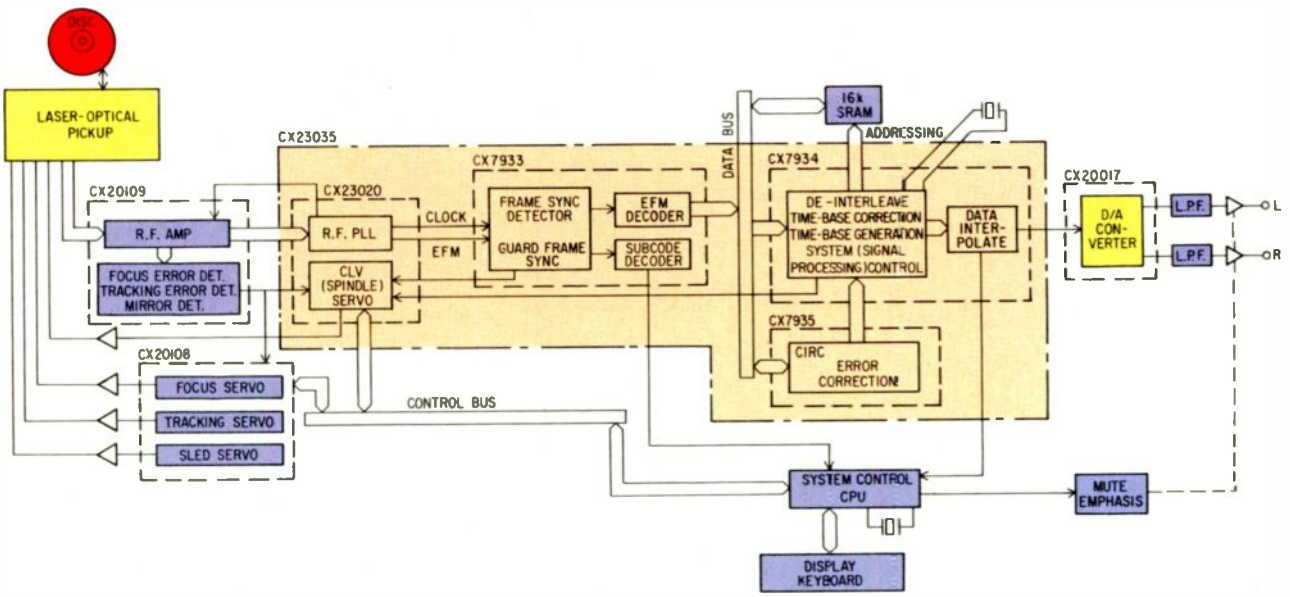
Of the several additional chips shown in Fig. 2, two were specifically designed for this car CD player and are of particular interest. The first of these, CX20108, is a silicon monolithic bipolar IC developed as a servo signal processor for the CD player. Its functions include focus control (search, servo on/off, gain control), tracking control (servo on/off, single track jump, multi-track jump and gain control), and sledding or scanning control (servo on/off, fast-forward scan and fast-reverse scan). This IC is housed in a 30-pin flat package.

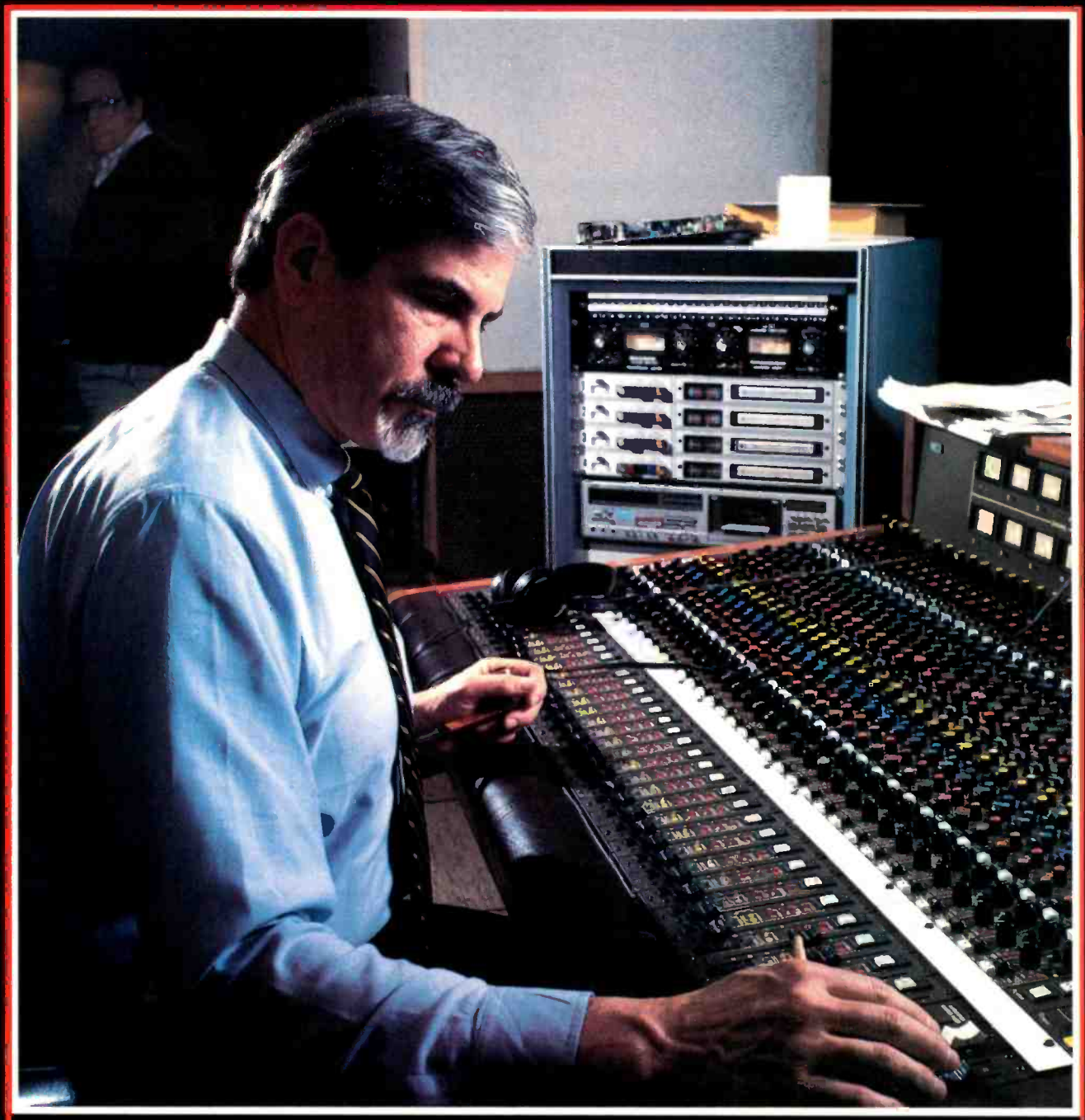
The other IC of particular interest, CX20109, is a silicon monolithic bipolar IC as well. This IC has an r.f. amplifier for handling the three-spot optical pickup output from the laser pickup and signal processing circuits that take care of the following functions required in the CD player: Focus-error amplification, tracking-error amplification, auto asymmetry-control amplification, focus "OK" comparator circuitry, mirror comparator circuitry, and EFM (modulation or data) comparator circuitry. This IC is configured as a 24-pin flat mini-package.

What Next for CD Technology?

There are many who feel strongly that the total impact of the Compact Disc on the typical consumer will not be realized until the complete CD product family reaches the marketplace. A Compact Disc player for cars is just one of those products. Other possible products envisioned by Sony and others include a practical CD-ROM (Read Only Memory disc for data processing and computer applications), CD-Still-Frame graphics (early forms of which have already been demonstrated by Sony and other high-tech companies), CD-DRAW (Direct Read After Write, or recordable CDs), and CD-CADA (CAble Digital Audio). These new digital media concepts and others are being worked on in laboratories all over the world and are sure to lead to exciting and useful products in the not too distant future. Meanwhile, the next exciting development is certainly going to be the car CD player. Will it eventually replace the cassette deck in cars as the cassette deck replaced the 8-track cartridge? Will a dedicated digital tape recording system (which may be standardized within the coming year) end up as a worthy competitor to the CD player in cars? How will digitally encoded graphics on CDs change the way we listen to music and watch our video monitors? All of this geometrically expanding digital technology is almost too much to contemplate—and to keep up with. But as always, I will keep trying to tell you about it as it happens.

Fig. 2—New ICs in Sony car player include CX20109 and CX20108 at left, and CX23035 LSI chip (which replaces four earlier ICs whose functions are indicated by dotted-line boxes within the beige-colored area).





As multi-track became more accessible, engineers yielded to demands to have more flexibility, to have bigger safety nets.

You might say Jack Renner has been living out the American dream. In just over two decades, the Telarc Records founder and president has gone from making records of high school bands to the vanguard of classical recording. Though Telarc's catalog includes barely more than 50 titles to date, their notable quality, both in the LP and CD formats, has earned the company an international reputation.

The fact that Renner and partner Bob Woods have achieved all this from a base in Cleveland may seem shocking to some jaded New Yorkers or devout denizens of Hollywood and its environs. But Renner himself reckons that, had he been surrounded by too many people rooted in the record business, they probably would have convinced him his goal of establishing a major classical label was impossible, causing him to abandon it.

The son of a professional trumpeter who worked with some of the big bands of his time, Renner himself played trumpet and, after graduating from the Ohio State School of Music, taught high school until tempted to earn his living at location recording and custom record production. From recordings of school and church groups, he moved on to making records of professionals, such

DAVID LANDER

Telarc's Jack Renner: Recording Without a Net

as organist Michael Murray and individual members of the Cleveland Orchestra, which were sold largely by word of mouth.

Even these attracted the attention of some audiophile reviewers, as did the 1977 production of *Direct from Cleveland* with Lorin Maazel conducting the Cleveland Orchestra; the first direct-to-disc recording of a symphony orchestra, this was an effort that drew boos along with kudos.

The following year, after convincing Soundstream's Thomas Stockham to increase the upper limit of his digital recorder beyond 17 kHz, Telarc used the machine to master its first digital sessions, featuring Frederick Fennell and the Cleveland Symphonic Winds. "I hate to be trite about it," the 49-year-old Renner smiles, "but the rest is history." Classical music lovers and audiophiles alike can only hope the historic few years to which he alludes are merely the beginning of an epoch, and that Telarc will endow us with many more records at least as remarkable as those it has already produced.

Telarc has attained a formidable reputation in a very short time. When you began to record digitally, did you envision where you'd be now?

I wanted to have 50 titles out in five years, and that's what we've done. I have to say it was not a structured plan any of us had around here, but that's where I felt I wanted to be with this company. Maybe I was naive enough not to be concerned that I was taking on the giants of the industry.

Did you feel at the time that you had something to offer that these "giants" weren't providing, that perhaps they were doing something wrong?

I'm not so sure they were doing something wrong as perhaps not doing a lot of things right. I had gained enough confidence over the years with my simple approach to microphone technique that I knew it was workable, and I had listened to an awful lot of the major companies' records and knew there was just a classic case of overkill going on here. There was also a growing awareness on the part of the consumer that there was something basically wrong about the approach the major companies were taking to recording classical music. That rested primarily with their approach to choice of microphones and equipment and the use of them. It's just ludicrous to think that you have to put 40 microphones out to

Photographs: Susanne Buckler

Jack Renner knows recording from the engineer's side (facing page) and the musician's (right, with Placido Domingo).

Photographs: David Lander

What the digital detractors are hearing has more to do with what they're hearing it on than the process itself.

record a symphony orchestra, and that's what many of the major companies do.

The president of Shure Brothers told us not long ago that recording engineers tell them all the time that, if they discontinue a certain mike that's been in the line for years, they'll switch to another brand.

This keeps them on safe ground. I'm in one way delighted and in another way a little bit threatened by the fact that Philips, Decca, Deutsche Grammophon and also RCA and CBS, strangely, in the last five years have started using fewer microphones and they've started buying the same kinds of mikes that I've been using. Now that just didn't happen. There's definite pressure that we have brought to bear.

Where did your ideas on miking come from?

Well, I have to give credit where credit's due. Bob Fine [of Mercury]. He proved in the '50s and '60s that you can go out with two and three of the *right* microphones and in the *right* acoustical environment, and you have to choose your halls carefully—but having done that, and having found the right spot in the hall for those microphones, you can make recordings that no one can really criticize. Take some of the old RCA recordings that were made with three or four microphones back in the early '50s, the Chicago Reiner stuff, the Boston Münch things. Beautiful recordings.

Why do engineers use so many mikes? Is it so they can airbrush the acoustical photos, as it were, if they have to?

The producer on the job has gotten to the point where he wants the safety net of being able to go back to the studio and decide, away from the heat of battle, what that recording should sound like. The part that really concerns me is that *he* will decide, not necessarily in consultation with the conductor. The other part of the whole package is that, as multi-track became more and more accessible over the years, engineers were yielding to the demands to have more flexibility, to have bigger safety nets, and every one of them has said to me such things as, "It's a lot easier to put out more microphones than you're going to need. It's a lot easier to turn on microphones than it is to go out and move people around."

Is less always more in terms of microphone techniques?

It certainly has been for me. What I find is that, the more microphones you put out, the more temptation there is to fool around and to change not only the musical balance that the conductor's working so hard to achieve, but also the perspective of the instruments. The common deficiency you hear on a lot of classical records today is that, when there is a solo passage and the recording's been made with a number of microphones, you tend to hear that solo player move closer to you when the solo's being played and then move back into the orchestra when the solo's over. Some people like this. I happen to feel it's not realistic, that it's not the way it happens in a concert hall. I really think that, if the conductor is balancing the orchestra the way he wants it heard out in the hall, then I ought to be able to give this back to him. After all, we are in a re-creative process here as opposed to the rock and pop field, which really is a creative process. There, the finished record sound is really made by the engineers in the studio.

The introduction of the Compact Disc last year marked the start of a very interesting period for your business. Do you think the CD will become the new standard, the music storage medium of the future?

Yes, I do. I'm not prepared to say it won't go through some changes over the next few years, but *I* am personally committed to the CD. I happen to be on the side of the fence that says CD really is good and really sounds fine.

Do you hear the edginess in the midrange, the coarseness that some other people claim to hear?

Yes, when I play it back on equipment that I feel is contributing this to it. The different brands of CD players out there may look on paper as if they all sound alike, but that couldn't be further from the truth. It's like every phonograph cartridge that's flat from 20 to 20 sure doesn't sound that way. I really think what the digital detractors are hearing has more to do with what is being used to play digital sound back than the actual digital process itself. We did an interesting experiment at our first digital session and we've done it many times since then. When there were a certain number of what I would call golden ears in the room, we would go through a process of comparing the input of the console itself, which is

what's coming right off the microphones before it goes to the tape recorder, and then listening back off the digital tape—with the Soundstream you actually can monitor the playback off the tape, just like you can with an analog machine. And I would say I've done probably 60 sessions with digital equipment, and so far no one has been able to tell the difference. Now, we've lined up digital players in our sound room here and put the same Compact Disc on each one, cued them so they are in sync, so you can pop back and forth with your preamp, and there is a startling difference between players. The players we don't like have this midrange edginess; they have a sense of graininess to the sound, and it's exactly what the people who don't like digital sound are describing.

How do recording engineers fit into the equation?

I think digital has been grossly misused by a lot of recording engineers who, over the years, have developed their whole approach to recording with the analog product in mind, and there tends to be some masking that goes on. A lot of overly bright microphones have been chosen in order to give an excessive amount of presence, some of which will be lost in the whole transfer process from microphone to finished disc. And they have learned, much to their horror, that you can't go out and put up 20 or 25 excessively bright microphones and feed this signal into a digital tape recorder without it sounding really strange.

How much does the Soundstream machine itself have to do with the quality of Telarc records? Do you feel it's a factor?

Absolutely. This machine is superior in every way, sonically, to anything that's out there. I can go out and make outstanding digital recordings with other people's digital equipment, but they are not going to sound as good as with the Soundstream. *But*, by the same token, an awful lot of the major companies have used the Soundstream machine and have gotten recordings that have been roundly criticized for their edgy sound, which goes back to the fact that the Soundstream machine itself does far and away the best job of giving you back exactly what you're feeding to it.

Are the differences in digital recorders measurable, or are they like some of the differences in speakers, things that we can hear but maybe haven't figured out how to measure yet?

Well, I haven't actually gone through the exercise of trying to measure the differences. I think most of them have to do with how you are actually hearing them, like speakers. As I said earlier, you can line up an awful lot of phono cartridges—or preamps or amplifiers—that on paper you can almost lay the specs one on top of the other and, boy, they sure don't sound the same! What I did in assembling my equipment package was to try to find what I felt were the most neutral-sounding pieces of gear—microphones, mixing desk, speakers and amplifiers—so at least the signal that I was feeding to that recorder had been colored as little as I felt possible within the confines of what's available.

The advent of the CD means that audiophile labels no longer have an exclusive option on such sonic qualities as wide dynamic range and quiet surfaces. How is your company facing this challenge?

First of all, by not considering ourselves as just an audiophile label. I think it could be fatal if we were to continue to try to sell ourselves as we did early in the game, with the best sound in town. I think we still have the best sound in town, but we are trying to pair that more and more with internationally recognized performers—conductors, orchestras, soloists, whatever.

It would be fatal to consider ourselves as just an audiophile label.

You've worked primarily with American-based artists so far.

Yes, but we are making a very conscious, planned effort now to establish, if you will, a European connection in terms of our branching out in our recording activity—because we are internationally recognized, and we need to have a larger percentage of our catalog devoted to performers who are highly visible internationally and also have European roots. As far as Telarc and the major classical labels are concerned, we've competed and, I think, in most cases won on strictly a sound basis. I still think we are ahead of them on that. Now we are going to take them on in regard to artists. That isn't to say we're in a position—nor do we want to be—to build a stable of Telarc artists who are committed exclusively or on a semi-exclusive basis to us, because that could lead you into obligations that might be very hard to fulfill. But we do expect to be working with more and more internationally recognized people. We can do a limited number of records with some big names each year and do them very well, and that's the direction we're headed in.

How long will your CDs continue to be better than those of the majors in sonic terms?

I think they will continue to be for a long, long time. Our competitors can assemble the same kind of equipment, but there is still something to be said for the fact that I have come into this from a totally different direction. I've done very few multi-mike jobs in my life. I have always believed a simple mike setup is a more accurate way to re-create the musical experience. The major companies are coming from the other direction. They've got to establish a totally new reference, and they are being very cautious about coming down from this huge overkill. I am *not* going to be foolish enough to say that we will take on the Deutsche Grammophons of the world forever at the sound game. I really don't think we can stay on top forever, but I will be very happy in a few years to be able to have a solid catalog and still be recognized as the company responsible for a lot of innovations in this business.

RICHARD J. KAUFMAN

PHASE FILTER

Digital audio discs have been available on the market for the past year. These 4-inch discs may well send the familiar 12-inch LP the way of the cylinder and the shellac 78. The praise lavished on this product in the equipment reviews is unparalleled in the history of audio. Radio stations have begun broadcasting CDs, and the response has been overwhelmingly enthusiastic. Has the ultimate sound playback medium been perfected?

Definitely not, according to a small group of audiophiles. They object to digital sound as being unmusical, harsh and strident, but they are not taken very seriously (after all, some people claim that tube equipment sounds better than transistors). Yet the claims of these people deserve serious examination. It's often worth pursuing the complaints of an audio minority; in the past, correcting problems the majority didn't hear has led to improvements everyone could hear—once there was a standard of comparison. Given the general excellence of digital reproduction, it could be that its virtues mask a form of distortion which does not exist in a pure analog medium.

Richard J. Kaufman is Consulting Design Engineer for Dennesen Electrostatics, Beverly, Mass.

Phase Distortion in Digital Media

Several theories have been advanced to explain the alleged "graininess" of digital sound. The only one that ever seemed to make sense claimed it was caused by phase shift introduced, in recording, by the anti-aliasing filter.

The digital sampling rate for most systems is 44.1 kHz; any signal whose frequency is near the sampling rate will cause a form of distortion audible as a spurious tone or "alias," unless the signal is passed through a very sharp cutoff filter. A representative anti-aliasing filter would be an 8-pole Butterworth with a −3 dB point of 22 kHz. Such a filter does an admirable job of suppressing signals above the cutoff frequency without affecting the frequency response of audible signals. Response is down 48 dB at 44 kHz, but the phase shift at cutoff is −360°, and it becomes significant above 6 kHz. Figure 1 plots phase shift versus frequency for an anti-aliasing filter. Other types of filters are also used; some, such as 9- and 11-pole elliptical filters, have group delay characteristics quite similar to those of the sample we've chosen to analyze, especially below 14 kHz. (Additional phase shift is introduced by the noise filter used in playback, but with a well-designed filter, it is slight in comparison to that caused by the anti-aliasing filter.)

The Audibility of Phase Shift

Just because the phase of a signal is altered doesn't mean it is distorted.

FOR DIGITAL

A phase shift that is a *linear* function of frequency is equivalent to moving the sound source. The shape of waveforms subjected to a linear phase shift is unchanged when displayed on an oscilloscope. But if you were to display the sum of two tones subjected to a *nonlinear* phase shift on an oscilloscope, the shape of the signal would be clearly different.

A square wave consists of a series of odd-order harmonics of its fundamental frequency. Thus, a 1-kHz square wave contains components of 3, 5, 7, and 9 kHz and higher. The effect of a nonlinear phase shift on a square wave is to introduce overshoot and ringing, as illustrated in Fig. 2. Because the harmonics no longer have the proper time relationship to the fundamental or to each other, they no longer sum to a straight line. Any impulse signal (quite common in music) will be similarly affected.

Correcting the phase response will eliminate this overshoot and so increase system headroom. Since even quite powerful amplifiers are frequently driven into brief clipping by digital recordings, even at low to moderate listening levels, any improvement in headroom will improve sound quality. Low-level portions of the reproduction chain also overload, even during recording, so the benefits are not limited to playback.

The audibility of phase distortion by itself is another issue. The experimental results that have been published to date have not produced clear-cut results. Apparently, it is audible under some conditions, but to what degree it is tolerable in music—and even how to specify it—is still undefined.

Even though a phase-shifted signal looks different on an oscilloscope doesn't mean it sounds different. Many clearly audible forms of distortion are not visible on a 'scope, and some wildly distorted-looking waveforms sound just fine. In fact, the great 19th-century physicist Ludwig von Helmholtz demonstrated that differences in the relative phase between two sine waves are inaudible.

Music, though, does not consist of pure sine waves. It is made up of many tones that are *modulated* by complex series of harmonics of other tones. Modulated signals are affected by nonlinear phase shift in a manner known as group-delay, or envelope, distortion. Based on my experience designing electrical networks to eliminate group-delay distortion, I believe that an emphasis on group delay rather than on phase shift alone would clarify the issue of the audibility of phase distortion. Such emphasis would also result in a rational standard for its measurement.

A description of group-delay distortion, how it is induced by a nonlinear phase shift, and how it can be eliminated is necessarily involved. The original work that made elimination possible was done at Bell Labs; its practical application prevents computer messages from being garbled going over the phone lines. Adapting these computer line-conditioning techniques to audio has proven to be a fairly straightforward matter. I have tried to keep the accompanying explanations as clear as possible, and hope the reading will prove worth the effort.

The Effect of Nonlinear Phase Shift

Phase delay is proportional to the phase shift divided by the frequency. A sine wave of 11 kHz that is shifted −180° is delayed the same length of time as a 22-kHz sine wave that is shifted −360°. If the phase delay is thus constant at all frequencies, then a complex waveform's shape is not altered, but is merely shifted in time. The difference is not audible. But an 11-kHz sine wave that is phase-shifted by −90° is delayed by 23 μS, compared to 45 μS for a 22-kHz tone shifted −360°. Hence, the two tones would not bear the same relationship to each other after passing through a filter that produced such a nonlinear phase shift.

Group-Delay Distortion

Figure 1 is a graph of phase shift versus frequency for an 8-pole Butterworth filter, sometimes used for anti-aliasing. Group delay is defined as the *derivative* of phase shift with respect to frequency; in other words, it is the slope (a line tangential to the phase shift) at a given frequency, as shown by line A in the figure.

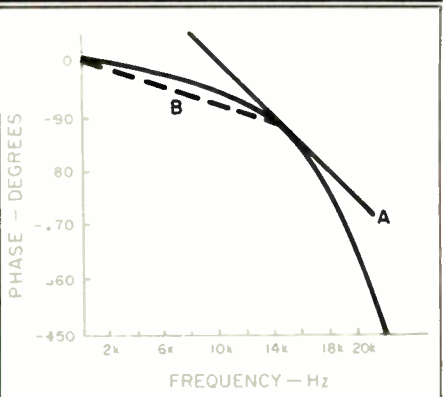


Fig 1—Phase response of an 8-pole Butterworth anti-aliasing filter. At any given frequency, group delay is represented by line A, which is tangent to the phase response, and phase delay by line B, which is between the origin and the phase response at that frequency.

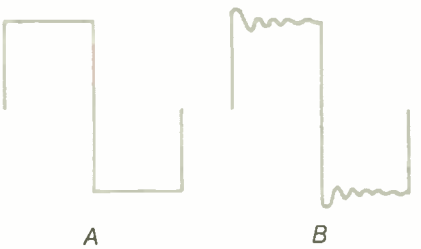


Fig. 2—Square wave before (A) and after (B) phase shift.

Line B represents the phase delay at the same frequency. Phase delay is defined as the phase shift divided by frequency; it is the slope of a line that passes through the origin of the graph and the point representing phase shift at a given frequency.

It is obvious that phase delay and group delay differ. They are identical only when the phase shift is linear. Then, the phase delay is constant at all frequencies, and identical to the group delay.

The effect of group-delay distortion is shown in Fig. 3. When a lower frequency tone modulates a higher frequency carrier, the carrier is shifted by an amount represented by the phase

The best explanation for digital's alleged "graininess" is phase shift in recording, due to anti-aliasing filters.

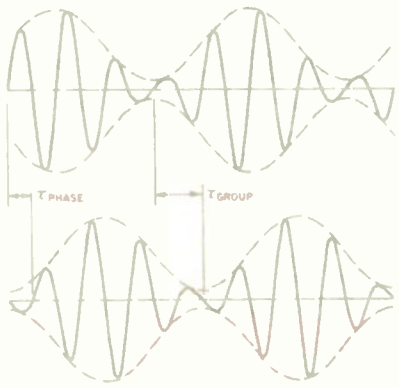


Fig. 3—Envelope distortion: Where phase shift is nonlinear, different phase-delay and group-delay times cause unequal delay of the carrier and modulating signal, changing the relationship between them.

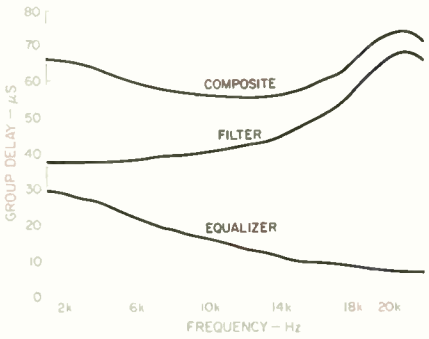


Fig. 4—Group delay of anti-aliasing filter (middle curve); first-order, all-pass phase-equalizer network (bottom curve), and composite response (top curve) of filter and equalizer.

delay, but the modulating signal is delayed by the time of the group delay. For this reason the effect is sometimes known as envelope distortion. (It can also be considered as a form of intermodulation distortion.) Voices and the sounds of musical instruments consist of a carrier modulated by a fundamental and its harmonics, and so will be affected by this kind of distortion.

Phase-Correction Networks

All-pass transfer functions have the property of causing phase shift while leaving frequency response unchanged. Ideally, we would like to reverse the phase shift caused by an anti-aliasing filter without affecting the frequency response, but this cannot be done; the phase shift of an all-pass function can never be complementary to that of a low-pass function, such as an anti-aliasing filter, and so this ideal cannot be realized.

Fortunately, the group delay can be made constant, resulting in an overall phase shift that is linear with frequency. A constant group delay indicates a linear phase shift, and a linear phase shift does not distort a signal.

Figure 4 illustrates the group delay of an anti-aliasing filter, that of a properly chosen first-order, all-pass network, and the product of the two. The remaining dip in this response can be further equalized by the use of higher order networks.

Figure 5 shows how an all-pass transfer function can be constructed by means of a summing amplifier. Figure 6 shows an actual, first-order, all-pass circuit to correct the group delay of a digital recording. Use of such a filter produces an audible improvement, as well as a visible improvement in the square-wave (and hence transient) response of a CD or other digitally mastered source. Third-order networks are more complex, and require components and tolerances not generally available to the amateur. (Second-order networks cannot be used alone to correct the phase shift of an anti-aliasing filter.)

Table I lists the group delay of an anti-aliasing filter, of the filter as corrected by a first-order network, and as corrected by a third-order network. Inspection of these figures shows that, although the first-order network produces a more nearly constant group delay, the variation at certain frequencies is nearly as great as for the uncorrected anti-aliasing filter. A third-order network produces a much more constant group delay, and also sounds better. The use of higher than third-order networks does not seem justified in view of the marginal improvement attainable.

My associates and I have been experimenting with delay equalization of digital media as a means of phase restoration. We have found that both true digital and digitally mastered material are greatly improved by the use of a properly designed delay equalizer. (As one might expect, pure analog material, played through the delay equalizer, sounds peculiar.)

The effect is often subtle, but at times dramatic. The difference is most evident with speakers that preserve linear phase relationships, but it is noticeable to some degree on all systems we have tried. Some source material has little information at the higher frequencies, where most of the distortion occurs, but even so there is a greater clarity to the sound, and its location seems more focused. Vocals are more intelligible. Violins sound smoother.

Table I—Group delay vs. frequency for an anti-aliasing filter alone, with a first-order phase equalizing network, and with a third-order network.

ANTI-ALIASING FILTER DELAY	
Frequency, Hz	**Delay, μS**
0	0
2.2k	0
4.4k	0
6.6k	0.800000012
8.8k	2.2
11k	4.40000001
13.2k	6.60000001
15.4k	11.6
17.6k	17.4
19.8k	28.3
22k	28.3

FILTER PLUS 1-POLE EQUALIZER	
Frequency, Hz	**Delay, μS**
0	0
2.2k	– 0.700000018
4.4k	– 3.60000001
6.6k	– 7.30000001
8.8k	– 9.40000001
11k	– 10.1
13.2k	– 10.9
15.4k	– 8.00000002
17.6k	– 3.60000001
19.8k	5.79999998
22k	5

FILTER PLUS 3-POLE EQUALIZER	
Frequency, Hz	**Delay, μS**
0	0
2.2k	0
4.4k	– 1.40000001
6.6k	– 1.40000001
8.8k	– 2.19999999
11k	0
13.2k	0.699999988
15.4k	2.19999999
17.6k	2.90000001
19.8k	8.69999999
22k	5.09999999

We can't reverse the anti-aliasing filter's phase shift, but we can make its group delay constant.

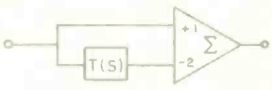


Fig. 5—Block diagram of an active, all-pass filter. Filter T(S) must be either a first-order high-pass, a first-order low-pass, or a second-order bandpass network.

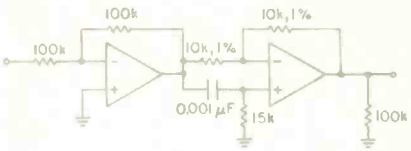


Fig. 6—A first-order, active, all-pass network for correcting group delay of digital recordings.

One sound engineer who tried the phase-restoration device said that, at first, the effect seemed so slight he wasn't sure it was important, but after listening with it for several hours, he found he could no longer tolerate the sound of digital material without it.

There is a great deal of variation in digital disc players, as well as in the source material. Some players use a gentle digital filter combined with oversampling to eliminate the glitches present after digital-to-analog conversion; others use a brick-wall filter that introduces as much group-delay distortion as the anti-aliasing filter. We have found that even a partial correction is an improvement, and so both kinds of CD players sound better when used with the same phase-restoration device. Similarly with source material: A recording may undergo several conversions, digital-to-analog and back again, for it is a usual practice to dump a digital master down to open-reel analog tape for editing (where digital editing facilities are not available) and then reconvert to digital for the finished "master." This will greatly increase the amount of group-delay distortion.

Eventually, I expect all digital recordings to be phase-corrected in the studio—the improvement is well worthwhile. It is possible that advances in digital techniques will make phase correction unnecessary; dbx's delta modulation system uses a very gentle anti-aliasing filter that introduces no phase-shift or group-delay distortion below 20 kHz. Perhaps the next generation of CD players will include phase-restoration devices. Even if the effects of group-delay distortion weren't sonically objectionable, the lessened incidence of clipping, due to increased system headroom, would justify the use of a delay equalizer. In the meantime, an add-on phase restoration device is necessary to realize the full potential of digital recordings.

ON THE TESTBENCH

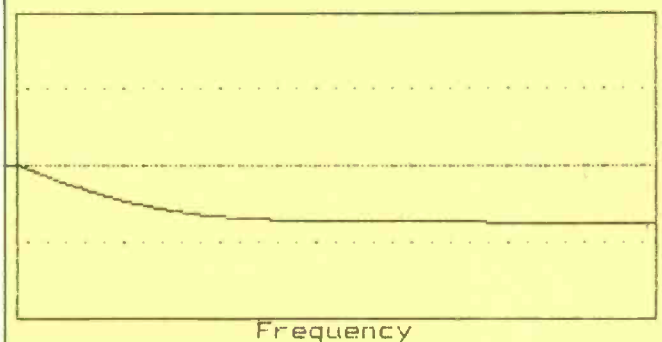
My measurements on the Dennesen phase-correction device, designed by Mr. Kaufman and Peter Madnick, show the following:

Frequency response extends to d.c. for both channels. In the bypass position, both channels are flat within ±0.02 dB to 30 kHz. With phase correction, both channels have a slight rise at 30 kHz (0.35 dB for the right channel and 0.25 dB for the left); within the audio band, frequency variations are negligible. The differences between the left and right channels are 0.08 dB of amplitude and 0.34° of phase at 20 kHz, with smaller differences in the audio range.

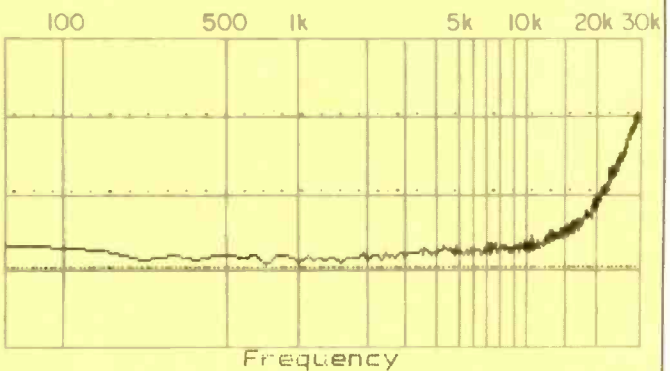
Group delay is 39 µS at d.c. and 27.5 µS at 20 kHz. Group delay does not dip at 20 kHz, as would be expected for complete compensation of a sharp-cutoff, 20-kHz, anti-aliasing filter. This implies a partial rather than a complete correction over the audio band. As the only anti-aliasing filters I had available for test do not cut off at 20 kHz, I could not perform a cascade response. The Dennesen group delay is in the correct direction to provide compensation, but I cannot positively say how effective it is. The Time Delay Spectrometry gear showed residual error of less than ±0.05 dB peak-to-peak, ±0.01 dB average, due to system noise in the 50-Hz tracking bandwidth.

Richard C. Heyser

Phase vs. frequency, high-frequency time delay removed. (Vertical scale: 45°/division; horizontal, 9053.48 Hz/inch.)



Output vs. frequency. (Vertical scale: 0.2 dB/division.)



1

ACOUSTIC RESEARCH TURNTABLE

Manufacturer's Specifications

Turntable

Drive System: Belt.
Motor Type: 24-pole synchronous, 300 rpm.
Speeds: 33⅓ and 45 rpm.
Wow & Flutter: 0.04%, DIN weighted.
Rumble: −73 dB, DIN B weighted.

Tonearm

Effective Mass: 13 grams without cartridge.
Pivot Friction: Less than 20 mg, horizontal or vertical.
Effective Length: 9 in. (229 mm).
Stylus Overhang: 0.6 in. (15 mm).
Allowable Cartridge Weight: 3 to 9 grams.
Tracking Force Range: 0 to 3 grams.
Cable Capacitance: 85 pF.

General Specifications

Dimensions: 18.2 in. (46.2 cm) W × 15.25 in. (38.7 cm) D × 7 in. (17.8 cm) H with dust cover closed; 17 in. (43.2 cm) H with dust cover open.
Weight: 18 lbs. (8.2 kg).
Price: $450.00 with tonearm, $325.00 without tonearm.
Company Address: 10 American Dr., Norwood, Mass. 02062.
For literature, circle No. 90

The September and October 1962 issues of *Audio* contained a two-part article by Edgar Villchur, Acoustic Research's founder, which belongs in the library of every turntable designer. By studying the best features of older turntables (such as the late-'50s Weathers and H. H. Scott designs), and digging out long-buried engineering data (such as the correct equations for minimizing lateral tracking error in pivoted tonearms), Villchur put together quite a "... thorough analysis of the physical principles and geometry involved in the design of an arm and turntable." Villchur emphasized ideas such as:

- Mounting the platter and the tonearm on a rigid subchassis in order to minimize unwanted *relative* motion of the stylus and platter;
- Using very compliant springs to obtain a suspension frequency below 5 Hz, in order to provide maximum isolation of the platter and stylus from external vibration;
- Minimizing the effective inertial mass of the tonearm (regardless of its total mass), for dramatically improved stylus tracking;
- Locating the arm's vertical pivot in the same plane as the record surface, to eliminate warp wow;
- Maintaining constant platter speed despite the drag of the stylus in the groove and that of a Dust Bug disc cleaner, and
- Evaluating turntable performance with "weighted" measurements of rumble and flutter that correctly reflect their audibility.

The culmination of Villchur's analysis was the original Acoustic Research turntable. It was introduced in 1962 at a list price of $58 (a remarkable bargain even in those pre-inflationary days), becoming both a popular best-seller and a critical reference standard. More than a third of a million AR turntables were sold over a 17-year period, and, thanks to its simple and reliable design, many of those are still in use today.

Minor faults in the product, such as a foam mat that decomposed and a drive motor that often ran backward, were soon corrected. But AR made the mistake of continuing to use its original tonearm, which lacked such niceties as anti-skating, cueing, end-of-side lift-off, and a convenient means of adjusting the tracking force. Most seriously, the arm had enough pivot friction to compromise the tracking of high-compliance cartridges. (By coincidence the AR turntable was born at the same time as the original ADC-1, the first of the new generation of ultra-high-compliance cartridges that proved to be the old AR tonearm's downfall.)

By the mid-'70s, the direct-drive revolution was in full cry, and the AR turntable was outclassed by many imported models which, though sonically inferior, had the advantage of modern conveniences and good tonearms. So five years ago, when AR's accountants discovered that rising manufacturing and overhead costs had made the turntable a money-loser, they chose to shelve it rather than investing in a new arm. Ironically, even as the AR turntable was being phased out here, a counterrevolution in turntable design was already underway in Europe, with companies such as Linn, Thorens, and Ariston (and currently a dozen more) producing new high-performance audiophile models whose design is fundamentally similar to the AR's. Ultimately, Villchur may turn out to have been as seminal an influence in the turntable field as he was in loudspeakers (he invented the acoustic-suspension woofer in 1953).

The excellence of the basic AR mechanism was never in doubt; some of the best-sounding record-playing systems of my acquaintance are 15-year-old AR tables fitted with modern tonearms. Happily, AR has now brought back this classic mechanism, in a restyled base and with a fine, Japanese-made tonearm.

The new AR turntable is also available without arm, for audiophiles who prefer to choose their own. AR modified the original T-bar suspension, shortening the I-beam and adding an open frame to which a wood-composite tonearm mounting board is bolted, so other arms may be substituted if one simply replaces the mounting board. The excellent bilingual (English/French) instruction manual explains in detail how to trim the spring tension to compensate for the different weight of another arm, and how to determine whether the motor must be shimmed to recenter the drive belt on the pulley.

Measurements

The following measurements were made by my colleagues Alvin Foster and J. K. Pollard of the Boston Audio Society:

The turntable speed, which is not user-adjustable, was unaffected by variations in power-line voltage from 75 to 130 V, and was exactly correct at both 33⅓ and 45 rpm. (The speed is changed by lifting off the outer platter and moving the belt to the larger or smaller of two pulleys on the motor shaft.) The DIN-weighted wow and flutter was 0.05%, which is excellent.

The drive torque was relatively low; under a 10-gram load the platter speed dropped by 0.27%, so if you plan to use a Dust Bug brush you may want to reduce its drag by taping a coin on its rear end as a counterweight. The instruction manual recommends dusting the drive belt annually with talcum powder to minimize slippage, which will help the platter to maintain correct speed despite modest variations in drag. Nevertheless, a Discwasher brush stops the platter completely, as it will most belt-drive units.

The new AR tonearm, a straight, black anodized-aluminum medium-mass arm, comes with a carbon-fiber headshell that is similar to (but, unfortunately, not plug-compatible with) the ADC-type headshells that are used by several brands of turntables. The tonearm's indicated vertical tracking force was accurate within 0.1 gram at all settings. Evidently, the anti-skating control is calibrated to balance the side-thrust on the stylus at average groove-modulation levels; with a 1-gram tracking force, an indicated 1.5-gram setting of the anti-skating control was required to obtain optimum tracking of very heavily modulated grooves.

The damped cueing worked well, but, since the cueing lever is on the floating subchassis, the entire platter/arm assembly tended to rock when the lever was touched. As with many other designs, the anti-skating force moves the arm slightly outward when it is raised.

The new AR tonearm, like most of today's arms, violates one of Villchur's dicta: The vertical pivots are nearly a half-inch above the record surface, which means that some

The AR sounds as good as its measurements suggest, and its splendid performance is matched by an elegant appearance.

warp wow may be audible when playing imperfectly flat records.

The captive tonearm cable, after emerging from the tonearm pillar, is looped in a semi-circle before being attached to the base of the turntable. This is to minimize the stiff cable's tendency to transmit vibration to the floating subchassis, bypassing the soft suspension. (Some turntable makers neglect this important detail.) The remaining length of cable, which terminates in gold-plated phono plugs, is a relatively short 32 inches. The measured cable capacitance was only 82 pF per channel.

Although AR has made no special claims about the damping of the infrasonic tonearm/cartridge resonance, their new arm turned out to be remarkably well damped. Its infrasonic behavior was assessed with the Shure V15 Type IV cartridge, to allow comparison with previous tonearms tested with the same cartridge. With the pickup's damping brush disengaged, the amplitude of the infrasonic resonance typically exceeds 20 dB in tonearms that have low pivot friction and no damping, but in the new AR arm, the resonance, at 7.5 Hz, peaked at only 8 dB. The combination of the V15's damping brush and the tonearm's damping yielded virtually ideal behavior: With the brush down, the infrasonic resonance became a gentle 2-dB rise in the 11 to 16 Hz range, with a rapid roll-off below 9 Hz.

In normal tonearms, the infrasonic resonance produces exaggerated cantilever deflection in response to record surface irregularities and warps, with a consequently large variation in the effective vertical tracking force holding the stylus in the groove. We used a strain-gauge cartridge to observe these effects. On a visibly flat record, the variation in effective tracking force was 0.2 gram peak-to-peak, increasing to 0.5 gram on a disc with a severe, 4-mm warp. These are excellent results, bettered only by a reference arm, which is equipped with paddles and a trough of silicone oil for optimum damping.

The spectrum of the rumble was measured with the aid of the Thorens *Rumpelmesskoppler*, a device which attaches to the spindle to provide data uncontaminated by the cutting-lathe rumble inherent in test records. The AR turntable had less rumble than any other turntable we have measured to date. Its low-level rumble was mainly infrasonic, with a narrow peak of −40 dB (unweighted) centered at 6 Hz, dropping to −60 dB at 12 Hz, −70 dB at 20 Hz, −80 dB at 30 Hz, and −90 dB at audible frequencies. With this turntable, the only rumble that you ever hear will be the fault of the record manufacturer.

The new AR turntable, like the original, has one remarkably serendipitous characteristic. The inner and outer cast-aluminum platters, tested separately, had very pronounced resonances, with clear, bell-like tones when tapped. But when the outer platter was installed on the inner platter (even without a mat), the assembly became, quite amazingly, dead! Since there is no need for a rubber platter mat to absorb metallic ringing, AR provides a simple felt mat to cushion the disc.

In an informal test of the turntable's isolation from external vibration, we placed the unit on the test bench 1 meter away from a full-range speaker and turned up the preamp's volume control until a low-frequency feedback howl occurred. The test was repeated with a second turntable in the same location (a Kenwood KD-500 direct-drive model fitted with an SME Series III Improved tonearm), and the difference in system gain was noted. The gain could be raised 19 dB higher with the AR than with the reference turntable, an impressive confirmation of the legendary effectiveness of the AR's suspension. However, the very low frequency (3 Hz) of the suspension resonance also means that the turntable must be placed on a stable cabinet or shelf that will not transmit any lateral or tipping motion to the turntable base. Such motions (which can be caused by heavy footfalls on a poorly supported wooden floor) will cause severe flutter or groove-skipping.

The AR turntable's thin felt mat is not as effective as a soft-rubber platter mat at suppressing the microphonic behavior of LP discs (the tendency of the large, thin disc to pick up the loudspeaker's sound directly from the air and couple it to the stylus). This was assessed by placing the stylus in the groove with the platter rotation stopped, playing midrange white noise at a high level, and measuring the cartridge output. The microphonic sensitivity of the AR was about average. It was improved about 6 dB by substituting a Platter Matter mat, but the latter's 1-pound weight nearly bottomed the turntable's soft suspension. While the spring tension could have been adjusted to compensate for this extra weight, doing so would have probably raised its frequency and so this is not recommended. Audiophiles who are concerned about disc microphonics may wish to investigate the use of a spindle clamp, perhaps with a thinner soft-rubber mat.

Conclusion

In listening tests, the new AR turntable/tonearm system sounded every bit as good as its measurements suggest. Its most notable characteristic (thanks, no doubt, to its freedom from rumble and acoustic feedback) is the clarity of the reproduced sound—with bass that is well-defined and non-boomy, open and transparent midrange, a deep and stable stereo image, and an almost palpable sense of hall ambience with good recordings. The splendid performance of this product is matched by its elegant appearance—which is in gorgeous contrast to the plain-Jane box of yore. Welcome back, AR!

Peter W. Mitchell

Peter W. Mitchell is a freelance writer (specializing in audio, video, and microcomputers) and a consultant providing design advice and technical writing to NAD and other manufacturers.

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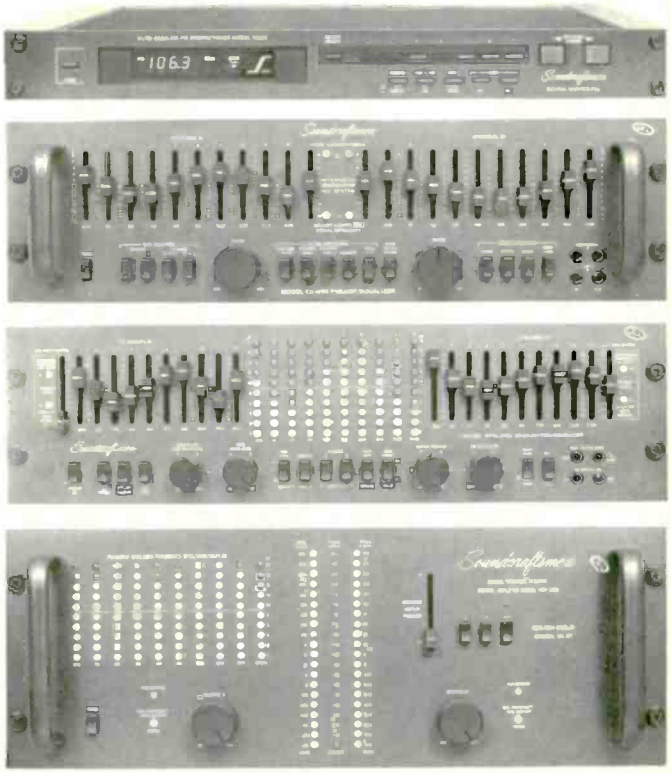

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2

VAN DEN HUL TYPE I PHONO CARTRIDGE

Manufacturer's Specifications
Type: Moving coil.
Frequency Response: 20 Hz to 20 kHz, ±1 dB.
Vertical Tracking Force: 2.0 to 2.5 grams.
Channel Separation: Greater than 25 dB.
Stylus: van den Hul Type I, vertical line-contact, 85 microns.

Compliance: 8×10^{-6} cm/dyne.
Output: 0.115 mV.
Optimum Load Termination: 3.0 ohms.
Weight: 6.3 grams.

Price: $1,095.00.
Company Address: c/o Audio Classics, 727 Creston Rd., Berkeley, Cal. 94708.
For literature, circle No. 91

When I first saw the van den Hul Type I moving-coil phono cartridge, it looked as if someone had decimated an EMT cartridge. It certainly looked like nothing I had seen in the past. I asked what had happened to the EMT XSD-15, and was politely informed that this was the new van den Hul Type I phono cartridge—the familiar EMT had been stripped down to the "bone" and reworked almost totally into the finished product I was looking at. I was further informed that the genesis of this cartridge actually goes all the way back to the early Ortofon SPU-GT. And that was a bulky phono cartridge!

A number of years ago, A. J. van den Hul had developed a new stylus design and decided to try it on the EMT phono cartridge. In not too long a time, he had almost totally rebuilt the EMT to meet his needs by installing a new stylus design, crafting the cantilever of boron and modifying its length, and optimizing the angle for mounting the new stylus. The relatively bulky body was removed to help eliminate various spurious resonances. It undoubtedly will be of interest to the audiophile to compare some of the original specifications of the EMT phono cartridge, presented in Table I, against the specifications of van den Hul's Type I, which are listed at the beginning of this report.

When all of his other modifications had been accomplished, van den Hul found that the cartridge coils needed to be modified to reorient the lead-out wires and make certain at the same time that the coils were correctly positioned for minimum distortion. Finally, it was necessary to retune the suspension of the cartridge by repositioning the elastomer of the suspension mechanism and physically manipulating it to linearize the frequency response. About two dozen other changes have been made; one wonders where the original EMT cartridge went, since so very little of it survives. Mr. van den Hul considers the Type I phono cartridge, incorporating all that he knows on the subject, to be the acme of phono cartridges currently available. By the end of this report, the reader may determine for himself if Mr. van den Hul has succeeded. In the meantime, I can tell you that, as a result of the design modifications, the user should exercise great care to prevent damage to this cartridge. It is sensitive to certain factors in the environment, as outlined in the "Use and Listening Tests" section of this review.

In designing stylus tips, the designer must always consider and use as his reference the currently used V-shaped cutting stylus, whose two sides form a 90° angle. The front of the cutting stylus is flat and is perpendicular to the lacquer during the cutting process. The edge of the cutting stylus is slightly rounded, usually having a radius ranging from 2 to 4 microns. The shape of the playback stylus in an ideal situation would be identical to that of the cutting stylus. But, then, each time a given record was played, a new groove would be cut over the existing groove, enlarging it to some degree

One wonders where the original EMT cartridge went, since so little survives after van den Hul's modifications.

and worsening the tracking, ad infinitum. Thus, the stylus designer is faced with the problem of developing a stylus tip which would reduce the wear of the record groove to near zero, reduce distortion to an absolute minimum, and maintain a solid contact at the stylus/groove interface while playing the most difficult and hard-to-reproduce musical passages present on a record. Obviously, such a perfect stylus tip has not been commercially available. Within the past few years, A. J. van den Hul has developed a stylus tip that appears to be nearly perfect and not too distant from the usual cutting stylus shape, namely, a front-to-back radius of 3.5 microns and a rather long vertical groove contact radius of 85 microns (extended line-contact tip). One of the more important aspects of this unusual tip shape is that it is capable of tracing an 85-kHz signal, cleanly. (Further discussions relating to the van den Hul stylus may be read in *Audio*, November 1981, page 62.)

The output of the van den Hul Type I phono cartridge is quite low; therefore, a step-up device is needed to raise its output voltage to a level that can be used with the usual preamplifier phono input stage. Some preamplifiers have pre-preamplifier phono input stages that may be used with low-output moving-coil phono cartridges. Unfortunately, in my experience, such pre-preamplifiers leave much to be desired. Their main problem is noise. I have tested the van den Hul Type I moving-coil phono cartridge with the a.c.-powered Audio Standards MX-10A pre-preamplifier, which proved to be an excellent combination. I also tested it with the Audio Interface CST-80L (3 ohms) step-up transformer, which is ideal for this specific purpose, as it provides maximum energy transfer without degrading the sound of the cartridge. Both of these step-up devices are used in my lab as reference devices.

Since the van den Hul Type I moving-coil phono cartridge is supplied with its own pre-preamplifier, including an outboard power supply, I used this active device for all the tests and listening evaluations. I found it to be among the best active devices I have ever used in my laboratory.

The van den Hul moving-coil phono cartridge comes encased in a black box bearing van den Hul's facsimile signature across the top of the box and the van den Hul name printed on one edge. The box does not indicate which specific van den Hul phono cartridge model it contains. The cartridge is supplied with the usual assortment of mounting screws and a removable stylus guard. Also included is, in my opinion, one of the most important tools needed for installing a phono cartridge—a bubble spirit-level, which weighs only 1.03 grams. I have used such a lightweight bubble spirit-level for many years to ascertain if a phono cartridge is level in the left-to-right and front-to-back planes when the stylus is in contact with the record-groove wall. For accuracy, I compensate for the weight of the bubble spirit-level when determining the optimum tracking force for the phono cartridge. A frequency response curve for each of the cartridge's channels is also included. However, I have been unable to accept these curves, because they are made with the CBS STR-140 RIAA pink-noise acoustical test record. On this disc, the pink noise is recorded with the standard RIAA recording characteristic, which simplifies its intended use in checking out loudspeakers, their placement in the room and the room itself. But cartridge measurements made with it will include the effects of any errors in the preamp's RIAA equalization. It is common practice throughout the world to measure a phono cartridge's frequency response using a sweep signal that has a constant amplitude from 40 to 500 Hz and a constant velocity from 500 Hz to 20 kHz. I did measure this cartridge's response using the CBS STR-140 pink-noise test record, in conjunction with a very accurate, RIAA-equalized preamplifier, to better than +0.25, −0.5 dB. For the official record, however, I also followed standard practice and measured the frequency response of this phono cartridge using the CBS STR-100 test record.

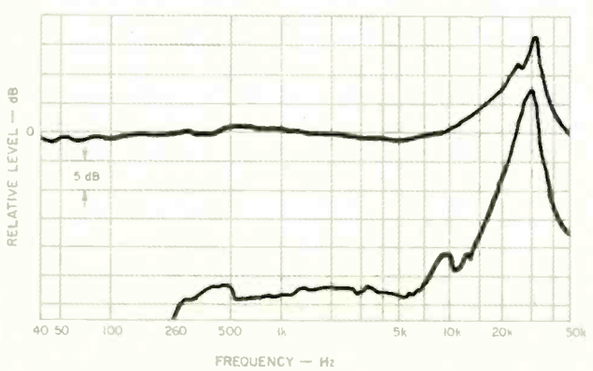

Fig. 1—Frequency response and separation. Note that curve extends to 50 kHz.

Measurements

The van den Hul Type I phono cartridge was mounted in a Technics headshell and used with the Technics EPA-A250 (S-shaped) interchangeable tonearm unit attached to the Technics EPA-B500 tonearm base and mounted on a Technics SP-10 Mk II turntable. The Type I was oriented in the headshell and tonearm with the Dennesen Geometric Soundtracktor.

Laboratory tests were conducted at an ambient temperature of 74.3° F (23.5° C) and a relative humidity of 66%, ±3%. The tracking force for all reported tests was set at 2.25 grams, with an anti-skating force of 2.3 grams. The Type I phono cartridge should be used in medium- to high-mass tonearms. The load resistance at the phono input was 47 kilohms, and the load capacitance was 250 pF. As is my practice, measurements were made in both channels, but only the left channel is reported (unless there is a significant difference between the two channels, in which case both channels are reported for a given measurement).

The following test records were used in making the reported measurements: Columbia STR-100, STR-112, and STR-120; Shure TTR-103, TTR-109, TTR-110, TTR-115, and TTR-117; Deut-

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With rare exceptions, I have not found any records that the Type I could not reproduce as intended.

sches HiFi No. 2; Nippon Columbia Audio Technical Record (PCM) XL-7004; B & K QR-2010, and Ortofon 0002 and 0003.

Frequency response, measured from 40 Hz to 50 kHz using the CBS STR-100 and STR-120 test records (Fig. 1), was: +0.75, −1 dB from 40 Hz to 700 Hz; ±2 dB from 1 kHz to 15 kHz; +3.5 dB at 15 kHz; +6.5 dB at 20 kHz; +14 dB at 30 kHz; +3 dB at 40 kHz, and −0.5 dB at 50 kHz. Separation was 29 dB at 1 kHz, 22 dB at 10 kHz, 22 dB at 15 kHz, 14.75 dB at 20 kHz, 6.5 dB at 30 kHz, 16 dB at 40 kHz, and 18 dB at 50 kHz. From this data it is noted that the van den Hul Type I has an excellent frequency response through 20 kHz and a very good high-frequency separation through the same range. The frequency response and separation beyond 20 kHz, though present, is not remarkable. The rise in the frequency response beyond 10 kHz is typical of most moving-coil phono cartridges. The 1-kHz square-wave response (Fig. 2), using the Columbia STR-112 test record, is consistent with that seen for just about all moving-coil phono cartridges, where a large overshoot is followed by a low-level ringing which decays rapidly.

From the 1-kHz square wave (Fig. 2), it is evident that the ultrasonic resonance frequency is at about 33 kHz. This was confirmed when the frequency response curve was extended to 50 kHz. A resonant frequency above 20 kHz usually introduces intermodulation distortion between the ultrasonic noise and the signal, thus producing difference tones which are in the audible range. The sonic result is generally a slightly distorted midrange, with the sound between 3 and 7 kHz having a sort of metallic quality, reduced definition, and a blurring of the stereo image. The resonant frequency also causes large phase shifts in the audible range, with a definite effect on the stereo imaging—a common problem with all moving-coil cartridges.

To measure the arm-cartridge low-frequency resonance, it was necessary to disable the arm's anti-resonance unit. The arm-cartridge low-frequency lateral resonance point for the left channel was 12.5 Hz with a 6-dB rise, while for the right channel it was 12.5 Hz, also with a 6-dB rise. Vertical resonance was at 10.5 Hz. The high-frequency resonance was at 33 kHz.

Using the Dynamic Sound Devices DMA-1 dynamic mass analyzer, the arm-cartridge dynamic mass was measured as 18 grams, and the dynamic vertical compliance as 12.76×10^{-6} cm/dyne at the vertical resonant frequency of 10.5 Hz. The harmonic distortion components of the 1-kHz, 3.54 cm/S rms, 45° velocity signal from the Columbia STR-100 test record are: 1.12% second harmonic and 0.32% third harmonic, with less than 0.18% higher order terms. The vertical stylus angle measured 22° for each channel, using the CBS Model 3002 vertical tracking meter.

Other measured data are: Wt., 6.94 g. Opt. tracking force, 2.25 g. Opt. anti-skating force, 2.3 g. Output, 0.96 mV/cm/S with the pre-preamplifier, and 19.99 μV/cm/S without the pre-preamplifier. IM distortion (200/4000 Hz, 4-to-1): Lateral (+9 dB), 2.1%; vertical (+6 dB), 2.3%. Crosstalk (using Shure TTR-109): Left, −18 dB; right, −27 dB. Channel balance, 0.5 dB. Trackability: High freq. (10.8-kHz, pulsed), 30 cm/S; mid-freq. (1000 and 1500 Hz, lat. cut), 25 cm/S; low freq. (400 and 4000 Hz, lat. cut), 19 cm/S. Increasing the tracking force to 2.7 g allowed the cartridge to track the mid-freq. cut at 31.5 cm/S; Deutsches HiFi No. 2, 300-Hz test band was tracked cleanly to 67 microns (0.0067 cm) lateral at 12.82 cm/S at +7.50 dB and to 55.4 microns (0.00554 cm) vertical at 10.32 cm/S at +5.86 dB.

Table I—Manufacturer's specifications of the EMT XSD-15 cartridge, on which A. J. van den Hul based his Type I.

Type: Moving coil.
Frequency Response: 40 Hz to 12.5 kHz, ±2 dB.
Tracking Force: 2 to 3 grams.
Channel Separation: 25 dB.
Output: 0.15 mV at 1 cm/S.
Load: 800 ohms.
Compliance: 12×10^{-6} cm/dyne, vertical and lateral.
IM Distortion: 0.5%.
Weight: 17 grams.
Price: $499.00.
Company Address: c/o Gotham Audio, 741 Washington St., New York, N.Y. 10014.

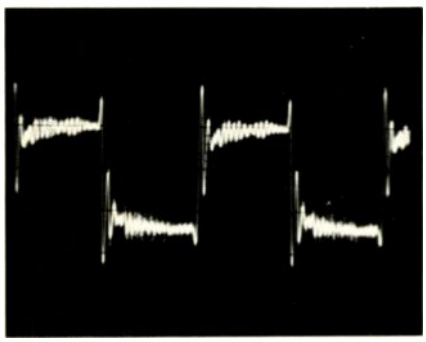

Fig. 2—Response to a 1-kHz square wave.

The van den Hul Type I was able to track all the various bands through level 5 on the Shure Obstacle Course Era III musical test record except for the bass drum, which was reproduced cleanly through level 4. The level 5 bass-drum note has a peak-to-peak amplitude of 304 microns, or a velocity of 4.9 cm/S at a frequency of 52 Hz. Similarly, the Type I was able to track all the various bands through level 5 on the Shure Obstacle Course Era IV musical test record except for the harp anc flute combination, which was reproduced cleanly only through level 3 before distortion was heard. Here, the flute is played at a level of 8 dB while the harp remains at 6 dB. On the Shure Era V test record, all six levels were tracked without mishap. It is a rare commercial analog record that has peak recorded velocities exceeding 15 cm/S, and thus the van den Hul Type I would undoubtedly be able to track all records without any noticeable mistracking, except for, on very rare occasions, passages in audiophile records from Telarc, Sheffield, or Reference Recordings.

Use and Listening Tests

The design modifications embodied in the van den Hul Type I have rendered it sensitive to various environmental factors. Because this cartridge is open, it should be kept away from

After more than 75 hours of listening, I find the Type I to be one of the best MC cartridges available today.

magnetic particles and any ferrous materials that could be attracted by the powerful magnet and damage the stylus-cantilever assembly. It should also be dusted frequently. To overcome the possibility of damage to the cartridge motor assembly and the stylus, I do not recommend cleaning the internal structure with any sort of brush. I used compressed air (gentle pressure) to blow the dust and dirt away. I suggest cans of compressed air, like those sold at camera shops for cleaning lenses. The Type I's open construction also makes it, I find, more temperature-sensitive, and I suggest that, for peak performance, it be used at ambient temperatures between 72° and 77° F (22.2° and 25° C).

After the optimum tracking and antiskating force was determined for the van den Hul Type I, I played various types of records for a period exceeding 10 hours (as is my practice) prior to performing laboratory measurements. The equipment used in the listening evaluation included the aforementioned Technics arm and turntable, the Audio-Technica AT666EX vacuum disc stabilizer, a Crown IC-150 preamplifier, two VSP Labs Trans-MOS 150 amplifiers (each used in the 300-watt mono mode), and B & W 801F loudspeakers. The speaker cable, Distech, and interconnecting cables were from Discrete Technology (2911 Oceanside Rd., Oceanside, N.Y. 11572).

I have lived with the van den Hul Type I moving-coil phono cartridge for quite some time, playing the gamut of recorded music from my record library. Except for the rare occasions mentioned above, I have not come across any recorded music that the Type I could not reproduce as intended. Sonic clarity was excellent, as were the transparency of sound and the transient response. Bass was sonically well defined and more than adequate. The human singing voice and the piano (the Bösendorfer in particular) were reproduced exceptionally well. Applause definition was excellent.

Having used different moving-coil cartridges fitted with the van den Hul stylus, it was very evident that this stylus shape reproduced details in the upper midrange very accurately. This was particularly evident with this cartridge when playing the superb *Cantate Domino* (Proprius Records 7762), where the choral passages were reproduced without the blurring I have noticed in the past. Continued listening brought out the fact that the van den Hul Type I did not introduce any sound or coloration.

During my listening evaluation, I compared two analog records with their CD versions, where both were derived from the same digital master tapes. On J. S. Bach's *Orgelmeisterwerke* (Helmuth Rilling, organist, Denon OX-7027-ND PCM on LP, 38C37-7039 on CD), I was pleased to note that the Type I reproduced this digital-analog recording very accurately, as it did Stravinsky's "Firebird" Suite (Atlanta, Shaw, Telarc LP DG-10039 and CD-80039).

Some of the other exceptionally good recordings I used in auditioning the van den Hul Type I were: Vivaldi's *The Four Seasons* (Boston, Ozawa, Telarc DG-10070), Respighi's *Pines of Rome and Fountains of Rome* (Chicago, Reiner, RCA Red Seal Point 5 ATL1-4040), *Solid Gold at the Bösendorfer* (Tibor Szasz, Sonic Arts Laboratory Series 16), *Late Night Guitar* (Earl Klugh, Mobile Fidelity MFSL 1-076), *Symphonie Fantastique* by Berlioz (Utah, Kojian, Reference Recordings RR-11), *Däfos* (Reference Recordings RR-12), and *The Sheffield Track Record* (Sheffield Lab. 20). The last three are superb recordings and will give your audio system a real workout.

After more than 75 hours of listening to this cartridge play practically everything and anything, I concluded that the van den Hul Type I is undoubtedly one of the best moving-coil phono cartridges available to the audiophile today.

B. V. Pisha

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3

NAKAMICHI RX-505 CASSETTE DECK

Manufacturer's Specifications
Frequency Response: 20 Hz to 20 kHz.
Harmonic Distortion: 0.9% at 0 dB.
Signal/Noise Ratio: 64 dBA; 70 dBA with Dolby C NR.
Separation: 36 dB.
Crosstalk: 60 dB down.
Erasure: 60 dB at 100 Hz.
Input Sensitivity: Line, 50 mV.
Output Level: Line, 1 V; headphone, 12 mW at 8 ohms.

Flutter: 0.04% wtd. rms, ±0.08% wtd. peak.
Fast-Forward Time: 60 S for C-60.
Dimensions: 17¾ in. (450 mm) W × 5-11/16 in. (144 mm) H × 11-13/16 in. (300 mm) D.
Weight: 22 lbs., 1 oz. (10 kg).
Price: $1,090.00.
Company Address: 19701 South Vermont Ave., Torrance, Cal. 90502.
For literature, circle No. 92

The RX-505 cassette deck features Nakamichi's UDAR (Unidirectional Auto Reverse) system, first made available in the lower-cost RX-202 deck. Initially, it sounds contradictory—unidirectional *and* auto reverse—but, briefly, here's how it works: The cassette is loaded, open (tape) edge up, in a carrier that rides on a drawer which moves out from the deck with a push of "Eject/Load." The drawer moves back in when the button is pushed again or when one of the transport modes is selected. In the latter case, the deck goes into the selected mode as soon as the cassette is seated. Reverse play or record can be selected at any time, by pressing "Reverse" (near the upper right) or by switching on "Auto Reverse" (at the left).

The big difference from other decks is that the transport does *not* reverse direction. Instead, the cassette drawer moves out, the carrier rotates 180°, and the drawer moves back in, seating the cassette for playing or recording its other side. It's really a mechanization of what the user normally does, taking the tape out and turning it around to use the other side.

The RX-505 has three discrete heads, each optimized for its particular task. Nakamichi also uses a tape-pad lifter, taking the position that their tape-path design provides good guidance and that the pad actually causes scrape flutter and other problems. I do like Nakamichi's practice of making record and playback head adjustments very accessible. It is true that some uninformed diddlers might be tempted to create their own problems, but some decks provide very poor access for such needed tasks, giving even experts a bit of a challenge.

The deck includes a number of other Nakamichi features: Their asymmetrical, dual-capstan, diffused-resonance transport; the automatic master fader; dual-speed cueing, and punch-in recording.

The cassette-carrier drawer is in the center, and with its clear, removable plastic cover, looks somewhat like a bay window. An "A" on the carrier indicates it is in the normal position. If "Reverse" is pushed, the drawer moves out, the carrier rotates and moves back in, showing a "B." A push of "Eject/Load" moves the carrier out and rotates it back to "A." These two control buttons are at the upper right corner, where they are somewhat out of the way but easy to find after a little practice.

If the drawer meets resistance in either direction of travel for more than a second or two, it will move back to its original position—an excellent design feature to prevent damage. With power off, it is possible to move the drawer out or to push it back in, but it cannot be pushed back and forth, and there should be no need for that. The plastic cover can be snapped out as needed, and, with the deck in pause or play, the heads are quite accessible for maintenance tasks, although a little neck bending is needed.

Just to the left of the cassette well is the four-digit counter display, at top, with its reset button just below. The counter reads minus numbers when rewound past "0000." The "Memory" switch below has three positions: "Stop/Off/Play." Near the bottom of the panel are the "Auto Fade" ("Off/On") and "Reel Hub" ("Large/Std") switches, and they merit some discussion.

With "Auto Fade" switched on, the deck begins a 2-S fade-out about 20 S before the end of side A; this is some distance before the leader begins, so the tape surface should be stable at this point. After the fade-out, the tape is reversed, and the sound is faded up again.

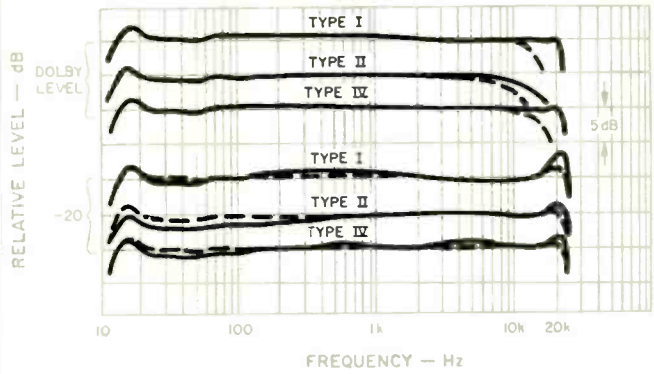


Fig. 1—Frequency responses with (solid lines) and without (dashed lines) Dolby C NR, using Type I (Nakamichi EXII), Type II (Nakamichi SX), and Type IV (Nakamichi ZX) tapes.

The hub-size switch should be left on "Std" for most tapes. But if the tape has a large hub (as most C-46s do), the "Large" setting must be used to get correct timing for the fades.

Next, to the left, are the main control buttons. All of them are angled out from the panel, which improves visibility and ease of use. "Play" at top and "Stop" just below are full width. Next down, from left to right, are "F.Fwd," "Cue" and "Rew." The symbols on the fast-wind and play buttons are a little confusing at first because they seem backwards, but they do match which way the upside-down tape will go. Next down are "Rec Mute," "Pause" and "Rec."

The bottom row consists of "Master Fader Down," "Program Seek" and "Master Fader Up." Normally, the master fader is all the way up, and levels are set by the input-level pots. During recording, however, the signal can be faded in and/or out, quickly and automatically, with a simple push of the appropriate "Master Fader" button. A light push gets a fade up (or down) in about 2 S; a harder push secures a 1-S fade. "Program Seek" initiates a fast wind from stop or play mode to the beginning of the next program and begins playback. If seek is activated during rewind, playback starts from the beginning of the current selection. You push the button twice to move one selection further away—but that's as far as the system can take you.

At the far left are the switches for "Power" (top), "Timer" ("Play/Off/Rec"), and "Auto Reverse" (which can be set for single-reverse recording or playback, off, and for continuous reversing at the tape ends in playback only). Next down are the "Skip" and "Auto Rec Pause" switches. In "Skip," any blank of more than 40 S will initiate fast forward to the end of the side, a tape flip, and then playback after skipping the leader. This is a nice feature to have with the many tapes whose music finishes quite some time before the end of the

The RX-505's transport does not reverse itself, but mechanizes what the user normally does in flipping the tape over.

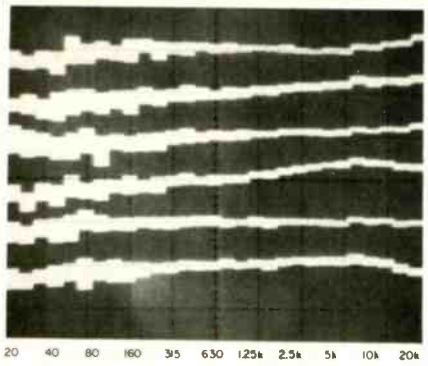


Fig. 2—Forward and "reverse" record/playback responses, overlaid. From top to bottom: EXII tape without NR, EXII with Dolby C NR, SX tape without NR, SX with Dolby C NR, ZX without NR, and ZX with Dolby C NR. (Vertical scale: 5 dB/division.)

tape. "Auto Rec Pause" will drop the deck out of recording mode if there is no incoming signal for 45 S, wind the deck back to a point 15 S after the end of the music, and enter "Rec/Pause." This can be helpful if the recordist isn't around when the record runs out. At the bottom is the jack for headphones.

To the right of the transport drawer are two vertical, bar-graph-type level meters, each divided into 10 steps with two red LEDs per step. Just above are red indicators for Dolby B and C NR. Alongside are the "Rec Level" pots for each channel, the output pot, and the center-detented "Bias Tune" control. Both "Rec Level" knobs are on the small side; the even-smaller ones for output and bias are somewhat difficult to turn for small adjustments.

Next, to the right, are interlocked tape-selector switches ("ZX" [Type IV]/"SX" [Type II]/"EX" [Type I]), the EQ switch ("70/120"), and two Dolby NR switches: "On/Off" and "C-Type/B-Type." All of these switch buttons are dark and nearly the same height (or thickness) as the plate with the designations. Except in bright light, it was very difficult to be certain of how the switches were set by looking, though the Dolby-NR status lights did help. The panel designations themselves were hard to read, being gold on black.

The last column of switches on the right start with "Eject/Load" at the top, followed by "Reverse" (both of which were referred to earlier when covering control of the cassette drawer). The next switch down, "Auto Rec Standby," is a convenience that all users can benefit from: A push of this switch, and the tape is rewound to the start, fast wound to the end of the leader and recorded blank for 6 S, after which the deck goes into "Rec/Pause." Two taps of the switch near the end of side A will automatically fast-wind the deck to the end of that side, reverse the tape, and do the same setup procedure for side B. One carp I have about this switch is its location, just above the "Monitor Tape/Source" switch, which has very nearly the same design. I would prefer that "Auto Rec Standby" be defeated in record mode, to prevent actuating it by mistake, as I did a number of times. At the bottom are the on/off switches for the subsonic and multiplex filters.

On the back panel are line-in/line-out phono jacks and a socket for the optional remote control. By removing the top and side cover, I was able to examine the interior. The microprocessor card was to the left of the center drawer/platform, with the amplifier card (into which the vertical Dolby NR card plugs) to the microprocessor card's right. There were three pigtail fuses soldered onto the power-supply card at the back of the chassis. The soldering on the cards was excellent, and the parts were of high quality. Interconnections were made with multi-conductor cabling with some wirewrap.

The transport was quiet in all of its modes. The construction was quite rigid and well supported on the frame around the drawer assembly. The drawer itself was well designed, and it operated smoothly during the cycles observed.

Measurements

The playback responses were within ±1.2 dB for both equalizations, except for a rise at the two highest frequencies for 70 μS. Playback of a standard level was indicated correctly, within the resolution of the meter segments. Tape play speed was less than 0.1% fast, substantially exact. Record/playback responses were checked for a wide range of tapes for all three types. With the bias adjust pot, it was possible to get at least very good results for almost all Type I tapes and a majority of the Type II tapes—but the high-sensitivity Type II tapes had mediocre responses with Dolby C NR, and the bias could not be reduced enough for good results with a couple of the Type IV tapes. All subsequent tests were conducted with the supplied tapes: Nakamichi EXII, SX and ZX. Each of them gave best performance overall with the bias set at about 11:00 o'clock.

The record/playback responses for the three tapes with and without Dolby C NR were excellent, as shown in Fig. 1 and indicated by the 3-dB points listed in Table I. Take particular note of the outstanding flatness from 20 Hz to 20 kHz at Dolby level with Dolby C NR. The −20 dB responses are excellent, in general, but the 20-kHz peak with EXII and the low-end droop with SX are not to be applauded.

It seemed likely that, with this transport design, there would be no essential difference between forward and "reverse" response. When record/playback responses to pink noise were taken for both tape directions and overlaid (Fig. 2), the correspondence was exact out to the 20-kHz band.

The record/playback response with SX tape varied about ±2 dB at 10 kHz over the range of the bias control. Other characteristics are listed in Table II, and they are all very good to outstanding. Take note of the 77-dB erasure of metal tape at 100 Hz, for example. The switchable subsonic filter introduced less than 3 dB of attenuation at 20 Hz but about 20 dB at 10 Hz.

Third-harmonic distortion versus level for the three tapes with Dolby C NR is listed in Table III. All of the figures are excellent, and those for ZX tape are outstanding: Just 0.25% at Dolby level and only 0.02% at −10 dB. The very high signal-to-noise ratios in Table IV reflect the low-distortion performance. All three tapes were excellent, and ZX made almost 80 dBA.

The sound with ZX tape I classified as great, and I could record up to +10 on some material without strain.

Table V shows the results of measuring HDL_3 from 30 Hz to 6 kHz, both at −10 dB (where I usually run such tests) and at Dolby level. At both levels, the distortion rises but moderately at the frequency extremes, and the figures are about the best I have ever measured.

Table VI lists input/output characteristics. The line output impedance would be on the high side for loads of less than 20 kilohms. The sections of the output pot tracked within 1 dB for about 40-dB attenuation from maximum. There was good volume with all headphones I tried, although one set was slightly low for those who would want very high listening levels. The output polarity matched the input, both in source and tape monitoring.

It was impossible to check the accuracy of half of the meter double-segment turn-ons because they did not line up with any specific scale markings. Those that did were accurate within 1 dB. The lack of resolution around zero complicated the checking of meter responses, but it did appear that the burst response time met the standard for peak program meters, as did the decay time of 1.5 S.

The meters did not, however, have true peak response, as indicated by an offset-pulse test. In this test, the deck is first fed a normal tone burst (one switched on and off at its zero crossing) and the meter reading noted. Then the deck is fed a burst of the same peak-to-peak amplitude but switched at its negative peak. A true peak-reading meter will indicate 6 dB higher for this burst. The RX-505's meter reading did not change.

Measurement of the playback of a recorded 3-kHz tone revealed no changes in tape speed when line voltage was varied from 110 to 130 V. The flutter was very consistent from one end of a C-90 to the other, and was exactly to specification: 0.06% wtd. rms. and ±0.08% wtd. peak. The fast-wind time for a C-60 was 54 S. Changes in mode were always less than a second, except that reversing the tape took about 2 S.

Use and Listening Tests

The owner's manual includes a fair amount of detail, and it is well written. There are good figures and accompanying text to explain the special modes. After some usage, it didn't seem as though cassette insertion was any more complicated than for a typical front loader. It did take me a little while to get used to the transport switch arrows pointing the "other" way. All of the controls and switches functioned as expected and without failure, with the exception of the master fader, which was erratic at times as to how much pressure was needed to operate it.

The record, pause and stop clicks were very low, down at the level of tape noise with Dolby C NR. I found that it was possible to load and start recording fastest by holding "Play," and then twice pushing "Rec" the moment the cassette was seated and the tape heads had lowered into position. As I get annoyed with abrupt cutoffs and turn-ons in the middle of music, I found "Auto Fade" very useful. The automatic fades and tape flip took just 6 to 8 S, but when I tried to go through the same fade-out/flip/fade-in cycle manually, I had to stare in at the tape hub to see when the fade should start; even so, I usually took 10 to 12 S overall, about twice as long, with little assurance that I had made good

Table I—Record/playback responses (−3 dB limits).

	With Dolby C NR				Without NR			
	Dolby Lvl		−20 dB		Dolby Lvl		−20 dB	
Tape Type	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Nakamichi EXII	10.4	20.5	10.4	23.7	10.4	13.8	10.4	23.5
Nakamichi SX	10.5	17.8	10.4	22.7	10.5	11.8	10.4	23.1
Nakamichi ZX	10.4	21.8	10.4	22.7	10.4	16.3	10.4	22.8

Table II—Miscellaneous record/playback characteristics.

Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase Error	10-kHz A/B Phase Jitter	MPX Filter At 19.00 kHz
77 dB	54 dB	−94 dB	40°	10°	−34.0 dB

Table III—400-Hz HDL_3 (%) vs. record level (0 dB = 200 nWb/m).

		Record Level						HDL_3 =
Tape Type	NR	−10	−8	−4	0	+4	+8	3%
Nakamichi EXII	Dolby C	0.09	0.13	0.20	0.36	0.71		+ 7.8 dB
Nakamichi SX	Dolby C	0.05	0.07	0.15	0.40	1.2		+ 7.2 dB
Nakamichi ZX	Dolby C	0.02	0.04	0.10	0.25	0.53	1.3	+11.3 dB

Table IV—Signal/noise ratios with IEC A and CCIR/ARM weightings.

	IEC A Wtd (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		Without NR		W/Dolby C NR		Without NR	
Tape Type	@ DL	HD = 3%	@ DL	HD = 3%	@ DL	HD = 3%	@ DL	HD = 3%
Nakamichi EXII	66.1	73.5	49.4	56.9	66.5	73.9	46.3	53.8
Nakamichi SX	69.9	76.6	53.6	60.2	70.6	77.3	51.1	57.7
Nakamichi ZX	69.0	79.8	52.5	63.4	69.8	80.6	50.1	61.0

Table V—HDL_3 (%) vs. frequency with Dolby C NR.

		Frequency (Hz)							
Tape Type	Level	30	50	100	400	1k	2k	4k	6k
Nakamichi ZX	−10	0.16	0.08	0.06	0.02	0.03	0.02	0.03	0.05
	0	0.67	0.40	0.34	0.25	0.22	0.22	0.40	0.32

Table VI—Input and output characteristics at 1 kHz.

Input	Level		Imp., Kilohms	Output	Level		Imp., Ohms	Clip (Re: Meter 0)
	Sens.	Overload			Open Ckt.	Loaded		
Line	45 mV	>30 V	58	Line	840 mV	709 mV	2.15k	+18.5
				Hdphn.	708 mV	519 mV	18	

In the fundamentals—response, distortion, noise and flutter—the RX-505 is one of the best decks overall.

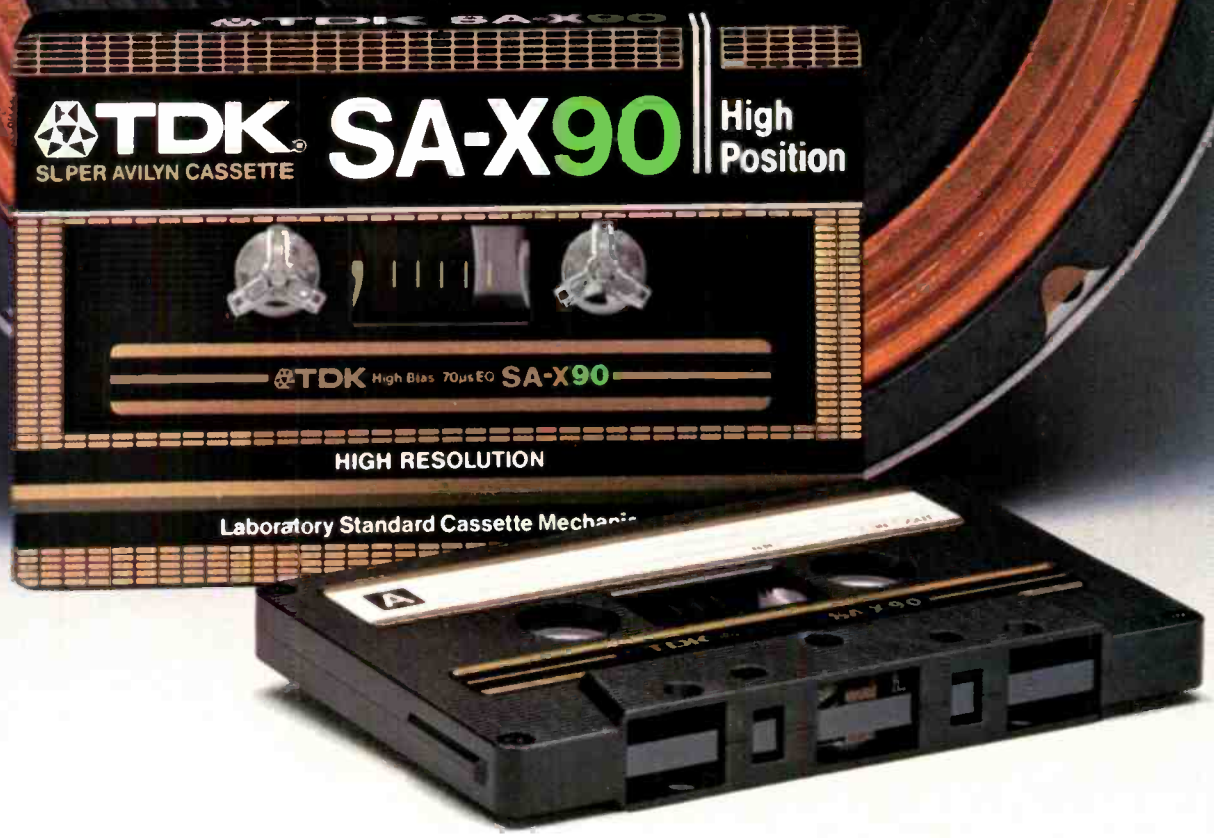
To maintain azimuth accuracy, the RX-505's UDAR (Unidirectional Auto Reverse) system physically reverses the cassette instead of merely reversing the transport's motion.

fades in the right place. "Auto Rec Pause" worked fine also, and the deck kept recording until the level fell below −50 dB or so—outstanding performance.

Record/playback performance was excellent, in general, for a number of wide-range sources. Discs used included Holst's *The Planets* with Georg Solti and the London Philharmonic Orchestra (London/Mobile Fidelity MFSL 1-510) and *Baroque Brass* with the Empire Brass Quintet (dbx SS-3001, the dbx-encoded disc version of Sine Qua Non SQN-SA2014). The results with EXII tape were very good, and I noted that the Dolby C NR matching was excellent. The sonic quality with SX tape was less satisfactory, in my judgment, adding some unneeded presence with Dolby C NR. At higher levels there was some evidence of reaching saturation, which better metering might have prevented. The sound with ZX tape I classified as great, and I could record up to +10 on some material without strain.

The Nakamichi RX-505 offers the unusual and successful UDAR transport, with several conveniences which increase its versatility. I am not enthusiastic about the metering or the possible confusion on button positions, but in the fundamentals—frequency response, distortion, noise and flutter—this is definitely one of the best decks overall. With its innovative and helpful features, the RX-505 deck really offers much for its price. *Howard A. Roberson*

Speaker Tweaker from TDK



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4

ALPHASONIK A-265 CAR STEREO AMPLIFIER

Manufacturer's Specifications

Continuous Power Output: Stereo, 65 watts per channel, 4- or 2-ohm loads, at 14.4 V d.c.; bridged mono mode, 130 watts into 4 or 8 ohms.
THD at Rated Power: 0.01%.
Frequency Response: 20 Hz to 20 kHz, ±0.5 dB.
S/N Ratio: 90 dB.
Damping Factor: 40, at 100 Hz.
Slew Rate: ±30 V/μS.
Low-Level Input Sensitivity: 100 to 500 mV, continuously variable, at 10 kilohms minimum impedance.
High-Level Input Sensitivity: 2.5 V at 100 ohms impedance.
Power Fuse Rating: 20 amperes, fast-blow type.
Dimensions: 6⅜ in. (16.2 cm) W × 2½ in. (6.4 cm) H × 10⅝ in. (27 cm) D.
Price: $350.00.
Company Address: Visonik of America, 701 Heinz Ave., Berkeley, Cal. 94710.
For literature, circle No. 93

Until the beginning of this decade, attempting to correlate the measured performance of car stereo amplifiers with the published specifications provided by the manufacturers was like trying to compare apples and oranges. Part of the problem was caused by an oversight or simple omission on the part of the Federal Trade Commission. Years before, this government body had mandated the way in which makers of *home* high-fidelity amplifiers had to be rated, but they failed to apply the same strict rules to published specifications for vehicular audio amplifiers.

Happily, a group of reliable and dedicated makers of car stereo equipment realized that exaggerated claims for the power of car amplifiers would do the industry no good. Without any arm-twisting from government sources, they developed their own standard of measurement which not only required the same carefully worded power rating, but adopted other important measurement standards developed by the Electronic Industries Association. The result was a standard which has now been recognized by the EIA and which I followed in measuring the performance of this high-powered Alphasonik amplifier from Visonik.

Visonik is, of course, no newcomer to the world of high fidelity. Their wide-range loudspeaker systems and subwoofers for home use, as well as their car speakers and electronic components, are highly respected in audio circles both here and abroad. The Alphasonik A-265 car stereo power amplifier is the most powerful amp in their car stereo line, and perhaps the only car amp using Class-A circuitry.

Physically, the A-265 is a simple-looking amplifier. Its surface is almost completely covered with black heat-sink fins. At one end of the unit are a pair of phono-tip jacks for input from the low-level (preamp) outputs of a car tuner or tape deck. This same end of the amplifier chassis has a small hole,

With a 14.4-V standard voltage, the A-265 delivered more than 75 watts per channel.

providing access to a recessed input-level control that can be used to change the amplifier's input sensitivity.

Those owning car stereo receivers without preamp-level outputs can also avail themselves of the higher (and much cleaner) power output provided by a unit such as this. For that purpose, two of the eight terminals of a Molex connector mounted at the other end of the chassis are intended for connection to the left and right "hot" (+) speaker terminals of your car stereo receiver. (Under no circumstances are the common [–] terminals of your receiver to be connected to the A-265.)

The A-265's speaker outputs must not be connected to ground (the manual shows how to check your speaker wiring for this), but must "float." The amplifier chassis must also be ungrounded, and so it is mounted to the car through built-in, rubber insulating grommets.

The unusual "floating" circuitry of high-powered car stereo amplifiers make it rather difficult to test such units using the normal bench setup used for measuring home audio equipment. The need for special internally bridged operation (which leads to "floating outputs" and non-grounded power supplies) arises with high-powered car stereo amplifiers because of the low battery supply voltages normally available in automobiles. Even if the car battery is supplying a high voltage of 14.4 V, that would correspond, with a grounded system, to a theoretical maximum rms output voltage of only a bit more than 5 V. Across a 4-ohm load, that voltage would produce only about 6.5 watts; across a 2-ohm load (assuming current capacity was available), it would deliver about 13 watts.

By bridging output stages internally, or by using internally generated d.c. power-supply voltages, manufacturers are able to produce high-powered amplifiers whose power ratings are independent of the battery voltage's limitations. This approach makes it difficult to measure power output using conventional lab-bench techniques: It becomes necessary to isolate all test equipment from ground by using isolation transformers to power oscilloscopes, meters and distortion-measuring equipment. Limitations in the current capability of my power supply

Frequency response was flat within 0.5 dB from 17 Hz to 25 kHz. Slew factor was better than 6.

made it impossible for me to measure power output (and other characteristics) with both channels delivering full power simultaneously, as I would normally do with home audio equipment. Nevertheless, the power output levels obtained are significantly higher than claimed, which leads me to believe that the A-265 would deliver at least its rated power output per channel if I could drive both channels simultaneously. I should emphasize at this point that none of the measuring problems which I encounter with an amplifier of this sort will in any way affect its performance in the real world of an actual automobile, *providing* you follow the wiring and installation instructions that are clearly spelled out in the well-written owner's pamphlet, and providing further that you don't accidentally ground either a speaker output or the amplifier chassis itself.

Measurements

While I feel that 14.4 V of supply voltage is a bit high for measuring the performance of a car stereo amplifier, it is, nevertheless, the value agreed upon in the standard referred to earlier. With that high a "battery" voltage, the Visonik A-265 delivered in excess of 75 watts per channel (one channel driven) into 4-ohm loads and better than 80 watts per channel when driving a 2-ohm load, for its rated THD of 0.01%. These results are for mid-frequencies. At 50 Hz, power output for rated THD of 0.05% decreased to its rated 65 watts per channel, with either 4- or 2-ohm loads.

Signal-to-noise ratio referred to 1-watt output measured 75 dB (corresponding to about 93 dB referred to rated output, or 3 dB better than claimed by the manufacturer). Thirteen millivolts of input to the low-level input jacks produced 1-watt output with the input-level control set to its maximum clockwise (maximum sensitivity) position. At the other extreme of the control, an input of 65 mV was required to produce the same 1-watt output. Input sensitivity via the high-level inputs (through the Molex connector) was 310 mV for 1-watt output.

Frequency response, using a nominal 1-watt output, was flat within 0.5 dB from 17 Hz to 25 kHz, while damping factor was exactly 40, as claimed, referred to a 4-ohm load impedance and measured using a test signal at 50 Hz. Slew *factor* (not to be confused with slew *rate*) was better than 6. As I mentioned, the A-265 can be operated as a mono bridged unit by connecting a single speaker to the two color-coded leads emanating from the 8-pin Molex connector (as specified in the instructions for bridged operation). Under those circumstances, the amplifier will deliver well in excess of the 130 watts at which it is rated, but the minimum impedance of a speaker used in such an arrangement should be 4 ohms.

Summary

I couldn't resist hooking the A-265 amplifier up to a new pair of B & W Model 3000 speaker systems. The choice of these speakers is not as ludicrous as it seems, for if they have one thing in common with recently designed car speakers, it is high efficiency. Driving the amplifier directly from a CD player and adjusting the amplifier's low-level input control so as not to overload the amp during 0-dB (maximum) recorded moments of some of my favorite CDs, the overall sound was every bit as good as that which I get when the B & W speakers are connected to my reference amplifier and preamplifier. The solid bass, so much a part of better CD recordings, came through with unmuddied clarity, and transient response was also excellent. Midrange and treble sounds were well balanced—but, of course, that's due as much to the excellent design of the home speakers I was using as to the uniform response of the A-265. In fact, the ultimate sound produced by this fine amplifier will depend more upon the associated speakers than upon anything else. In my opinion, the speakers you use will definitely prove to be the limiting factor in any car system, so I would advise you *not* to economize in your choice of speakers if you elect to buy this amp.

As far as I am concerned, the Alphasonik A-265 amplifier lived up to its published performance specifications, and then some. I'm so certain its sound quality will be up to par when it is installed in a car, that I may even ask to hitch a ride with someone who ends up owning this amplifier. Anyone care to give me a lift? *Leonard Feldman*

5

PERREAUX SM2 PREAMP

Manufacturer's Specifications

Frequency Response: 20 Hz to 50 kHz, ±0.25 dB.

Input Sensitivity: MC phono, 250 μV rms at 1 kHz; MM phono, 2 mV rms at 1 kHz; all others, 110 mV rms.

Input Impedance: MC and MM phono, 50 kilohms, 100 pF; all others, 25 kilohms.

Input Overload: MC phono, 120 mV rms at 1 kHz; MM phono, 1.2 V rms at 1 kHz; all others, 50 V.

Output Level: Main, rated 1.4 V rms, max. 27 V rms, into 10 kilohms or higher; tape, 110 mV.

Output Impedance: Main, 470 ohms; tape, 2 kilohms.

Distortion (THD and IM): Phono, 0.005%, 20 Hz to 20 kHz at rated sensitivity, 0.01% at 0.9-V input at 1 kHz; all others, less than 0.0009%, 20 Hz to 20 kHz at rated sensitivity, 0.008% at 26-V output at 1 kHz into 10 kilohms or higher.

Noise (Inputs Loaded): MM phono, −86 dB re: 10-mV input, −78 dB (−86 dBA) re: 2 mV at 1-kHz in; MC phono, −64 dB (−72 dBA) re: 250 μV; all others, −104 dB (−108 dBA).

Output-Stage Phase Accuracy: ±1°, 20 Hz to 20 kHz.

Channel Separation: 70 dB, 20 Hz to 20 kHz.

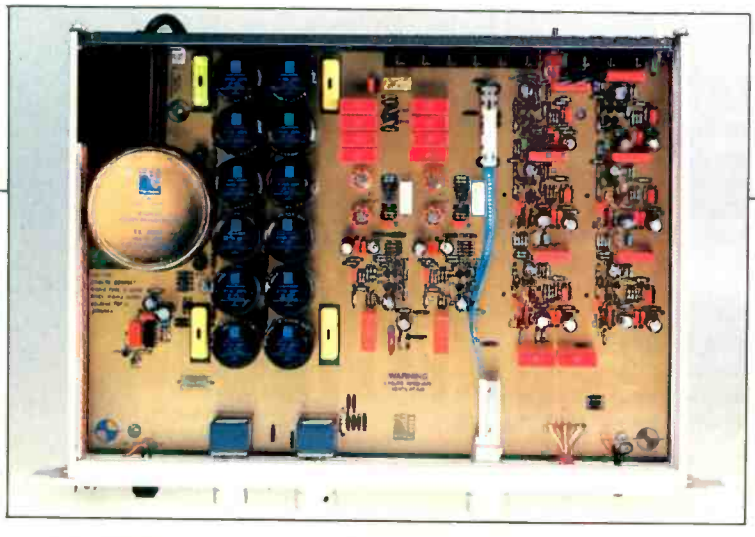
Dimensions: 19 in. (48.3 cm) W × 12.5 in. (31.8 cm) D × 2.1 in. (5.3 cm) H.

Weight: 11 lbs. (5 kg).

Price: $1,299.00.

Company Address: Techport Ltd., 875 Merrick Ave., Westbury, N.Y. 11590.

For literature, circle No. 94



The Perreaux SM2 is, I believe, the first preamp to be sold in the U.S. from this "down-under" company in New Zealand. It is of the straight-line, no-tone-control, no-frills school.

A number of interesting circuit ideas are incorporated into this preamp: The phono-stage power supplies deliver unusually high voltages (for a solid-state) design to provide high input acceptance; phono-circuit gain is switchable to allow use of MM or MC cartridges, and a shielded, toroidal power transformer allows MC gain without hum, even though the transformer is in the preamp chassis. The circuit also uses polypropylene and polycarbonate capacitors in the signal path, unregulated power supplies (but with very large filter capacitors), and MOS-FET transistors in the line-amplifier output stage.

Front-panel controls include, from left to right, a pushbutton on-off power switch, balance and volume knobs, an input selector, and a tape-monitor toggle switch. On the rear panel are gold-plated connectors for inputs and outputs, a phono gain switch, and a three-wire a.c. power cord.

All of the circuitry, including the power transformer, is on one large p.c. board taking up the entire internal area of the chassis. The ground plane and interconnecting traces are 24-karat gold plated to prevent corrosion, reduce resistance, and provide better r.f. shielding. Parts quality and construction appear to be first-rate.

Circuit Description

Since a schematic was not provided with this unit, exact circuit details could not be determined without lengthy circuit tracing.

The phono amplifier appears to be a three-stage affair. The first stage is where the gain is changed for MM or MC use. Gain is most likely changed by altering effective emitter resistance or shunt feedback resistance, as noise is lower in the high-gain position. The high-frequency portion of the RIAA equalization is done by a passive RC network at the output of this first stage. The second stage, like the other two stages, is flat. The bass boost portion of the RIAA curve is accomplished by a passive RC network at the output of the second stage. The third stage acts as a buffer and has a small voltage gain.

These three amplifier blocks have similar circuitry, consisting of five NPN and PNP bipolar transistors in a complementary configuration.

Power-supply voltages to the phono stages are ±45 V to the first stage and ±90 V to the second and third stages. A block diagram of the phono preamp is shown in Fig. 1.

The output amplifiers are a combination of NPN and PNP bipolar transistors feeding a complementary pair of MOS-FET devices for the outputs.

These MOS-FETs are run at much lower current than in the Spectral DMC-10 (*Audio*, September 1983), about 0.4 mA. Further, there is one N and one P device, whereas the Spectral used two P devices in parallel to more closely match the N device. Why such a low quiescent current is used, I can't fathom. One can see crossover distortion at high frequencies, even though the amount of distortion is very low. Turning up the bias pots gets rid of this distortion without overdissipating the MOS-FETs. Power supply voltage for the output amplifier is ±45 V.

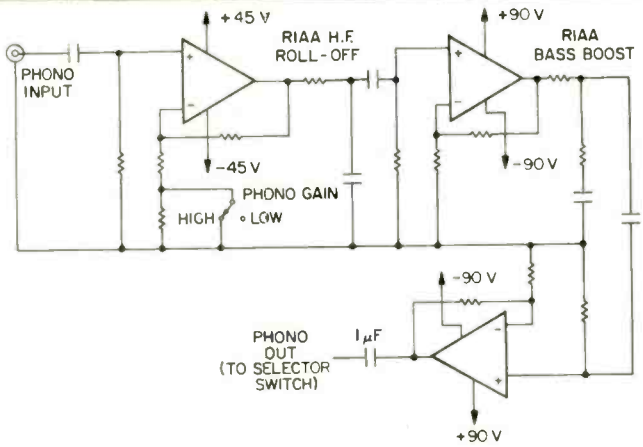


Fig. 1—Phono-circuit block diagram.

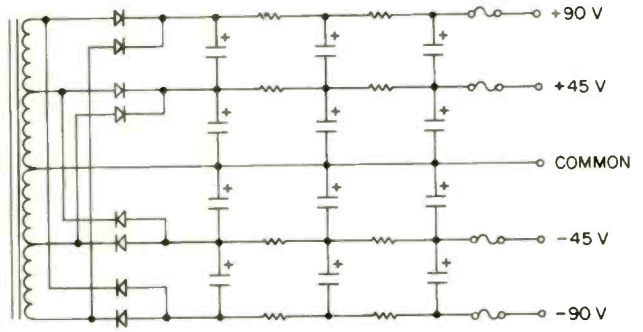


Fig. 2—Power-supply configuration. Four diodes at center form one bridge rectifier, top and bottom diode pairs form a second bridge rectifier. Each capacitor is 4,700 μF, 50 V.

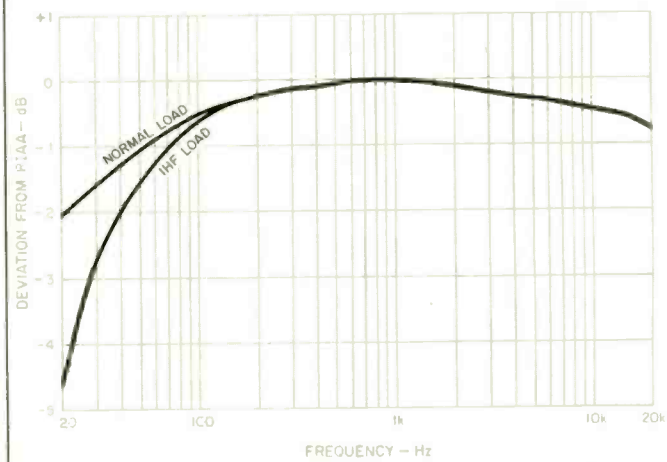


Fig. 3—RIAA equalization error for normal load (90 kilohms and 250 pF) and IHF load (10 kilohms and 100 pF). Shown for right channel, measured at tape output.

With phono input overload beginning at 1 V, it's unlikely any phono cartridge will overload the Perreaux SM2.

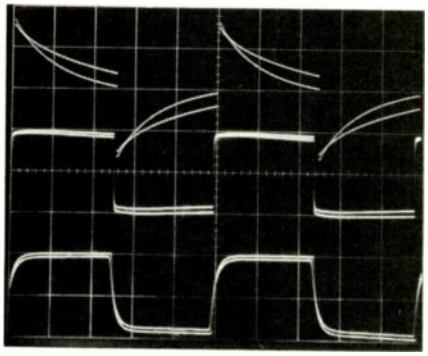


Fig. 4—Phono-preamp square-wave response: 40 Hz (top), 1 kHz (middle), and 10 kHz (bottom). Dual traces show effects of normal and IHF loads. (Vertical scale: 1 V/cm; horizontal, sweep frequencies adjusted for constant trace width at each frequency.)

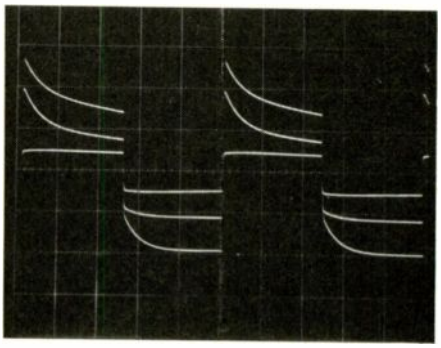


Fig. 5—Effect of increased drive level into phono section, showing 1 kHz at three different signal levels. (Vertical scale: 2 V/cm; horizontal, 200 μS/cm.)

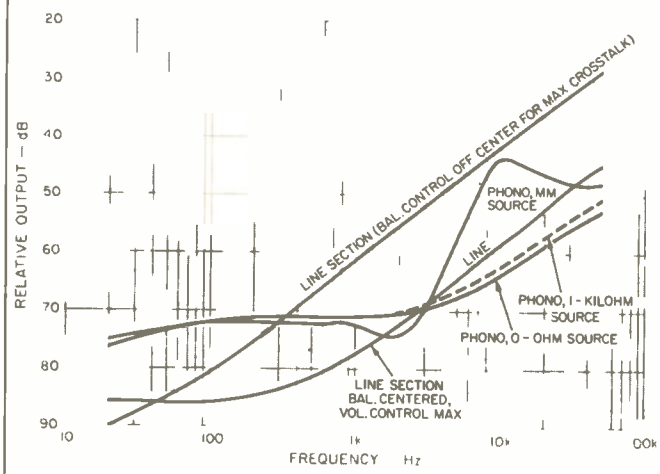


Fig. 6—Crosstalk vs. frequency for line and phono sections. Note increase in line-section crosstalk when balance control is moved towards driven channel. (The same effect was seen with balance control centered and volume control lowered 6 dB from maximum.) Also note phono crosstalk increase at high frequencies with IHF MM source.

The output of this line amplifier is muted by relay contacts which short the main outputs to ground against series 470-ohm resistors. This is in contrast to the usual connection, which puts the contacts in series with the output signal. Perreaux claims, correctly, that their configuration gets the contacts out of the signal path. The time delay of the relay control circuit is short, about 2 S, as the circuitry settles down about that quickly.

The power supply in this preamp is unusual in that it is unregulated and also has an interesting topology. The equivalent amount of filtering is tremendous due to the number and large size of the filter capacitors. A schematic of this circuit is shown in Fig. 2.

Measurements

As has been my custom of late, circuit gains and sensitivities were measured first and are presented in Table I. Next, phono input noise was measured for different source impedances, bandwidths, and gain settings. This data is enumerated in Table II. Noise values are on the high side of what can be achieved with solid-state circuitry. IHF signal-to-noise ratios for the phono and line sections are listed in Table III.

Phono total harmonic distortion plus noise was measured at 5-V output with my normal load (distortion analyzer plus 'scope and connecting leads; 90 kilohms and 250 pF) and with the IHF load (10 kilohms and 1,000 pF); it was less than 0.01% from 20 Hz to 20 kHz with either load. Distortion at high frequencies starts to rise above 5-V output, which is due to the phono input amplifier reaching its maximum input acceptance.

Phono overload versus frequency, gain, and loading at tape output was measured (Table IV). In all cases, the limit is some aberration on the output waveform as observed visually on a 'scope. In a perfect RIAA preamp section, the shape of the overload versus frequency curve would be the inverse of the RIAA curve itself, and the maximum output level would be constant with frequency. This is not the case here: Once the input level reaches about 1 V for low gain and about 0.16 V for high gain at 1 kHz, the output level attainable begins to drop. This is caused by the input amplifier in the phono preamp section going into clipping, preventing any further increase in input level without distortion. However, let's face it: 1-V input at 1 kHz is indeed a high input level acceptance! It's unlikely that any cartridge will overload the phono section of the SM2. A worst-case scenario—a Shure M44 cartridge puts out 10 mV at stan-

Less low-end roll-off might produce better sound in the midrange as well as producing better bass.

dard level at 1 kHz. Let there be 20-dB peaks over the whole frequency range. Then, 10 mV becomes 100 mV at 1 kHz and 1 V at 20 kHz. This would just tick the maximum input acceptance of the SM2. However, 20-dB peaks in the range of 10 to 20 kHz are not very likely because of cutting limitations.

Phono equalization error versus frequency is shown in Fig. 3. The curves are for low gain and the right channel, which was slightly worse than the left. In the high-gain mode, the errors were essentially the same above 500 Hz, but 20 Hz was down about 1 dB more with IHF loading. The low-end roll-off in this unit is excessive, in my opinion, as I have found that (all other things being equal) extending the low-frequency bandwidth in a phono equalizer or any flat amplifier generally produces better sound in the midrange in addition to producing better bass. This general tendency of restricted l.f. bandwidth throughout the whole circuit allows it to settle down so quickly upon turn-on. 'Scope patterns of the phono circuit response to square waves are shown in Fig. 4. Figure 5 shows the effect of increasing drive level into the phono section at normal gain. The asymmetry is caused by the phono first stage clipping asymmetrically.

Interchannel phono crosstalk versus frequency and source impedance is shown in Fig. 6. Crosstalk increased at high frequencies with the IHF MM source, though not to the same extent as in the Audio Research SP-10 (*Audio*, June 1984). Crosstalk in the high-gain position was about the same as shown for low gain. Crosstalk was in phase with the driving source, using square-wave excitation. The phono preamplifier's input impedance was representable to a satisfactory degree of accuracy by a parallel combination of 51 kilohms and 125 pF.

The line amplifier was measured for THD plus noise, which was found to be less than 0.01% from 20 Hz to 20 kHz, at 10-V output or less with normal or IHF loads.

When crosstalk versus frequency was measured for the line section, some anomalies showed up. With the volume control fully clockwise and the balance centered, everything was quite good. Moving the balance control toward the driven channel increased crosstalk substantially at high frequencies. With the balance again centered, but with the volume control down 6 dB, a similar effect occurred. These results are also plotted in Fig. 6. Crosstalk for the line section was in phase.

'Scope pictures for the responses to square waves are shown in Fig. 7. Rise-time and slew rate for the output amplifier were measured; for a 50-V peak-to-peak output signal and IHF load, the output was definitely slewing. The negative-going transition was −40 V/2 μS or −20 V/μS, and the positive-going transition was 40 V/1.6 μS or 25 V/μS. These figures can be interpreted as large-signal rise and fall times, since 40 V out of 50 V is 80% (90% − 10%) of the total amplitude of the step transition. For the normal load, things speeded up to a positive transition of 40 V/μS and slowed to a negative transition of 23.5 V/μS. Small-signal linear rise and fall times at 10 V peak-to-peak were 1 μS for normal load and 1.3 μS for the IHF load. With the volume control down 6 dB from maximum, the rise and fall times lengthened to 2 μS for normal load and 2.5 μS for the IHF load.

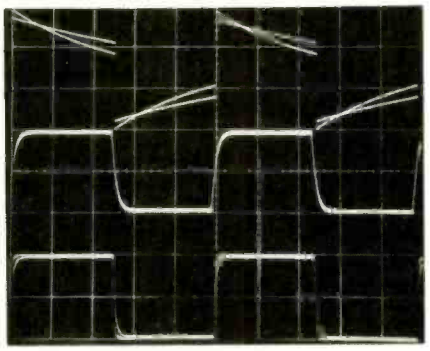


Fig. 7—Line-amp square-wave response: 20 Hz (top), 20 kHz with volume control set 8.5 dB below maximum (middle), and 20 kHz with volume control fully clockwise (bottom). Dual traces show effects of normal and IHF loads. (Vertical scale: 2 V/cm for top and middle curves, 5 V/cm for bottom; horizontal, sweep frequencies adjusted for constant trace width at each frequency.)

Input impedance of the line section, with volume at maximum and balance centered, turned out to be 22 kilohms in parallel with 180 pF. The preamp's output impedance was about 470 ohms.

Use and Listening Tests

Functionally, the SM2 works perfectly, with no operational glitches. Turn-on with gain advanced on phono produces no thumps; turn-off is also quiet. Switching my turntable on and off with gain at playing level on phono produces a mild pop. On this basis of rating r.f.-interference susceptibility on phono input, the SM2 rates as good.

A note about the three-wire power cord of the SM2 (or any other preamp with such a cord). The third wire connects to the chassis and signal ground. If other pieces of equipment in a hi-fi system have three-wire a.c. cords, which most power amps have, a potential ground loop between the chassis exists which could cause hum and sonic degradation. I recommend third-wire grounding to the a.c. outlet at only one piece of equipment—usually the power amp. Use three- to two-wire, ground-lifter plug adaptors on any other three-wire power cord in the system.

Equipment used to evaluate the SM2 included an Infinity air-bearing turntable and arm; a Koetsu EMC-18 cartridge; Fidelity Research XF-1 Type M moving-coil step-up transformer (used only with a reference tube preamplifier); Marantz Model 9, Dyna Stereo 35, Mark Levinson ML-9 and Audio Research D-70 power amplifiers, plus the Audio Research SP-10 preamp and GC/BHK developmental tube preamp (the latter two as references). Speakers included the Infinity RS2 and RS2a and a hybrid system with a cone woofer array and Infinity EMIM midrange and EMIT tweeter drivers.

When the SM2 was first received for evaluation, it was listened to on the RS2 speakers with either Marantz 9s or the Audio Research D-70. My initial reaction at that time was not very favorable. My listening notes indicated flat, nondimen-

The SM2's sound is smooth and easy, but with deficiencies in replicating space and musical excitement.

Table I—Gain and IHF sensitivity, SM2 preamplifier.

Condition	Gain, dB L	Gain, dB R	IHF Sensitivity, mV L	IHF Sensitivity, mV R
AUX or Tape to Main Out				
Normal Load	21.9	22.3		
IHF Load	21.7	22.1	41.5	40.5
AUX to Tape Out				
Normal Load	0	0		
IHF Load	0	0	500.0	500.0
Phono to Main Out				
Low Gain, Normal Load	56.1	56.4		
Low Gain, IHF Load	55.7	56.0	0.82	0.795
High Gain, Normal Load	73.9	74.1		
High Gain, IHF Load	73.7	73.8	0.105	0.102
Phono to Tape Out				
Low Gain, Normal Load	34.5	34.3		
Low Gain, IHF Load	33.4	33.5	10.6	10.5
High Gain, Normal Load	52.0	52.0		
High Gain, IHF Load	51.3	51.1	1.36	1.39

Table II—Phono noise, referred to input.

Condition and Bandwidth	Source Impedance, Ohms	Referred Input Noise, nV L	Referred Input Noise, nV R
Low Gain			
20 Hz to 20 kHz	0	600	650
400 Hz to 20 kHz	0	355	355
A-Weighted	0	325	325
A-Weighted	100	330	330
A-Weighted	1k	380	380
A-Weighted	IHF MM	780	780
High Gain			
20 Hz to 20 kHz	0	450	500
400 Hz to 20 kHz	0	150	145
A-Weighted	0	150	145
A-Weighted	100	162	160
A-Weighted	1k	250	250

Table III—IHF signal-to-noise ratios, phono and AUX inputs.

Condition	Source Impedance, Ohms	IHF S/N, dB L	IHF S/N, dB R
Phono Inputs			
Low Gain	IHF MM	−75.8	−75.5
High Gain	100	−69.5	−69.6
High-Level Inputs	1k	−91.2	−91.0

sional sound that seemed to alter the harmonic structure of instruments and voices, making them sound somewhat unreal. I then loaned the unit to a friend who uses the hybrid cone/EMIM/EMIT speaker system. He is a very perceptive listener, and thought the SM2 preamp was generally okay. A later substitution of a conrad-johnson PV-2A made his system sound more spacious and musically natural.

Recent listening with the SM2 in my system, using the RS2a speakers, has allowed me to finally quantify this preamp. The combination of the SM2 and the Dyna Stereo 35 or Levinson ML-9 yields a very smooth, listenable sound. I would characterize the sound of the SM2 as smooth and easy but with deficiencies in replicating space and musical excitement. By comparison, when I use the SP-10 or my reference tube preamp with either of the above-mentioned power amps, resolution, spaciousness and excitement return to my system's reproduction. If I were to compare the SM2 to the Spectral DMC-10, which is reasonable, I would prefer the Spectral preamplifier, as it is more open and spacious sounding.

A few last observations: Sound through the SM2 was a little better with the phono gain at low. Perceived S/N was okay using the Koetsu this way, and it was obviously better in the high-gain mode.

The above are substantially my personal opinions on the sound of the Perreaux SM2. As with any well-made piece of gear (which the SM2 is), I recommend that potential buyers listen to this preamplifier with potential combinations of equipment they are interested in, to form their own personal opinions.

Bascom H. King

Table IV—Phono overload (in V rms) vs. frequency, loading and gain.

	LOW GAIN			
	Normal Load		IHF Load	
Frequency	E In	E Out	E In	E Out
20 Hz	0.143	53.5	0.095	26.8
100 Hz	0.258	56.0	0.177	33.0
400 Hz	0.705	56.5	0.69	49.5
1 kHz	1.0	52.5	1.0	47.5
5 kHz	1.1	21.6	1.18	20.6
7 kHz	1.11	16.3	1.19	15.4
10 kHz	1.14	11.8	1.1	10.5
20 kHz	1.13	6.0	1.11	5.35

	HIGH GAIN			
	Normal Load		IHF Load	
Frequency	E In	E Out	E In	E Out
20 Hz	0.0207	54.5	0.0136	26.8
100 Hz	0.034	56.8	0.028	32.8
400 Hz	0.094	57.0	0.09	49.2
1 kHz	0.131	53.0	0.129	47.0
5 kHz	0.153	23.0	0.16	21.4
7 kHz	0.15	16.6	0.162	16.0
10 kHz	0.147	11.5	0.152	10.8
20 kHz	0.148	5.95	0.145	5.25

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There is no obligation to accept the "Selection of the Month"—you order *only* the recordings you want when you want them. A special response card will be enclosed with each Magazine—mail it by the date specified to order or reject any selection. And if you want *only* the "Selection of the Month," do nothing—it will be shipped automatically.

What's more, you'll have at least ten full days in which to make your decision—if you ever have less time than that, feel free to return the "Selection of the Month" at our expense.

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6

SPECTRASCAN BPA-100B POWER AMPLIFIER

Manufacturer's Specifications

Power Output: 100 watts per channel, both channels driven, from 20 Hz to 20 kHz, 8-ohm loads; 175 watts per channel into 4-ohm loads; 350 watts bridged mono into 8-ohm loads.

Rated THD: 0.05%.

SMPTE-IM Distortion: 0.05%.

Input Sensitivity: 1.0 V rms for rated output.

Damping Factor: 300.

Frequency Response: 2 Hz to 100 kHz, +0, −1.0 dB.

S/N Ratio: 100 dB below rated output.

Input Impedance: 10 kilohms.

Slew Rate: 50 V/μS.

Power Requirements: 100, 120, 200, 220, or 240 V a.c.; 50/60 Hz, 500 watts maximum.

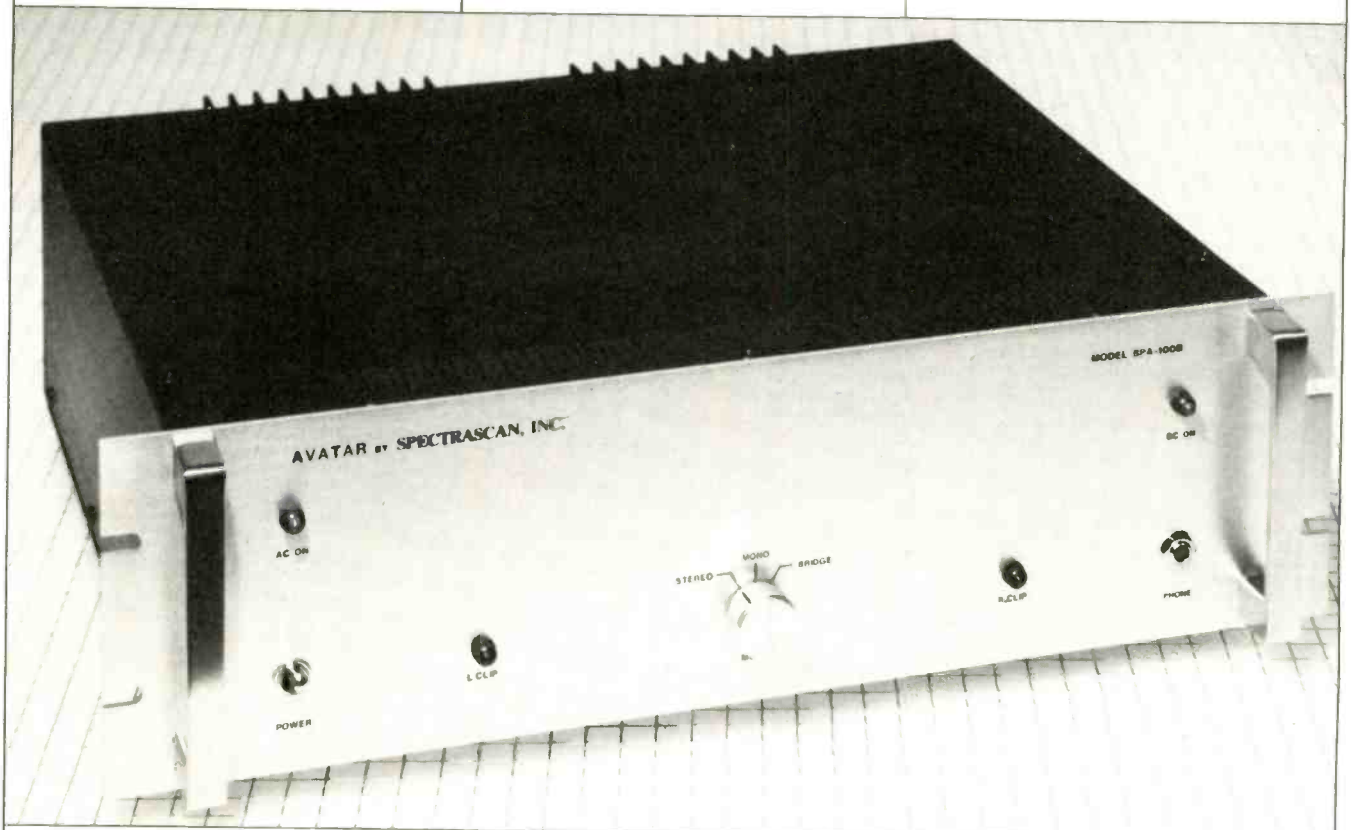
Dimensions: Rack version, 19 in. (483 mm) W × 5¼ in. (133 mm) H × 14 in. (356 mm) D; with wood cabinet option, 20 in. (508 mm) W × 6¼ in. (159 mm) H × 14½ in. (368 mm) D.

Weight: 35 lbs. (15.9 kg).

Price: $995.00.

Company Address: 5923 North Nevada Ave., Colorado Springs, Colo. 80907.

For literature, circle No. 95



The Spectrascan Avatar BPA-100B (as well as the meter-equipped BPA-100M) is one of the most unusual amplifiers I have ever had the opportunity to test. I still suffer from somewhat mixed emotions concerning this novel design. For more years than I care to tell, it has been my contention that amplifier evaluations must include thorough bench testing as well as listening tests. For virtually all the amplifiers I have tested, this philosophy has been borne out, and I have run into relatively few problems in pursuing that approach. Spectrascan's BPA-100B is one of the notable exceptions. Here's a blow-by-blow description of what I ran into the first time I tried to measure this amplifier.

Things went smoothly enough as I started to measure harmonic distortion

If noise, hum and distortion turn you off, turn on Sansui's new AU-D77X* integrated amplifier for pure, true sound.

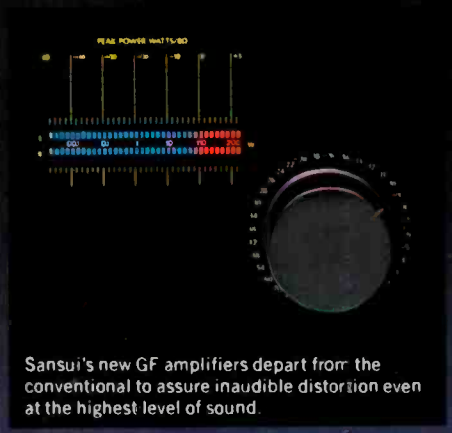
Only Sansui offers a trio of exclusive noise-eliminating innovations.

First, the unique Super Feed-forward DC power amplifier system routs virtually all types of distortion at all frequencies in the power amplifier.

Then, DD/DC circuitry, another Sansui breakthrough, produces high speed response and unmeasurable TIM in the predriver stage of the power amp.

And finally, Sansui's latest contribution to silent performance, the newly developed Ground Free circuit that substantially reduces Interface Hum Distortion (IHM) in the output, driver and pre-amp stages of the amplifier.

The result is clean, uncluttered music—virtually free of noise, hum and distortion. (You also get this impeccable performance with Sansui's 130-watt* top-of-the-line AU-D11 MKII integrated amp.)



Sansui's new GF amplifiers depart from the conventional to assure inaudible distortion even at the highest level of sound.

One outstanding performer deserves another. The TU-S77X tuner adds a new dimension to the state-of-the-art. Its new FM multiplex decoder improves channel separation and reduces distortion significantly. Also available is the TU-S77AMX tuner which automatically receives and switches to every approved AM stereo broadcast system.

The AU-D77X and TU-S77X make the perfect tuner/amp combination for people who appreciate great technology as much as they enjoy the silence in great sound. Get the "Silent Treatment" at your Sansui audio specialist, or write.

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Lyndhurst, NJ 07071; Carson, CA 90746
Sansui Electric Co., Ltd., Tokyo, Japan

THE SILENT TREATMENT

Putting More Pleasure in Sound

Sansui

*AU-D77X—110 watts, 0.0028% THD; AU-D11 MKII—130 watts, 0.0025% THD. Minimum RMS, both channels driven into 8 ohms, from 10-20kHz.

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There's even a cassette maintenance monitor in every in-dash unit to tell you when your system needs a "cleanup."

All because there's no limit to how far Yamaha will go to bring you great sound. Wherever you go.

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

YAMAHA

Amplifiers with stiff, regulated power supplies have no dynamic headroom, but there are those who find this an advantage.

at low output levels. I usually plot THD and IM, beginning at 1-watt output per channel and working my way up to and beyond rated output, to produce the familiar curve of Fig. 1, using a mid-frequency test signal of 1 kHz and two end-frequencies of 20 Hz and 20 kHz. When I got to about 10 watts per channel, I noted that something strange was happening. Distortion, as read on my THD analyzer, was beginning to rise while I watched a steady-state signal at a fixed level! Examining the distortion components on the 'scope, I noticed, to my amazement, that "spikes" were showing up (and growing) at the points corresponding to the zero-axis crossings of the sinusoidal test signal. After a few seconds of this, I was convinced that there was something wrong with the amplifier, perhaps some sort of thermal runaway. Had I had a complete owner's manual and some of the literature which Spectrascan's president and chief designer, Jan C. Hoigaard, sent me later, I might not have jumped to that conclusion so quickly. I quote from that literature:

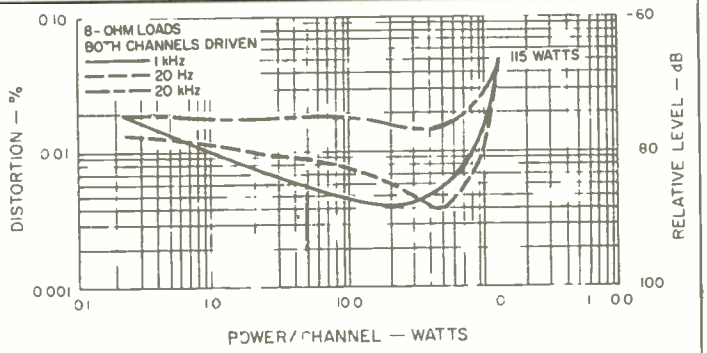
"A word about BENCH TESTING: This unit was designed for ultimate performance with even the most demanding music material, rather than with steady-state laboratory test-bench signals. For this reason, the automatic bias-control circuit, which is one of the advanced features of this amplifier, is optimized for music signals, rather than steady-state sine waves. This remarkable control circuit is so fast that the amplifier will be fully stabilized and reach optimum operating conditions in approximately 60 seconds from cold turn-on. With the Spectrascan, Inc. amplifiers, there is no need to wait for one hour or more for optimum performance!

"This amplifier, therefore, does not require, nor benefit from, the IHF [sic] prescribed one-hour conditioning at ⅓ power, prior to bench measurements. Such conditioning may cause excessive heat-sink temperature and cyclic shutdown. (NO DAMAGE WILL RESULT!)

"To perform bench measurements, simply turn the unit on, leave on for a minute, and proceed with the measurements."

What the above paragraphs fail to mention is that after each measurement, you had better turn off the signal, allow some time for the self-adjusting bias circuitry to readjust itself, and proceed to the next measurement! That is what I ended up having to do in order to come up with the results shown in Fig. 1, and the process, as you might guess, took several hours! I have no problem with all of this, especially since everything stated regarding the sonic excellence of the amplifier under music-signal conditions turned out to be true. What concerns me, just a little, is the fact that this amplifier would not, under any circumstances, be able to meet the power rule requirements of the FTC (not the IHF, which simply adopted the Federal Trade Commission's wording in its standards). I'm not talking about the preconditioning part of the rule, which Spectrascan dismisses so lightly. I'm referring to the requirement that rated output be sustained for at least five minutes, and during those five minutes rated THD must not be exceeded. There's no way this amplifier could meet that requirement. Still, if that doesn't bother Spectrascan, I guess I'll say no more about it. It is, after all, the musical reproduction capabilities of an amplifier that count, Federal rules notwithstanding....

Fig. 1— Power output vs. THD.



Panel Layout

"AC On" and "DC On" indicator lights are found at the upper left and upper right of the front panel of the BPA-100B. A "Power" switch is located below the "AC On" light, while a headphone jack can be found below the "DC On" light. A mode selector switch at the center of the panel selects normal stereo, mono, or bridged mono operation of the amplifier. Left- and right-channel clipping indicators are located on either side of the mode switch. The front panel is equipped with the usual pair of rugged handles associated with rack-mountable equipment.

The BPA-100B has a single pair of input jacks on its rear panel. In the mono or bridged mode, only the right input jack is active. Three pairs of five-way binding posts are used for speaker connections. Each pair is on ¾-inch centers so that dual banana plugs may be used. The top pair is for the right-channel speaker, the center pair for the left channel, and the bottom pair for bridged operation. The red binding post of the left channel is actually connected to chassis ground. Because the two channels of this amplifier are out of phase with each other (to simplify bridged mono operation), the red terminal must, nevertheless, be connected to the "hot" or "+" terminal of the associated speaker to maintain proper acoustical phasing of the two channels. This arrangement also precludes using a common ground wire for speaker connections. In home use, this seldom poses a problem, but audio dealers having speaker switching panels that employ a common ground, LOOK OUT! In addition to two massive heat-sinks, the rear panel also contains an unswitched a.c. convenience outlet and a fuse-holder containing a replaceable 5-ampere slow-blow fuse.

Circuit Design Philosophy

The following circuit information was condensed from the owner's manual supplied with the BPA-100B. There are essentially two important and novel design techniques used in this amplifier:

I'm reluctant to say so, but some CDs which I had previously found a bit harsh sounded a bit smoother through this amp.

Nested, multiple-loop feedback networks and an electronically regulated power supply. Using nested, multiple-feedback loops makes it possible to employ poles and zeroes positioned so that open-loop phase shift remains less than 90° beyond the loop gain crossover frequency, even though overall gain roll-off may exceed 12 dB per octave. This would seem, at first, to fail the Bode criteria for stability, which state that each 6 dB of roll-off adds 90° of phase shift to the feedback loop's desired 180°, that more than 90° (or 6 dB) leads to marginal stability, and that 180° (12 dB) turns the circuit into an oscillator. However, it can be shown that it is the *relative* roll-off closure rate between adjacent loops that determines stability and not the absolute roll-off rate. Expressed somewhat differently, each successive pole is cancelled by a zero in the next nested loop, so the accumulated loop phase shift remains less than 90°.

All feedback loops originate from the amplifier output terminal. The outermost loop is fed back to the input-stage summing junction, while the remaining inner loop feeds back to intermediate stages. Unlike conventional single-loop designs, the early stages within the outer loops of a multiple-loop amplifier receive the least amount of feedback, while the output section receives the largest amount of feedback. According to Spectrascan, this is an ideal situation, since most open-loop distortion originates in the output stage.

The output section of the amplifier uses a symmetrical, mirror-image compound stage that yields high linearity and high efficiency. With a regulated supply voltage of ±45 V, the output stage is capable of a swing of ±43 V into 8 ohms before the onset of clipping. That is precisely the power level I measured for this amplifier before it reached rated distortion.

Although the advantages of a brute-force "soft" power supply versus a stiffly regulated one can be argued (and have been, endlessly), Spectrascan cites the following advantages for the "stiff" or regulated-supply approach they have elected to use in their BPA-100 series of amplifiers:

1. Specified rated output power is always available, even with music waveforms that are square-wave shaped;

2. A regulated power supply reduces TIM phenomena caused by the shift in transistor operating points which results from supply voltage variations;

3. Power-line voltage variations (brownouts, etc.) will not affect the amplifier's audio power-output capability, nor will high line voltages cause damage to the amplifier, and

4. An electronically regulated power supply offers new possibilities for circuit protection without introducing TIM associated with conventional current-limiting circuits that come on gradually. A regulated power supply may simply be electronically shut down on command from overload-sensing circuitry.

The obvious disadvantage of a regulated supply (and there are those who don't consider it a disadvantage at all) is that amplifiers employing this design exhibit virtually no dynamic headroom. Maximum output power is the same for short-burst signals as it is for steady-state signals.

Measurements

Using the rather unusual measurement methods described earlier, I measured exactly 115 watts per channel of output power, for 8-ohm loads, at all relevant frequencies. At rated output (100 watts per channel), THD measured 0.018% at 1 kHz, 0.01% at 20 Hz and 0.03% at 20 kHz. SMPTE IM for rated output measured 0.035%, while CCIR IM measured a much lower 0.0016%. IHF IM was below the measurement limits of my test equipment (well under 0.03%), and since it appears that IHF IM is a good indicator of the presence or absence of TIM, this would tend to confirm Spectrascan's claims regarding dynamic forms of distortion. With 4-ohm loads, the amplifier was able to deliver just under 200 watts per channel for its rated THD of 0.05% at mid-frequencies. At rated power output (175 watts per channel), THD measured 0.01% at 1 kHz and 20 Hz and 0.05% at 20 kHz. SMPTE IM under those conditions measured 0.04%.

Frequency response extended from 2 Hz to 100 kHz for the −3 dB roll-off points. Input sensitivity, referred to 1-watt output, measured exactly 100 mV. Since 1 watt is exactly 20 dB below the rated output of this amplifier (into 8 ohms), that sensitivity corresponds exactly with the 1 V (for rated output) claimed by the manufacturer. Unweighted signal-to-noise ratio referred to 1 watt measured 72 dB, increasing to 79 dB when an A-weighting filter was introduced. Adding 20 dB to that figure (to reference the S/N to rated output, as Spectrascan chose to do) brings the figure to 99 dB—close enough to the claimed 100 dB.

Dynamic headroom, as I expected, was almost nonexistent, measuring less than 0.5 dB. Damping factor, referred to an 8-ohm load and measured with a 50-Hz test signal, was in excess of 200. The amplifier was unconditionally stable under a variety of load conditions, including application of high capacitance values across the open-circuit output terminals.

Use and Listening Tests

Despite the BPA-100B's inability to pass FTC power rule tests, it ran remarkably cool when fed with actual musical program signals, reproduced with peaks approaching maximum available power levels. Those arguing that the FTC rule is obsolete and doesn't represent real-world conditions can have a field day with this great-sounding amplifier. Not only did it coast along at relatively cool temperatures, but it never shut down during any of my rather demanding listening tests, during which there were several moments when the clipping indicators were flashing merrily away (deliberately, of course). I felt that reproduction of some of my most demanding CDs was uncompromised, with good, solid bass and extremely good definition and transparency. In fact (and I am almost reluctant to admit this), some of the CDs which I had previously felt were a bit on the harsh side actually sounded a bit smoother when played through this amplifier.

Certainly $1,000 is a fairly high price to pay for 100 watts per channel of amplifier power. But to the very discerning and critical listener who is likely to favor this amplifier, no price is too high if the resulting sound is as good as it was during my several evenings of very pleasurable listening.

Leonard Feldman

VAN DEN HUL TYPE III PHONO CARTRIDGE

Company Address: c/o Audio Classics, 727 Creston Rd., Berkeley, Cal. 94708.
For literature, circle No. 96

Editor's Note: This is the second appearance of "Auricle," a review column concentrating on the sonic aspects of "high-end" components. While we are not abandoning our tradition of listening backed by careful measurements, we feel that "Auricle" will help us discuss more gear—and more quickly than full-scale "Equipment Profile" reviews allow.—E.P.

Many cartridges can be exciting for a few hours or even weeks; few stand up to months of concentrated listening. Far too often, what initially seem to be exciting new insights into the music are revealed as anomalies in frequency response, dynamics, tracking, the ability to resolve detail, resonance, or the host of other problems to which cartridges are prone. Worse, the better the system, the more the choice of cartridge has to be made on the basis of both outstanding performance and sonic characteristics that suit the particular components in that system. The choice of a cartridge is like the choice of a speaker: It ultimately boils down to personal taste.

I make this caveat because my own favorite reference cartridges are currently the van den Hul Type I, reviewed by Barney Pisha elsewhere in this issue, and the Argent Diamond. These cartridges have stood the test of hundreds of hours of listening. In spite of any weaknesses that Barney describes in the van den Hul Type I, I believe it provides an overall mix of linearity, musical detail, imaging, depth, and dynamics that I have never heard surpassed by any cartridge, and that I enjoy in listening to every kind of music I can find.

At the same time, the van den Hul Type I has sufficiently low output so that it requires a step-up device for best performance, even though it has the highest output of any regular moving coil I know of. Ideally, I would prefer a cartridge I could use with the best tube preamplifiers, without any step-up device. No matter how many step-up devices I test, every transformer and active gain stage I know of at least slightly degrades the sound as the price of the gain necessary to play low-output moving coils.

I cannot stand listening to low-output moving coils directly into a conventional gain stage. The noise dries out the sound, and the lack of gain compresses the dynamics to an unacceptable degree. The frequency balance of the cartridge is usually changed, and the entire system tends to appear somewhat lifeless. At the same time, there is a false impression of sound-stage expansion with tube preamps, which is largely a function of tube noise.

This keeps me searching for a high-output cartridge that can offer the same benefits as low-output moving coils. Some of these cartridges, such as Joe Grado's Signature Eight, are already strong rivals. A new generation is emerging, however, which includes high-output cartridges like the Decca van den Hul, several new Adcoms, a high-output version of the Sumiko Talisman, and the van den Hul Type III, the subject of this review.

I must confess that I approached the Type III with mixed feelings. It is a direct modification, as is the van den Hul Type I, but costs $395 versus some $1,095 for the Type I. Its output is easily high enough to eliminate any need for a high-gain stage or step-up device. On the other hand, the van den Hul Type III is a modification of the Goldring Type II moving-coil cartridge, and my tests of the initial version of the Goldring indicated that it was distinctly mediocre, audibly slower and less detailed than many far cheaper moving magnets.

Regardless of measurements or technical explanations, the better low-output moving coils have been more dynamic and detailed, and musically sweeter, than their high-output moving-coil or moving-magnet competitors. Such deficiencies, in fact, have been the curse of every high-output moving coil I have tested to date.

Fortunately, the van den Hul Type III definitely proved to be a significant step in the right direction, and particularly if it was loaded at 100 ohms and tracked at 2 grams.

At the normal 47-kilohm loading used with most high-output cartridges, it is only moderately faster than the Goldring Type II, which is to say, not fast enough. There is also a slight apparent rise in the treble that does not work well with its lack of speed. The Type III does have some of the benefits of the van den Hul stylus, even with

The better low-output MC cartridges are more dynamic and detailed, musically sweeter, than their high-output rivals.

47-kilohm loading. It is even superior to the current generation of its high-output competition. But, with that loading, it does not come close enough to the better low-output moving coils. My sample was also only a good tracker at its recommended 1.75 grams. It did reasonably well with most test records, but it did not offer the firm imaging and low-level musical detail in complex passages that is the real-world test of tracking with most music.

This situation changes significantly when the van den Hul Type III is loaded at 100 ohms. It still has over 1.0 mV of output versus around 2.0 at any loading over 250 ohms. This is a high enough output for any good preamp I know of, and it makes a moderate but extremely important shift in the cartridge's apparent speed while eliminating most of the high-frequency rise. It also produces better center fill and a tighter and better controlled bass. At 2.0-grams tracking, this improvement is reinforced by more solid imaging and more realistic harmonic detail with less artificial "air" or expansion of the sound stage. It will never be a tracker on the level of a Shure V15 Type V, but it will do an excellent job of tracking all musical instruments, except the cannon, on any rationally cut record.

In fact, if you are willing to take the time to alter your preamp's loading resistor—or shunt it—you will get a very good bargain indeed. You will not get a Type I van den Hul or a true rival for the speed, delicacy, and resolution of the best low-output moving coils, but you will get a very good compromise. If you listen to a wide variety of well-recorded jazz and chamber music, you will find that the van den Hul Type III has excellent ability to provide natural musical detail while preserving excellent sound-stage depth and width. It will provide musical life and transient response without the exaggerated high-frequency output common to many moving coils. Low-level piano and guitar sound natural, even when the musical information is near the noise floor—a very demanding test of a cartridge.

The upper midrange is not as quick and detailed as the best low-outputs, but it is comparatively linear, both in terms of measurement and sound. The middle and low midrange are very good; the bass has good detail and is well controlled, if slightly lean in the deep bass and lacking in the ability to resolve dynamics and low-level bass transients compared to the Type I and other top-performing cartridges.

Sound-stage width, depth, and detail also are not directly competitive to the best comparatively priced low-output moving coils, but they are very natural and well balanced. This often means the Type III will have superior overall realism. Most low-output moving coils in the Type III's price range tend to accentuate some feature of the sound stage over others. Such accentuation may be more dramatic, but it is also less natural.

Given the proper loading and tracking weight, the van den Hul Type III emerges as the best high-output moving coil I have tested over the last four years. It is not equal to the van den Hul Type I, but it is certainly superior to many low-output moving coils I have surveyed in the past. I could easily live with it using *ne plus ultra* components and speakers, and it definitely merits auditing with the kind of components likely to be used with cartridges at a price of $395.

Some cautions, however: Audition this cartridge at a dealer who will load it properly. The step-up instructions are good, and a small bubble level is provided. A van den Hul cartridge does, however, require very careful installation, and the vertical tracking angle must be set very carefully by ear. You also ought not run down to Radio Shack and buy a cheap resistor for loading. High-quality, 100-ohm loading resistors, or shunt resistors, are a necessity. Try Resistas, Vishay, or any other top-quality brand. Unless you are handy with phono cartridges and a soldering iron, get your dealer to set up the Type III.

I also should note that preliminary listening to the new Decca van den Hul indicates that it also deserves keen attention if you are searching for a way to avoid step-up devices. The new Adcoms and Talismans are coming, and others may surface at the Chicago CES. The van den Hul Type III may be the first of a new trend, and one that may well bring moving coils to a far wider range of audiophiles.

Anthony H. Cordesman

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The CA260 is the debut of a line of superior and fundamentally advanced car stereo products from Harman Kardon.

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COP A CD

Illustration: Rick Tulka

Synchronicity: The Police
A&M CD-3735.

This is the CD version of The Police's extraordinary 1983 LP, *Synchronicity*. There are three excellent reasons to grab hold of this as soon as possible, and one silly reason not to. Let's get the silliness out of the way first. The photos on the CD jacket and liner sheet are far too small, perhaps one-sixth the size they appear on the LP version. I don't know about you, but I want to see as much of Sting as possible. Forgive me; it's summer and the juices are flowing. That said, let's get on to the serious reasons for plunking down the extra bucks.

This is an album that deserves every accolade it has received. It is high-caliber music-making—disturbing, exciting, beautiful, touching, and technically superb. You will wear your LP grooves as smooth as the surface of a billy club or snap your cassette tape out of its shell before you tire of listening to it. The Compact Disc is a long-term investment in the future of your musical pleasure.

Besides the marked, blessed absence of surface noise, the CD version adds a subtle presence to the instrumentals, a fullness that becomes significant only in the fine details that effectively disappear on the analog versions. Some wonderful percussion accents on "Walking in Your Footsteps" and strange, electronic effects in the fade-out of "Tea in the Sahara," for instance, are almost nonexistent on the analog. It should be noted that this release is part of A&M's Audio Master Plus Series, in which extra care is taken from mix to master to ensure accurate, clean sound reproduction.

Coproducers Hugh Padgham and The Police have a unique perspective on the music, and their production values are unusual. Emphasis may be placed on an unexpected element of a cut, then shifted elsewhere without warning. It is an always intriguing effect. Sting's voice is largely located in the center ground, not full-front as one might expect. A guitar may take the foreground ("Miss Gradenko") or an acoustic piano ("King of Pain"). However, each cut is a carefully integrated whole in which the music superbly underlines the gist of the always thought-provoking lyrics. Many of the aural effects are extraordinary: The suggestion of reptilian-behemoth cries running through "Walking in Your Footsteps," for example, or the nerve-wracking jangling of tambourines suggesting a ringing telephone, faint but maddeningly insistent, on Andy Summers' "Mother." (All other songs are by Sting, except for Stewart Copland's "Miss Gradenko" and Summers' musical contribution to Sting's lyrics for "Murder By Numbers.")

Multiple aural planes give this stuff a palpable sense of depth and keep the ear busy attuning to the subtle musical doings on each level. Left-right perspective is equally intriguing. The clarity of the CD allows the full richness of The Police's work to come through, and, believe me, you don't want to miss one iota of *Synchronicity*'s complexities.

This CD features a bonus cut not included on the analog disc. "Murder By Numbers," a sardonic, jazzy song which closes out this digital package, appeared before only on the prerecorded cassette, the theory being that tape users would thus be encouraged to buy the prepackaged cassette instead of taping their own from a friend's LP.

Of course, there are many more reasons to get this CD. Get it because it is extraordinary music, wonderfully reproduced, and because it will please the boys' Mums. *Paulette Weiss*

Night and Day: Joe Jackson
A&M CD-4906.

Joe Jackson is an admirable figure in modern pop/rock, a musician willing to experiment who is also concerned with taking his audience along on his exploratory ventures. From his power-pop beginnings (*Look Sharp*, *I'm the Man*), to his own ominous brand of reggae (*Beat Crazy*), to his dabbling in '40s swing (*Jumpin' Jive*), Jackson keeps on moving, walking his tall, lanky body down musical sidestreets in search of the perfect sound to carry his sharp observations of life in this decade.

His 1982 effort, *Night and Day*, finds him in a New York state of mind, ex-

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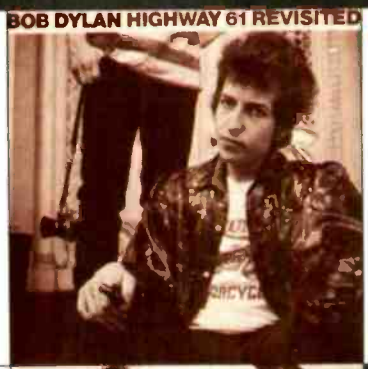

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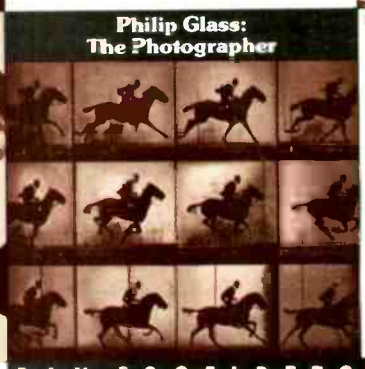

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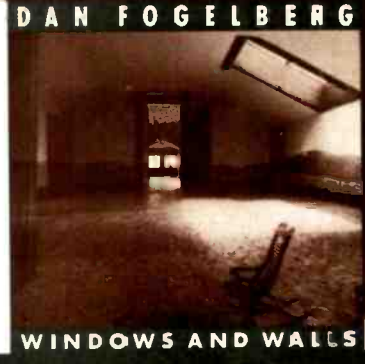

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COMPACT disc DIGITAL AUDIO

Surface noise is eliminated on the CD version of *Night and Day,* which is a boon to the reflective nature of Joe Jackson's work.

ploring the Latin community's exciting salsa sound. The album also incorporates funk and minimalist elements, but its flights of Latin percussion and rhythms are its outstanding features.

Originally an analog recording made entirely in New York, *Night and Day* was shipped overseas to Japan for digital remastering. Japan had better-than-average material to work with, for the album is part of A&M's Audio Master Plus Series, which uses stringent quality control and superior materials from the mixing to mastering stages of the recording process. The resultant CD has, of course, eliminated the slightest hint of surface noise present on even the superior-quality vinyl disc produced by this method. And it's a great boon to *Night and Day* on the quiet, reflective passages characteristic of Jackson's work. One example is the simple, clean acoustic-piano intro of "Real Men," where even minimal surface noise would be a real distraction. The extended dynamic range of this CD enhances a cut such as "A Slow Song," in which another Jackson pattern surfaces: The artist is fond of musical contrasts of all sorts. Here, he moves quickly from a simple, poignant arrangement of his own vocal, acoustic piano, bass and drum located in the center phantom channel, to a great swell of instrumentation which fills both left and right channels with sound at a sharply increased volume level. It's nice to know that, somewhere, this CD is saving some poor stylus from being brutalized by slamming into the walls of the equivalent grooves of the LP.

Jackson has put all of his considerable intelligence into the music, lyrics, and arrangements and leaves the focus there, where it should be. There are few fancy production gambits, and the mix is relatively gimmick-free. For the most part, Jackson, as producer, and his coproducer, longtime associate David Kershenbaum, concentrate on the center channel. There is some playfulness with left-right channel effects, though. "Steppin' Out," one of the album's well-deserved hits, plays with Jackson's centered vocal, throwing his voice's echo into both left and right channels for an unusual aural effect. Here, too, the memorable, chiming electric-keyboard line splits intriguingly into both channels.

Although the accuracy of reproduction of a great range of fascinating percussion instruments—timbales, congas, bongos, orchestra bells, xylophones, vibraphones, cowbells, clavés, and drums of all sorts—is excellent and their aural placement is occasionally imaginative, there is not much feeling of depth throughout the album. Jackson's nine selections are all presented on a fairly shallow plane, with little sense of fore- and background.

This is not the sort of CD you would use as a demonstration of the system's capabilities. It is a good CD, though, one which accurately reproduces the work of a modern pop mastercraftsman, Joe Jackson. As such, you can use it as a vehicle to accompany the master on his musical explorations.

Paulette Weiss

Grieg: Incidental Music from Peer Gynt. The Academy of St. Martin-in-the-Fields, Neville Marriner; Ambrosian Singers; Lucia Popp, soprano. **EMI/Angel CDC 7470032.**

Another of the new EMI/Angel CD recordings, *Incidental Music from Peer Gynt* is an especially welcome addition to the catalog of Grieg's music. All the favorites are here—"Anitra's Dance," "Hall of the Mountain King," "Solveg's Song"—plus other selections that will probably be unfamiliar to most listeners. Neville Marriner conducts the Academy of St. Martin-in-the-Fields in an ingratiating performance, including the well-disciplined contribution of the Ambrosian Singers and soprano Lucia Popp.

The sound is quite full-bodied, in a warm and spacious ambience. String tone is smooth and clean, and orchestral/choral balance nicely handled. A lovely recording that is convincing evidence of the high quality of EMI/Angel engineering.

Bert Whyte

Water Music of the Impressionists: Music of Ravel, Liszt, Debussy and Griffes. Carol Rosenberger, piano. **Delos D/CD 3006.**

I reviewed this program in LP form some years ago, commenting on the apt sound of Ms. Rosenberger's new Bösendorfer Imperial Grand with its still-soft hammers. The sound on CD is even more ravishing, with none of the breakup and low-frequency perturbations of even the best piano LPs.

While all of the impressionistic pieces are superbly played, for me the high point is still Ravel's fiendishly difficult "Ondine," which Ms. Rosenberger seems to play with such ease.

The low C on the Imperial's extended bass is used in Debussy's "Engulfed Cathedral" to suggest an organ pedal point. The low end of this instrument has a sustaining power which is unique to its massive 9-foot, 6-inch scale. One consequence is that the player is not called upon to work as hard to produce a big sound at the bottom of the keyboard.

For both sonic and musical values, this disc is highly recommended.

John M. Eargle

Carol Rosenberger

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MICHAEL TEARSON
JON & SALLY TIVEN

SHARKEY'S SONG

Photograph: ©Deborah Feingold

Mister Heartbreak: Laurie Anderson
Warner Bros. 25077-1, $8.98.

Sound: B+ Performance: A

Laurie Anderson's second album is at once more musical, more accessible and more challenging than her first release, *Big Science*. Perhaps part of it is that the artist is more comfortable making records and using the potentialities of the recording studio to fullest advantage.

The pieces Laurie Anderson composes really can't properly be called songs, and they really don't compare to what anyone else is doing. The closest analogies I can think of are the works by Brian Eno, when he was creating song lyrics by random selection, and those by the ever-challenging Peter Gabriel, who actively participated in several pieces here. You never really feel as if you know what Anderson's pieces are about; the best thing is to let them just wash over you and tickle your brain and body. (I suspect it is no accident that Laurie named her music publishing company Difficult Music.)

Two related pieces about the same character frame the album with what seem to be comments about the effects of fame and fortune. They are "Sharkey's Day" and "Sharkey's Night." According to the former, Sharkey is the Mister Heartbreak for whom the album is named. This opener has a wonderful sing-song refrain offset by Adrian Belew's fiery guitar. Anderson's voice here wafts angelically. Obversely, in "Sharkey's Night," Anderson turns vocal chores over to William S. Burroughs, who delivers what are often the same lines in a laconic deadpan.

Reading back over what I've written so far about *Mister Heartbreak*, I begin to realize that writing about Laurie Anderson's songs/pieces is like trying to hold a stream of water in your hands. You can't do it. All you can do, at best, is to change the stream's path, but you can never get a firm grip. Her pieces move at their own pace and are never rushed. As a result, this album is not likely to be found on the radio, save only the most adventurous shows and stations. But it is one of the truly original records of this or any season.

I'll try to explain once again. In quantum physics, a central principle is that you cannot measure both a particle's mass and velocity at the same time. Trying to describe the wondrous work of Laurie Anderson is like that.

Michael Tearson

Heartbeat City: The Cars
Elektra 60296-1, $8.98.

Sound: B+ Performance: B+

The Cars' choice of producers this time is indicative of their target audience—straight in the middle. Mutt Lange, whose recent successes are best typified by Def Leppard, does not make New Wave records. Although The Cars have often been thrown into this category, due to lead singer Ric Ocasek's tendency to wax poetic, *Heartbeat City* is a straight-pop record to the core. Background vocals sweeten almost every tune, the lyrics tend more toward mush than ever before, and the guitars lean more toward cleanliness than distortion. This streamlined edition of The Cars certainly is an interesting departure. Trying to make so naturally quirky a force sound wholesome and mainstream is an amusement unto itself, but on the whole the group's last album was a more likable statement. And going after the AC/DC and Foreigner marketplace is an adventurous undertaking, but, if anything, they should have gotten dirtier and grungier (via guitarist Elliot Easton) rather than this pristine. What's more, their longstanding relationship with producer Roy Thomas Baker has been a rewarding one, and change for its own sake is not always advisable. The result is not a disaster—far from it—but an album filled with Pyrrhic victories.

Perhaps the biggest reason for switching producers was that every new Cars album gets compared to their first and ultimately loses, for their debut record was unquestionably one of the few classic LPs of the late '70s. The failures of subsequent albums have rarely been the fault of the production or the playing, both of which have been exemplary, but of Ocasek's

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Ohm makes much of the imaging qualities of this speaker, and it certainly lives up to those claims. A demo record produced by Ohm provides convincing evidence that the Walsh 4, playing a variety of commercial music recordings, is capable of generating distinct spatial images that are apparent from almost any position in the room. For example, Leroy Anderson's musical typewriter moves with impressive smoothness between the speakers, with not a trace of the vague, uncertain, or erratic position shifts that we observed with some other speakers.

In case I have not made the point sufficiently clear, this is a superb-sounding speaker—not inexpensive by any means, but worth every cent of its price."

—Julian Hirsch

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Finish	Genuine walnut veneer	Genuine wood veneer, walnut and oak standard. Scandinavian rosewood and black or white lacquer on oak finishes available on special order.	Genuine wood veneer, walnut and oak standard. Scandinavian rosewood and black or white lacquer on oak finishes available on special order.
Inputs	Press connectors accepting "banana plugs" or bare wire up to 12 gauge	Press connectors accepting "banana plugs" or bare wire up to 12 gauge	Press connectors accepting "banana plugs" or bare wire up to 12 gauge
Controls	None	2 — low and high frequency each with 3 positions	3 — low, high and perspective each with 3 positions
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writing. When the guy is on, such as in "You Might Think" (on this album), there's simply no holding back his amusing irony. But when he tries too hard and comes up with a forced song, the results are tedious and agonizing. The problems of the past have been due to a lack of inspiration rather than flaws in the formula.

The songs on *Heartbeat City* are, for the most part, strong compositions. "Hello Again" kickstarts the album with a catchy guitar riff and pumping 4/4 keyboard part which provide a similar rhythmic function in the other upbeat numbers, "I Refuse," "Why Can't I Have You," and "You Might Think." The treatment of Ocasek's compositions (which are, at their least, workmanlike) errs on the side of conservatism. All the tracks could use a taste of Easton's axe chops, if not some full-fledged solos—which are pointedly missing from the arrangements. The latest sanitized Cars sound is exemplified by "Drive," a ballad sung by their other vocalist, Ben Orr. Although technically better than Ocasek as a singer, Orr's voice has less character, so what we get is an ultra-straight song bordering on boredom. Had Ocasek's quirky vocal delivered the lines, the lush instrumental would have been given an interesting ironic twist, but for some reason the group opted to let the bass player croon instead.

Although there are probably no more than two throw-away songs on this record, this collection, as a whole, tends to sound more like mood music and less like a group of pop (forget rock) tunes because the production leans on synths instead of guitars. Adding heaps of chorus effect to the backing vocals or channeling them through a Vocoder is gratuitous when you've castrated a band's sound. As good as *Heartbeat City* gets, the failure of the band to *rock* overwhelms the listener—and who needs another synthpop group with a Bowie-like singer up front? Forget this newest model and bring back the classic Cars. All of their parts work, but they've forgotten how to drive. *Jon & Sally Tiven*

The Waterboys
Island 90147-1-B, mini LP, $5.98.

Sound: C Performance: B

The Waterboys is really Mike Scott's show. He writes and sings the songs, plays the foundation and lead instruments of guitar and piano and produced the record, save the lead track, "Johnny," which Rupert Hine produced.

Scott has charisma. His vocals are anguished yet sturdy, much in the manner of U2's singer, Bono. The songs tell tales of anguish to match the voice. Driven by a rollicking tack piano, "Johnny" relates the downfall of a very confused woman/man. "I Will Not Follow" melodically recalls U2's "I Will Follow" (purposely?) as it rails against conscription to send the young off to die in war. Scott switches to guitar here, while Anthony Thistlewaite gets a monster of a sax line which alone could make "I Will Not Follow" a hit, as the sax did for Gerry Rafferty's "Baker Street" and Al Stewart's "Year of the Cat." An urgent "It Should Have Been You" closes the blistering first side.

The obverse's two songs are each longer and moodier than those on side one. "December" is about inner strength in the face of adversity, set against elegant guitar lines. Scott obviously cares a lot about the finale, "Savage Earth Heart," what with the lyrics being printed on the back cover. However, I find it the murkiest song here, with a bizarre mix that places rhythm guitars in front of both vocal and lead-guitar parts.

For the main, the sound design feels reminiscent of the earlier, less-polished U2 on their first album. Mike Scott has learned some lessons well and left room for growth. Doing only half an album first, in effect, serves him well, as filler is kept to a minimum and only what is felt to be front-line material is included. It should be noted that this mini album contains a generous 26 minutes of music.

Watch out for The Waterboys. Their grooves sparkle with real electricity and some crackling good songs too. A good start here, with indications of more to come. *Michael Tearson*

Talk Show: The Go-Go's
IRS SP 70041, $8.98.

Sound: C+ Performance: B−

Nearly two years after *Vacation*, The Go-Go's are back, still that bubbly confection of a pop band. Their new album is not really much different from what has come before, despite the streamlined yet elegant quality imparted by the capable Martin Rushent's production chores. What the all-female unit does is to make easily digestible pop songs loaded with hooks. Their songwriting is consistent, even if there isn't the obvious standout track. It may be hard, even dangerous, to take them too seriously, but you've got to have some candy sometimes. I mean, there's got to be more than just meat and potatoes.

Bright spirits and good times prevail for the '84 model Go-Go's. *Talk Show* is an easy album to like.

Michael Tearson

The Go-Go's

China Crisis

Working with Fire and Steel: China Crisis
Warner Bros. 25062-1, $8.98.

Sound: B– Performance: C+

China Crisis makes dreamy, adventurous pop music. They are yet another export from Britain's Virgin Records, which had as its first release Mike Oldfield's *Tubular Bells*. Virgin continued this tastemaking tradition by unleashing on us Culture Club, Human League, Heaven 17, and XTC.

With the nicely streamlined sound of Mike Howlett's production, China Crisis has made a very attractive album. The sound design features a modern, danceable beat, tasty horn fills on most songs, and modern synthesizer sequencer bits throughout. The vocals tend to melt into the music so that the dreamy feel carries you through whatever it is they are singing about. Thus, it is fortunate that the inner sleeve provides a lyric sheet, which is needed here to get at the humor in the songs. Most times, not hearing vocals clearly only frustrates me, but China Crisis makes music attractive enough to compensate.

As luck has it, I'm writing this on a rainy day that China Crisis' American debut has made much less oppressive. They can bring cheer to the gathered gloom, and that is a lovely thing to be able to do. *Michael Tearson*

Hot Spot: The Nighthawks
Varrick 009, $8.98.

Sound: B– Performance: A

Few bands in America can play with the raw authority of The Nighthawks. Still together and intact after over 11 years, they remain the blues band I most love to see play live. Mark Wenner on harmonica and Jimmy Thackery on guitar are both artists of strong virtuosity, while Pete Ragusa on drums and Jan Zukowski on bass form a rhythm section that actually plays with a wicked swing, a rare commodity. This is a band that can play in lots of styles with commitment, and they love to showcase their diversity with a sense of fun and discovery.

Hot Spot is their latest in a long string of fine, fine albums. The newcomer is one of their best, which is to say that it is an exhilarating experience. They start each side with a piece of solid rock 'n' roll, Eddie Hinton's "Searchin' is Over" on one side and Keith Sykes' great "Big Time" on the other. Neither side falters for a moment. Some choice slices include Thackery's "Crash Course in Love," Wenner going rockabilly on Carl Perkins' "Put Your Cat Clothes On," the intense and bluesy title tune by The Nighthawks, a high-stepping "Smack Dab in the Middle," the raucous New Orleans beat of "Too Tall to Mambo" and the open-throttle "Heartbreak Radio." Truth be told, I don't hear a duff cut on the album.

If I'm going to quibble, it is with the sound that should be much ruder, like Bob Clearmountain's mix of George Thorogood's *Bad to the Bone*. *Bone* had the effect of a sharp slap, while *Hot Spot* sounds a bit more polite. You can hear how dirty The Hawks play, but some of that dirt gets smoothed out of the final mix. Wenner's harp sound is excellent.

Speaking of Thorogood reminds me of what I say when people ask why The Nighthawks have never connected with the acclaim many of us feel they deserve. The way I see it is that George and The Destroyers are all rock, while The Nighthawks are all roll. Nobody is ever likely to accuse the very entertaining George Thorogood of being subtle; he really comes straight at you. On the other hand, that swing in

the rhythm section which makes The Nighthawks special makes their music much headier. They love to incorporate cute little tributes here and there, like Mark Wenner going into "When the Saints Go Marching In" in the fade of "Too Tall to Mambo." Somehow, body music almost always outsells the more cerebral stuff.

However, the issue at hand is The Nighthawks' terrific *Hot Spot* album and how much fun it is. Especially turned up loud. It is a great partying rock 'n' roll album by a band that knows and respects and loves its roots deeply. A band that plays its music straight and true, smart and sweet.

Michael Tearson

This Are Two Tone: Various artists **Chrysalis FV41425.**

Sound: C+ Performance: A

This Are Two Tone is a collection of singles from various groups on England's Two Tone label. We are dealt a generous portion of 13 of the best from The Specials, The Selecter, The English Beat, Madness and the great trombonist, Rico. This album is loaded with tunes to make you move to the rock-steady beat; it's a fabulous party record.

If you aren't familiar with the ska sound, this album is the perfect introduction to it. *This Are Two Tone* is an uncommonly exciting sampler.

Michael Tearson

Alchemy: Dire Straits **Warner Bros. 25085-1G,** two-record set, $11.98.

Sound: C Performance: B

Most so-called live albums have been painstakingly enhanced in the studio with overdubbing and trickery to make them appear more perfect. This is all the more reason to welcome the notation on the back cover of Dire Straits' live double set, which reads: "This is a recording from one Dire Straits performance. As it contains no re-recordings or overdubs of any kind, there are occasional stage 'buzzes.' "

What is special about the performances on *Alchemy* is that the band does not attempt to merely re-create their studio arrangements. Rather, they use the records as a point of departure from which they extend virtually every song included here. Leader/singer Mark Knopfler reveals himself, more than ever, as a soulful performer who loves to seize the moment and embellish it. His singing is imprecise enough so that each performance is unique, never repeated quite exactly, and he is a brilliantly lyrical guitarist. His cinematic tableaux of songs are excellent vehicles for such extrapolation.

The songs are a fine cross-sampling of Knopfler's work to date. Naturally, "Sultans of Swing" is extended to 10 delicious minutes. Also present are the sprawling "Once Upon a Time in the West," "Telegraph Road" and "Tunnel of Love." "Romeo and Juliet," that West Side Story-type of tale, is here, as are "Expresso Love," "Solid Rock," "Private Investigations," and the rocking "Two Young Lovers." The finale, "Going Home," first appeared as the main theme of Knopfler's gorgeous soundtrack score for the film *Local Hero*.

Yes, there are quite audible warts in the sound, and, yes, I would like to feel a bit closer to the band than I do on *Alchemy*, but the performances are riveting and the band is one of rare musicianship. Their decision to leave things alone was correct.

I've never had the opportunity to see Dire Straits live, but, after hearing *Alchemy*, I'm going to correct this as soon as possible. *Michael Tearson*

EDWARD TATNALL CANBY

RUBATO A LA RUSSE

Rosina Lhevinne Plays Chopin Concerto in E Minor, Op. 11; Schumann: Overture, Scherzo and Finale, Op. 52. Alumni of the National Orchestral Association, John Barnett.
Vanguard (Everyman) SRV 392 (LP) or CSRV 392 (cassette), $3.98.

We are now fast learning the historical power of music recording when combined with the forces of tradition—and a long life. Rosina Lhevinne was a celebrated Juilliard piano teacher right from that institution's founding, along with her equally gifted husband Josef Lhevinne, who died in 1944. Both were top piano virtuosos and for years made a celebrated two-piano team. Both these remarkable people came out of the famed Moscow Conservatory in Russia, back at the turn of our almost-completed century.

Rosina Lhevinne first played this Chopin concerto at the Moscow Conservatory in 1895! And here we listen to the same notes from her fingers nearly 90 years later, recorded in stereo in 1961 at Carnegie Hall. Lhevinne formed her concept of Chopin back when Tchaikovsky was still short of his Pathétique Symphony; other familiar Russians were still around, not to mention Westerners like Dvořák and Brahms. We are thus hearing, in a very real way, through the ears and fingers of the 1890s. If we could move back only another 50 years, we might have Chopin himself. That's how recording extends the power of tradition.

As you will quickly hear, even at 80 this lady was a masterful (mistressful?) pianist of the very top rank, one of those who make difficult music sound simple and straightforward—result of a lifetime of artistic effort. Above all, the music is *right*, unforced, easy—in its mood, in its tempi, in its unassuming quiet, easily rising to the moderate climaxes—and, in particular, in the wondrous way she uses rubato, that slight stylized lingering over many notes that can never be learned from cold print. Plenty of young virtuosos now go in for a lot of it—in the wrong places. You must hear it, absorb it from such as this Rosina, as she learned it from those before her.

Illustration: Rick Tulka

Everyman is now Vanguard's prime label for recordings out of its own earlier years. They are impressive. A bargain, too, at such a price. I should note that Vanguard is one of the very few independent record companies which has survived the entire LP era under the same continuous management, where most of its contemporaries—Westminster, Unicorn, Concert Hall, and so on—are either deceased or long since absorbed into some larger conglomerate. Seymour Solomon, Vanguard's founder, is still in charge.

Note, too, that Vanguard very early established high technical standards, without the fanfare of some other labels but just as memorably. These standards are easily evident in assorted Vanguard reissues, including this one. In the Chopin, the piano is faultless, without distortion or hardness and well balanced against the somewhat skimpy orchestra. That skimpiness is Chopin's doing, not Vanguard's; the accompaniment is at times so skeletal that the orchestra might as well not be there. The piano is what matters.

On side two, evidently from the same 1961 concert, is an all-orchestra work by Schumann, of some rarity and plenty of energy. The semi-pickup orchestra (i.e., put together for the occasion) has plenty of enthusiasm and not much finesse—enthusiasm wins, and the much fuller sound of the Schumann music is well projected. You may be mildly surprised at how different this early stereo is from ours today, which is mostly either multi-miked or cross-miked from a single point. You'll adjust to its sound very quickly and discover that it is good, if milder and with less impact than ours.

These reissues have surfaces that are very quiet, if not silent, and probably much better than those of the original releases. We have moved forward on that crucial LP front. There were a few sudden loud pops, one of which threw my pickup out of its groove; I suspect some sort of sticky stuff adhering to the surface, rather than gouges or embedded micro-pebbles, which probably affected only my pressing. In any case, the combination of low price, quiet surfaces, and classic performance make this disc quite worthwhile.

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Marilyn Horne

I am thrilled with the vocal sound of Ms. Horne's album and pleased with the recording, but the music I find replete with blandness.

The Great Voice of Marilyn Horne. London Jubilee 411.649.1, $6.98.

This is for opera lovers, but some of the rest of us, including a lot of engineering-minded listeners, may find the disc pretty interesting.

Harold Schonberg is quoted, in a list of the top 20th-century voices, as having added Marilyn Horne (and her only) to the great ones of the past—Caruso, Sembrich, Flagstad. The famed "creamy voice" is the only one on that list who is singing now—and recording in the sort of fi that London gives her here, excerpting a batch of different originals. It is indeed an amazing organ if you go for voices. Worth hearing, so close, just as an experience.

Of course there's the agony and the ecstasy. The latter with every note for the opera-minded! The former for those who wince whenever a big opera voice lets go full power. This one does, quite often enough.

Some of the ecstasy might apply to the engineer who marvels at the clean sound of this voice when it emits an overwhelming high note. No trace of edge or coarseness, not in the voice, not in the recording. One might also note how uniformly the excerpts are recorded, though in different places at different sessions. Only the most minor changes from one item to the next, perhaps from Vienna to London. (Or were they all recorded in England? Could be.)

As for me, I am thrilled at the vocal sound and much pleased with the recording, but the music I find replete with blandness, just too white in the harmony and melody. An old story, for a million opera standards. Opera people will violently disagree, of course. There is no right or wrong to it.

I also found Horne's styling disarmingly neutral, about the same whatever she sings, and always with those incredible, startlingly loud high notes to blow your ears. I do not think they are authentic to the music, but merely part of today's way of singing, which happens to be perfect for her.

Mahler: Symphony No. 1 in D. The St. Louis Symphony, Leonard Slatkin. **Telarc DG 10066,** digital, $17.98.

I'm a bit late—this one dates back a couple of years and more. But, as we know, Telarc's quality has been good from the beginning. I just plain wanted to hear the music in a "modernized" version. I knew it all too well from the overfraught, deadly serious recordings and performances that were audible in the early electric era.

The piece is youthful, though not immature; it is long and its construction is complicated. But it doesn't measure up to those monster works beginning with the Fifth and on, the ones that involve vast visions of the cosmos (in artistic terms, not scientific) and enormous masses of performers, to overwhelm even an LP album in size.

Well, let me tell you, this recording brought me, so to speak, a refreshing breeze. Maybe it missed a lot of the great, searching impact of a Bruno Walter or Dmitri Mitropoulos, but it gains in easy coherence and unforced naturalness. Everything is much faster than it used to be—to the good. A few superb details that I remember are smeared or underplayed. Not too many. And the finest virtue of this music, its endless series of good tunes (mostly out of earlier Mahler songs) are just ripping, as the British might say. You'll love them.

Moreover, Slatkin is good at rhythm and phrasing and overall shape; there is little sense of rush or haste in these new speeded-up tempi. Even the frowning doom of the beginning of the last movement, full of terrifying dissonances, gets its way easily at this speed. No problem. Better still, some of the more lugubrious and overfreighted elements (the young Mahler), notably that dismal Frère-Jacques-in-the-minor canon in the slowest movement, are made much more palatable in this offhand and efficient version. What a relief!

Yes, there's still the super-Alpine or Black Forest aspect, full of cowbells and cuckoos and little girls in dirndls—it's all very Germanic, and correctly so. Shades of Grumpy and Dopey and the other Disney dwarfs! Or is it dwarves? But the light touch also improves this somewhat weighty aspect, for today's ears, at least. Under Slatkin, it is all smiles. (Remember, there is a large German population in St. Louis.)

There is also the literary-poetic background of allusion, the sort popular in the 1880s, set forth in relentlessly good-humored detail by the Mahler expert, Jack Diether. You can skip most of it, as I did when I got to a hero, one Albano, who after tragically losing his girlfriend, Liane, "marries her surrogate, Iodine"! Surrogate, my foot—he should have married Miss Mercurochrome.

This time I'll add nothing about the Telarc recording and processing—we all know how good it is, with its three-mike overall pickup and all the rest. Enough to say that Mahler is well suited to the Telarc technique, as is not necessarily true of all composers the company has recorded.

Leonard Slatkin

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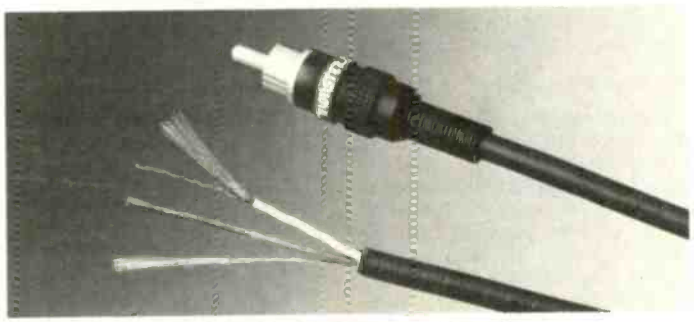

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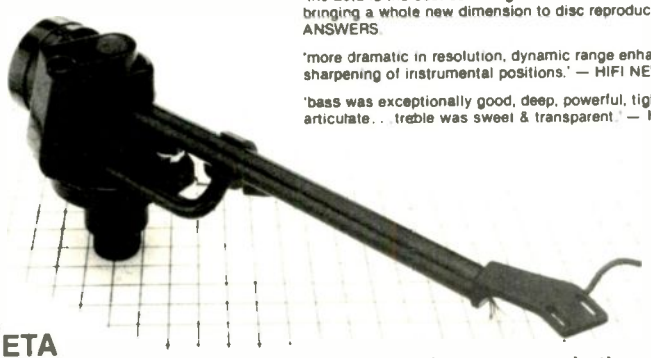

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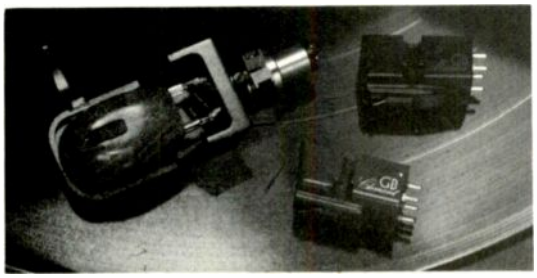

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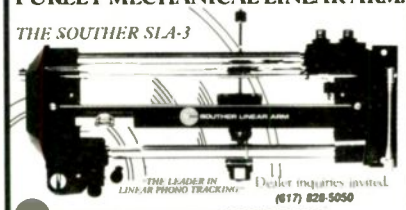

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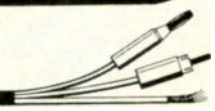

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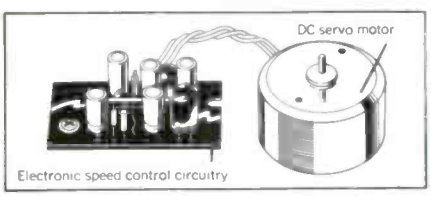

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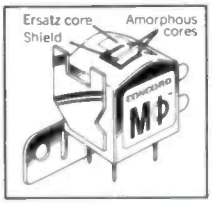

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THE EQUIPMENT AUTHORITY

APRIL 1996

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HDCD
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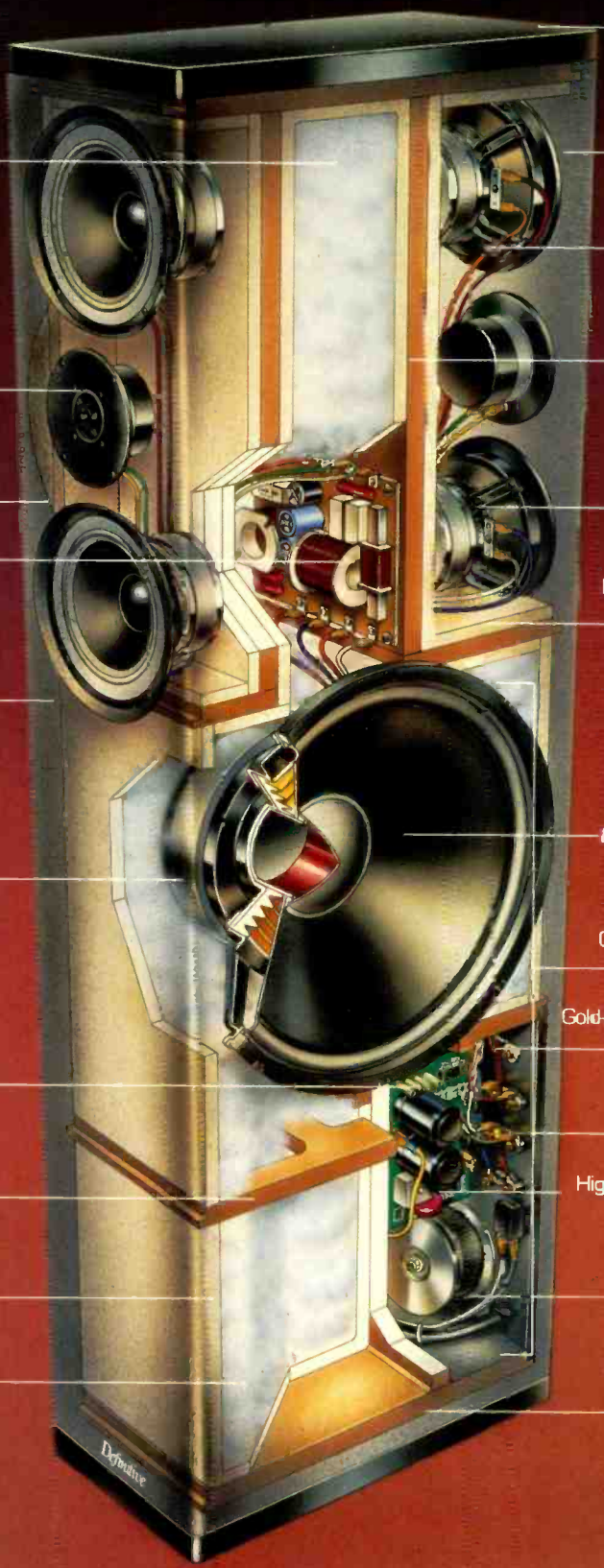

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–Julian Hirsch, *Stereo Review*

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

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AUDIO

THE EQUIPMENT AUTHORITY

Golden Sound Cones, *page 96*

Yamaha AC-3 Decoder, Citation A/V Preamp/Processor, and Yamaha A/V Receiver

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NSM Speaker, *page 50*

Cover Photographer: Bill Kouirinis Studio
Cover Equipment: Yamaha DDP-1 AC-3 decoder, Harman Kardon Citation 7.0 A/V preamp/processor, and Yamaha RX-V2090 A/V receiver

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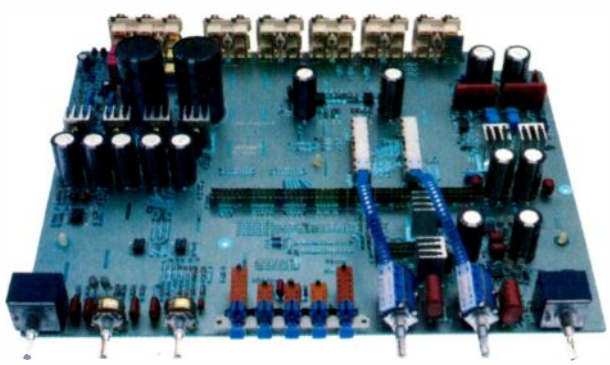

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FAST FORE-WORD

Every once in a while the audio business serves up a real head-scratcher—something that manages to provoke a lot of interest or controversy without, on careful examination, actually amounting to much. The most prominent recent examples I can think of are the alleged consumer version of the DTS multichannel audio coding system (I say "alleged" because it gets talked up relentlessly in some quarters without ever materializing in products people can buy and use) and HDCD. Both have seemed from the beginning to be solutions in search of problems.

HDCD, which gets close scrutiny this issue in "Digital Deliverance" (page 26), does have a leg up relative to DTS because it is a real product. There are a handful of HDCD recordings on the market, and a growing number of outboard D/A converters and high-end CD players either incorporate the HDCD decoder or make it available as an option. But what does HDCD do—and why? Considering how much attention the process has received, it's been astonishingly hard to get answers to those questions. HDCD's developer, Pacific Microsonics, will tell you that it eliminates distortions present in conventional digital audio, that there's a compander in the system, and that decoder operations are regulated by control codes buried in the dither noise. Beyond that, it gets pretty murky. It's not even clear what the distortions that supposedly are eliminated might be. Promotion of HDCD rides on the back of the idea that there is something basically wrong with digital audio as we know it, which some audiophiles and writers now seem to take as an article of faith. (This attitude also fueled some of the early, effusive press on Super Bit Mapping, which was often treated like some sort of magical sonic elixir rather than, accurately but mundanely, a potentially useful technical development in requantization of digital recordings possessing exceptional dynamic range.)

The HDCD recordings I've heard have sounded good when decoded but no better than other good recordings made without the process. They sound *different* when undecoded, which makes sense given that HDCD is supposed to be (ideally) an encode/decode process. That difference is pretty much by definition a distortion, however. And therein lies HDCD's most troubling aspect. It's a bit like somebody throwing a rock through your front window and then offering to repair the damage for a fee. The system is compatible with conventional CD equipment only in the sense that you can still get passable sound from HDCD releases on non-HDCD players. But if you don't have an HDCD decoder, no HDCD recording will ever have a chance of sounding the way it's really supposed to on your system. In the absence of a clear, compelling benefit, is that something we really want?

I don't doubt the sincerity of the folks at Pacific Microsonics or their belief in the system they've created. But I think that HDCD, as it stands now, demands too much for too little return.

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LETTERS

TheaterMaster Made Easier

Dear Editor:

Right after Edward J. Foster's "Equipment Profile" of the EAD TheaterMaster Dolby AC-3 surround processor appeared (March), we introduced the System Controller. This touch-screen remote puts even the most complex operation of the TheaterMaster, and almost all other infrared-operated home theater equipment, a single keystroke away. All operating modes and setups of the TheaterMaster, our new TheaterVision laserdisc player, and our about-to-be-introduced SwitchMaster video switcher are handled by this remote through a series of 18 linked screens. Simplified GUI (graphic user interface) techniques guide the user through even the most complex procedures.

Alastair Roxburgh
V.P., Engineering
Enlightened Audio Designs
Fairfield, Iowa

Kudos to Cordesman, King, and Crew

Dear Editor:

Thanks to Anthony H. Cordesman's informative "Auricle" review of Vandersteen's 3A speaker (June 1995), I auditioned and later bought a pair. Their soundstage and overall range, especially in the deep bass, is a big improvement over my Dahlquist DQ-10s.

At first I was quite upset when the 3As didn't sound as good at home as they did in my dealer's demo room. I then reread the Vandersteen review, noting Cordesman's mention of careful setup, a break-in period of about 100 hours, and that his pair of 3As was equipped with Sound Anchor braces. I bought the braces and, after installation, heard a remarkable difference. The soundstage opened up, and the imaging improved immensely.

I did find the Vandersteens to be less efficient than the DQ-10s. Considering I was driving them with a GAS Son of Ampzilla, I thought more power was needed. After reading Bascom H. King's "Equipment Profile" of the Legacy High-Current amp (April 1995), I bought it along with Legacy's preamp. Although my Legacy amp/preamp combo overshadows the 3As in price, I'm quite happy with the sound.

Thanks again to Cordesman, King and the rest of the staff for helping me assemble my best system to date.

Jeffrey C. Dyer
Columbus, Ohio

Bad Connections

Dear Editor:

I must take issue with Ken Kessler on the subject of connectors ("Mondo Audio," January). The connectors used on audio equipment are at least 50 years behind the state of the art. As Kessler says, the only suitable connector is the so-called XLR Cannon, and that is because it was intended for a battery box used with a movie camera.

Connectors I have used on military and medical equipment were chosen because of their utility, not because of custom or cost. A suitable connector always has a hood to protect the male pins, has a strain relief to protect the wire-to-contact junction, and is shaped to allow insertion only with the proper mate and orientation. It should also have a locking device to prevent accidental removal. The contacts should be gold on gold, mated at high pressure to force a cold weld, or used above 24 volts.

Look at the connectors used on computers, telephones, cellular phones, automobiles, and professional equipment of any sort. They are as safe and reliable as they can be made. It is ridiculous to hook up high-end equipment with RCA jacks and banana plugs; they are just not reliable or safe. And there still isn't a standard speaker connector!

Gilbert A. Johnson
Minnetonka, Minn.

Simple Solutions

Dear Editor:

Several months ago, I bought a couple of JBL Control One Plus speakers for the RCA 27-inch TV in my bedroom. Being lazy, I just hooked these speakers to the TV's speaker jacks directly instead of feeding them through an outboard power amp. Lo and behold, the TV cranks rather well, sans external amp! My wife and grandchildren can detect no distortion at really loud levels.

Last Thanksgiving, I put one of the JBLs atop our small 13-inch TV in the kitchen and got a similar result. Lots of folks are listening to their bad little TV speakers when they can upgrade, via the earphone jack, without going to the trouble of hooking up a power amp. Sometimes less is better.

Along these same lines, my son mounted a fine old JBL D123-4 12-inch speaker in an Altec wall cabinet several years ago. He stuffed it with fiberglass and sealed it up. The result was a speaker that has become a family legend. It's the best-sounding single speaker for vocals that any of my son's cohorts had ever heard. And it's very efficient in the bargain. This speaker system is too big for most uses but remains the family standard for testing out a source of audio.

Don Helgeson
Evanston, Ill.

We Can See for Myles

Dear Editor:

I was stunned recently by a bargain classical CD made with Sony's Super Bit Mapping recording technique. Where can I find information discussing the various labels' recording techniques, as well as an education on analog-to-digital and digital-to-analog conversion?

Cliff Myles
Cleveland, Ohio

Editor's Reply: Compiling individual recording techniques of each label is difficult because they often vary, depending on the artist and producer. However, we can recommend our series by D. W. Fostle on the latest CD mastering technologies ("19 Bits in a 16-Bit Sack," March, and "Digital Deliverance," this issue), which discusses Sony Super Bit Mapping and other similar techniques.

A good reference for A/D and D/A conversion is Ken C. Pohlmann's book, *The Compact Disc Handbook* (A-R Editions, 800/736-0070).—*S.V.C.*

Erratum

An incorrect company phone number was given for JoLida in the "Equipment Profile" of its SJ 302A integrated amplifier (March issue). The correct number for JoLida is 301/953-2014.

Rotel Report 5

Rotel's RSP-980 provides Dolby® Pro Logic® and THX® certified surround-sound decoding, video switching, and audiophile quality preamp functions for two independent zones.

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The RCC-945 — convenience and performance in a six disc CD changer

RSP-980 Processor/Preamp

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"The Rotel RMB-100s deserve serious consideration."
Dayna B., The Audio Adventure, Vol. 2, Issue 2, Dec. 1995

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WHAT'S NEW

AMBIANCE ACOUSTICS SPEAKER

Instead of a woofer, tweeter, and crossover, the California Cube, from Ambiance Acoustics, uses four full-range 4½-inch drivers plus an external equalizer. This equalizer features a 64-Hz bass rolloff filter with an 18-dB/octave slope, an EQ bypass switch, and a tape monitor. An optional "purist" upgrade replaces the standard speaker and equalizer wiring (including circuit-board traces) with silver wiring and adds premium ICs. The California Cube is available in a laminate or painted finish. Prices: $1,995 per pair, including equalizer and prepaid shipping; upgrade, $200 for two speakers and one equalizer.
For literature, circle No. 100

• MB QUART SPEAKERS •

Emulating quick-change artists, the speakers in MB Quart's Domain line have detachable grilles and trim panels. Ten different finishes are offered; depending on the model, the trim you select (and change yourself) will cost from $49.95 to $123.95 per pair ($53.95 each for subwoofers). Shown are the D20 satellite and D1000S powered subwoofer, in honey burl. The D20, with a 5¼-inch woofer and ½-inch titanium-dome tweeter, has a rated frequency range of 70 Hz to 22 kHz. The range of the D1000S, with a 10-inch woofer in a ported cabinet, is specified as 28 to 200 Hz; its amp is rated at 100 watts. Prices: D20, $299 per pair; D1000S, $649 each.
For literature, circle No. 101

AudioSource Subwoofer

The AudioSource SW 8 powered subwoofer is rated to deliver response down to 20 Hz from an 8-inch driver in a vented cabinet measuring only 11½ x 15 x 14 inches. The built-in amplifier, rated at 50 watts rms, has both line- and speaker-level inputs and outputs. Adjustable crossover frequency (50 to 180 Hz) and subwoofer level controls help you match the SW 8 to a wide variety of speakers, as does a polarity switch. The electronics automatically turn on when signal is present and turn off a few minutes after the music ends. Price: $299.95 each.
For literature, circle No. 102

TDL Speaker

Standing 4 feet tall, the Studio Monitor M is among the latest transmission-line speakers from TDL. The transmission line provides loading for an 8 x 12-inch oval woofer with a glass-reinforced polystyrene diaphragm. The other drivers are a 6-inch aluminum-diaphragm midrange and a ferrofluid-cooled 1-inch magnesium-alloy dome tweeter. Rated impedance is 8 ohms; sensitivity is 87 dB for 1 watt at 1 meter. Walnut and black-ash finishes are available. Price: $6,500 per pair.
For literature, circle No. 103

ADVENT SPEAKER

At the top of Advent's new B_2R (Bach to Rock) line, the Jade is a two-way speaker with a shielded 8-inch long-throw woofer and 1-inch dome tweeter. Overall frequency response is rated as 43 Hz to 21 kHz, ±3 dB. Sensitivity is 89 dB, and recommended power is 10 to 125 watts (400 watts peak). Price: $449 per pair.
For literature, circle No. 104

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AUDIO CLINIC

JOSEPH GIOVANELLI

Midrange Output from a Subwoofer

Q *Even though my subwoofer is fed frequencies only below 125 Hz, I can still hear most of the information above this point, albeit at much lower levels. I tested this by passing a 1-kHz tone from a test CD through the sub alone, and I was able to hear it clearly. Do I need to use an electronic crossover network rather than the passive networks I now use in order to prevent these frequencies from being heard?*—Paul Hanley, Jersey City, N.J.

A Crossovers don't chop off frequencies above or below the crossover point; they roll those frequencies off. If your crossover is a first-order type, which rolls off at 6 dB per octave, the signal fed to your subwoofer would be only 18 dB lower at 1 kHz than it is at 125 Hz (though the woofer may have some additional rolloff of its own). With a fourth-order crossover, which rolls off at 24 dB per octave, the level at 1 kHz would be down 72 dB, but even that might be audible if the original signal were loud enough. If you feel the need for a steeper rolloff than you're getting, you'll need a steeper crossover; you can use either a passive or an electronic type. On the other hand, if the leakage through the subwoofer is apparent only when the main speakers are disconnected, there may be no real advantage to changing

Shielding TV Sets

Q *In the past, you've discussed how to shield a TV set from nearby speakers by using thin sheet iron or sheet steel. I bolted four pieces of 16th-inch sheet metal to the underside of the shelf that holds my center-channel speaker. That gave me an undistorted picture, but only if I moved the speaker nearly all the way to the back of the shelf. I wanted to put the speaker as far forward as possible.*

When I wrote to you about this, you suggested magnetizing these sheets with a permanent magnet (first moving the shield and the TV apart, of course). Your advice was right on target. I magnetized the bottom plate with a magnet from a hefty 10-inch woofer, which cleared up 80% of the problem; I still got a bit of picture distortion when I moved the speaker back and forth on the shelf. But tilting the rear of the loudspeaker up, to aim it at the listening position, eliminated the picture distortion and put the speaker at the front edge of the shelf, right where I wanted it. Thank you for your advice.—Wayne A. Pflughaupt, Katy, Tex.

A The reason this works is that magnetizing the sheets increases their permeability to magnetic fields, which improves the shielding.

High-Output Cartridge into MC Input

Q *I want to add a second turntable and use a mono phono cartridge whose rated output is 22 millivolts for a 1-kHz recording at 10 cm/sec. My preamp's moving-magnet phono input is already in use. I have a moving-coil input available, but its sensitivity is 100 microvolts. The MC input's impedance is 50 ohms; the cartridge's required load depends on the type of equalization needed. What kind of network could I use to match the cartridge to this MC input?*—Name withheld

A I'm not at all convinced you can do this without serious overload, but here's a possibility: Use a Y connector to feed your cartridge's mono output into both the left and right MC inputs. Then put a 47-kilohm resistor in series with the "hot" lead from the cartridge. This should form a voltage divider with the preamp's 50-ohm input, reducing the signal going to the preamp. It should also satisfy the cartridge's load requirements, flattening its response so you can use your preamplifier's RIAA equalization.

If this doesn't work, you'll have to make a shielded switchbox that lets you select either your regular stereo cartridge or the mono cartridge to feed to your MM input. If you like, you can wire the mono cartridge so that its output feeds both channels. Paralleling the two channels this way will alter the frequency response a bit, giving you a peak followed by a rather fast rolloff; if you're playing 78s, this could be desirable, however. If you want flat response from the cartridge, put a series resistor of about 22 kilohms between the cartridge's hot lead and the switch. You'll lose about 6 dB of signal, but chances are that will also be to your advantage.

Equalizing 78-RPM Records

Q *I'd like to transfer my 78-rpm records to tape. I think I could really do a good job if I had information about the various recording curves used by record companies when they were producing these discs. (Most of my records are from the '40s and '50s, with a sprinkling of discs from the '30s.) Where can I find this information, and can I use my stereo third-octave equalizer somehow?*—Harry R. Porter, Louisville, Ky.

A I don't know of any books that include the information you're seeking. But I can tell you from experience that published curves won't be very useful, because you can tell just by listening that many companies' curves varied from record to record within the same time frame. On the other hand, once you have a setting for a given record company, you will need to depart from it only occasionally.

When I transferred my 78s to tape, I started with my preamp's standard RIAA curve, which was designed for LPs. I fed my preamp's output to a graphic equalizer and, listening for the most lifelike sound, made adjustments by ear for each record. If you try this, you might want to have a friend listen with you, to get a second opinion.

Since there's probably no bass below 40 Hz on any of your discs, you can turn your equalizer's lowest band all the way down, which will reduce rumble quite a bit. If this low-frequency cut intrudes into the next octave, you might need to boost that octave just a bit. In many cases, you may need to reduce bass between 100 and 200 Hz in order to avoid boominess. Keep in mind that you will also be starting with the RIAA

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

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David Ranada, Stereo Review, January, 1996

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What Hi-Fi?, Great Britain. February, 1996

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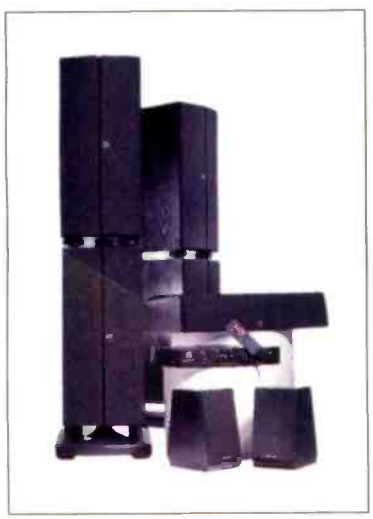

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curve, which boosts bass—often more than is needed for 78s.

I roll off highs above the highest frequency on the discs (usually 10 or 12 kHz), to minimize background noise. You may wish to boost highs somewhere below this cutoff point.

You may find that you'll be reducing frequencies in the region of 2 to 3 kHz, to compensate for the record producer's idea of what sounded good on phonographs of the day.

Experiment! It's amazing what a small change in settings, sometimes just 2 to 3 dB, can make.

This technique of equalizing for the difference between a record's correct playback EQ and the RIAA curve is also the basis of a commercial product from Esoteric Sound (4813 Wallbank Ave., Downers Grove, Ill. 60515). The Re-Equalizer ($310) comes with data on suggested settings for various companies' recordings (and was reviewed in the November 1985 issue).

Slow Preamp Warm-Up

Q *When I first turn my preamp on, the left and right channels fade in and out but not in unison. It takes approximately 5 minutes for the unit to operate properly. There is no reliable repair shop in my area, and I am reasonably good with electronics; should I repair the preamp myself?*—Grant W. Prokop, Winnipeg, Manitoba, Canada

A This sounds to me like a real challenge, because your problem has many possible causes. I would not proceed without first getting your preamp's service manual.

Dirty controls or poor solder connections can cause this problem, as could a defective IC.

If your amplifier has a volume or gain control, you may be able to use it as a signal tracer. Connect a test lead to the amp's input through a capacitor of about 10 microfarads. Use this lead to check various stages of the preamp, working from input to output, until you find the one that's acting up.

You might also want to measure voltages, to see if they change during warm-up. Perhaps the power supply is slow in coming up to voltage on one channel. If you get really frustrated, you might want to replace ICs without regard to which one is causing the problem. But this is easier said than done if the ICs are soldered to the board rather than socketed, and it is often difficult to obtain the proper ICs.

Turntable Safety

Q *While I admire the sonic qualities of belt-drive turntables, I worry that those thin little belts will let go, allowing the heavy platter to spin across the room at a wicked 33⅓ rpm. Do you know of a turntable I can rely on not to do this?*—B. Wildered, Fanwood, N.J.

A I have recently been informed that Lirpa Laboratories is developing a turntable that will offer the utmost in security, thanks to a revolutionary belt-and-suspenders drive.

Static "Pops"

Q *On cold winter days when the air is dry, I have noticed static buildup that causes a popping noise when I touch my components. Is this harming any circuits?*—Sal Rosselli, Leominster, Mass.

A I don't think you have anything to worry about. And if you touch a grounded object just before you touch your components, the problem will go away.

Improving Car-Speaker Gaskets

The gaskets I've seen supplied with car speakers are thin, hard, and cardboard-like. These gaskets don't readily conform to the often irregular surfaces surrounding typical loudspeaker cutouts and can't keep speaker vibrations from being transmitted to the mounting surface. Worse, some drop-in speakers have no gasket at all.

When I heard considerable buzzing from my rear-shelf car speaker, I removed it and applied a liberal thickness of silicone rubber around its periphery, to form a resilient gasket. I used a layer about ¼ to ⅜ inch thick and about ⅜ inch wide, mounted on top of the original gasket. This eliminated the vibration. It also created a really air-tight seal, which is important for good bass response. The same approach could be applied to drop-in car speakers by forming a silicone gasket on the underside of the speaker rim. I wouldn't be surprised if this same technique might improve the performance of some home loudspeaker installations. It seems to me that manufacturers could supply better gaskets, maybe even just as add-ons.—Ken Massey, Indianapolis, Ind. A

MONDO AUDIO

KEN KESSLER

BREAKFAST OF HIGH-END CHAMPIONS

Illustration: Danuta Jarecka

Consumer Electronics Shows might rightly be all about new products ready for the shops, but an aspect that's rarely covered in hi-fi magazines is industry maneuvering. Whether or not it means anything to you if you don't earn your living from hi-fi is another matter, but certain events that took place in January at the Las Vegas CES just might influence your audio future. Such affairs occur in and around the Show, often after hours, or—in the case of the AAHEA meeting—before hours.

The Academy for the Advancement of High End Audio is one of the only organizations in the world that exists solely to promote high-end audio beyond the audience of the converted. You don't have to think hard to realize why we need it. The home entertainment scene has changed radically since digital technology stripped away the soul, the hobby element, and the passion. The advent of home cinema? Yet another attempt to turn audio equipment into run-of-the-mill appliances, divorced from any semblance of quality or intellect. Meanwhile, AAHEA is fighting a rear-guard action designed to keep pure audio—that is, sound-only, music-for-music's-sake hardware—in front of the public. Pure audio will never again have the glamour it possessed in the '60s and '70s. It can never compete in the minds of the knuckle-draggers who want five channels' worth of Arnold-induced explosions, but some of us still like our music without cinematic accompaniment. Which almost explains why the most oft-heard demo laserdisc at the Winter CES was The Eagles' *Unplugged* in sound-only mode.

CONCERNS SHOWN FOR THE STANDARDS APPLIED TO THE SOUND CARRIER OF THE FUTURE ARE VERY REAL.

Whatever, the AAHEA breakfast meeting was a real ear-opener after a couple of years of ho-humminess. Ordinarily, one asks one's self, "Why on earth did I get up for an 8 o'clock meeting to listen to self-serving drivel about room prices at CES and parallel importing into Bucharest?" Good question. But invariably you always answer, "Because I care about the high-end audio industry." And so you rationalize your way through another 90 minutes even more boring than your typical Merchant-Ivory flick. Except this year's meeting was a shocker, and not just because the Academy's president stood up and spoke like a leader rather than an apologist.

Previously discussed in this column (January) are the CE regulations, the European directives designed to turn hi-fi into, well, crap. But safe crap. It emerged that the EIA (Electronic Industries Association), AAHEA, and all manner of industrious individuals have been doing their best to assist any American manufacturers who didn't understand what these regulations meant, how they could be addressed, how the testing was to be undertaken, and whatever else was involved in ensuring that American-made high-end equipment would still be available in Europe after January 1, 1996.

One day, a statue will be erected in honor of Mike Elliott of Counterpoint, who (unpaid and barely as-

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WAYNE: LEHMAN'S • HUNTINGTON: LEHMAN'S • LAFAYETTE: PRO AUDIO • WABASH: WORLD SCAN • KS: WICHITA: CUSTOM SOUND • KY: LONDON: THE SOUND GARDEN • LA: BATON ROUGE: ART COLLEY'S • LAFAYETTE: THAT'S ENTERTAINMENT • NEW ORLEANS: WILSON AUDIO • MA: ARLINGTON: STEREO SHOP • CAMBRIDGE: O AUDIO • NORTHAMPTON: TRIPOD AUDIO • SUDBURY: ELECTRIC GRAMOPHONE • WORCESTER: O'COIN'S • MD: BALTIMORE COUNTY A/V • ME: SCARBOROUGH: NEW ENGLAND HI FI • MI: DEARBORN: ALMAS HI FI • DETROIT: PECARS • FARMINGTON HILLS: ALMAS HI FI • FLINT: STEREO CENTER • GRAND HAVEN: BEKINS A/V • GRAND RAPIDS: STEREO SHOWCASE • IRON MOUNTAIN: SOUNDNORTH • KALAMAZOO: STEREO SHOWCASE • PETOSKEY: PUFFS • ROYAL OAK: ALMAS HI FI • TRAVERSE CITY: SOUND ROOM • TROY: PECAR'S • MN: ALEXANDRIA: SOUND SHOP • BEMIDGI: OVERBEEK ELECTRONICS • MINNEAPOLIS: STEREOLAND • ROCHESTER: AMALGAMATED A/V • WILLMAR: SOUND IMAGE • MO: COLUMBIA: D & M SOUND • SPRINGFIELD: GREYSTOKES • ST. LOUIS: HI FI FO FUM • MS: STARKVILLE: IDEAL ACOUSTICS • MT: BILLINGS: U.S. TECH • MISSOULA: STEREO PLUS • NC: ASHEVILLE: A/V CHAMBER • CHARLOTTE: PREMIER A/V • DURHAM: AUDIO VISIONS • WILMINGTON: A/V WORLD • WINSTON SALEM: PLATINUM AUDIO • ND: FARGO: TODAY ELECTRONICS • MANKATO: TEAM ELECTRONICS • NE: GRAND ISLAND: VIDEO KINGDOM • OGALLALA: VIDEO KINGDOM • OMAHA: STEREO WEST • NH: NASHUA: ENSEMBLE • NORTH HAMPTON: NEW ENGLAND HI FI • NJ: BERNARDSVILLE: STEVEN'S AUDIO • BLOOMINGDALE: SOUND CITY • CHERRY HILL: HI FI SALES • E. BRUNSWICK: ATLANTIC STEREO • FLEMINGTON: PROFESSIONAL VIDEO & SOUND • FREEHOLD: ATLANTIC STEREO • MIDDLETOWN: STEREO DYNAMICS • PARAMUS: RABSONS A/V • POMPTON PLAINS: SOUND CITY • SOMERVILLE: SOUND EXCHANGE • TOWACO: SOUND CITY • WEST NEW YORK: PARK PLACE • NM: ALBUQUERQUE: ABSOLUTE AUDIO • LAS CRUCES: DESERT SOUND • NV: RENO: WILD WEST • NY: ALBANY: ALTAIR AUDIO • COMMACK: SOUND APPROACH • GREAT NECK: SOUND EFFECTS • HAMBURG: SOUTHTOWN A/V • ITHICA: GALLAGER • JOHNSON CITY: OLUMS • LAKE GROVE: AUDIO DEN • MT. KISCO: AUDIO OUTLET • NEW YORK: AUDIO SALON • A/V CENTER • PARK AVENUE • SOUND CITY • PLEASANTVILLE: AUDIO EXCELLENCE • ROCHESTER: ROWE A/V • SYRACUSE: GORDON BROTHERS • WATERTOWN: HAPPY EAR • WEST BABYLON: AUDIO VISIONS • OH: AKRON: OHIO SOUND • CANTON: BELDON AUDIO • CINCINNATI: OHIO VALLEY AUDIO • DAYTON: AUDIO ETC • DUBLIN: AUDIO ENCOUNTERS • TOLEDO: JAMIESON'S STEREO • OK: BARTLESVILLE: SOUND STATION • MIDWEST CITY: AUDIO MIDWEST • STILLWATER: AUDIO S&V • OR: BEND: STEREO PLANT • EUGENE: ADVANCED AUDIO • PORTLAND: FRED'S SOUND OF MUSIC • ROOM SERVICE • SALEM: ADVANCED AUDIO • HEAR NO EVIL • PA: BROOMALL: HIGH FIDELITY HOUSE • CAMP HILL: HI FI HOUSE • CHAMBERSBURG: LINCOLN LECTRONICS • EPHRATA: STEREO BARN • GREENSBURG: STEREO SHOP • HARRISBURG: HI FI HOUSE • JENKINTOWN: STEREO OUTLET • JOHNSTOWN: CONNECTING POINT • LANCASTER: GNT STEREO • MCMURRAY: GOOSEBUMPS • MONTGOMERYVILLE: WORLD WIDE • PITTSBURGH: AUDIO GALLERY • WORLD WIDE STEREO • STATE COLLEGE: PAUL & TONY'S • WHITEHALL: PALMER AUDIO • RI: PROVIDENCE: STEREO A/V CENTER • SC: COLUMBIA: SOUND ADVICE • GREENVILLE: AMERICAN AUDIO • HILTON HEAD ISLAND: A/V ARCHITECTS • MT. PLEASANT: PEACHTREE • SD: BROOKINGS: ZEPHYR AUDIO • SIOUX FALLS: ENTERTAINMENT DIRECT • TN: JOHNSON CITY: MR. TOADS STEREO • KINGSPORT: AMERICAN VIDEO • KNOXVILLE: STATEMENT A/V • MEMPHIS: MODERN MUSIC A&V • TX: AMARILLO: AUDIO VISIONS • AUSTIN: AUDIO BY DESIGN • BRYAN: SOUND WAVES • CORPUS CHRISTI: ABSOLUTE A/V • DALLAS: HILLCREST HI FI • HOUSTON: ALL STAR AUDIO • GROOVE A/V • LUBBOCK: SOUND WAVE • MCALLEN: AUDIO PLUS VIDEO • MIDLAND: MIDLAND SOUND • SAN ANTONIO: AUDIO CONCEPTS • SAN MARCOS: DISCOVERY AUDIO • SHERMAN: WORLD WIDE • TYLER: S&V CENTER • UT: PROVO: AUTO SPECIALTIES • VA: BLACKSBURG: SCOTTY'S • CHESAPEAKE: DOMES • OAKTON: MUSICSCOPE • VT: WILLISTON: CREATIVE SOUND • WA: BELLEVUE: DEFINITIVE AUDIO • EVERETT: AUDIO WAVES • KENNEWICK: QUICK SILVER AUDIO • PULLMAN: OPTIMUM SOUND • SEATTLE: DEFINITIVE AUDIO • SPOKANE: S&I INTERIORS • WI: APPLETON: SUESS ELECTRONICS • GREEN BAY: HI FI HEAVEN • MADISON: UNIVERSITY AUDIO • MILWAUKEE: AUDIO EMPORIUM • RACINE: AL'S STEREO • SHEBOYGAN: ABSOLUTE S&V • WASHBURN: AUDIO WORKS • WV: MORGANTOWN: SOUND INVESTMENTS • WY: CHEYENNE: NOW HEAR THIS • LARAMIE: KEN'S MUSIC BOX •

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"Stunning!"
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"Awesome!"
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CIRCLE NO. 19 ON READER SERVICE CARD

sisted) set out to make certain that any of his colleagues—and that means his competitors—in need of assistance could turn to him for lucid explanations and guidance. Mike provided an update at the meeting while exhorting those present not to ignore the threat that the CE directives pose to all hi-fi manufacturers wishing to trade in Europe. Honestly, the man should run for office. And any who heard him who still choose to ignore the warnings will deserve what they will get, which is a total loss of access to a market of 300 million people.

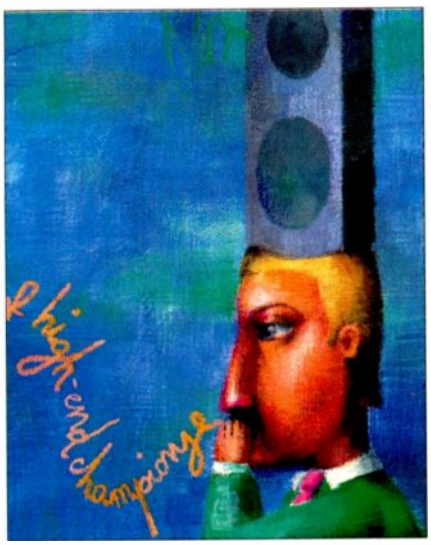
During the show, I talked to a number of manufacturers that I know have a serious European presence and asked them if all of their products were CE-approved. As I'd hoped, the larger and more professional manufacturers had everything covered: Counterpoint (as you would expect, given Elliott's crusade), Audio Alchemy, Krell, Madrigal (the Proceed and Mark Levinson brands), and dozens more assured me that their wares would be wearing the requisite certificates. Ironically, it was a British manufacturer (who shall remain nameless) who told me that he discontinued a handful of models rather than modify them for CE approval because the mods would have ruined the products and the cost was prohibitive: It would have pushed the models' retail prices up into the next level.

I was even treated to a glimpse of a CE-ready alternative to the conventional and probably-to-be-banned multiway binding posts by Stu Wein of SW Marketing; he produced from his box of samples a neat chassis-mount binding post that offers full compliance with CE standards, along with a neat side-entry slot to accept spade connectors. Manufacturers who are worried about connector status vis-à-vis the CE rules should contact Stu by fax at 215/953-7483 or via e-mail at swmktg@ix.netcom.com.

And leave it to Dan D'Agostino of Krell to go all the way, by designing a new speaker terminal for the next generation of Krell amplifiers. This stout binding post features what looks like the center section of a Mercedes emblem as the screw-down portion. Lastly, on the matter of CE regs, Karen Sumner of Transparent Audio said she was ecstatic about CE regulations if it meant that she could terminate all of the company's speaker cables with spades; she, for one, detests banana plugs. (Sumner,

by the way, is in charge of AAHEA's long-overdue drive for foreign members. It's about time the organization realized that the world does not end at the Golden Gate Bridge and Long Island.)

But it was Bob Stuart of Meridian who alerted the assembly to what might be perceived as the biggest threat to the future of high-quality music playback: the forthcoming setting of standards for the audio-only version of the DVD. Bob is the chairman of Acoustic Renaissance for Audio (ARA), an organization founded by Hirokazu Negishi of Canon. The ARA's purpose is to act as an independent watchdog, trying, for example, to keep the major corporations from settling on shamefully low standards for new formats, as is their wont. The current target of the ARA's scrutiny is the audio-only application of DVD, also known as the High-Density Audio Disc, or HDAD.



THE ARA AND AAHEA WILL GO DOWN IN HISTORY AS VOICES THAT SPOKE OUT AGAINST MEDIOCRITY.

While conspiracy theorists love to wallow in such stuff, the concerns shown for the standards applied to what probably will be the sound carrier of the future are very real. There are four proposals on the table, not all of which are available for public scrutiny, and the headlong rush to quickly establish the standard smacks of the kind of political machinations that really happen only in the movies. Indeed, by the time this issue reaches the street, the standards will have been set, and heaven help us if the lobbying of a certain giant Japanese firm is enough to shove the poorest one down our throats.

Bob Stuart, along with Tom Holman (of THX fame), briefly explained what's on the table; we all knew what was at stake. The necessary background fills a 23-page ARA document, but Stuart explained succinctly what the high end should support; there was remarkably little dissent. (I don't wish to identify the guy who sat behind me, grumbling and muttering under his breath. Suffice to say, the words "vested" and "interest" spring to mind.) Stuart's plea was for AAHEA to draft a letter stating categorically what format the high-end manufacturers want to see implemented, the urgency created by a March deadline. The curious nature of publishing means that I have a copy of the proposed letter from the Academy before me, but it's not supposed to be made public yet. Of course, this column will appear long after these decisions are made.

What I can tell you is that AAHEA has lent its support to an HDAD system based on elements of the ARA proposal, calling for: (1) multichannel capability using a minimum of six channels of uncompressed or losslessly compressed data; (2) 88.2- and 96-kHz sampling rates; (3) a minimum of 20-bit resolution, expandable to 24-bit; and (4) pulse-code modulation rather than "bitstream" (delta modulation). The Academy's letter also addresses such points as backward compatibility and requirements for compatibility with first-generation DVD players. But, above all, it is based on a consensus that has determined the preceding recipe as the one to go for if sound quality is to be preserved.

As I said before, you'll likely know which way the industry went by the time this sees print. And you'll likely also know if your future holds the promise of realistic music reproduction or mere digital noise. Either way, the ARA and AAHEA will go down in history as the voices that spoke out against mediocrity. That's no consolation should we inherit a digital turkey, but it kinda makes me proud that I paid my dues again this year. A

IVAN BERGER

THE BUZZ OF THE BIZ

If you'd asked me last year what buzzword would dominate the 1996 Winter Consumer Electronics Show (WCES), I'd have said AC-3. I'd have been wrong. The Dolby Digital 5.1-channel surround format, based on the company's AC-3 audio compression system, *was* all over the show. But the biggest buzzword was DVD (originally Digital VideoDisc, now unofficially called Digital Versatile Disc by some).

I hadn't expected DVD to take this show by storm because, for most of last year, two mutually incompatible DVD formats were vying for support. Both the Sony/Philips Multi-Media CD (MMCD) and the Toshiba/Time Warner SD systems could pack about seven to 25 times as much data as a CD onto a CD-sized disc. Each had its own technical advantages, so the battle could have gone on for years (remember LP versus 45? CD-4 versus SQ? VHS versus Beta?). But for once, the opposing sides managed to work out a compromise format, and quickly.

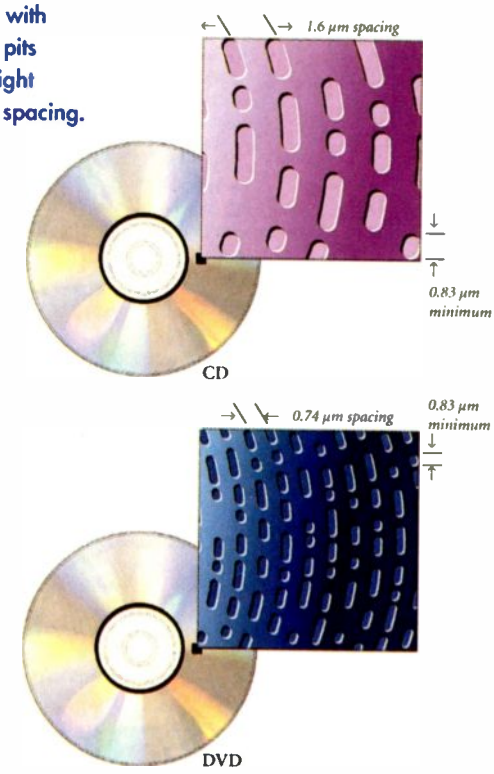
DVD PROMISES TO BE THE SINGLE MEDIA SYSTEM THAT CAN REPLACE EVERYTHING.

The January show brought DVD promises, prototypes, and preproduction samples from Onkyo, Panasonic, Philips, Pioneer, RCA, Sony, Toshiba, Zenith, and several others. The players should arrive later this year, at prices variously quoted from $500 to $900. About 400 to 500 movies should be available on DVD at launch time; even pessimists predict 125 titles.

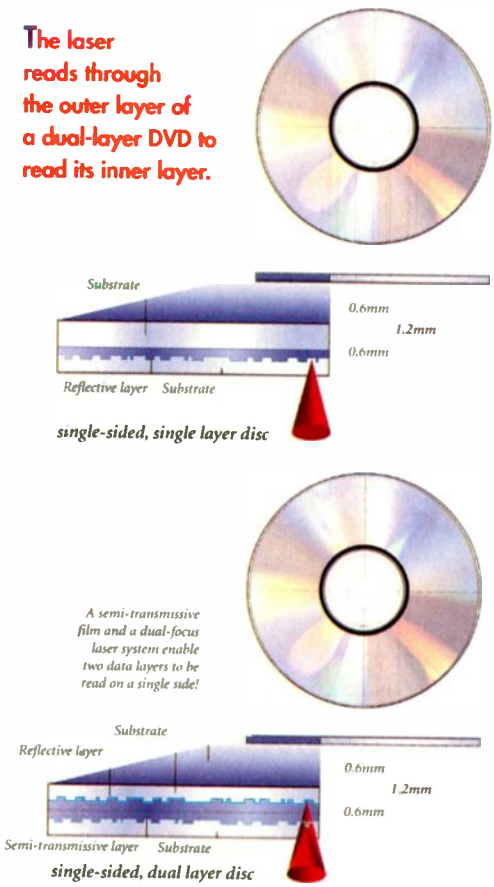
This far exceeds the initial enthusiasm for CD. But DVD promises to be the single media system that can replace everything: laserdisc, CD, CD-ROM, and ultimately perhaps even videocassette. As a replacement for laserdisc, DVD will offer higher picture quality, digital surround sound (using Dolby Digital AC-3 encoding in this hemisphere and other NTSC markets), more compact storage, the convenience of complete movies on one side of the disc, and more. For audiophiles, DVD players will be able to accommodate audio CDs, with the possibility of super-audio discs to come. In computer use, DVD-ROM drives will play today's CD-ROM discs as well as new discs with much greater data storage capacity and the ability to deliver substantial amounts of high-quality, full-motion video. And recordable DVD, due later, may eventually let us time-shift programs, the way we now do with our VCRs, and permanently archive our camcorder footage (after editing, I hope).

In part, DVD's immense capacity stems from the use of shorter laser wavelengths, shallower disc substrates, and dual-layer technology.

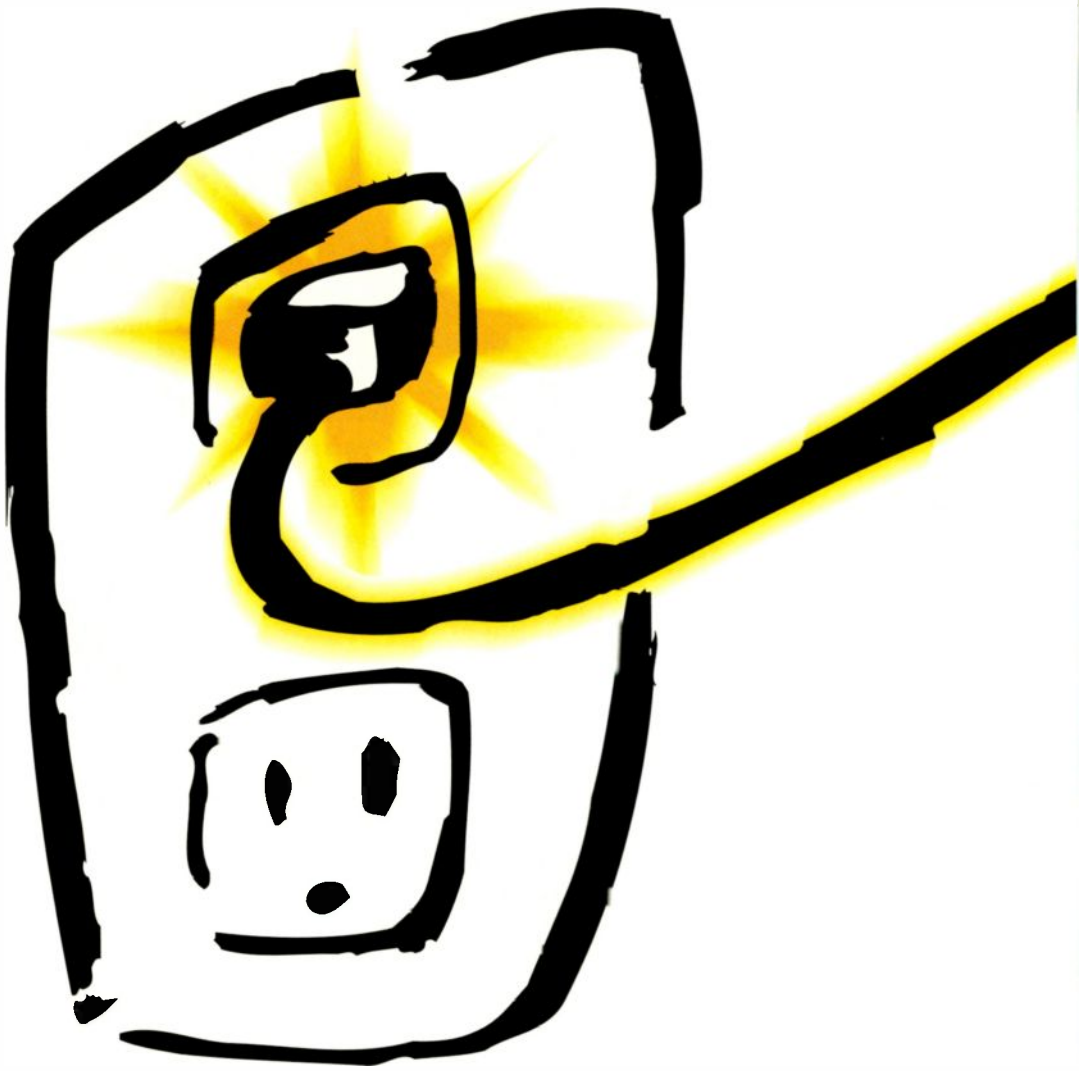
In DVD, high data density starts with small pits and tight track spacing.



The laser reads through the outer layer of a dual-layer DVD to read its inner layer.



Illustrations: Courtesy of Sony



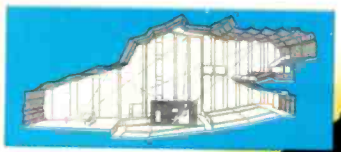
We've spent 10 years connecting people to
the greatest advancement in Home Theater technology.

YAMAHA DSP
10th
1986–1996

1996 marks the 10th anniversary of Yamaha's introduction of our unique digital sound field processing technology. Many years in development, this technology was the first of its kind and remains unique to this day.

There's DSP. And then there's DSP. From the very beginning, Yamaha digital sound field processing has been different than digital *signal* processing. Rather than simply creating a computer model for what a performance venue might sound like, Yamaha engineers literally travelled the world digitally analyzing very specific venues. A stadium. An intimate jazz club. A gothic cathedral. A concert hall. And many others. We used four microphones, carefully located in each venue to precisely measure the level, direction and exact timing of individual sound reflections. The result is perhaps the most realistically accurate reproduction of live performances ever devised. But right there in your living room.

1986 Yamaha introduces the DSP-1 digital sound field processor. For the first time, a component recreates digitally sampled music halls in the home. It includes a setting for Dolby Surround. Critics call DSP "the most significant advance in the control of auditory space since stereo." The show begins.



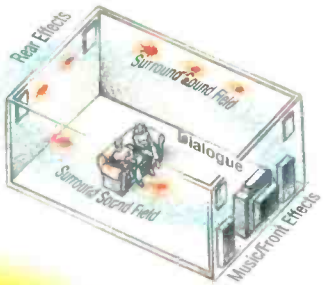
1987 Yamaha engineers embark on a new United States sound field sampling tour. Meticulously setting up a battery of carefully placed microphones and digitally sampling the sound fields of Anaheim Stadium and the Roxy Theater in California. The Village Vanguard, Village Gate and Riverside Church in New York. Orchestra Hall in Chicago, among others.

1988 The DSP-3000 is introduced. Many of the venues sampled in 1987 are incorporated as new programs, computer-modeled sound fields specifically designed for home theater applications are added. On-screen display and master volume control are also incorporated for the first time.

1995 Headlined by the RX-V2090, Yamaha introduces a new series of A/V receivers, with five models featuring DSP and Cinema DSP and ranging in price from $1,499 to $399. The flagship, RX-V2090, is the company's first 7-channel A/V receiver and is ready for the next step–Dolby Surround AC-3. All five units receive critical acclaim, with the RX-V2090 lauded as "A blockbuster product!"

And now, the next generation of Cinema DSP. AC-3, very simply, is the spectacular home version of Dolby Digital Surround found in the best movie theaters. Technically, it includes five discrete, full-bandwidth channels plus a sixth subwoofer channel. Yamaha combined Dolby Surround AC-3 with our own unique DSP to create "Tri-field processing," including presence and left and right surround fields, reproducing movie sound tracks with unequalled positioning, depth and realism. Essentially, Yamaha's DSP acoustically enlarges the listening room to that of a large movie theater. What you hear is exactly what a film's director intended you to hear. The new generation Cinema DSP represents the absolute state-of-the-art in taking the movie theater experience home.

Then came Cinema DSP.
Yet another milestone in audio history. Only Yamaha Cinema DSP (a combination of Digital Sound Field Processing and Dolby Pro Logic) creates phantom speakers to fully replicate the rich, full, exciting sound of a multi-speaker movie theater. Which means you'll hear sounds coming from virtually every place in your room. Even in places that have no speakers.



Phantom Speaker Effect

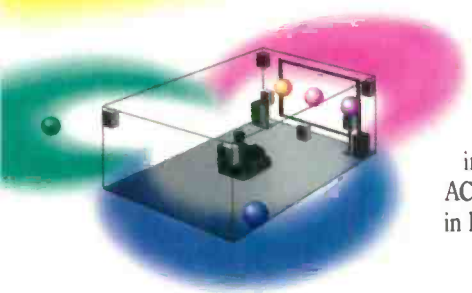
1990 The 7-channel DSP-A700 is introduced. For the first time DSP is included with on-board amplifiers. Dolby Pro Logic is added for more realistic movie surround.

1991 The DSP-A1000 breaks new ground. Hailed as "the only electronics you'll ever need for surround or home theater," the A1000 provides the most versatile control and switching yet on a Yamaha product. It's also the first Yamaha component to provide digitally processed Dolby Pro Logic and Cinema DSP with "Pro Logic Enhanced" and "70mm Theater" settings. Additionally, our RX-V1050 and RX-V850 become our first 5-channel A/V receivers with DSP.

1993 The DSP-A2070 is introduced, with newly developed IC chips for greater sound resolution, and more 70mm Cinema DSP movie modes. Critics hail "simply the best!" "Does everything." "The best integrated A/V component ever created." Four new A/V receivers are also added, all featuring 35mm Cinema DSP and two with 70mm Cinema DSP modes.

1994 Yamaha's DSP-A780 provides the versatility and processing of 7-channel processor/amp in a 5-channel format.

1996 Yamaha celebrates its 10th Anniversary of DSP with a spectacular new product. The DSP-A3090. A 7-channel DSP processor/amplifier which, for the first time, includes built-in Dolby Digital Surround AC-3 and Yamaha's own DSP enhancement to truly make the home theater as spacious as a movie palace. Using the power of DSP, five additional AC-3 programs are engineered, including AC-3 Enhanced and AC-3 Spectacle. The next decade in DSP is under way.



YAMAHA DSP 10th 1986 - 1996

RX-V2090 7-Channel A/V Home Theater Receiver. 100 watts output L/C/R channels. 35 watts x 4 Front and Rear Effects. Multi-room, multi-source capability. Discrete 5 channel input for Dolby Surround Digital AC-3. 10 DSP programs.

DDP-1 Dolby Surround Digital AC-3 Processor. Built-in AC-3 RF demodulator for AC-3 laser disc players. For use with the Yamaha RX-V2090 Receiver.

RX-V890 5-Channel A/V Home Theater Receiver. 100 watts output L/C/R channels. 25 watts x 2 Rear Effects. 10 DSP programs.

RX-V690 5-Channel A/V Home Theater Receiver. 80 watts output L/R/C channels. 25 watts x 2 Rear Effects. 10 DSP programs.

RX-V590 5-Channel A/V Home Theater Receiver. 75 watts output L/C/R channels. 20 watts x 2 Rear Effects. 8 DSP programs.

RX-V490 5-Channel Receiver. 70 watts output L/C/R channels. 15 watts x 2 Rear Effects. 6 DSP programs.

RX-V390 5-Channel Receiver. 60 watts output L/C/R channels. 15 watts x 2 Rear Effects. 4 sound fields.

DSP-E580 3-Channel Digital Sound Field Processor. Use as complete add-on to existing stereo system or as processor only. 25 watts for center channel and 2 Rear Effects. 16 DSP programs.

The new DSP-A3090 Digital Sound Field Processor. Incorporates Dolby Digital Surround AC-3. Provides the 5.1 channels of AC-3 surround as well as the 7 channels of Yamaha's Cinema DSP surround settings for Dolby Pro Logic sources. Five new modes that combine AC-3 with Yamaha DSP to deliver the most spectacular home theater experience possible today. 30 different surround modes in all. 80 watts output L/C/R channels, 80 watts x 2 Rear Effects, 25 watts x 2 Front Effects. 11 analog audio, 1 AC-3 RF, 5 optical, 1 coaxial, and 6 video inputs with S capability.

DSP-E390 3-Channel Digital Sound Field Processor. Use as complete add-on to existing stereo system or as processor only. 60 watts per channel for center channel and 15 watts x 2 Rear Effects. 5 DSP Programs.

CDV-W901 CD/LD Player. Dolby AC-3 Laser Disc Player. 2 sided play. Plays LD, CD and CDV discs.

YAMAHA DSP 10th 1986–1996

Yamaha Digital Sound Field Processing has most assuredly changed the way the world listens to its music. Watches its movies. And we fully expect the newest generations of this revolutionary technology to make the next ten years every bit as exciting as the last. For the dealer nearest you, please call 1-800-4YAMAHA.

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Toshiba promises family fun with DVD (left). Below, a DVD prototype from Sony.

The wavelength of the new lasers' red light is only about 15% shorter than the infrared light used for CDs now (blue lasers, which have very short wavelengths, are not yet practical). But that and new optics let DVD makers shrink the pits that carry the data, and the spacing between them, enough to increase data capacity about fourfold. More efficient modulation and error correction increase capacity by half again, letting a DVD store 4.7 gigabytes of data, about seven times a CD's capacity—for openers.

Use of a 0.6-mm plastic substrate, half as thick as that used for CDs, cleans up the optical path by giving the laser beam half as much plastic to work through. A second 0.6-mm substrate is bonded to the back of this, to protect the recording's reflective layer, stiffen the disc, and maintain compatibility between the new players and conventional discs. But the second substrate can also carry data, turning the DVD into a double-sided disc whose capacity has doubled once again, but which must be flipped over to play its second side. (Label information for double-sided DVDs will be on the unrecorded ring around the center hole.)

The short-wavelength laser, new optics, and thinner substrate also make it possible to put two layers of recording on each side of a DVD, raising capacity to 8.5 gigabytes per side (17 gigabytes for a double-sided disc). The outer recorded layer is semitransparent, so the laser can be focused past it to reach the inner layer.

Massive capacity? Not for the DVD's main application, digital video. Getting a single-sided, single-layer DVD to hold 133 minutes of video instead of just 15 minutes calls for massive compression. But by using the MPEG-2 compression scheme, DVDs can even have room for multiple versions of a video program. This will let you match wide-screen movies to your video screen by showing them in letterboxed form, in 4:3 pan-and-scan form, or, if you have a widescreen set, in 16:9 form. DVD can also carry multiple versions of a film, so parents will be able to lock out an "R"-rated version for their kids. DVDs can carry soundtracks and subtitles in multiple languages. Some discs might let you choose camera angles.

What about audio? Right from the start, the DVD standard provides for three digital audio formats. The first is CD-type 16-bit two-channel linear recording (stereo or Dolby Surround); this can be used with relatively short video programs or even full-length features, though at the sacrifice of multiple-language and discrete multichannel capability. But most soundtracks will be 5.1-channel Dolby Digital with AC-3 encoding, in our part of the world, at least. (In Europe and other PAL/SECAM markets, the standard compressed-audio format will be two-channel MPEG-2, with Dolby Digital as an option.) The third provision is for playback of MPEG-1 audio, for compatibility with the CD-V format.

DVD also has potential for audio-only applications. Today's CDs hold enough music (about 75 minutes) to satisfy most listeners, but many audiophiles think they don't hold enough bits. They would like to see the sampling rate and sample size increased and would like multichannel capability—without AC-3, MPEG, or any other form of data reduction. With DVD, we can have it all—if proper standards are set and followed from the beginning.

A group called Acoustic Renaissance for Audio has proposed just such standards for what various proponents call the High-Quality Audio Disc (HQAD) or High-Density Audio Disc (HDAD), as discussed by Ken Kessler in "Mondo Audio" in this issue. A particularly interesting aspect of the ARA proposal is its flexible allowance for "trade-offs between precision, frequency, bandwidth, number of channels, and playing time." Through these trade-offs, a 93-minute disc could carry a 7.1-channel, 24-bit program with 48-kHz sampling or eight channels of 16-bit audio at 96 kHz, to name just two possibilities. And an archive disc could carry 472 minutes (nearly 8 hours) of 16-bit stereo with 48-kHz sampling.

As for AC-3, it probably will be all over next winter's CES. But it won't be a buzzword: Within weeks of the 1996 WCES, Dolby Laboratories announced that the system's name will be "Dolby Digital AC-3" for laserdiscs and laserdisc equipment, but for DVD (which is where it should really catch on), its name will be just plain "Dolby Digital."

Music, but Not Sound, by Wire

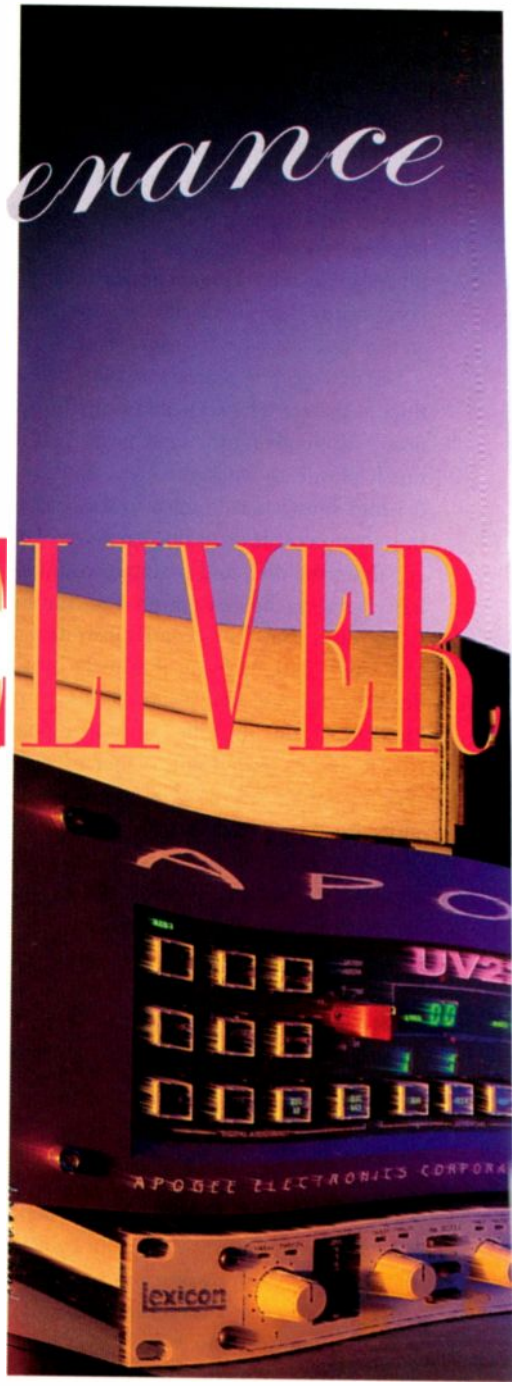
Yamaha plans to distribute music by wire in Japan, but that music will be in the form of MIDI commands rather than recorded sound. Visitors to any of 200 shops in Japan will be able to download MIDI sequences onto floppy disks, for playback on MIDI-compatible home PCs or MIDI sequencers. Signals will be distributed to the stores via ISDN (Integrated Services Digital Network) lines; if such lines ever become common in homes, direct MIDI distribution might become practical.

Remote Possibilities

Two multiroom A/V distribution systems that require no new wiring were introduced at the Winter CES this past January. They are similar in principle but connect differently: Elcom's EZ system transmits via your home's AC wiring, whereas the Terk Technologies HomeNetwork will use telephone wiring. Either way, a basic system of one transmitter and one receiver should cost less than $200. The cost should come down further if either HomeNetwork or EZ gets popular enough that makers of other home electronic devices incorporate the technology in their own equipment. A

NEW RECORDING TECHNOLOGIES SUCH AS NOISE SHAPING AND HDCD PROMISE MUCH, BUT DO THEY REALLY LIVE UP TO THEIR HYPE—AND ARE THERE BETTER ALTERNATIVES?

DIGITAL DELIVERANCE



BY D. W. FOSTLE

In last month's examination of 20-to-16-bit noise-shaping techniques ("19 Bits in a 16-Bit Sack?"), real musical signals recorded on practical systems were shown to contain enough noise to swamp the effect of the noise-shaping filters. Recordings with noise floors approaching even the 16-bit theoretical limit, without noise shaping, prove to be rare, and it can be safely stated that the "19-bit equivalent" performance predicted by both digital theoreticians and advertising copywriters has not yet been achieved.

If noise shapers as a class are typically defeated by noise in the signals on which they operate, the question arises as to whether their use is otherwise benign. Do these devices alter the musical information that passes through them, or are their operations confined solely, if largley ineffectively, to noise?

To gain insight into the issue, 20-bit "test" recordings were made. Assembled was a high-quality recording system comprising two Schoeps CM-65 microphones with 958 capsules, a Hardy M-1 microphone preamplifier, a Wadia Digital 4000 20-bit analog-to-digital (A/D) converter, and a Nagra D 20-bit digital recorder. With this system, Marc Aubort recorded performances by Jerome Lowenthal, a concert pianist and chairman of the Juilliard School piano department.

The main purpose of the recordings was to document the amazing variety of timbres and musical effects produced by Steinway pianos built over a period of 140 years, but the 20-bit masters also provided material having low noise, a musical dynamic range in excess of 60 dB, a complex reverberant field, and daunting transients. Some piano attacks contained instantaneous energy beyond 20 kHz, and even at moderate levels, "sprays" of energy up to 16 kHz were commonly measured.

Noise Shaping or Sound Shaping?

To audit and measure the effects of the noise shapers, I created a 20-bit edited master on a digital workstation and then transferred it back to the Nagra D. Using the Nagra's built-in error-logging facilities, I monitored digital error rates and found

D. W. Fostle is the author of The Steinway Saga *(Scribner, 1995).* *His techniques for computer-based measurement of musical signals, developed in researching that book, form the basis of this article.* *For their technical services in making the test recordings, the author wishes to thank Marc Aubort, Elite Recordings; Jerry Bruck, Posthorn Recording; Keith Johnson, Pacific Microsonics; and Chris Rice. A debt is also owed to pianist Jerome Lowenthal, producer Joanna Nickrenz, and piano tuner Tali Mahanor, who prepared "Penelope" (a.k.a. Steinway Model D, 56 290).*

PHOTOGRAPHS: MICHAEL GROEN

none. I then used the edited 20-bit data, now on tape, as a source to feed each of several noise-shaping devices (a Weiss SFC-1, a Meridian 618, and a Sony K-1203), whose outputs were transferred to a Marantz CD recorder.

The final result was a CD, playable on any system, that contained the various noise-shaped versions of the original 20-bit recording. On audition, I found that the different noise shapers yielded differences in instrumental timbre, reverberation color, and stereo presentation of the piano. As a class, the noise shapers tended to "harden" or "brighten" the sound, particularly in the reverberant decay. Though difficult to describe, the effect was similar to that of increasing the area of the performance space covered with plaster or stone and reducing the area covered with wood. The timbral corollary of this is a "brightening" of the piano, particularly in the top two octaves.

That the noise-shaping filter plays a role in these effects can be demonstrated with the Meridian 618, which has several increasingly powerful noise-shaping selections. Moving from the milder to the steeper curves causes a progressive brightening of both the piano and the reverberant field.

The noise-shaping devices also influenced the stereo image, sometimes in unexpected ways. The apparent size of the piano was noticeably smaller with the Sony Super Bit Mapping (SBM) processor than with other processors. This could be described as a more defined image or, if one does not prefer a smaller piano, as a reduction in

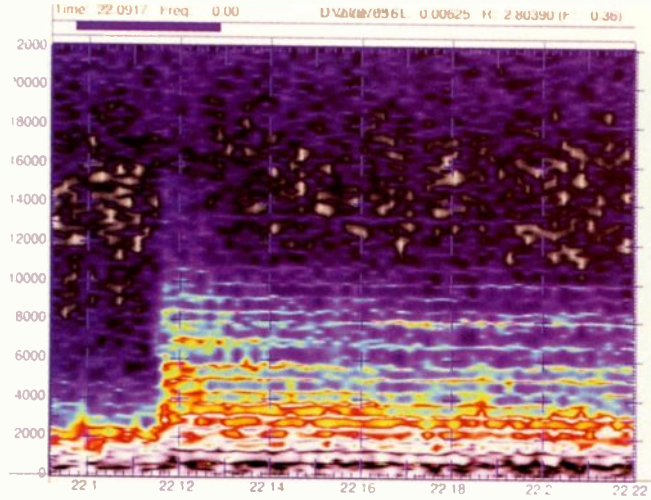


Fig. 1—*"Three-dimensional" spectrogram of a piano-attack transient after passage through a Sony K-1203 SBM noise shaper. Time is charted horizontally in seconds, frequency vertically in hertz; amplitude is indicated by color (see color key below). Note the slight bulge, or "puff," from the left edge of the attack's vertical structure, between about 6 and 8.8 kHz.*

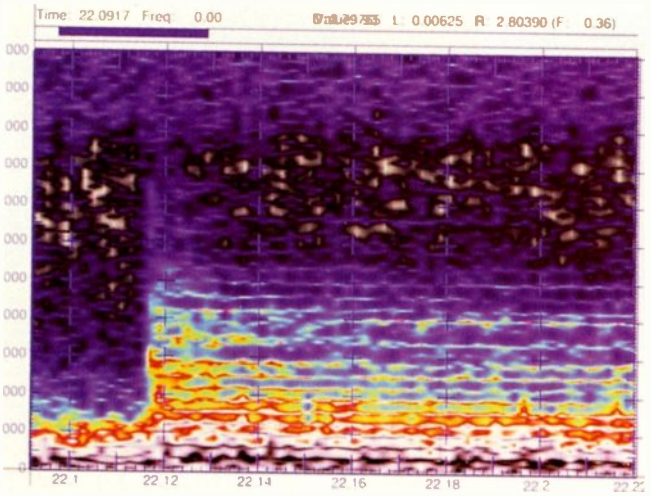
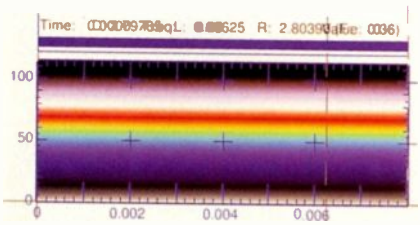


Fig. 2—*Spectrogram of the same piano attack in Fig. 1, this time processed through an Apogee UV-1000, which uses the company's UV-22 20-to-16-bit redithering process but no noise shaping. The slight "puff" of energy visible in Fig. 1, ahead of the attack, is absent here.*



scale. I also noticed that the Weiss SFC-1 seemed to "push" reverberation toward the speakers when compared with the other noise shapers.

There remained the question of how reproducible these effects would be on other systems in other rooms. To explore that issue, the comparison CD was auditioned through the same digital-to-analog (D/A) converter on two other systems, both owned by audio professionals. Although rendered differently in degree, the effects were sustained. The most robust effects were on piano timbre and the general brightening of reverberation. Stereo presentation, while consistent in direction, had markedly different scale among the three systems. (And in general, the sonic differences among the noise shapers were much smaller than the variations among the systems on which the recordings were played.)

A specific and measurable case can be seen in Fig. 1, a spectrogram of the piano-attack transient produced after passage through the Sony K-1203 SBM processor. The single, sharply struck mid-treble note, with a peak level 11.9 dB below digital full scale (0 dBFS), pops from a softly played bass figure in Paderewski's Minuet in G. Note the "puff" of energy between 6 and 8.8 kHz prior to the main attack's vertical structure. This manifests itself as something like a click, the reproduction of which was found to depend on the playback system.

On one system the puff was very sharply rendered, producing a sound similar to an instantaneous digital overload, a clear impossibility given the levels involved. On another playback system a light tick was heard, which could easily be confused with the click of the artist's fingernail accidentally contacting a piano key. On a third playback system the puff emerged as a low-level "thock" sound, which, in that instance, listeners might well have identified as a sticking piano action or as other mechanical noise from the instrument itself.

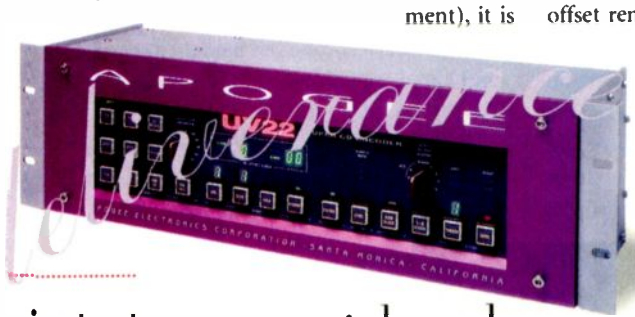
When the same signal is passed through a processor that doesn't use noise shaping, in this case the Apogee Electronics UV-1000, the puff is absent and there is better overall alignment of the attack transient. The Apogee's reproduction of the attack can be seen in Fig. 2. The puff is an artifact produced by the SBM processor and was not present on the master recording when played back directly from the original 20-bit tape. Since each playback system rendered the artifact differently, listeners could easily come to different conclusions as to its cause. Without reference to alternative 16-bit masterings through other processors or a 20-bit original, the listener would not realize the sound was actually created by a noise-shaping process.

Some piano attacks contained 20 kHz, and "sprays" up

Caution is in order, however, with regard to generalizing from these observations. They emerged from experiments with only one class of program material, and a particularly daunting one at that. A signal having less natural reverberation would make it harder to distinguish between the various noise shapers. And the alterations to stereophonic imaging would likely have been reduced, if not obliterated, had more than a simple stereo pair of microphones been used, as is sometimes done even on classical piano recordings and which is the essence of multitrack recording.

It is nonetheless evident that noise shaping can have sonic effects, and those effects may alter not merely the noise floor but other aspects of the presentation as well. Of

those detected, the alterations of the piano's timbre and attack transients are perhaps the most important musically. Classical pianists are judged, in part, by their "touch" and their "tone," both of which can be modified by effects such as those introduced by the noise shapers. Since the general tendency of the process is to harden transients and brighten the overall piano sound (the two phenomena are correlated in the instrument), it is possible that subtleties of musical meaning or judgments of artistic capacity will be altered. That is not *necessarily* adverse; for example, the effect of transient "sharpening" might be to increase the definition of individual notes in a complex musical passage. But any such aesthetic application of a noise shaper, which effectively transforms it into a very peculiar form of equalizer, is separate from its design goal.



instantaneous energy beyond to 16 kHz were common.

The connection between equalization and noise shaping is not as farfetched as it might seem, noise shapers being a specialized permutation of a larger class of devices that includes equalizers and tone controls. In fact, the well-known tendency of filters to "ring" may possibly be relevant. Since the shapers examined can introduce alterations of 20 to 50 dB in the signal, it seems possible that they may alter transient waveform shapes. I advance this notion not as a finding but as an informal speculation as to the physical cause of some of the phenomena heard. Whatever the reason, however, it appears that noise shapers can, at least under some conditions, "shape" music as well.

The Apogee Alternative

One special alternative to noise shaping in converting 20-bit masters to 16-bit CDs is Apogee Electronics' UV-22 redithering system, incorporated in the company's UV-1000 mastering processor and, more recently, as a built-in function in its 20-bit A/D converter. Apogee reports wide adoption of the UV-1000 in mastering facilities. Intended as a "final step" mastering processor, the UV-1000, like some of the other devices examined, has other capabilities. In the case of the UV-1000, they include DC-offset removal, signal generation, left/right channel reversal, and an ability to slightly reduce digital signal levels to prevent overload.

In the UV-1000's manual, Apogee says that the UV-22 process "adds an inaudible, high-frequency 'bias' to the digital bit stream, placing an algorithmically-generated 'clump' of energy around 22 kHz." Figure 3 shows the spectrum of the Apogee's output (green curve) in comparison to that of the Meridian 618's "flat dither" (red curve). Until about 14 kHz, the Apogee's noise level is 4 to 5 dB below that of conventional dither. This is generally consistent with Apogee's claim that the process's noise floor is the same as the theoretical 16-bit minimum. By 16.5 kHz the energy in the Apogee's output is equal to that of the Meridian, and the small peak at 19.5 kHz is about 23 dB above the Meridian's noise. A second peak occurs at 20.9 kHz and a third, smaller peak at 21.8 kHz.

Apogee's claim that UV-22 is "not a new flavor of dither noise" is confirmed by Fig. 4, a spectrogram of 1 second of the UV-22 signal. It shows multiple frequency modulations that, over time, tend to center at the spectral peaks of Fig. 3 but vary as much as 1 kHz in either direction. If this signal were conventional random-noise dither, the spectrogram would show only small lacy patterns of blue and white. Underlying this unusual signal is a very complex, statistically based theory (not entirely explained in published papers) as well as extensive listening tests. The question is, does UV-22 work?

The Apogee's noise floor itself, when digitally multiplied 60 dB, had the least unpleasant sound of any of the processors examined. The 4- to 5-dB reduction in noise below flat dither was readily apparent, and

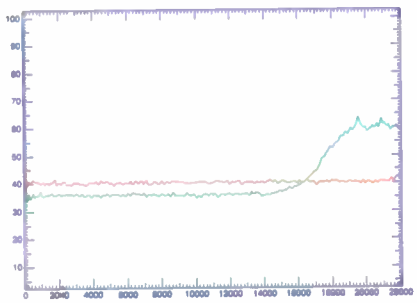


Fig. 3—*Spectrum of the Apogee UV-1000 processor's noise floor (green curve) compared with that of the Meridian 618 mastering processor in its "flat dither" mode (red curve). The bulge in the Apogee spectrum at extremely high frequencies results from its concentration of dither energy in the near-ultrasonic range, which reduces noise at lower frequencies. (As on most of the amplitude-versus-frequency graphs, the decibel scale to the left is strictly for evaluation of relative levels and is not based on any absolute reference.)*

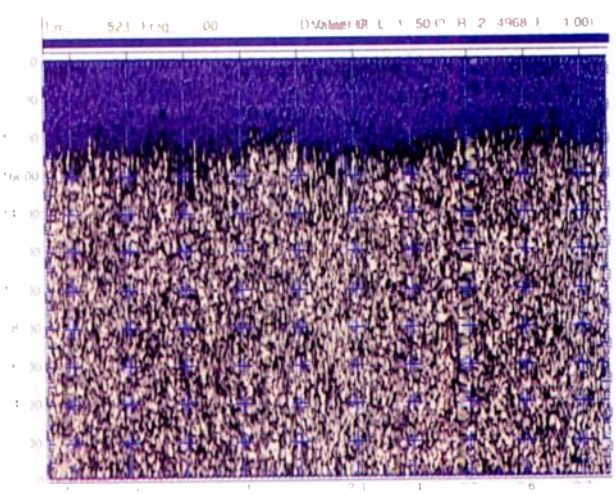


Fig. 4—*Spectrogram of the Apogee UV-1000's noise floor. Visible in the band at the top are multiple frequency modulations that, over time, tend to center at the spectral peaks of Fig. 3 but vary as much as 1 kHz in either direction.*

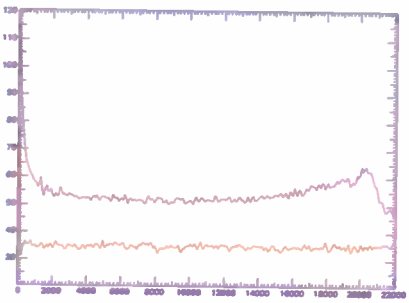


Fig. 5—*Spectrum of the noise floor at the beginning of cut 6 on the first Reference Recordings HDCD sampler (purple curve). Shown for comparison is the noise spectrum of a Meridian 618 in its "flat dither" mode, fed by a Lexicon 20/20 20-bit A/D converter with no input signal (red curve).*

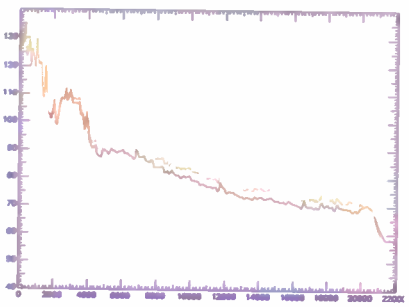


Fig. 6—*Spectra of the opening 1.7 seconds from two versions of "Lux Aeterna" on the second Reference Recordings HDCD sampler. The purple curve is for the HDCD version, the orange curve for a version recorded through a conventional Sony 1630 16-bit A/D converter. Note the slight high-frequency rolloff in the HDCD spectrum, starting a little below 2 kHz.*

the signal was devoid of the strong "hissy" quality of flat dither. Notably absent were the crackling and frying sounds or the strangely hollow noises produced by some noise shapers. If a noise floor is to be heard, the Apogee's seems the most benign.

The Apogee is notable for what it does *not* do to music signals. There was no detectable alteration of the piano's timbre or its attack transients. No "hardening" of reverberation was perceived, nor was any stereo image alteration detected. In sum, the Apogee UV-1000 seems to go about its word-length reduction chores in a minimally intrusive manner. As with the other processes, however, caution is urged in generalizing these observations to other types of program material and other recording techniques.

HDCD (Unplugged)

Apogee's UV-22 is a low-profile process. Although there is a UV-22 logotype, it is rarely, if ever, seen on CDs, and few people outside the trade seem to know of its existence. Precisely the opposite is true of Pacific Microsonics' HDCD, or High Definition Compatible Digital, process. Prestigious publications such as *The Economist* ("uncannily realistic"), *Fortune* ("captures important aural cues"), and *The New York Times* ("fully flowered music") have covered HDCD. Specific information about how the process works is in short supply,

but a document filed by Pacific Microsonics and published under the Patent Cooperation Treaty gives some insight into HDCD. The system's principal benefits are claimed to be "ultra-low distortion" and "improved apparent resolution" while maintaining compatibility with standard CD players. "The overall system of the invention," states the international application, "makes possible a more accurate reconstruction of the original analog signal than would have been possible using the same digital recording standards." Elsewhere in the document are claims of "an extra 4 bits of dynamic range" and "better spatial sense and less brittleness" as well as improved "inner detail perception."

The "smart optimization" techniques used in HDCD are also claimed to provide "improved sonics for portable and automotive playback when not decoded." That, Pacific Microsonics says, is because "conventional decoding. . .yields a signal with slightly less dynamic range and only slightly higher background noise." But, because of "lower quantization and slew induced distortions," the music will "sound equal to or better than an unencoded product."

Elsewhere in the patent document it is claimed that "signals lacking the encoding process [that is, conventional CDs] are provided some overall enhancement." In sum, according to these claims, everybody wins, and more than compatibility is provided. Play an HDCD disc in your car, and it will sound better. Play a conventional CD through an HDCD decoder, and it will be better too. But best of all is supposed to be the combination of HDCD encode and decode, with its promise of "increased apparent bandwidth and resolution" and an implied 19- or 20-bit dynamic range.

To summarize the dense aggregate of techno-speak and legalese in the 88 pages of the international patent document, which includes 107 specific claims, it appears that there are a number of methods by which HDCD *may* operate on an incoming music signal. The first of these is boosting low-level signals and attenuating peaks. This compress-during-recording, expand-during-playback function of HDCD appears conceptually similar to conventional compander-based analog schemes (such as Dolby and dbx noise reduction), but it is also stated that the process reduces distortion.

Amplification of low-level signals during HDCD encoding is claimed to "maintain a minimum LSB [least-significant bit] dither-like activity" that reduces distortion.

> The noise shapers or "brighten" particularly in the

It is also asserted that the higher average recording levels permitted by peak compression further reduce distortion, albeit at the cost of *increased* distortion on "infrequent" peaks. Whereas conventional noise reduction usually relies on fixed and known signal levels for both the encode and decode

operations, HDCD tells the decoder how to vary its gain via a code embedded in the least-significant bit as a part of a pseudo-random dither noise. The gain increase on low-level signals helps conceal the code insertions, which for classical music are said to last for about 1 millisecond and occur several times per second "at most."

It seems that the codes can, at least potentially, control at least two other HDCD functions. One of these is filter shape during playback. The document lists three types of interpolation filters—one for high-level signals, another for low-level signals, and a third for transients. The HDCD decoder, if this function is implemented, switches between filter types according to signals in the control code. Pacific Microsonics claims that this technique removes the need to "compromise" filter design and that both "extended high-frequency response" and "improved transient settling" are obtained.

A third potential operation of HDCD is "wave synthesis." When the HDCD encode processor detects a waveform with distortions "known to occur at the reproducer," another waveform can be substituted. The new waveform is either looked up in memory, amplitude scaled, and then substituted, or, alternatively, data is sent via the control subchannel to enable the HDCD decoder to synthesize the signal. The "restructured" waveform is said to have more data points and therefore reduced distortion. Pacific Microsonics says the wave-synthesis feature is not used now, however, as it was found to be unnecessary.

It is clear that HDCD potentially involves very large amounts of signal processing.

tended to "harden"

the sound,

reverberant decay.

Most of this appears to occur during encoding. The encoder incorporates an A/D converter running at an 88.2-kHz sampling rate and generating 24-bit words, 20 bits of which are devoted to the audio signal. Its output feeds a buffer memory that stores the signal while the encoding logic analyzes for its salient characteristics. Another system performs the actual HDCD operations, such as compression, and then generates the control codes that are embedded in the output signal.

At the receive end, a Pacific Microsonics LSI chip, which includes a digital interpolation filter along with the decoder, performs the "conjugate" operations, thereby producing a signal incorporating whatever improvement the entire process provides. Independent of its HDCD decoding capabilities, the Pacific Microsonics PMD-100 chip is considered by some to be a very good filter that is adaptable to many D/A converter designs, and it is now used in equipment from roughly three dozen manufacturers. Those desiring HDCD should budget a substantial sum, as the average retail price of 42 D/A converters using the HDCD chip is now about $3,200, with a high of $15,950 and a low of $599. An outboard converter is almost a necessity, as only six integrated HDCD players—with an average price of more than $2,700 and none below $1,995—were available in late 1995.

Beyond the cost issue is the fact that HDCD-encoded program material is still scarce. That is at least partly because there was no commercially available version of the HDCD encoder until recently. Consequently, most HDCD recordings have come from the San Francisco-based Reference Recordings label, with which Keith Johnson, one of the HDCD developers, has long been associated.

Reference Recordings has released two HDCD samplers containing examples of recordings made in the format. Since almost all of that material was originally captured on an analog tape deck without noise reduction, the recordings themselves tend to be somewhat noisy. This is seen in Fig. 5, which shows the quiescent noise floor for about a quarter of a second at the beginning of cut 6 on the first Reference Recordings HDCD sampler (RR-S3CD), Mike Garson's version of Miles Davis's "All Blues" (purple curve). The plot was made directly from the digital signal on the CD, ported into a Silicon Graphics computer workstation. Shown for comparison is the noise spectrum from a Lexicon 20/20 A/D converter feeding a Meridian 618 processor, presented in last month's measurements, with the 618 set to "flat dither" (red curve).

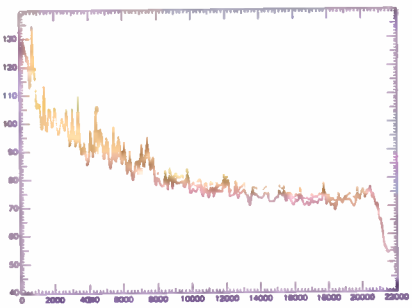


Fig. 7—*Spectra from alternative masterings of "Moonglow" on the second Reference Recordings HDCD sampler. As in Fig. 6, the HDCD version (purple curve) rolls off slightly above about 2 kHz relative to the Sony 1630 version (orange curve).*

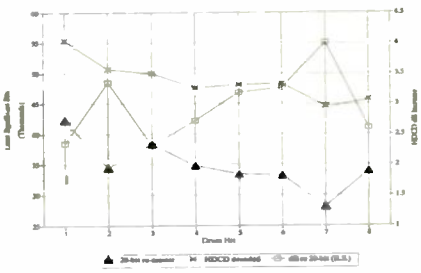


Fig. 8—*Peak levels, in LSBs (left scale), of eight drum hits from two masterings of Jimi Hendrix's "Gypsy Eyes," one a conventional 20-to-16-bit remastering, the other an HDCD remastering. A third curve plots the energy difference between the two, in decibels (right scale).*

In the region of greatest aural sensitivity, roughly from 3 to 5 kHz, the noise in the Garson recording is 17 to 18 dB above the noise floor of the Lexicon/Meridian combination. That's equivalent to about 3 bits of resolution. Had the original recording been made digitally, roughly similar noise levels would have been produced by a 13-bit analog-to-digital converter.

Also seen in Fig. 5 is HDCD's use of dither, possibly of a high-pass form but definitely noise. The dither accounts for the rise in the noise floor beginning at about 13 kHz. Since Pacific Microsonics claims in its patent papers that dither "creates new distortion," its presence on these and other HDCD recordings is as interesting as it is enigmatic. This, however, is only the first of a number of surprising behaviors by the HDCD process.

Notwithstanding the relatively high noise levels and the very strange shift in piano

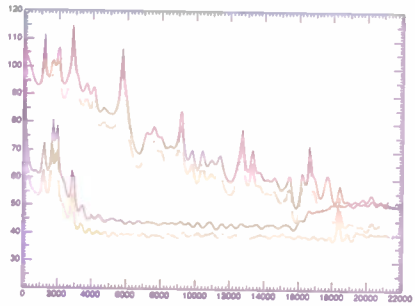


Fig. 9—*Spectra for the "heads" (upper pair of curves) and "tails" (lower pair) of a high-treble piano note. The purple curves are for the HDCD-encoded version, the orange curves for an unprocessed 16-bit recording of the same event.*

perspective that occurs in the first part of the recording, the Garson "All Blues" is a sonic confection with plump but not overbearing bass, well-delineated brushwork, and a large (though still crisp) saxophone sound. If there is a "process" at work here, it is difficult to detect it.

A word is in order about the influence of D/A converters on this recording. The reference converter—an Apogee DA-1000 that is widely used in professional recording, mastering, and some instrumentation applications—has no HDCD-decoding capability. It produced a particularly pleasing rendition of the Garson. When played through two different HDCD-capable converters, one from Proceed and another from EAD, and with sound-pressure levels adjusted for equality in the opening bars, the presentation turned out to be audibly different.

In comparison with the Apogee, *both* HDCD-equipped converters sounded rolled off in the high treble—particularly evident in percussion—and, at the same time, the Garson recording took on a "wetter," more reverberant quality, as if the walls of the space in which it was recorded were moved back and the microphones placed further from the musicians. It is a personal matter as to which presentation is preferred, but the difference is distinct.

In a separate test I found that this difference was due in part to the characteristics of the PMD-100 chip, not as a decoder but as an interpolation filter. Through the courtesy of Madrigal Audio Laboratories, a demonstration was mounted in which the same Mark Levinson No. 30.5 D/A converter was alternately fitted with an NPC filter chip and the PMD-100. With conventional recordings and precise level matching, the

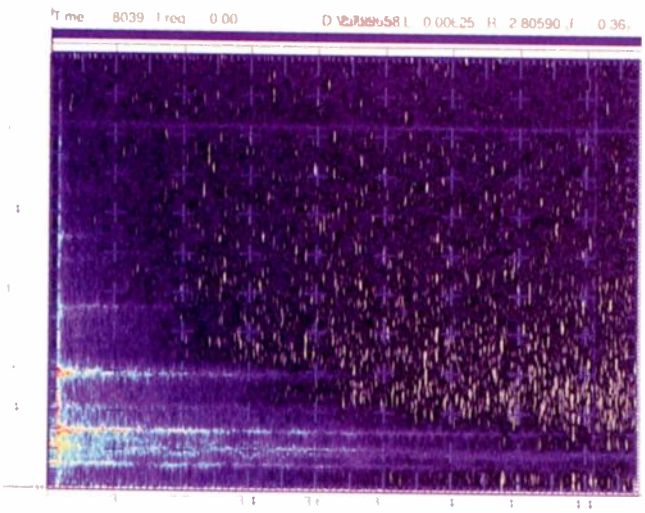


Fig. 10—*"Three-dimensional" spectrogram of the unprocessed 16-bit recording of the entire piano note depicted in Fig. 9.*

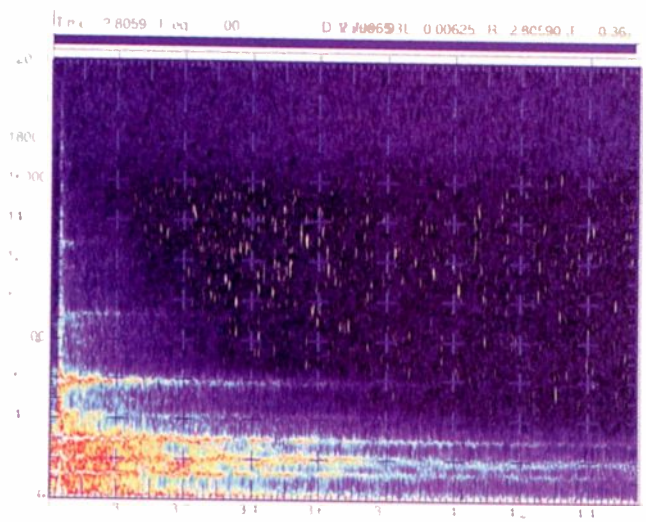


Fig. 11—*Spectrogram of the HDCD-encoded rendering of the piano note. Note how the tails of the partials are lengthened and intensified.*

> The HDCD rendering "wetter," and both the and its timbre

PMD-100 exhibited a different high-treble characteristic. Whereas the NPC filter had a certain "glisten" or "edge" when presenting choral voices and strings, this effect was absent when the Pacific Microsonics chip was installed. In comparing the Apogee to either of the HDCD-equipped D/A converters, playing conventional recordings, the alteration of treble was more pronounced and was particularly apparent on the ride-cymbal figures common in jazz recordings. Potential adopters of the HDCD technology, particularly those with single-box CD players that are sometimes "bright," should carefully audition HDCD decoders to ascertain that their performance on *conventional* recordings suits their taste and system characteristics. The HDCD-capable converters I auditioned have, to my ears, an inclination toward the mellow.

Given the current paucity of HDCD titles (and even if HDCD is wildly successful, encoded discs will be a small fraction of the total catalog for many years to come), the issue of the rendering of conventional recordings is certainly pertinent and largely

a matter of personal taste. With regard to HDCD itself, the issue is more clearly one of performance. The record there might be described as mixed, all puns intended.

A second Reference Recordings sampler (RR-905CD) contains HDCD versions and conventional Sony 1630 masterings of the same performances. I examined two of these, again by the all-digital method. The spectrum of the opening 1.7 seconds of "Lux Aeterna," a choral work from tracks 12 and 13, is seen in Fig. 6. In this section, peak levels nearly match, with the Sony 1630 version (orange curve) having a slightly higher peak level (+0.24 dB), measured in LSBs. Observe that at 1 kHz, the energy in the two versions closely matches, but as the frequency rises, the curves diverge. By 9 kHz the HDCD version is 3 dB down relative to the Sony 1630 version. That difference is maintained to about 18 kHz, where the HDCD curve starts to rise slightly; by 21 kHz it is up 1.7 dB relative to the 1630 curve. This rise at near-ultrasonic frequencies is probably due to dither noise. Except for that rise, the signal spectrum of the HDCD version of "Lux Aeterna" appears to have a substantial rolloff that begins before 2 kHz (roughly three octaves above middle C) and continues far into the range of musical partials. Comparative listening with both HDCD and conventional converters, as well as with two single-box CD players, demonstrated that the spectral difference was readily apparent in all cases.

was noticeably sustain of the piano were altered.

On another pair of tracks from the Reference Recordings sampler, alternative masterings of "Moonglow," the HDCD version's peak level measures 0.4 dB higher at the piano/percussion "hit" that begins the track. I also found a rolloff similar, but not identical, to the one on the "Lux Aeterna" cut, as seen in Fig. 7. At 2 kHz, the energy in the HDCD version is 0.1 dB below that in the Sony 1630 version, descending to –2.6 dB at 6 kHz. After rising slightly, about 0.3 dB on average, the HDCD signal is again down 2.5 dB at 13 kHz. As in the case of "Lux Aeterna," there is a sharp rise at extremely high frequencies.

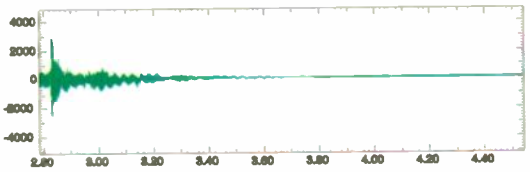


Fig. 12—*Energy-versus-time plot of the unprocessed 16-bit recording of the piano note, as depicted in Figs. 9 and 10.*

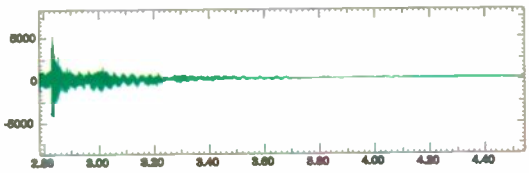


Fig. 13—*Energy-versus-time plot of the HDCD-encoded recording of the piano note, as depicted in Figs. 9 and 11.*

Once again, the difference in the spectra of the two versions was easy to hear through a variety of converters. Among the discernible effects of the HDCD process was an alteration in the timbre of the trumpet solo and a shift in the position of the piano. Apparent reverberation grew greatly, and the position of the trumpeter moved back with respect to the rest of the ensemble. These effects were audible in both conventional and decoded playback. A general and further darkening of the sound field occurred when the recording was played back through an HDCD converter on four otherwise entirely different systems.

In a demonstration conducted by Pacific Microsonics with the "Moonglow" tracks, a distinctly concave sound field was created by the HDCD version: The horn ensemble was forward and roughly at the longitudinal axis of the speakers, while the trumpeter seemed far to the back. The Sony 1630 version did not exhibit this "warpage." Although an interesting presentation, the HDCD "Moonglow" violates convention, which usually has the soloist in front. The measurable reduction in treble energy on this recording is probably the prime cause of the imaging changes relative to the standard track.

Another HDCD comparison is possible between a European HDCD release of Jimi Hendrix's *The Ultimate Experience* (Polydor 517 235) and a conventional, 20-bit-mastered domestic version (MCA MCAD-10829). Detailed analysis is confounded by both a speed difference (the HDCD being slower) and a polarity inversion. In comparison to a third, older version, *The Essential Jimi Hendrix* (Reprise 9 26035), the HDCD release again appears inverted but is of similar speed on the track examined, "Gypsy Eyes." Subjectively, both the HDCD and the "20-bit" CDs are substantial improvements over the older release. The reason is unclear, but there is a slight rolloff above 12 kHz, as well a small bass boost, in the oldest version.

Right from the start, the HDCD rendering of "Gypsy Eyes" delivers a subjectively startling presentation of Hendrix, whether decoded or not. One reason is found in Fig. 8, which shows the peak levels, in LSBs, for the first eight drum figures (a bass drum and hi-hat combination in which the bass drum naturally dominates the peak measurement). The data was taken from the balanced analog outputs of an HDCD-capable Proceed Digital Audio Processor (D/A converter), converted again from analog to digital by an Apogee AD-1000 running in 16-bit mode and transferred to the computer. There were substantial differences in both peak and relative levels.

On the first beat (reading the difference curve against the right-hand scale of Fig. 8), the HDCD version is 2.3 dB higher than the 20-bit-mastered version. This difference grows to 3.3 dB on the second beat, drops by

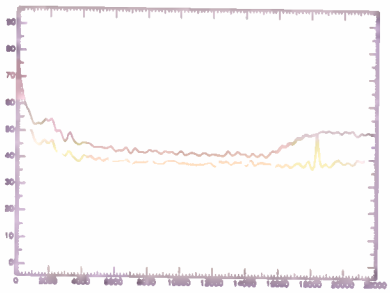


Fig. 14—*Noise floors of HDCD-encoded and unprocessed 16-bit recordings (purple and orange curves, respectively).*

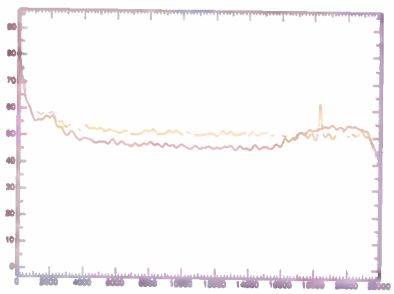


Fig. 15—*Noise floors of decoded HDCD and unprocessed 16-bit recordings (purple and orange curves, respectively).*

about 1 dB, and then climbs to a 4-dB differential by the seventh event. The eighth "hit" drops back to a 2.6-dB advantage for HDCD. The increased level is probably one reason for the subjective power of the HDCD version of this track. Since the relative level keeps changing, it is impossible to make a level-matched comparison.

If one thinks of the *shapes* of the 20-bit-mastered and HDCD curves (which read to the left-hand scale in Fig. 8) as musical indicators, it is clear that there is a rhythmic difference between the two versions. This is most apparent at the second and seventh events, but the overall shape of the curves is also different. As to which of these is "correct," the answer is unknowable: Both may have been subjected to other processes. It seems, however, that in the HDCD mastering the engineer may have taken advantage of the "gain interplay" features of HDCD, in effect using it creatively. The "oldest" version of "Gypsy Eyes" (not shown) yielded yet a third set of levels. The philosophically or musicologically inclined may wish to ponder the question: What did drummer Mitch Mitchell *really* play?

The Ultimate Comparison

As you probably have recognized by now, analysis of existing commercial recordings, even those released for formal comparison, is fraught with difficulty. Needed is a stable process in which known variables are controlled. To that end, an HDCD encoder and Pacific Microsonics personnel ventured to New York City, where a superb recording venue was rented and concert pianist Jerome Lowenthal was again engaged. We also obtained an exquisite 19th-century Steinway concert grand, along with the services of a concert-piano technician. A small platoon of engineers with a large complement of equipment was in attendance, along with me and both the Editor and Publisher of *Audio*.

The purpose of the exercise was to obtain *directly* comparable master recordings, all fed simultaneously by the same microphones and microphone preamplifier. Master media comprised a Nagra 20-bit digital recorder, an HDCD encoder feeding a 16-bit Sony DAT machine, a Stellavox professional 16-bit DAT deck, and two analog recorders, one a Studer 1-inch transport with custom tube electronics designed by Tim de Paravicini and the other a standard Studer quarter-inch, solid-state model. (A CD containing all versions of this comparison recording will be offered to *Audio* readers in the near future for evaluation on their own systems.)

I later made measurements comparing the digital information in the HDCD-encoded and 16-bit Stellavox recordings. (This was straightforward and avoided any need to process a 20-bit recording.) In listening to the two recordings, I noted the most marked differences at relatively low levels, particularly when using the Apogee D/A converter. With respect to the Stellavox DAT, the HDCD rendering of passages in the region of –20 dBFS was noticeably "wetter," and both the sustain of the piano and its timbre were altered. The first impression was similar to that created by the "rolled-off" HDCD tracks on the Reference Recordings samplers, particularly with respect to the sense of greater reverberation. In this case, however, no high-frequency rolloff was apparent, as short-interval measurements of the signals yielded essentially similar spectra on typical events when adjusted for level.

Refer to Fig. 9 for the likely solution to the mystery. The upper pair of curves shows the spectrum of the HDCD rendering of the "heads" of two high treble notes (purple curve) and just below it the DAT rendering (orange curve). This event is "out in the open" and sustains for about 1.75 seconds. At all of the many points measured, there is a 5-dB differential, ±0.1 dB, which is reasonably linear for the comparative deviations of two separately recorded signals.

Now examine the lower pair of curves in Fig. 9, the spectra of the "tails" of the same event over a period of 330 milliseconds. Here deviations at the peaks range from 9.5 dB at 1.25 kHz to 8.7 dB at 2.85 kHz. By 5.8 kHz the HDCD signal is into the noise floor, which is about 5 dB above the DAT noise floor until the HDCD dither starts pushing it further up at about 16 kHz. (The 6-dB spike in that DAT signal at 18.3 kHz is a recording artifact rather than part of the signal.) What this indicates is that HDCD raises the tails of musical events dynamically and probably introduces a time-varying frequency and amplitude response. Implied by this behavior is the ability to distinguish signal from noise, which might possibly be done by autocorrelation. In any case, this example shows that HDCD encoding materially alters signal dynamics in audible ways. Listeners are invited to decide for themselves if this is an acceptable trade-off for the claimed HDCD benefits.

HDCD is the ... and obvious of the ...

Figures 10 and 11 are full "three-dimensional" (time, frequency, and amplitude) spectrograms of the straight 16-bit DAT and HDCD versions of the entire event. You can see the tendency of HDCD to lengthen and strengthen the tails of the partials. The partial at 5.8 kHz, for example, is about a quarter of a second longer in the HDCD recording than in the unencoded DAT recording. Substantial increases in the low-level partials are also evident; locally, these variations can exceed 10 dB between the two signals.

The energy-versus-time plots (all frequencies summed) corresponding to Figs. 10 and 11 are shown in Figs. 12 and 13. Interestingly, there is little difference except in the tails. Without knowing the behavior of HDCD, one might attribute the fattened tail on the plot to the roughly 5-dB difference in large-signal amplitude.

Decoding does improve HDCD's behavior. The curves in Fig. 14 show the relative quiescent noise performance of undecoded HDCD and the straight 16-bit recording. In this condition, HDCD's measured noise is clearly higher (typically between 5.7 and 4.5 dB from 3 to 5 kHz and dropping slightly, to between 4 and 5 dB, from 7 to 15 kHz, after which the floor rises because of HDCD's dither). But since HDCD's companding action raises the recorded level by about 5 dB at low to moderate inputs (–20 dBFS or below), an undecoded HDCD disc can still have a signal-to-noise ratio roughly equivalent to that of the conventional 16-bit recording.

The curves in Fig. 15 indicate the comparative noise levels for the same recordings but with the HDCD segment decoded. This data was captured by taking the balanced analog output of the Proceed D/A converter and taking it back to digital with an Apogee AD-1000 A/D converter operating at 16 bits. (To keep the Apogee converter's own noise from confusing the measurement, I used its gain controls to raise the input level about 13.5 dB.) The curves show the quiescent noise of decoded HDCD is below that of the straight 16-bit recording, which suggests that the process is providing some noise-reduction effect. But whereas the undecoded HDCD signal was 5 dB above the straight 16-bit level, the decoded HDCD signal is 1 dB below the 16-bit when measured at the same point. Although the signal level swings 6 dB between the two formats, the noise level drops somewhat less. At 4 kHz the noise of HDCD is about 4 dB lower than the straight 16-bit; at 5 kHz this difference grows to 5 dB in favor of HDCD and then drops to about 4 dB until 11 kHz, where it again approaches 5 dB. Even given potential differences introduced by the decode to analog and return to digital, it does not appear that HDCD provides a large noise advantage over conventional 16-bit recording on this program material, even with an exceptionally quiet source such as that provided for the test recordings.

The significance of that fact becomes evident when you consider that the test recordings are substantially quieter than any material yet released in HDCD. This implies that HDCD is not getting much closer to true 18- or 19-bit equivalent performance than the noise shapers. At least in part, that is because HDCD is no more able than other processes to overcome the limitations of hall, microphone, and microphone preamplifier noise.

The Bottom Line

It is clear that HDCD encoding audibly changes the spectra and envelopes of piano tones. Decoding the signal largely eliminates this problem, however, which is to say that the levels within spectral peaks on the heads and tails of notes are the same (within about 0.5 dB) in decoded HDCD recordings and conventional digital recordings of the same passages. Examination of the spectrograms for the two signals also reveals much greater similarity after decoding of the HDCD version. (These spectrograms are not shown because the differences are so small that they would probably be obliterated in reproduction.)

Decoded or undecoded, HDCD has a signature sound, some portion of which is attributable to the encoding process, the rest to the decode side and, particularly, to the sound of the digital filter incorporated in the HDCD chip. Perhaps this characteristic follows from a certain reverence for analog on the part of HDCD's designers. Of all the processes examined, HDCD is the most aggressive and obvious in operating on the incoming signal. Pacific Microsonics undoubtedly would say that such operations are necessary to overcome the limitations of the digital medium. There is no clear evidence to support such a claim, however, at least in the test recordings or other material currently available, and the nature of the process raises other issues.

In particular, there is the matter of undecoded playback. The way in which HDCD operates on a piano signal has strong musical implications. The rate of sustain, which is altered by HDCD in the example presented, has been the subject of intense development by piano makers for two centuries or more. The "singing" quality for which some pianos are renowned emerges during sustain, and artists modify sustain through subtle manipulations of the piano's pedals. Measurable modification of sustain, whatever its motive, is not likely to yield a faithful reproduction of either the instrument or its use by artists who create refined performances in any genre.

The effect seen and heard on the grand piano is probably not confined to it. Any instrument that continues to sound after it is struck—be it a plucked string on a violin or guitar, a drum, a cymbal, or a vibraphone—has a characteristic decay that is probably susceptible to modification by HDCD. When altering such signals, the process also modifies the associated reverberation. That may possibly account for at least some of the tendency for HDCD recordings to sound "wetter" than conventional recordings. For those who prefer a recording style built around large spaces and a relatively distant perspective or who believe analog recordings are somehow "richer" than digital recordings, HDCD may well be deemed an aural success. If, however, the criterion is accurate reproduction of a musical event, then HDCD's signal-processing operations are less successful, particularly when they're not decoded.

Most remarkable, though, are the wide spectral variations evident among various recordings that are all claimed to represent "good" sound. The 15-kHz energy found in the cymbals on the Super Bit Mapped Sony Mastersound *Kind of Blue* and the HDCD version of "Moonglow" might easily differ by 15 dB or more. Digital technology is clearly being used to serve greatly varying aesthetic objectives and preferences. And if SBM and HDCD represent the future, or perhaps alternative futures, the traditional canons of recording and high fidelity are in need of revision. A

Pacific Microsonics most aggressive processes examined.

EQUIPMENT PROFILE

EDWARD J. FOSTER

HARMAN KARDON CITATION 7.0 A/V PREAMP/PROCESSOR

Harman Kardon has been introducing some impressive products in its upscale Citation line, the flagship of which is the Model 7.0 A/V preamp/surround processor. According to the company, the 7.0 is the culmination of more than three years of intensive research and development and incorporates the most recent versions of Jim Fosgate's movie and music modes. Among these Fosgate innovations is a new "six-axis" technology, which derives a pair of stereo-like surround channels from Dolby Surround's mono surround track. Fosgate, for those who may not know, championed surround sound well before there was such a thing as Dolby Surround and, over the years, developed a number of highly acclaimed surround sound processors under the Fosgate•Audionics label.

The Citation 7.0 is so novel that I don't expect to be able to describe it fully here. The owner's manual runs some 125 pages, which gives you an idea of its complexity. Fortunately, it is well written, and the 7.0's microprocessor and on-screen menus are designed adroitly enough to make the system usable in reasonably short order—even if mastering its potential takes some time.

The 7.0 accepts eight audio/video inputs. Four connections can be in S-video or composite-video form; the remaining four video connections are in composite form only. You can record composite- or S-video signals on two recorders, and both main and auxiliary video outputs also are carried on composite- and S-video jacks. In addition to stereo audio feeds for each recorder, there are line-level outputs for the main front and center channels, for stereo and mono subwoofers, and for two sets of surround channels (side and rear). If Citation's Dual-Drive dipole speakers are used in the surround channels, *both* sets of surround outputs are used, and the speakers switch between bipole and dipole operation under the 7.0's control. Which outputs are active and which are not is determined during initial setup, when the microprocessor is programmed. On the rear panel are 42 gold-plated RCA jacks for the audio and composite-video inputs and outputs; the S-video connectors are base metal. A calibration microphone, supplied with the 7.0, plugs into a rear-panel jack.

Three trigger outputs are provided: One to control room lighting, another to raise and lower a projection screen, and a third to activate compatible Citation power amplifiers. (Interface boxes are usually required to control screen motors, room lighting, et al.; the necessary switching interfaces are built into some Citation power amps.) The projection-screen trigger can be programmed to activate whenever the Citation 7.0 is on or only when specific inputs are selected. A "Custom Install" menu (which contains specialized commands for complex programming of trigger signals) is provided but is accessible only to specially trained dealers and installers. An RS-485 bus jack provides an expansion port for such options as multiroom controllers and external multichannel digital audio decoders, which Citation may introduce in the future.

The Citation 7.0 has two power switches: a master switch on the rear panel, which is normally left on, and an activating switch on the front, which brings the system to life. Although the 7.0 can be operated from its seven front-panel buttons (which select surround mode and source, raise and lower volume, and toggle muting on an off), operation is easier from the remote. With the remote, you can call up any of the eight sources, the eight factory-set surround modes (Dolby Pro Logic, THX, "70 mm,"

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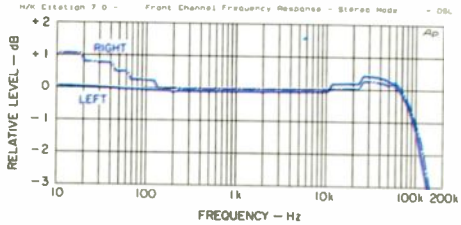

Fig. 1—Front-channel frequency response, stereo mode.

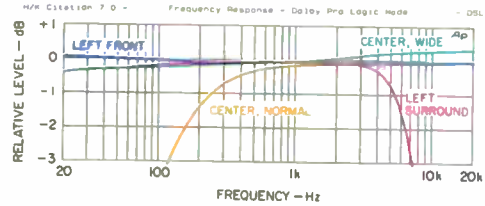

Fig. 2—Frequency response, Dolby Pro Logic mode.

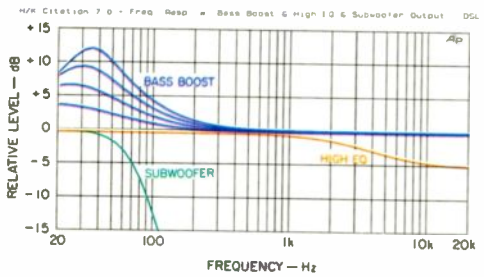

Fig. 3—Effects of bass boost and "High EQ" and response of subwoofer output.

"6-Axis," classical, "Jazz," "Rock," and "Mono"), and four surround modes that you can configure. Needless to say, the remote controls power, volume, and muting. It also permits you to revert the system to factory parameters ("Reset"), switch in equalization, and disable surround processing ("Stereo Only"). For equalization, your choices are "Bass EQ" (in four steps) and "High EQ" (THX-like front-channel re-equalization for use in modes other than Home THX).

The remote has a switch for a sibilance filter ("SIB. Filter"), which reduces leakage of center-channel dialog to the surround channel, and a panorama circuit ("PAN."), which widens the soundstage and creates a wraparound effect. (Neither function is available when you're using Pro Logic or Home THX processing.) A "Center Speaker" button turns that channel on and off, chooses between center-normal and center-wide operation, and enables you to boost center-channel level by 4 dB.

The remote's "Venue" button controls surround-channel DSP. Your choices are "Night Club," "Cinema," "Concert Hall," "Stadium," and a "Custom Venue" mode that you can configure. The remote's "Panel Dim" key turns off the front panel's vacuum-fluorescent display and its steering-logic and input-level indicators. The display wakes up for a few seconds when you press any remote-control key and then goes back to sleep.

The owner's manual refers to some of the remote's controls as "direct access functions," since each of these buttons performs a specific function. Other buttons on the remote are referred to as "menu call functions," which bring up menus, and "navigational controls," which you use when you're making choices. Four of the navigational controls are directional arrows that move an on-screen cursor. Another, "Select," lets you choose control options or advance to the next menu level. "Cancel" aborts changes to the current menu, and "Exit/OK" confirms a selection and exits the current menu.

Of the remote's four menu call buttons, "System Setup" is of primary importance. Using its menus and submenus, you can program the microprocessor for the sizes and types of all your loudspeakers, the number of subwoofers you have in your system, whether you're using a center-channel speaker, whether you have one or two sets of surround speakers (and whether they're direct radiators, Home THX dipoles, or Citation's Dual Drive types), and so forth. With the second option in the "Speakers" menu, you can calibrate and balance levels automatically or manually. The third option calls up submenus for instructing the microprocessor how far your listening position is from the center speaker and each surround speaker. Based on the information you've entered, the Citation 7.0 automatically sets itself up for your viewing room and speaker arrangement.

So far, I've discussed only the first level of the "System Setup" menu; I'll not discuss the other options in such detail. Suffice it to say that the "Video CONFIG" menu selects the way video is routed from the 7.0 to your TV, while other menus enable you to personalize the system with your name and to lock and reset settings. You can check the setup status on-screen by tapping "System Setup" once and exiting the menus without changing them.

With the remote's "Options Set" menu button, you can review such settings as how the two record output circuits are set up, which video output (or both) will carry the on-screen messages, the front-panel display's brightness level and time-out period, and the volume level at power on. You can change the options as desired and even defeat the subwoofer output if you don't want to use your subs when you're listening in stereo.

The remote's "Source Edit" menu button lets you check and customize the settings automatically selected for each input source. It gives you control over input level and balance, each adjustable manually or automatically. You can choose to display on-screen warnings, select the background color for on-screen displays, configure and customize the projection-screen trigger for each source, and customize the name of each source.

THIS IS A PROCESSOR AS MUCH FOR MUSIC CONNOISSEURS AS IT IS FOR CINEMA AFICIONADOS.

The remote's final menu call button, "SURR. Mode Editing," is covered in the manual's "Advanced User Operation" section. I think I'll let you find it there yourself, because fully describing its possibilities will open Pandora's box. With these menus you can program the surround DSP almost from scratch and adjust it for room type, size, and acoustical brightness and reflectivity. You can choose among low-pass filter cutoffs for the surround channel and even change the speed of the steering logic. Fortunately, the manufacturer tells you how


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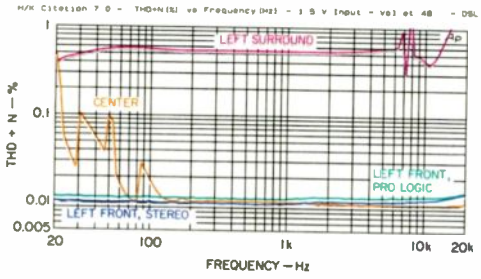

Fig. 4—THD + N vs. frequency.

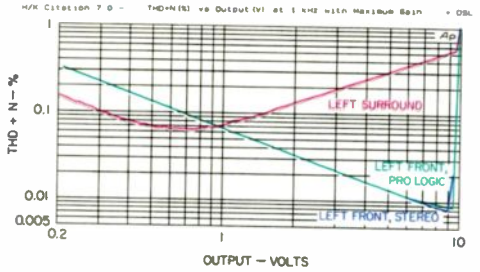

Fig. 5—THD + N vs. output.

the system is set when it leaves the factory, which gives you a road map if you find you've strayed too far.

Measurements

I tested the Citation 7.0 rather fully in its stereo and Dolby Pro Logic modes but checked only surround-channel noise in the other surround modes. For the most part, the readings in "Measured Data" and in the graphs were taken on the left channel, with the factory settings for gain and seating distance. Except for the test of subwoofer frequency response, I set the system up as if no subwoofer were used. I switched the center channel to the appropriate mode for each particular test I was running and set up for Home THX dipole speakers in the surround channels. The volume was set to "48," the Home THX reference point.

Frequency response in stereo is shown in Fig. 1. I have no explanation for the stair-case-like curve shapes (especially noticeable on the right channel). But even worst-case response within the audio band, for the right channel at 20 Hz, is up less than a decibel, which I guess is reasonable. The –3 dB points are well beyond the audio band, below 10 Hz (the bass limit of the measurement) and at 130 kHz.

Figure 2 shows frequency response in Dolby Pro Logic mode, plotted on the same scale as Fig. 1. The response of the left front channel is flatter here than in stereo. In the center-wide mode, there's an overall tilt in the response that amounts to a 0.35-dB boost at 20 kHz and an equal cut at 20 Hz. In the center-normal mode, which you would use with small center speakers, the treble rise does not appear and all bass below 110 Hz is shifted to the main front speakers. Surround-channel frequency response parallels that of center-wide response in the bass and midrange; it then rolls off sharply above 7.5 kHz, as dictated by Dolby Labs standards.

Figure 3 again shows front left frequency response, this time with a more compressed scale so that you can see the effect of "Bass EQ" when it's set to its four boost options (+3, +6, +9, and +12 dB). There's a close match between the settings and the maximum boost each setting yields. However, each 3-dB increase in boost slightly raises the frequency at which the boost peaks, too. I expect this is purposeful, since it's dangerous to apply excessive boost in the infrasonic region.

In Fig. 3, I've included a frequency response curve taken with "High EQ" switched in. This setting is automatically activated when Home THX processing is selected but can also be applied when the 7.0 is in other surround modes. The curve meets Home THX re-equalization standards reasonably well, although its initial slope could be somewhat steeper. I have also included the response taken at the subwoofer output; it is down 3 dB at 60 Hz and is about –8 dB at 80 Hz. As the THX standard demands, the curve has a slope of 24 dB/octave.

Figure 4 shows total harmonic distortion plus noise (THD + N) versus frequency, in Dolby Pro Logic mode. This set of curves was taken using a 1.5-volt input and a volume setting of "48." I also ran curves using a 0.5-volt input and a volume setting 12 dB higher. The THD + N was higher in the front channels with the lower input level and the higher volume setting but was lower in the surround channels. However, since the readings at the high volume setting were more noise than distortion, I have not included those results. Either way, distortion in the front channels is unusually low for a Pro Logic processor.

I measured distortion versus output at 1 kHz, using various volume settings. It soon became clear that the maximum output level was limited by input overload, not by output-stage clipping, and that all channels overloaded at pretty much the same point. Thus, Fig. 5 reflects performance with the volume set to maximum but does not include a curve for the center channel. Obviously, there's more than enough output to drive even the least sensitive power amplifier into clipping.

With the factory gain settings, input overload occurred at 2.27 volts, which is typical of many processors. Although this level is usually considered adequate, it's actually somewhat marginal because the D/A converters in some new laserdisc and CD players put out more than the standard 2 volts. This need not be a concern with the Citation 7.0, however. I found that if I reduced the input gain (a function available on yet another menu), the 7.0 could accept nearly 4.5 volts before running into trouble; that's more than enough for any current source.

Input impedance was adequate, and output impedance at the main front terminals and recording outputs was nice and low.

I'VE NEVER HEARD A PRO LOGIC PROCESSOR THAT COULD SEPARATE SOUNDS SO BELIEVABLY.

Spectrum analyses (not shown) unearthed power-line-related components at 60 and 180 Hz, but they were quite low. Over most of the spectrum, there was only white noise; there was also a noise spike at 100 kHz, presumably related to the digital sampling rate.

On an A-weighted basis, noise was approximately 83 dB below the 0.5-volt reference in all channels. Since typical power amps reach full output with an input of about 1.5 volts, you can count on a usable system dynamic range of about 93 dB. The Citation's own dynamic range, referenced to its maximum output, approached 110 dB! The A-weighted noise in the surround

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channels was 2 to 3 dB higher with the "70 mm," "6-Axis," "Jazz," and "Rock" settings than in the Pro Logic or THX modes. Steady-state channel separation at 1 kHz in Pro Logic mode averaged about 43 dB; that average would have been better but for a leakage of –21.7 dB from the surround channel to the right front.

Use and Listening Tests

It may seem strange to speak of the Citation 7.0 first as a surround processor for *music*, but when I hear one of Jim Fosgate's creations, I never fail to be awed. What I find most impressive about his algorithms is how *un*impressive they are—until you turn them off! It's easy these days to program a DSP system to wow people with a hot demo of an all-enveloping soundstage. But live with such a DSP system for a while, and the wow will probably wear off.

I don't want my head inside Itzhak Perlman's violin (it wouldn't fit), nor do I want to live in a piano (much as I like its sound). I want to be in the audience. I want the performer in front of me, not surrounding me, and I want a natural and believable sense of ambience. This is precisely what the Citation 7.0 creates in its classical music mode. It provides a solid front image and a remarkably natural hall acoustic. Even the "Jazz" and "Rock" modes are not overly aggressive. (Unlike the classical mode, by the way, they use the center channel.) When the Citation 7.0 was in my home theater, I began listening to *music* in the various soundfield modes for the sheer enjoyment of it. Normally, I take my music in straight stereo, thank you, and in my listening room, not in my theater.

Some readers will view the Citation 7.0 primarily as a processor for home theater rather than for music. There's nothing wrong with that; it does a remarkably fine job for both. It's not a system that knocks you off your chair but, rather, one that reveals subtleties other Pro Logic and Home THX decoders miss. I've not heard another Pro Logic processor distinguish the raindrops hitting Gene Hackman's umbrella from the surrounding downpour (*Crimson Tide*) as well as this one does. (AC-3 does it better still, but relatively little material is available in that format yet.) Nor have I heard others that can separate left-side helicopter flyovers from right-side flyovers quite so believably as this one (*Clear and Present Danger*). Why is the 7.0 superior? I'm really not sure, but I suspect it has to do with the speed of Fosgate's steering logic. Whatever the reason, the results are terrific!

The Citation 7.0 is a surround processor designed as much for the music connoisseur as for the movie aficionado. Its subtlety is unsurpassed, its surround effects the most natural I've heard short of a true discrete-channel system. The Citation 7.0 gets *my* citation for excellence and rides high on my recommended list. A

MEASURED DATA

Maximum Gain, Stereo Mode: 14.3 dB.

Gain to Recording Output: –0.16 dB.

Input Overload: With factory settings, 2.27 V; maximum, 4.5 V.

Output at Clipping, 1 kHz: Stereo, 9.85 V; Pro Logic, more than 9.65 V for all channels.

Frequency Response, Stereo Mode: 20 Hz to 20 kHz, +0.26, –0 dB (–3 dB below 10 Hz and at 130 kHz).

Frequency Response, Pro Logic Mode: Main front channels, 20 Hz to 20 kHz, +0.12, –0 dB; center channel (wide mode), 20 Hz to 20 kHz, ±0.35 dB; center channel (normal mode), –3 dB at 110 Hz; surround channels, –3 dB at 7.5 kHz; subwoofer output, –3 dB at 60 Hz.

THD + N, Stereo Mode: Less than 0.0133%, 20 Hz to 20 kHz.

THD + N, Pro Logic Mode: Main front channels, less than 0.0135%, 20 Hz to 20 kHz; center channel, less than 0.03%, 100 Hz to 20 kHz; surround channels, less than 0.867%, 100 Hz to 7 kHz.

A-Weighted Noise re 0.5 Volt, Stereo Mode: –83.2 dB.

A-Weighted Noise re 0.5 Volt, Pro Logic Mode: Main front channels, –83.2 dB; center channel, –83.4 dB; surround channels, –82.9 dB.

Channel Separation: Stereo, greater than 46.3 dB, 100 Hz to 10 kHz; Pro Logic, 43.16 dB at 1 kHz (average), 21.7 dB at 1 kHz (worst case).

Input Impedance: 16.6 kilohms.

Output Impedance, Left Front and Record Outputs: 300 ohms.

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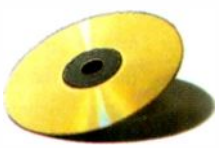

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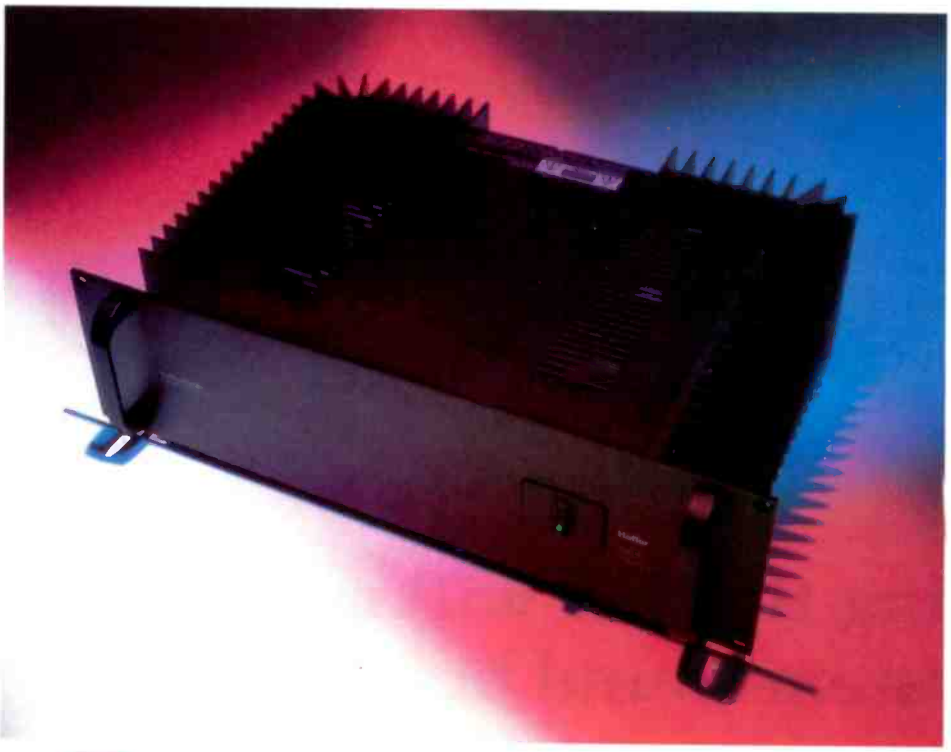
EQUIPMENT PROFILE

BASCOM H. KING

HAFLER TRANS-NOVA 9505 AMPLIFIER



The Trans-Nova circuit design goes back to about 1984, when it was introduced by Acoustat (later bought by Hafler) in two solid-state power amps (the Models TNT120 and TNT200). "Trans-Nova" is a contraction of Transconductance Nodal Voltage Amplifier (U.S. Patent No. 4,467,288). When I first examined the circuits for these amplifiers, I was most impressed with the topology of the output stage. Other aspects of the original circuit design were quite elegant also.

Rated Power Output: 250 watts per channel into 8 ohms, 375 watts per channel into 4 ohms.
Dimensions: 19 in. W x 5¼ in. H x 12½ in. D (48.3 cm x 13.3 cm x 31.8 cm).
Weight: 50 lbs. (22.7 kg).
Price: $2,200.
Company Address: 613 South Rockford Dr., Tempe, Ariz. 85281; 602/967-3565.
For literature, circle No. 91

The 9505, a third-generation Trans-Nova design, is aimed primarily at the professional audio market. It is the larger of two otherwise similar pro models and is rated at 250 watts per channel into 8-ohm loads. (The smaller 9303, rated at 150 watts per channel into 8 ohms, is priced at $1,300.) A reasonably sized package for its power output, the 9505 has a front panel graced by a single on/off rocker switch. An indicator in the switch glows when the amp is turned on. Both balanced and unbalanced input connectors are provided on the rear panel.

THE 9505 USES THE THIRD GENERATION OF HAFLER'S IMPRESSIVE TRANS-NOVA CIRCUIT.

The interesting XLR connectors will accommodate either the usual mating XLR connector or a ¼-inch phone plug. Speaker connections are made via two pairs of five-way binding posts. Three recessed slide switches select balanced or unbalanced input mode, stereo or mono (bridged) operation, and connection or disconnection of the chassis to the third-wire ground. The AC line connection is via an IEC socket and mating power cord.

Inside the 9505 is a main p.c. board in a "C" shape, oriented with its long side to the rear. A large, rectangular, UI-lamination power transformer is situated in the opening of the p.c. board. The main filter capacitors for each channel are mounted on the short sides of the board, adjacent to the heat sinks. All of the input connectors and slide switches on the rear panel are mounted to the rear portion of the p.c. board. This is the first power amplifier I've seen that uses surface-mount parts for most of its signal circuitry and the low-power parts of its power supply.

If one considers the power supply as part of an amplifier, the standard "half-bridge" output-stage topology is actually a full bridge, consisting of four elements. These elements are the two output devices (or the equivalent, where multiple devices are paralleled for more power-handling capacity) and the positive and negative power supplies. In the usual arrangement, the center point of the power supplies is grounded, and the load is connected between this ground reference point and the midpoint between the two output devices. In most designs, these output devices are driven as followers, with their input driving voltage slightly higher than the output voltage.

In the Trans-Nova design, the load is still connected between the same two points in the bridge. What's radically different is that the Trans-Nova uses the midpoint between the output devices as its ground reference and lets the center tap of its power supply move with the signal. In this arrangement, the output devices (MOSFETs in the 9505) are operated as common-source amplifiers with voltage gain, and

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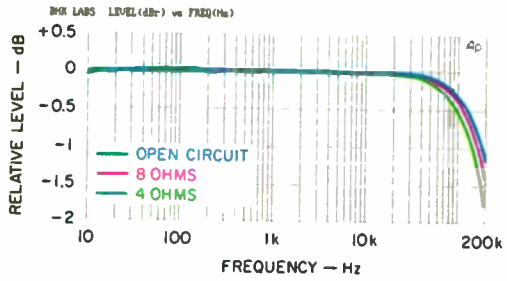

Fig. 1—Frequency response.

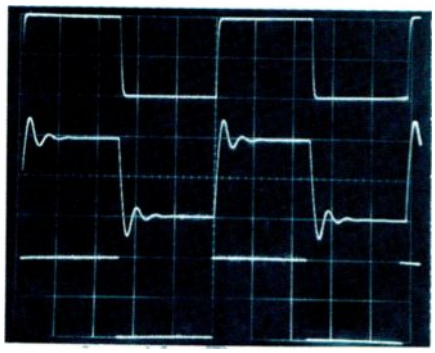

Fig. 2—Square-wave response for 10 kHz into 8 ohms (top), 10 kHz into 8 ohms paralleled by 2 µF (middle), and 40 Hz into 8 ohms (bottom).

their input driving signal is referenced to ground. The input signal required is much smaller, so the front-end driving circuitry can be operated from a much lower supply voltage than that needed for the output stage. As the 9505's excellent owner's manual points out, the output stage's voltage gain gives this stage approximately 10 times the power gain of a conventional follower circuit using exactly the same MOS-FET devices.

Negative feedback is taken from the output point back to the input gates of the MOS-FETs. This inverting feedback converts what would be a high-impedance input to a low-impedance input. In other words, the output stage has been made into a transimpedance stage, or current-to-voltage converter. This stage is fed by the driver circuitry, which is configured as the output stage's complement, a voltage-to-current (or transconductance) circuit.

The driver stage is a newly developed circuit, DIABLO (Dynamically Invariant A-B Linear Operation), that is designed to provide up to 14 dB greater headroom than the usual Class-A driver stage. This extra headroom is needed because the output stage has four pairs of MOS-FETs per channel, used in their common-source mode. The appreciable input capacitance of this arrangement calls for a driver stage that has more output current at high frequencies than the usual Class-A stage, with its limited 2-to-1 ratio of peak to quiescent current, can provide. To get around this limitation, the DIABLO circuit uses a complementary common-base first stage, direct-coupled to a complementary cascode-connected second stage.

At the input of the 9505, the phases of the signal are each buffered by a discrete circuit that consists of an N-channel J-FET source follower with a bipolar current source. This is coupled into a complementary bipolar emitter follower. Grounding one phase of this buffer input changes the input from balanced to unbalanced; the balanced/unbalanced switch merely ungrounds (or grounds) the negative input phase for balanced (or unbalanced) input configuration. For bridged operation, the stereo/mono switch establishes an inverted-polarity signal path from the left channel's input (which doubles as the mono input) to the right channel's. An op-amp servo circuit monitors the amplifier output's DC level and applies any error to the ground end of a signal-voltage divider that feeds the positive input of what I consider the power amplifier proper (i.e., everything that follows this buffer).

As is often the case, the amplifier proper is embedded in a four-resistor, differential-to-single-ended circuit that incorporates two voltage dividers, one for each signal phase. The input of the power amplifier proper is a differential amplifier using a matched pair of N-channel J-FETs. The J-FETs' sources are connected to a bipolar current source whose drain outputs are coupled to a bipolar current mirror. One of the differential amplifier's outputs is direct-coupled to the input of the driver stage.

THE MORE I USED THE TRANS-NOVA 9505, THE MORE I LIKED ITS HIGH RESOLUTION AND SMOOTHNESS.

Overall negative feedback is taken from the output to the inverting input of this differential amplifier.

The power transformer is somewhat unusual, having separate primary and secondary windings for each channel; each of the long sides of the transformer's UI core carries one such primary-secondary pair. This reduces the capacitive coupling between the high-current secondary windings as they move with the signal in respect to ground and to each other.

Measurements

The test results cited here are for the left channel with unbalanced input. Any significant departure, for the right channel or balanced input, is noted.

Frequency response for open-circuit, 8-ohm, and 4-ohm loading at a nominal level of 2.83 volts (1 watt into 8 ohms) is plotted in Fig. 1. Bandwidth is very wide; further, the curves are very close together over the audio range, indicating a very low output impedance and consequent high damping factor. Rise and fall times measured 1.1 microseconds for an output level of ±5 volts into 8 ohms, yielding an equivalent bandwidth of about 318 kHz. Square-wave response is shown in Fig. 2. For 10 kHz (top trace), rise time is sharp and fast. The addition of a 2-microfarad capacitor across the 8-ohm load (middle trace) causes ringing, typical of most solid-state am-

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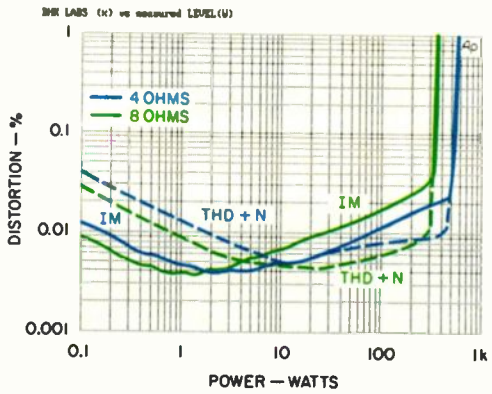

Fig. 3—THD + N and SMPTE IM distortion vs. power output.

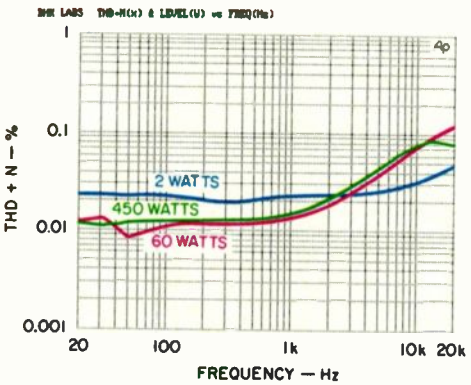

Fig. 4—THD + N vs. frequency.

plifiers. The absence of tilt in the low-frequency trace (bottom) is indicative of excellent, extended infrasonic response.

Figure 3 shows total harmonic distortion plus noise (at 1 kHz) and SMPTE intermodulation distortion versus power. With the balanced inputs (not shown), THD + N was about the same as seen in Fig. 3, but IM distortion was a third to a half as much from 10 to 400 watts. Figure 4 shows THD + N versus frequency for low, medium, and high power into 4 ohms. Spectrum analysis (not shown) revealed that the second harmonic was the dominant distortion component over much of the power output range. When the second harmonic is dominant, harmonic distortion level is relatively constant with change in output, as can be seen in Figs. 3 and 4.

With the unbalanced inputs, crosstalk was more than 100 dB down up to 2.5 kHz; there was remarkable similarity between the right-to-left and left-to right directions. Crosstalk then increased at 6 dB/octave, reaching –86 dB at 20 kHz. With the balanced inputs, the symmetry between directions was not as good; the amount of crosstalk was some 2 to 10 dB worse, depending on frequency and direction.

For the 9505's balanced inputs, common-mode rejection ratio (CMRR) rose by approximately 6 dB/octave over the audio range. It started at –106 and –110 dB at 20 Hz for the left and right channels, respectively; it ended up at –54 and –60 dB at 20 kHz.

Output noise levels for the right (worse) channel were 314 microvolts wideband, 252 microvolts from 22 Hz to 22 kHz, 131 microvolts from 400 Hz to 22 kHz, and 130 microvolts A-weighted. The results for the left channel were about 10% to 20% better. The unit's A-weighted signal-to-noise ratio was –88.2 dB for the left channel and –86.7 dB for the right, relative to a 1-watt output into 8 ohms. The noise was satisfactorily low, mainly hum components induced by power-transformer flux. (There was also some audible mechanical hum emanating from the transformer.)

Output impedance was very low in both channels. Damping factor, referred to 8 ohms, was 670 from 20 to 500 Hz, decreasing to 615 at 1 kHz and to 100 at 20 kHz. Voltage gain into 8-ohm loads was slightly greater than 28.7 dB.

In the test of dynamic power, the 9505 produced 390 watts into 8 ohms at the beginning of the tone-burst signal and 380 watts at its end; dynamic headroom was 1.9 dB. For 4-ohm loads, output was 666 watts at the start of the burst and 648 watts at its end, corresponding to a dynamic headroom of 2.5 dB. Maximum undistorted output into a 1-ohm load with one channel driven was 48 volts at the start of the burst and 44 volts at its end, equivalent to peak currents of 48 and 44 amperes, respectively.

Power attainable at the visual onset of clipping was 345 watts into 8 ohms and 553 watts into 4 ohms. Clipping headroom was therefore 1.4 and 1.7 dB, respectively.

The 9505's AC line draw was about 2 amperes. The current remained quite constant from cold turn-on to the point where the amplifier became quite hot during the power tests; this indicates excellent output-stage thermal stability.

Use and Listening Tests

During the review period, the equipment in my system included an Oracle turntable fitted with a Well Tempered Arm and an Accuphase AC-2 moving-coil cartridge, used with a Vendetta Research SCP-2C preamp. A Counterpoint DA-11A CD transport drove a Museatex Bidat or a Sonic Frontiers SFD-2 MKII D/A converter. Additionally, a Genesis Digital Lens jitter-reducing device was placed between the CD transport and the D/A converter. Other program sources were Nakamichi's ST-7 FM tuner, a Nakamichi 250 cassette recorder, and a Technics 1500 open-reel recorder. I used a Forssell balanced tube line driver with the Sonic Frontiers D/A converter and a Quicksilver preamp with the other components. Power amplifiers on hand were a Crown Macro Reference, a pair of Quicksilver M135s, an Arnoux 7B digital switching design, and a JoLida SJ 302A integrated tube unit. Loudspeakers used in the tests were B&W 801 Matrix Series 3s, each of which was augmented from 20 to 50 Hz by a subwoofer.

The Hafler Trans-Nova 9505 impressed me right away with its smooth presentation. The more I used this amplifier, the more I liked it. I found its ability to deliver excellent resolution and detail, without producing much edginess or irritation, endearing. Space, dimension, and air were excellent, as were tonal balance, bass definition, and impact.

"Resurrection," track 6 of *Bourbon & Rosewater* (Waterlily Acoustics WLA-CS-47-CD), yielded a sound so sweet, clear, and realistic that it was hard to imagine it sounding better. Similarly, on Mendelssohn's "Die Tageszeiten," track 7 of *The Times of Day* (Reference Recordings RR-67CD, an HDCD-encoded disc), the sound of an orchestra playing and men singing in a chorus was very palpably present.

Both in the lab and in my listening room, the Hafler Trans-Nova 9505 behaved just about flawlessly. I liked it very much. And although I didn't audition the less powerful 9303, I expect its sonic character is very similar to the 9505's. A

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Dr. Erol Ricketts has received many awards as an expert in urban poverty and public policy (about which he's written a book) and the spread of venereal disease and AIDS. And since 1991, he's been president of NSM Loudspeakers, a high-end company he founded and named after his children, Nsombi, Sekou, and Makeda. The company now makes more than 10 speaker models, ranging in price from $495 to $6,495 per pair. NSM also manufactures sand-filled speaker stands, called Sandbags (30-inch Matador stands, which cost $295 per pair, were supplied for this review), and a line of amplifiers under the GREO brand name.

The Model 10S is the smallest (though not the least expensive) speaker NSM manufactures. Although the 10S speakers were submitted for review as stand-alone systems, the company primarily intends them for use with a companion subwoofer, the Model 15-EXP.

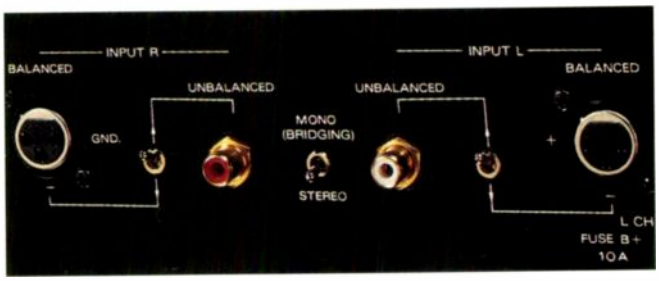
The 10S is a two-way, closed-box design. Its cabinet, tightly constructed of half-inch MDF, is strengthened with an internal shelf that divides the enclosure into two equal parts. A large hole in the shelf lets the woofer use all of the box's internal volume. The cabinet is finished on all six sides. The grille frame, of molded plastic, is covered with black grille cloth. The grille attaches to the front of the enclosure via four pegs that mate with rubber-lined holes in the corners of the cabinet's front panel.

The drivers are centered on the front of the cabinet, with the tweeter above the woofer, and are flush with the cabinet. The tweeter's large faceplate keeps the centers of the tweeter and woofer separated by a significant 4½ inches. The 1-inch soft-dome tweeter is magnetic-fluid cooled and incorporates a large ferrite magnet, 3 inches in diameter and 0.6 inch thick. The 4½-inch woofer is a long-throw unit. Its inch-diameter voice coil is attached to a molded-plastic cone with rubber surround; its magnet is the same size as the tweeter's.

The crossover is a minimalist design, containing only three components. A hefty 3.1-millihenry air-core inductor, wound with large-diameter wire, is in series with the woofer, and a series combination of a high-quality, 5-microfarad capacitor and 24-ohm power resistor drives the tweeter. These components form first-order (6-dB/octave) high- and low-pass filters. The series resistor effectively attenuates the tweeter level to match the woofer's relatively low sensitivity. The crossover is mounted on a small piece of fiberboard attached to the back of the cabinet, behind the tweeter. The NSM's internal connections are soldered and use audiophile-grade, large-diameter stranded wire. Connections to the speaker

Rated Room Frequency Response: 55 Hz to 20 kHz, ±3 dB.
Rated Sensitivity: 84 dB at 1 meter, 2.83 V rms applied.
Impedance: 8 ohms, nominal.
Recommended Amplifier Power: 50 to 200 watts per channel.
Dimensions: 10 in. H x 5½ in. W x 6½ in. D (25.4 cm x 14 cm x 16.5 cm).
Weight: 6 lbs. (2.7 kg) each.
Price: $695 per pair in satin black, $795 per pair in walnut; single-wire version (Model 10), $595 per pair in satin black or white.
Company Address: P.O. Box 326, Garden City, N.Y. 11530; 516/486-8285.
For literature, circle No. 92

Photo: Michael Groen



"The HCA-2200[II] has all the features and flexibility any audiophile could want...," notes Stereophile.

Sure, it's nice to be hailed as a "benchmark." But what, exactly, does that mean? Well, let's read the quote in context:

"While the HCA-2200[II] has virtually unlimited brute power, it has enough finesse to let the music come through largely unscathed. Over the last six months it has proven, with a variety of speakers in both my listening rooms, that it's a benchmark product against which other amplifiers can be measured. If an amp of equal or greater price isn't at least as good as the HCA-2200[II], it doesn't cut it."

It's clear that Mr. Stone has discovered the virtues of our amplifier. And while we're pleased he found the process so enjoyable, we aren't surprised. It's all part of our design philosophy, whose essence he captures nicely when he says, *"...a middle-class audiophile like myself no longer has to take out a second mortgage on his house to afford a musically satisfying amplifier."*

"...A Benchmark Product Against Which Other Amplifiers Can Be Measured."

– Steven Stone, *Stereophile*, Vol. 17 No. 3, March 1994

But what did surprise us, as well as flatter us, was being thrown into the ring with $12,000 monoblock behemoths. The result of this apparently absurd comparison? Not carnage, but rather: *"...the Parasound HCA-2200[II] gives them all a run for the money, and even beats 'em in flexibility and price."* He continues, *"...a pair of HCA-2200[II]s performed with Apogee full-ranges on a par with a pair of Boulder 250 AEs and four VTL Deluxe 300 amps. Dynamic impact and attack were excellent...Compared to the VTL300, the HCA-2200[II] had a greater sense of extension..."*

Enough quotes. It's time to experience one yourself. Just visit your local Parasound dealer and learn that "benchmark" is the expert's way of saying you don't have to break the bank to get the best. And you can quote us on that.

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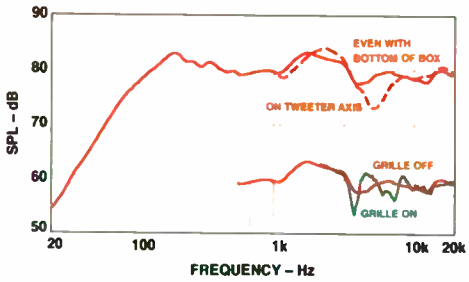


Fig. 1—On-axis frequency response.

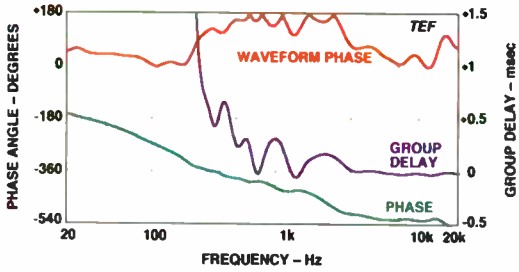


Fig. 2—On-axis phase response, group delay, and waveform phase (see text).

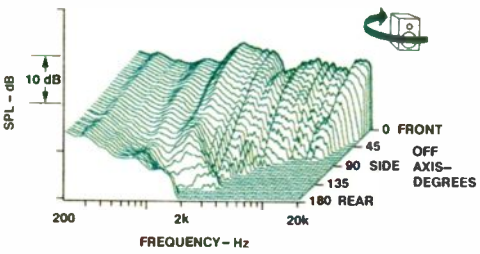


Fig. 3—Horizontal off-axis frequency responses.

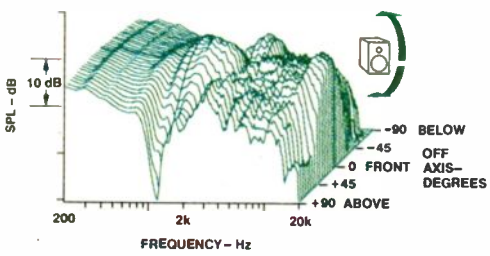


Fig. 4—Vertical off-axis frequency responses.

are through a pair of gold-plated, audiophile-grade terminals on the cabinet's bottom rear. (You may bi-wire the terminals; a single-wire version, the Model 10, is available.) Standard double-banana jacks and cable up to 0.3 inch in diameter (AWG #2!) are accepted.

Measurements

I measured the NSM Model 10S's anechoic frequency response (Fig. 1) at a distance of 1 meter from the front of the cabinet and used a tenth-octave filter to smooth the curves. The top curves, taken without the speaker's grille, show the response at two locations: on the tweeter's axis, which yields a quite rough response through the crossover region, and at a point even with the bottom of the cabinet (the woofer end), which yields a much flatter response.

I experimented with different measurement locations because of the poor response I obtained on the tweeter's axis. That curve has an octave-wide hump of about 4 dB centered at about 2 kHz and a narrower, 7-dB dip at 5 kHz. If you exclude this hump and dip, however, the curve is fairly flat. To explore why this curve was so poor, I remeasured the response but reversed the tweeter connections. (I could do this easily by changing the speaker's bi-wire connections.) The curve (not shown) exhibited a significant reduction in level between 1 and 4 kHz but had much higher output between 4 and 8 kHz. This indicates that in the normal connection, the woofer and tweeter are approximately in phase in the lower frequency range but are significantly out of phase in the upper range, which can yield poor vertical coverage. The out-of-phase condition was responsible for the dip at 5 kHz. The wide range of interaction between the woofer and tweeter (the three octaves from 1 to 8 kHz) is a result of the gradual rolloffs of the speaker's first-order crossover and the drivers' consequent broad, overlapping responses.

I searched for other measurement locations that would yield flatter response through the crossover region when the drivers were connected in normal polarity and also yield a reduction in response through the same region when the drivers were connected in reverse. I obtained the desired results when I measured the 10S on the woofer's axis (or lower), at a point even with the bottom of the cabinet. The response (Fig. 1, top curve set) is much smoother than on the tweeter's axis. The hump at 2 kHz is reduced, and the dip at 5 kHz has disappeared. On this new axis but with the tweeter's connection reversed, there was a reduction of some 5 to 15 dB from 1 to 8 kHz (response not shown), which is a good sign. Having the drivers more nearly in phase through the crossover range minimizes lobing and improves vertical coverage.

THE NSM 10S SEEMED QUITE SUBSTANTIAL FOR ITS VERY DIMINUTIVE SIZE.

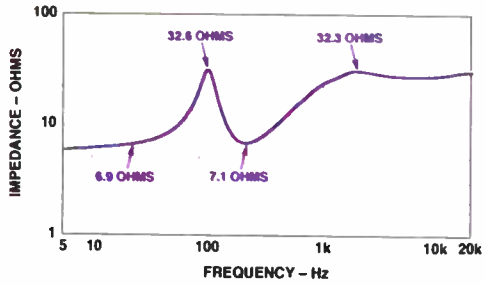
The 12-dB/octave rolloff in the bass is normal behavior for a closed-box speaker system. In the NSM 10S, this rolloff begins at a fairly high frequency (180 or 80 Hz, depending on whether you count its beginning from the slight upper-bass peak or from the –3 dB point relative to 1 kHz), but that would be inconsequential if the 10S were used with a subwoofer.

The lower set of curves in Fig. 1 demonstrates the effect of the speaker's grille. The grille significantly roughens the response above 2.5 kHz.

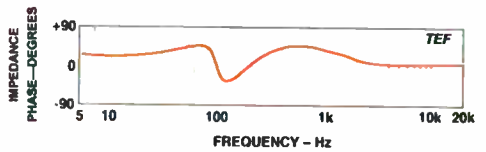
Averaged from 250 Hz to 4 kHz (with equal emphasis on each third-octave frequency band), the 10S's sensitivity was a very low 80.7 dB, about 3 dB below NSM's low, 84-dB, rating. The right and left speakers matched within a very close ±0.5 dB from 100 Hz to 20 kHz.

Figure 2 shows the phase and group-delay responses, referenced to the tweeter's arrival time. The phase curve is very well behaved and decreases only 90° between 1 and 10 kHz. When averaged from 1 to 4 kHz, the group-delay curve indicates a low offset of about 0.15 millisecond, with the woofer delayed relative to the tweeter.

Also shown in Fig. 2 is the waveform phase, which indicates whether waveshapes



A



B

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

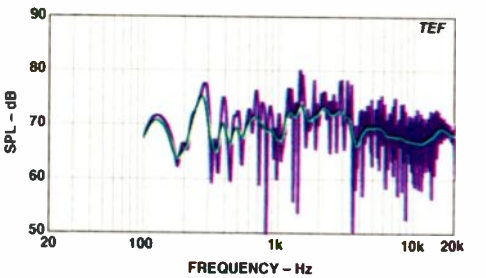


Fig. 6—Three-meter room responses.

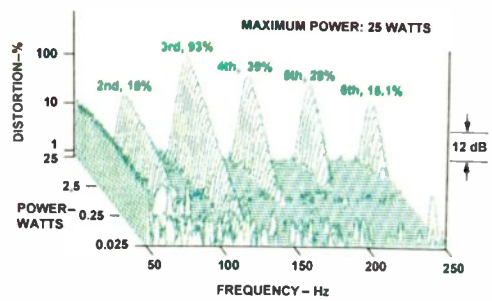


Fig. 7—Harmonic distortion for E_1 (41.2 Hz).

will be preserved in specific frequency ranges. In previous reviews, I have plotted waveform phase on a wrapped ±180° scale. However, here the graph shows the absolute value of the waveform phase, plotted on a scale from 0° to 180°. This eliminates the sharp transitions when the phase rotates from –180° to +180°. If the waveform phase is at or near 0° over a specific frequency range and the frequency response is relatively flat over that range, waveforms will be preserved (and will be in proper polarity) if the signal's energy is constrained to that range. Likewise, if the waveform phase is at or near 180°, waveshapes will be preserved but inverted. For the NSM 10S, the curve of waveform phase indicates that waveshapes in the woofer's range from 300 Hz to 2.5 kHz will be somewhat preserved but will be inverted, while signals whose energy is constrained to higher and lower frequencies will come through in proper polarity. Odd as it may sound, this actually represents unusually good performance on the waveform phase test. Interestingly, when I examined the drivers' crossover connections, I found that the woofer was connected in reverse polarity and the tweeter in normal polarity.

Figure 3 shows the speaker's horizontal off-axis responses. (The bold curve at the rear is on-axis response.) The curves here and in Fig. 4 were obtained by rotating the speaker around the woofer's axis and measuring 1 meter in front of the 10S. The curve-to-curve uniformity in Fig. 3 indicates very even horizontal coverage; from 10 to about 18 kHz, only moderate narrowing is evident.

The 10S's vertical off-axis responses are shown in Fig. 4. (The bold curve in the middle of the graph was taken on the woofer's axis.) In the important range from on-axis to 15° above axis, the curves are quite uniform except for a dip between 4.5 and 7 kHz (which corresponds to the dip in Fig. 1 in the response taken on the tweeter's axis). At downward angles in the same range, a broad depression between 1.8 and 7 kHz develops not far below the axis (not clearly seen in the graph). At angles far above the speaker's axis, a sharp dip develops at about 1.3 kHz. The vertical responses are quite asymmetrical, with the curves above axis much better than those below it.

At low frequencies, the NSM's impedance magnitude (Fig. 5A) exhibits the classic characteristic of a closed-box loudspeaker—a single peak. Here, the peak is at 90 Hz, the resonant frequency of the woofer in the closed box. At higher frequencies, the impedance reaches a minimum of 7.1 ohms at 200 Hz and then rises smoothly to about 32 ohms above 1.4 kHz. The high impedance at high frequencies is directly due to the crossover's resistor in series with the tweeter. Between 20 Hz and 20 kHz, a 32.6-ohm maximum occurs at 90 Hz and a moderately low minimum of 6.9 ohms at 20 Hz. The max/min impedance variation is thus a moderate ratio of 4.7 to 1 (32.6 divided by 6.9). Cable series resistance should be limited to a maximum of about 0.1 ohm to prevent cable-drop effects from causing response peaks and dips greater than 0.1 dB.

APPEARANCE AND CONSTRUCTION WERE UPSCALE, WORTHY OF THE BEST HIGH-END SPEAKER SYSTEMS.

For a typical run of about 10 feet, therefore, you should use 16-gauge (or larger), low-inductance cable with the NSM 10S.

The impedance phase (Fig. 5B) stays within a moderate ±45° over the entire frequency range. Above 2 kHz, the phase is essentially 0°, which indicates a resistive load. The 10S should be no problem for any amplifier, and solid-state amplifiers should have no difficulty handling a pair of these speakers in parallel.

When I subjected the 10S to a high-level sine-wave sweep, the cabinet exhibited minimal side-wall vibrations. The maximum *linear* excursion of the woofer was about 0.25 inch, peak to peak; the absolute maximum excursion (with high third-harmonic distortion) was about 0.3 inch, peak to peak. I could not detect any sign of dynamic offset.

Figure 6 shows the 10S's 3-meter room response, with both raw and sixth-octave-smoothed data. The speaker was upright in the right-hand stereo position, mounted on the supplied 30-inch stand, and aimed laterally at the test microphone. I raised the front of the cabinet by about ⅜ inch so that the test mike was even with its bottom. The

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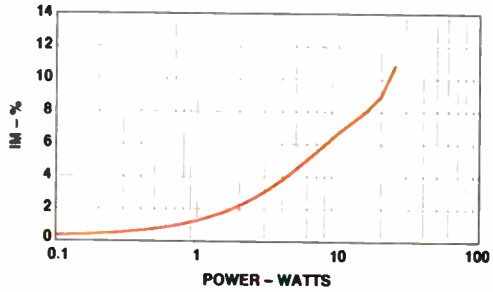

Fig. 8—IM distortion for A_4 (440 Hz) and E_1 (41.2 Hz).

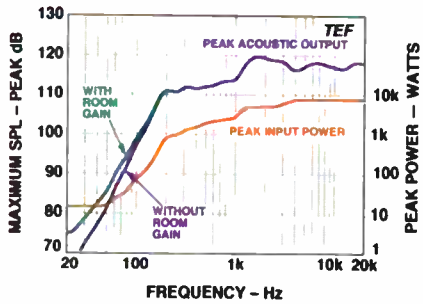

Fig. 9—Peak input power and sound output.

system was driven with a swept sine-wave signal of 2.83 volts rms (corresponding to 1 watt into the speaker's rated 8-ohm impedance). The direct sound and 13 milliseconds of the room's reverberation are included. If you exclude the range below 340 Hz, the smoothed curve fits a moderately tight, 7.5-dB window. This curve's distinguishing features are many small undulations, a dip at 190 Hz followed by a peak at 270 Hz, and a broad rise between about 1.2 and 3.4 kHz. Above 4 kHz, the curve fits a very tight, 3-dB window.

Figure 7 shows the Model 10S's E_1 (41.2-Hz) bass harmonic distortion; input power ranged from 0.025 to 25 watts (14.14 volts rms into 8 ohms). Even at the relatively low 25-watt input power level, the third harmonic reaches a very high 93%; this indicates hard symmetrical limiting in both directions of woofer excursion. Other results include 15% second harmonic, 39% fourth, 28% fifth, and 15% sixth. Clearly, this speaker is being overloaded by this amount of power at 41.2 Hz. Although the distortion at the E_1 tone was quite high, the speaker handled the overload well and did not sound excessively distressed.

The A_2 (110-Hz) bass harmonic distortion (not shown) rose to only moderate levels at a 25-watt input. The maximum distortion was 8.9% second harmonic, with only 4.0% third and 2.7% fourth. The A_4 (440-Hz) harmonic distortion (also not shown) rose only to the low level of 1.6% second harmonic; higher harmonics were below the floor of my analyzer. It is obvious from the differences between the 41.2-Hz and 110-Hz distortion readings that the 10S would benefit greatly from being used with a subwoofer.

Figure 8 shows the IM versus power created by tones of 440 Hz (A_4) and 41.2 Hz (E_1) of equal power, over the range from 0.1 to 25 watts. The IM rises gradually and reaches 11% at full power. Although moderately high, 11% is a relatively low IM level for a speaker of this size that reproduces both tones from the same driver.

Figure 9 reveals the 10S's short-term peak-power input and output capabilities. (The peak input power was calculated by assuming that the measured peak voltage was applied across the rated 8-ohm impedance.) The peak input power starts at a moderate 12 watts at 20 Hz, stays constant until 50 Hz, and then rises rapidly. It crosses 100 watts at 120 Hz and 1,000 watts at 300 Hz before leveling off at 6,000 watts above 4 kHz, in the tweeter's range. With room gain, the speaker's maximum peak SPL starts at an unusable 74 dB at 20 Hz and then rises rapidly. It crosses 90 dB at 60 Hz, 100 dB at 105 Hz, and 110 dB at 180 Hz before rising into the loud range of 115 to 119 dB SPL above 1.1 kHz. Although the 10S will play sufficiently loud above 180 Hz, its bass output is rather anemic; it is at the bottom of the list of all systems I have tested. However, the 10S is also the smallest speaker I've tested for *Audio*, and its low-frequency output competes favorably with that of other speakers in its size range I have used.

THE NSMs SOUNDED BIGGER THAN THEY LOOKED, WITH SMOOTH AND EXTENDED HIGHS AND SUPERB IMAGING.

Use and Listening Tests

The NSM 10S speakers arrived at my lab packed two to a box, in a carton whose size seemed more appropriate for a single small system. The diminutive size of the Model 10S must be seen to be appreciated. Although I could easily carry a pair under one arm, subjectively these speakers seemed quite substantial and weighty for their size. My review samples were finished in walnut, and their appearance and construction proclaimed a very upscale quality. Everything fit very well, including the grilles. Even the large, gold-plated bi-wirable terminals were worthy of the best high-end system.

For my listening tests, I mounted the NSMs on the 30-inch-high Matador stands. These stands, which must be assembled, came in a box more than twice the size of the speaker carton. And at nearly 20 pounds, each sand-filled stand weighs more than three times the speaker it supports! Each stand had four screw-in adjustable spikes, which came in quite handy when I needed to change vertical aiming. When the 10S is mounted on the Matador, the speaker's tweeter is approximately at ear height for a seated listener (37 inches).

The owner's manual goes into reasonable detail about unpacking, break-in, connections, bi-wiring, placement, use with subwoofers, and amplifier requirements. For best imaging, NSM suggests placing the systems on 30-inch stands, 2 feet or more from any walls, and about 8 feet apart. (My usual speaker locations conform to these guidelines.)

Hooking up the NSMs was a breeze, because their terminals are large and very accessible. I did not bi-wire them; instead I used supplied gold-plated straps. I connected the speakers to a Krell amp with Transparent Audio's Music Wave Reference cables. Other listening components included Onkyo and Rotel CD players, Krell's KRC preamp, and B&W's 801 Matrix Series 3 speakers for comparison.

I placed the NSMs in my customary positions: about 8 feet apart, well away from walls, and aimed toward my listening position (10 feet away). I conducted the listening tests both before and after the bench tests. One valuable piece of knowledge I

gained from the measurements was that the NSM's response could be improved by raising the speaker's axis so that a line extended from the bottom of the enclosure intersected my ear. To accomplish this, I tilted the stand backward and adjusted its spikes so that the stand's bottom was about ⅜ to ½ inch higher than the rear. This adjustment provided an audible improvement when I was seated, and most of the following comments apply to the tilted-back configuration.

THE 10S MADE HARPSICHORDS SOUND CONVINCINGLY ALIVE, WELL BALANCED, AND FULL.

First listening to the NSMs revealed excellent imaging, smooth and extended highs, and a much bigger sound than the speakers' size would suggest. However, their bass output was quite restricted compared to that of larger systems, and their sensitivity was significantly less than that of the B&W 801s. The B&Ws needed some 6 to 7 dB of level reduction, depending on the program material, to match the NSMs' acoustic output.

When I listened to jazz and pop that had significant bass, such as kick drum or bass guitar, the 10S speakers could not be turned up very loud before being overloaded in the bass range. On the title track of Dave Grusin's *Mountain Dance* (GRP GRD 9507), for example, I could turn these speakers up only to about 80 to 85 dB SPL before exceeding the woofers' linear excursion range. At this level, the output was quite satisfying, however; everything except the bass sounded very good.

On program material that had less bass content, the NSMs could generate much louder levels. On Benedetto Marcello's Four Sonatas and a Concerto for Harpsichord (Jecklin-Disco JD 5001), the NSMs generated a very usable 90 to 95 dB SPL before starting to sound congested. On their own, the 10S speakers are much better suited to this kind of music. They made the harpsichord sound convincingly alive, producing a full and well-balanced sound.

On other classical chamber music, such as Dvorak's *The Piano Quintets* (Dorian DOR-90221), the Model 10S speakers presented a very solid and well-defined soundstage. The strings sounded quite convincing and realistic, and room ambience was excellent. The NSMs also did quite well on larger-scale symphonic works, but only if I restricted them to moderate to low levels. The low end of the NSMs sounded quite lightweight compared to that of the B&Ws.

Since NSM primarily intends these speakers for use with a subwoofer, I also tried them with a Velodyne subwoofer connected to one channel. For simplicity's sake, I kept the NSMs connected directly to the power amp, which meant that no high-pass filtering was provided. I was pleasantly surprised by how much the additional bass improved the sound, even though the acoustic output of the NSMs was, obviously, unchanged.

On pink noise, the NSMs exhibited significant tonality, primarily an emphasis of the upper midrange. The lower two octaves of bass (the characteristic bass rumble of pink noise) were missing. These systems did do fairly well on the stand-up/sit-down test, exhibiting only moderate midrange tonal changes when I stood up. On third-octave band-limited pink noise, no usable output was produced at the 20-, 25-, 32-, and 40-Hz bands. At 50 and 63 Hz, there was some usable output, but these speakers could not be played very loud before they generated high levels of third-harmonic distortion. From 80 to 125 Hz, the usable output was much better, but I noticed a tendency to overload at high levels. On higher bands the output was quite acceptable. When I moved the 10S speakers closer to the wall behind them, the lows improved but at the expense of smoothness at higher frequencies.

On female vocals, the NSMs presented a significantly more forward sound than the B&Ws. Sibilants were reproduced properly, with no undue emphasis, and the overall sound was otherwise well balanced. On male speaking voice, I judged the NSMs' performance to be slightly better than that of the B&Ws. In my listening room, the 801s have a tendency to add some chestiness to male voice; the NSMs didn't do that.

If you need a very small speaker that has great looks and offers solid performance, consider the NSM Model 10S. A pair would work well in a small room or would be a fine choice as satellites coupled with a subwoofer. A

EQUIPMENT **PROFILE**

EDWARD J. FOSTER

YAMAHA RX-V2090 A/V RECEIVER AND DDP-1 AC-3 DECODER

Yamaha is among the first to ride the Dolby Digital AC-3 bandwagon. Like most companies introducing a new technology, Yamaha has put the new technology into an add-on component (the DDP-1) and adapted a more traditional product (the RX-V2090 A/V receiver) to accept the add-on—not that this receiver is all that traditional, as you'll soon see. At present, Dolby Digital sound is available only on laserdiscs that carry the AC-3 logo, and extracting the AC-3 data stream from them requires a special player (such as Yamaha's CDV-W901 CD/CDV/LD player). In the future, however, Dolby Digital audio sources will include DVD, HDTV, and perhaps others, as well.

YAMAHA'S DSP MODES USE SOUND-FIELD MEASUREMENTS FROM REAL ACOUSTIC ENVIRONMENTS.

Although Yamaha has been making seven-channel A/V amplifiers for a while, the RX-V2090 is its first seven-channel receiver. (With 8-ohm loads, the three front channels are rated at 100 watts each, while the four effects channels are rated to put out 35 watts apiece.) This receiver is also the first Yamaha product that can accept five-channel audio from an AC-3 decoder. Besides AC-3, the RX-V2090 offers digital sound-field processing (including Yamaha's Cinema DSP enhancement of Pro Logic) plus a number of other features you'd hope to find in a top A/V receiver.

For Cinema DSP, Yamaha recommends that two front effects speakers be placed about 6 feet above the floor, to the outside of the main left/right pair, and about a foot behind the main speakers; two rear effects speakers are to be placed similarly, behind the listener. With Cinema DSP, these four speakers simulate an array of phantom speakers along the side and rear walls to create a sound pattern similar to what you'll hear in a first-run movie theater. However, although the objectives of Cinema DSP are similar in some respects to those of Home THX, the optimum speaker types and placements are different. Cinema DSP works best with "forward-radiating" speakers all around, not with the dipolar surround speakers that are recommended for Home THX, and the rear speakers are behind—rather than aligned with—the viewing position.

The RX-V2090's digital sound-field processing offers 10 program modes. Four modes are for film sound: Dolby Pro Logic, "Pro Logic Enhanced," "70mm Movie Theater," and "TV Theater." The remaining six modes are for audio only: "Sports," "Stadium," "Rock Concert," "Jazz Club," "Church," and "Concert Hall." These six modes are based on sound-field patterns measured in real acoustic environments; the cinema modes are based on the consensus of a group of recording engineers regarding ideal acoustic environments. With the exception of relative levels and sur-

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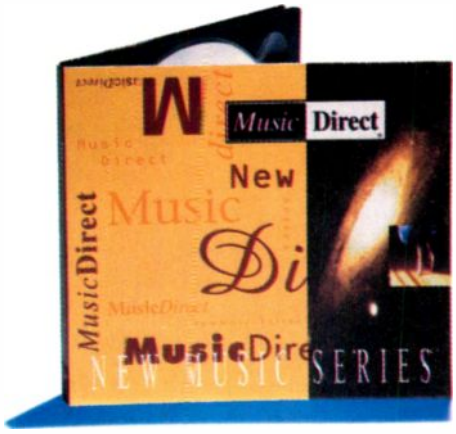

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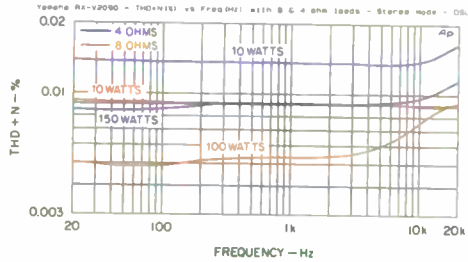

Fig. 1—Receiver's THD + N vs. frequency, stereo mode. (All graphs presented here are for the RX-V2090.)

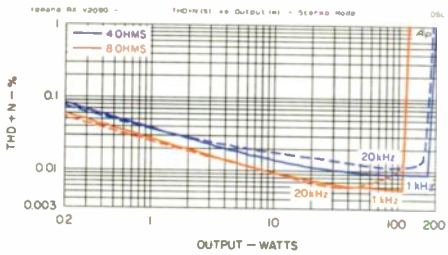

Fig. 2—THD + N vs. output.

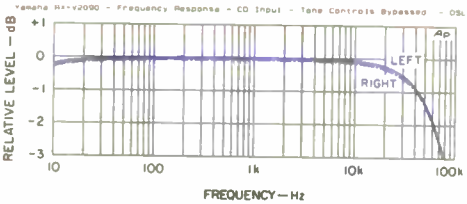

Fig. 3—Frequency response and channel balance via CD input.

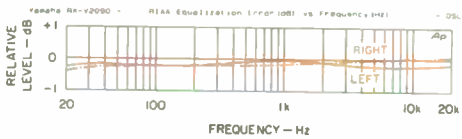

Fig. 4—RIAA equalization error.

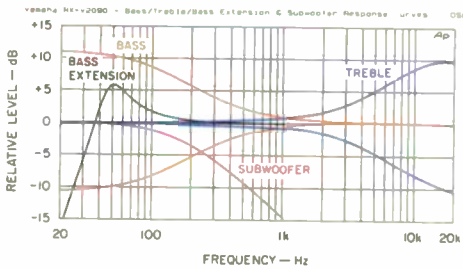

Fig. 5—Effects of tone controls, Bass Extension circuit, and subwoofer filter.

round-channel delay, you can't change the DSP parameters. Digital sound-field processing is defeated when the receiver is in the five-channel discrete (AC-3) mode, as are some functions not used with AC-3 (for example, center-mode selection and surround-channel delay).

Although Cinema DSP works best with a seven-speaker array, Yamaha provides a back-panel switch ("Front Mix") that, in the five-channel position, folds the front effects signals into the main front channels so the system can be used with a five-speaker array. The "Phantom" center option covers situations in which a center speaker isn't used, although I don't recommend doing without a center speaker.

The RX-V2090's back panel looks as if someone went crazy with a hole punch. In addition to the "5CH DISCRT Input" set, there are RCA (pin-jack) stereo inputs for MM phono, a CD player, two audio tape decks, two VCRs, and a laserdisc player (marked "LD/TV"). You'll find audio outputs for recording on both tape decks and both VCRs, as well as line-level outputs for every channel so that you can upgrade to more powerful amplifiers. The main-channel left/right preamp outputs are externally linked to their respective power amp inputs; therefore, by removing the links and rewiring, you can use the receiver's 100-watt/channel main front amplifiers for the front or rear effects channels if you do upgrade. A "Main Level" slide switch initiates a 10-dB change in amplifier gain, and a filtered "Low Pass" output will feed a powered subwoofer.

Additional preamp and composite-video output jacks enable you to drive an audio or A/V system in a second room, with independent source selection. The "Room 2" composite-video output is the only video jack not accompanied by an S-video connector. Inputs and outputs for both VCRs, the "LD/TV" input, and main "Monitor Out" have both composite- and S-video jacks. (Hear! Hear!)

Multiway binding posts are provided for all speakers, including sets for two pairs of front left/right speakers and for two center-channel speakers. You use buttons on the receiver's front panel to select either or both main speakers. A pushbutton near the center-speaker connectors selects a single center speaker or a pair; the latter arrangement enables you to flank your TV with two center-channel speakers if a single one won't fit

THE DDP-1'S CONTROL MODES PROVIDE FOR JUST ABOUT ANY SPEAKER ARRAY YOU MAY HAVE.

above or below it. If you use one center speaker, its minimum impedance should be 8 ohms; if you use two, they should be identical units, with a 4-ohm minimum impedance, as they're connected in series. The main front and center connectors are on standard ¾-inch centers and can be used with dual-banana ("GR") plugs; the connectors for the effects speakers are not on standard centers. All back-panel connectors are base metal; a fourth video input, behind a hinged door on the front panel ("Video AUX"), is outfitted with gold-plated audio and composite-video pin jacks and a base-metal S-video connector. Completing the back-panel array are a 75-ohm FM antenna connector, wire clips for connecting the (supplied) AM loop antenna, a ground terminal for a turntable, one unswitched and two switched convenience outlets, and input and output remote-control jacks to send and receive signals between the receiver and a second room.

Two remotes are provided, one for each room. The secondary remote permits you to select program sources, choose among tuner presets, and control the basic func-

tions of other Yamaha components (a CD player, a laserdisc player, and two audio tape decks). The primary remote is more versatile and can be "taught" the control codes of other companies' components. It offers full access to the DSP selections as well as control of volume and relative levels in the center and the four effects channels. With the primary remote, you can initiate the speaker-balance test sequence for Dolby Pro Logic operation, activate a sleep timer, control power, and mute the sound. The primary remote also offers more complete control of auxiliary equipment—for example, search functions for CD and laserdisc players and record/pause and record/muting for tape decks.

Although volume can be set from the primary remote, left/right balance and bass and treble are adjustable only from controls behind the hinged door on the receiver's front panel. Here too is the "REC Out" selector, which can be set to record from any of the eight inputs while you listen to another or can be set to follow whatever source has been chosen by the main selector. "Tone Bypass" and "Bass Extension" switches also lie behind the door. I like having a separate recording selector (a Yamaha tradition) and the ability to bypass the tone controls, and Yamaha goes one better in the RX-V2090: "Tone Bypass" and "Bass Extension" are independent. In other words, you can bypass the bass and treble controls and still use "Bass Extension" to boost 50-Hz response in the main front speakers and interpose a sharp, high-pass filter below that frequency.

EVERY VIDEO INPUT AND OUTPUT EXCEPT "ROOM 2" HAS BOTH COMPOSITE- AND S-VIDEO CONNECTIONS.

Relative channel levels are adjustable from the receiver's front panel as well as from the remote, although the test-tone sequence can be initiated only from the remote. "Center" mode ("Normal/Wide/Phantom") and "Delay Time" are controlled exclusively via pads on the RX-V2090's front panel. Nine panel buttons choose the listening/viewing source; 10 others choose the digital sound-field processing mode, while an 11th ("Effect") enables you to bypass DSP and return to normal stereo.

The receiver's tuner section has automatic and manual tuning plus 40 station presets (which can be manually or automatically programmed). Stereo reception is possible only in the auto-tuning mode; mono reception prevails whenever the "Tuning Mode" switch is set to the manual position.

The DDP-1 decodes Dolby Digital AC-3 signals into their six components: five full-bandwidth channels (for left/center/right front and left and right surround) and one limited-bandwidth channel for low-frequency effects (LFE). Output connections are via base-metal RCA jacks on the back. This processor has two digital inputs and one pin-jack RF input specifically for connection to an AC-3-capable laserdisc player. One digital input is Toslink optical; the other is coaxial. These two inputs are intended for future Dolby Digital sources, which will have direct digital outputs instead of the RF output used for laserdisc. One unswitched convenience outlet is provided.

The DDP-1's controls are relatively straightforward. "Mode" cycles through three setup categories ("A," "B," and "C"), while "Menu" advances through the options within each category. Settings are changed with a "Parameter +/–" bar and are shown in the display.

Mode "A" adjusts center- and surround-channel delay. It also offers a choice between AC-3's two options for dynamic range: "Max," which affords full dynamic range on each channel, and "Standard," which compresses the dynamic range when you're listening at low levels. With "Standard" dynamics, you have five choices of high-level

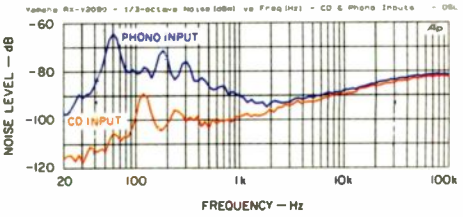

Fig. 6—Noise analysis.

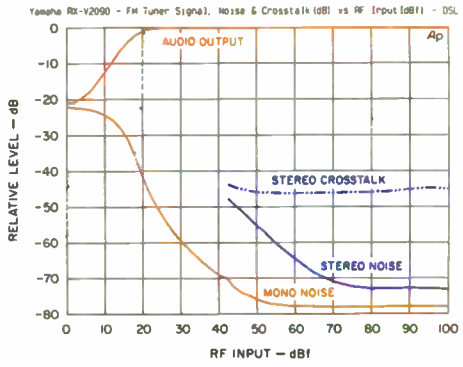

Fig. 7—FM tuner section's quieting characteristics and stereo crosstalk.

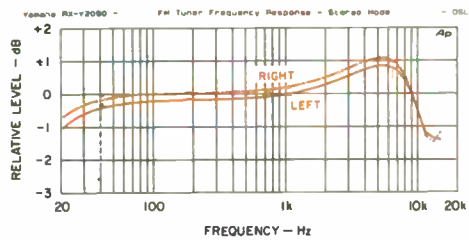

Fig. 8—Frequency response and channel balance, FM tuner section.

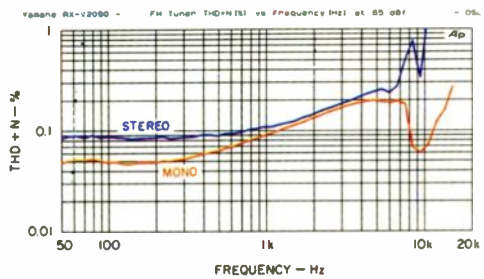

Fig. 9—THD + N vs. frequency, FM tuner section.

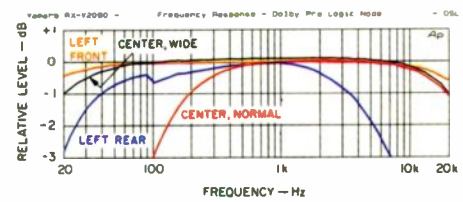

Fig. 10—Frequency response, Dolby Pro Logic mode.

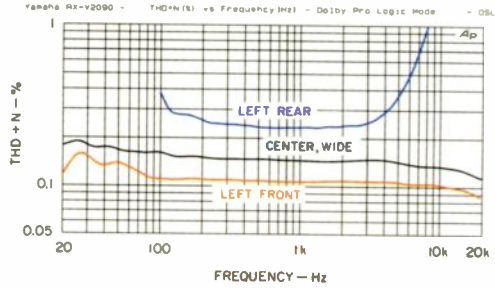

Fig. 11—THD + N vs. frequency, Dolby Pro Logic mode.

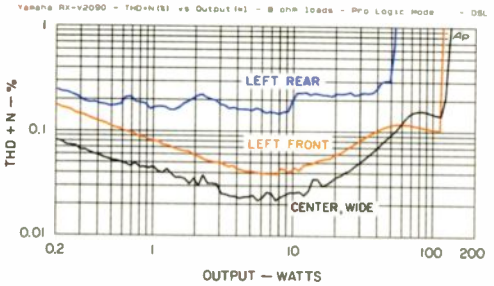

Fig. 12—THD + N vs. amplifier output, Dolby Pro Logic mode.

compression and five choices of low-level boost.

Mode "B" has five options. The first controls the internal test-tone generator, which cycles pink noise through the five full-range channels. "Menu" then accesses each channel in turn, so you can adjust speaker level with the "Parameter" bar. With the next three "B" options, you can modify balance by individually adjusting the levels of the left and right surround channels and of the LFE channel. The final option in mode "B" is for trimming the level of all outputs.

Setup mode "C" also has five options. The first is input selection (RF, optical digital, or coaxial digital); the other four adapt the output channels' responses to match your speaker setup. The options for the center and the surround channels give you the choice of full-bandwidth output when the speakers are large enough to handle it or, if your speakers are small, let you redirect bass below 90 Hz. The center-speaker option also has a "Phantom" choice, which redirects center information to the main speakers if you have no center speaker. A similar option lets you redirect front left/right bass below 90 Hz to the subwoofer output. The final option allows you to select whether bass redirected in the previous options goes to the main outputs or to the subwoofer output.

Measurements

Although I used the RX-V2090 and DDP-1 in combination, I tested them individually—the RX-V2090 as a "standard" A/V receiver, the DDP-1 as a stand-alone AC-3 decoder.

Yamaha rates the RX-V2090 for 8- and 6-ohm loads, whereas I customarily use 8- and 4-ohm terminations. Yamaha specifies 120 watts/channel into 6 ohms; I made 4-ohm "full-power" tests at 100, 120, and 150 watts/channel to establish my own rating. The results for full-power output listed in "Measured Data," and the total harmonic distortion plus noise (THD + N) curves of Fig. 1, reflect the amp section's performance at 100 watts into 8 ohms and 150 watts into 4 ohms, in stereo mode with both channels driven. Curves taken at 10 watts also are included in Fig. 1. (I took data at 1 watt but have not included it since it showed mostly noise rather than distortion.) Needless to say, the data suggests excellent performance: The receiver's worst-case distortion at an output of 10 watts into 8 ohms is less than 0.01% and barely more than that at full power.

Figure 2 shows the receiver's THD + N versus output at 1 and 20 kHz. (The 20-Hz curves, not shown, were almost identical to the 1-kHz plots.) Data was taken on the left channel, but both channels were driven for the test. From these curves, I determined that the clipping point at 1 kHz was 120 watts/ channel with 8-ohm loads and nearly twice that (200 watts/channel) with 4-ohm loads. Clearly, the RX-V2090 has no trouble driving 4-ohm speakers, even though Yamaha declined to rate it that way. On the IHF tone-burst signal, the receiver delivered 135 watts into 8 ohms and 225 watts into 4 ohms, for a "dynamic headroom" of +1.3 dB into 8 ohms. (I could not calculate dynamic headroom with 4-ohm loads since there's no manufacturer rating.)

Besides being competent power-wise, the RX-V2090's output stage had a high damping factor, and output impedance remained quite low to 10 kHz. I have found that these characteristics often correlate with better-than-average sound quality.

Figure 3 shows frequency response and channel balance of the RX-V2090's amp section, measured from the CD input with the tone controls bypassed, while Fig. 4 shows phono equalization error. As you can see, the channels are well balanced, equalization error is within ±0.23 dB, and basic response is reasonably flat to 20 kHz and relatively extended. Although the RX-V2090 is not the most wideband receiver I've tested, it's certainly capable of delivering everything my ears can hear.

Figure 5 shows the receiver's maximum tone-control range and the effect of the Bass Extension circuit; I've also overlaid the response curve taken at the subwoofer output by scaling the data to 0 dB at 20 Hz. The tone controls operate symmetrically and, for my taste, have more than adequate range. Bass Extension boosts 50-Hz output by almost 6 dB and rolls off the low bass sharply; it should prove valuable if you use small bookshelf-type speakers. The slope of the subwoofer low-pass filter is too gentle to be truly effective, but since powered subs usually have internal filters, this doesn't concern me.

Noise-spectrum analyses (Fig. 6) reveal a small amount of power-supply hum (–89 dBW at 120 Hz) from the CD input and (as is often the case) rather greater amounts of magnetically induced hum at 60, 180, and 300 Hz from the phono input. On an A-weighted basis, output noise with the CD input came in at –81.7 dBW. From the phono input, S/N was 7.5 dB lower. Considering the circuitry in the RX-V2090, these figures don't strike me as worse than can be expected.

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These Mini-Mags are the smallest speakers that Magnepan makes – they even have the great quasi-ribbon tweeter/mid-range. Their size may be small but their sound is BIG.

In preparation for this review, I listened to a number of speakers in the price range. (And remember, with ordinary box speakers you have to figure another one or two hundred dollars for stands. The MMG's are, of course, floor standing and thus require no stinking stands.) I have yet to hear any other competitive speakers that sound as real, or as natural as the Mini-Mags. In order to grab your attention in a dealer show room, the box speakers have a boosted bass and exaggerated highs. Take one of these boxes home and see how long it takes you to tire of boomy one note bass and ear splitting treble.

Let's face it, there are few - very few - good $500 speakers out there. Most of them will make Bonnie Raitt sound like Lyle Lovett, and they will not have the definition and imagery, breadth or depth of sound stage that a planar speaker can give you. On the MMG's, a Steinway will sound like a Steinway and not like that old spinet in your uncle's basement.

Buy these! They are one of the true bargains in audio. And then in three or four months when you've become as hooked on planar sound as I am, truck 'em on down to your Magneplanar dealer and trade 'em in (remember that 100% trade-in allowance) on some bigger and better Maggies.

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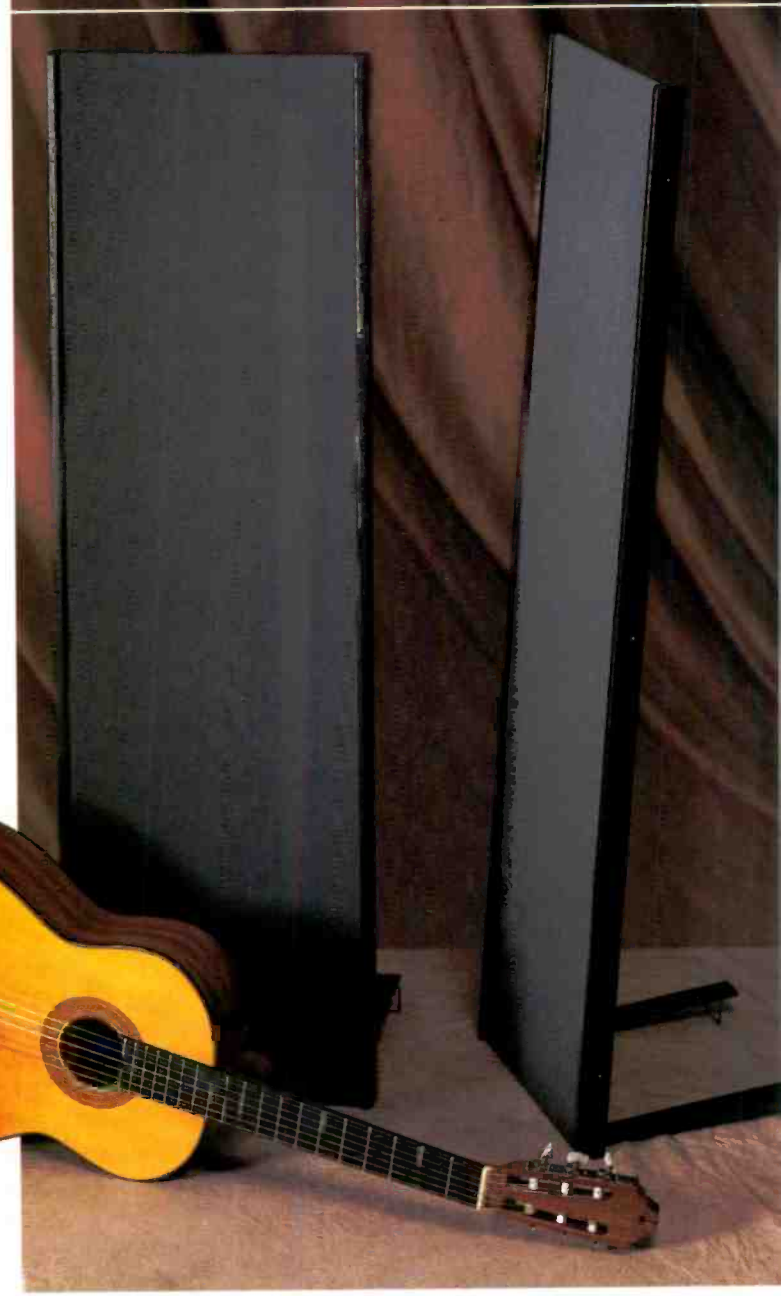

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MEASURED DATA

RECEIVER, AMP SECTION

Output Power at Clipping (1 kHz, 1% THD): 8-ohm loads, 120 watts/channel (20.8 dBW); 4-ohm loads, 200 watts/channel (23 dBW).

Dynamic Output Power: 8-ohm loads, 135 watts/channel (21.3 dBW); 4-ohm loads, 225 watts/channel (23.5 dBW).

Dynamic Headroom re 8-Ohm Rating: +1.3 dB.

THD + N, 20 Hz to 20 kHz: 8-ohm loads, less than 0.0135% at rated output and less than 0.0092% at 10 watts/channel out; 4-ohm loads, less than 0.0116% at 150 watts/channel and less than 0.0165% at 10 watts/channel out.

Damping Factor re 8 Ohms: 410 at 50 Hz.

Output Impedance: At 1 kHz, 22 milliohms; at 5 kHz, 43 milliohms; at 10 kHz, 79 milliohms; at 20 kHz, 130 milliohms.

Frequency Response: Tone controls bypassed, 20 Hz to 20 kHz, +0, –0.24 dB (–3 dB at 10 Hz and 77.4 kHz); tone controls at detent, 20 Hz to 20 kHz, +0, –0.35 dB (–3 dB at 110 Hz and 62.5 kHz).

Tone-Control Range: Bass, +10.7, –11.1 dB at 100 Hz; treble, +8.5, –7.9 dB at 10 kHz.

Bass Extension: +5.8 dB at 51 Hz.

Subwoofer Crossover: –3 dB at 175 Hz and –6 dB at 305 Hz, 6-dB/octave slope.

RIAA Equalization Error: ±0.23 dB, 20 Hz to 20 kHz.

Sensitivity: CD input, 16.8 mV for 0 dBW out and 168 mV for rated output; MM phono input, 0.277 mV for 0 dBW out and 2.77 mV for rated output.

A-Weighted Noise: CD input, –81.7 dBW; MM phono input, –74.2 dBW.

Input Impedance: CD input, 39.4 kilohms; MM phono input, 44.3 kilohms + 275 pF.

Input Overload for 1% THD at 1 kHz: CD input, 7 V; MM phono input, 120 mV.

Channel Separation: CD input, greater than 54.4 dB, 100 Hz to 10 kHz.

Channel Balance: CD input, ±0.03 dB.

Record Output Level: CD input, 0.488 V for 0.5 V in; MM phono input, 0.292 V out for 5 mV in at 1 kHz; FM tuner, 0.6 V.

Record Output Impedance: 1,080 ohms.

RECEIVER, FM TUNER SECTION

50-dB Quieting Sensitivity: Mono, 23.8 dBf; stereo, 44.7 dBf.

S/N at 65 dBf: Mono, 77.7 dB; stereo, 68.5 dB.

Frequency Response: Stereo, 20 Hz to 15 kHz, +0.9, –1.3 dB.

Channel Balance: ±0.1 dB.

Channel Separation: Greater than 38 dB, 100 Hz to 10 kHz.

THD + N at 65 dBf, 100% Modulation: Mono, 0.049% at 100 Hz, 0.092% at 1 kHz, and 0.195% at 6 kHz; stereo, 0.087% at 100 Hz, 0.109% at 1 kHz, and 0.237% at 6 kHz.

Capture Ratio at 45 dBf: 1.4 dB.

Selectivity: Adjacent-channel, 5 dB; alternate-channel, 58.5 dB.

Image Rejection: 45.2 dB.

AM Rejection: 56.2 dB.

Stereo Pilot Rejection: 81.9 dB.

Stereo Subcarrier Rejection: 85.6 dB.

RECEIVER, DOLBY PRO LOGIC MODE

Output Power at Clipping, 8-Ohm Loads: Main front channels, 120 watts/channel (20.8 dBW); center channel, 135 watts (21.3 dBW); rear channels, 52 watts/channel (17.2 dBW).

THD + N at Rated Output, 8-Ohm Loads: Main front channels, less than 0.112%, 75 Hz to 20 kHz; center channel, less than 0.171%, 70 Hz to 20 kHz; rear channels, less than 0.65%, 100 Hz to 7 kHz.

Frequency Response: Main front channels, 20 Hz to 20 kHz, +0, –0.59 dB (–3 dB below 10 Hz and at 46.8 kHz); center channel, wide mode, 20 Hz to 20 kHz, +0, –1.17 dB (–3 dB at 10.7 Hz and 34.6 kHz); center channel, normal mode, 100 Hz to 34.6 kHz, +0.04, –3 dB; rear channels, 18.5 Hz to 7.2 kHz, +0, –3 dB.

A-Weighted Noise: Main front channels, –79.4 dBW; center channel, wide mode, –83.8 dBW; rear channels, –73.7 dBW.

Channel Separation at 1 kHz: 48 dB or greater.

AC-3 DECODER

Maximum Output Level: All front channels, 1.957 V for 1-kHz signal at 0 dBFS.

Output Level re Left Front: Surround channels, –0.11 dB; LFE (low-frequency effects) channel, +9.85 dB.

Frequency Response: Main front channels, 20 Hz to 18.9 kHz, +0, –0.25 dB; center channel, 20 Hz to 18.4 kHz, +0, –0.42 dB; surround channels, 20 Hz to 16.8 kHz, +0, –0.28 dB; LFE, 20 to 61 Hz, +0.03, –0.33 dB.

THD + N at 0 dBFS: Front and surround channels, 0.007% or less at 1 kHz; LFE, 0.046% at 30 Hz.

Channel Separation at 1 kHz: 84.5 dB or greater.

for normal cartridges. The overload point of the CD input was more than you'll ever need. Recording output levels were typical, as was the source impedance of the output circuitry. Channel separation was better than 60 dB over the most meaningful range, which is pretty decent (and more than you need, in any event.)

I checked FM tuner performance at the RX-V2090's tape recorder outputs. The tuner section proved less sensitive than I would have hoped (Fig. 7), possibly because my test sample was slightly mistuned. Mono "usable" sensitivity measured 20.3 dBf and improved by 1.3 dB when I adjusted my test generator to agree with the tuner. With auto tuning selected, the tuner shifts to stereo at 42.5 dBf, at which point channel separation and quieting are already quite good. The 50-dB quieting point is reached with a 44.7-dBf stereo input or a 23.8-dBf mono input.

With adequate FM signal strength, the RX-V2090's tuner performs well. Frequency response (Fig. 8) is reasonably flat (±1 dB from 20 Hz to about 11 kHz), and channel balance is excellent. The S/N ratio at 65 dBf was almost 78 dB in mono and 68.5 dB in stereo. The THD + N (Fig. 9) is better than average for a tuner. Channel separa-

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tion was impressive—better than 40 dB from about 130 Hz to 9 kHz, worst case. Capture ratio was excellent. Selectivity and image-rejection ratios were modest; these tuner characteristics are less important in the home than in a car, so I'm willing to sacrifice them—especially since lower distortion and better channel separation usually result from doing so. The AM rejection was fine, and pilot rejection and subcarrier rejection were unbelievably good.

Figure 10 shows the RX-V2090's frequency response in Dolby Pro Logic mode. The results are classic and almost uniformly excellent. Main front response is nearly as broad and flat as that in stereo, although the center channel's response droops a bit more at 20 kHz. In the "Normal" center mode, response is down 3 dB at 100 Hz, as it should be, and rear-channel response rolls off above 7.2 kHz, again according to Dolby Labs norms. The A-weighted noise was greater in Pro Logic than in stereo mode, but that's to be expected. Referenced to rated power, S/N approached or exceeded 100 dB in the front channels and attained almost 90 dB in the rear channel. Steady-state separation at 1 kHz ranged from a low of 48.1 dB (between the rear and right front) to a high of greater than 100 dB (between the right front and the center). In general, separation approached 60 dB, which is excellent Pro Logic performance.

Figure 11 shows the receiver's THD + N versus frequency in Dolby Pro Logic mode; the results, once again, are far better than typical for an A/V receiver. In the front channels, distortion remains at or below 0.17% across the meaningful frequency range. In the rear, it's less than 0.3% from 120 Hz to above 3 kHz. The rapid rise in high-frequency THD + N in the rear channel is as much due to the fundamental rolloff called for by Dolby Labs standards as it is to an increase in the level of the distortion components. (Note that in Fig. 11, and in some of the prior figures, I've expanded the vertical scale to reflect the RX-V2090's superior performance and to allow you to see differences more readily.) Figure 12 shows THD + N versus output.

In Dolby Pro Logic mode, the receiver's output power at clipping (8-ohm loads) for the main front channels was 120 watts/channel, with 135 watts available in the center. The main front's clipping point was precisely the same in Dolby Pro Logic mode as in stereo. The rear channel delivered 52 watts/channel at clipping, far above Yamaha's specified 35 watts/channel.

At present, AC-3 decoders are difficult to evaluate in a lab because the only available test disc is far from adequate. I was able to measure the DDP-1's output level and channel balance as well as make a stab at measuring the unit's frequency response, 1-kHz THD + N at 0 dBFS, and channel separation at 1 kHz. I found nothing to complain about in any respect.

YAMAHA'S "CINEMA DSP" TRADES IMAGING PRECISION FOR A BROAD, ENVELOPING SOUND FIELD.

I was unable to graph frequency response of the DDP-1's front and LFE channels, because my Audio Precision system can't track the test disc's fast sweep when levels change substantially. Nonetheless, I have reasonable assurance that the response was within +0, –0.25 dB from below 20 Hz to above 18 kHz in the main front channels and to almost 17 kHz in the surround channels. The center channel was down less than 0.5 dB at 18.4 kHz, and the LFE was essentially flat from below 20 Hz up to 60 Hz. The THD + N at 1 kHz and 0 dBFS was no more than 0.007% in all five main channels and was less than 0.05% at 30 Hz in the LFE channel. Output level in the main channels was about 2 volts, and all channels were balanced within ±0.055 dB. With its gain at maximum, the LFE channel's level was approximately 10 dB above that of the main outputs. Channel separation in most cases exceeded 100 dB at 1 kHz; worst-case separation (between the right and left surround channels) was still greater than 84 dB.

Use and Listening Tests

The main potential weakness in Yamaha's Dolby Digital AC-3 setup is that the RX-V2090's five discrete-channel inputs render the receiver unable to accept the DDP-1's subwoofer output. You must set up the DDP-1 so that it reroutes the LFE channel to the main front pair. (If you use small speakers, you must also set up the DDP-1 to strip the bass out of the center and effects channels.) True, you can connect a subwoofer to the RX-V2090's "Low Pass" output, but the bass will still remain in the main front channels, where it will place an additional burden on the main front amplifiers as well as on the speakers. It is imperative that those speakers be able to stand the gaff even if they can't reproduce the bass. (It's not feasible to connect a powered sub to the DDP-1's subwoofer output, since then the sub's level can't be adjusted with the receiver's volume control.)

It also should be noted that although the DDP-1 can switch among three Dolby Digital sources, it can't switch video. When Dolby Digital becomes available from DVD and satellite, you'll be able to decode the bitstream, but you'll have to rig a separate video switcher to keep the picture with it. What a nuisance.

Laying aside those negatives, I was quite pleased with the performance of the Yamaha combo. I set it up in my home theater and connected full-range tower speakers that could handle the bass (Paradigm 9se Mk3s) as the main front pair. Sometimes I also used Paradigm's PS-1000 subwoofer, and to maintain tonal balance, I used Paradigm's CC-300 speaker in the center.

You can toggle between AC-3 and Dolby Pro Logic with the RX-V2090's "LD/TV" pad. Out of the box, the sound level with AC-3 was higher than with Pro Logic, but I corrected this with the DDP-1's "Output Trim" function. Once I got the system balanced, I could make fairly direct comparisons of AC-3, Dolby Pro Logic, and Pro Logic with Cinema DSP.

On every disc I used, Dolby Digital AC-3 was cleaner and had deeper and stronger bass than Dolby Pro Logic (with or without

Cinema DSP). I always preferred AC-3 to Dolby Pro Logic; its sound field was notably more stable and believable, and it correlated better with the picture than Pro Logic's sound field did. Yet the degree of difference between the two depended on the disc. For example, although the flyovers in *Top Gun* had better left/right rear definition in AC-3 than in Pro Logic, the old system really did a fine job, too. (That's because the flyover sounds are the dominant signal, and Pro Logic has little trouble steering this signal appropriately—albeit, in this case, into a mono surround channel.)

Dolby Digital really showed its mettle in scenes where there was dominant on-screen action and subtle off-screen sounds. In a scene in *Rob Roy*, softly lowing cattle and bleating sheep are far in the distance while the main action takes place on-screen. AC-3 was able to place the animal sounds off-screen and distinguish between off-screen left and right, while Pro Logic just placed them in an anomalous and comparatively ill-defined world.

In some cases, the differences between AC-3 and Pro Logic were so apparent that I wondered if the soundtracks had been mixed differently. I think of Gene Hackman standing in the rain while haranguing his submarine crew, an early scene in *Crimson Tide*. The Pro Logic mix has rain pretty much everywhere; in AC-3, I could hear individual raindrops plopping onto Hackman's umbrella amidst the background of rain. Wow!

Most of today's programs aren't encoded with AC-3, so I compared the RX-V2090's Pro Logic and Cinema DSP modes. I found its Pro Logic operation on a par with the finer surround systems I've used and far above that of run-of-the-mill A/V receivers. Cinema DSP broadened and widened the soundstage and made it more enveloping. This was especially noticeable in the 70mm mode, where sounds were placed considerably further off-screen and had more "wrap." However, I felt this widening was achieved at some sacrifice in the precision of on-screen sound images. On-screen sounds seemed more diffuse with Cinema DSP and occasionally could slip off-screen. Whether somewhat less precise sound placement is a worthwhile trade-off for the more exciting and enveloping experience of Cinema DSP is a decision that you probably should make on a movie-by-movie basis.

The same can be said for the RX-V2090's music sound fields. Although you can't adjust these fields the way you can on some Yamaha stand-alone music processors, they sound better than most such processing programs and were quite enjoyable on the demo disc that Yamaha provided. Long-term, I might find the processing somewhat aggressive for everyday listening to classical music.

Because the main front speakers I used had substantial bass, the RX-V2090's lack of an LFE input proved less of a problem than I thought it would. This is not a system to be used with weak-kneed main front speakers, so I give the RX-V2090/DDP-1 combination my seal of approval only if you do use it with speakers that aren't bass-shy. It's always disappointing to find an otherwise first-rate product with a design flaw that could easily have been prevented. But I'm sure Yamaha will correct it in future products. A

When you've got questions about Audio and Video,

see a specialist

Q How do I provide from one audio system "high quality" stereo sound to more than one location within my home?

A There are many ways to distribute stereo sound into remote locations within your home. The trick is in reproducing "high quality" sound. As in a single room application, source equipment, speaker selection/placement and cabling choices should be considered. Source equipment options can include a preamp with multiple outputs or a multi-room controller. Consider each room's individual decor, size and shape when selecting and placing speakers. In-wall speakers are discrete in appearance and work fine for background music environments. Where uncompromised sound quality is desired, any high quality mini-monitor or floor-standing speaker can be utilized. Due to the long lengths of wire involved, selection of interconnects and speaker cabling is just as important as it is in your primary audio system. Working with a reputable retailer is highly recommended as they can assist you in making the best possible choices.

–Peter Lee and Steve Toth
Future Sound Audio Video Design Group
Burlingame, California

FUTURE SOUND
audio/video design group

Q Now that I've bought a number of stereo components, how do I choose a cabinet?

A The equipment stand is a surprisingly important part of any stereo/home theater system. Beyond aesthetics alone, there is performance and convenience to consider. "Open-air" cabinet designs–with no doors, sides or backs–are generally the best choice for both of those. Because there are no sides to interfere with the sound waves, the open-air designs lets the equipment run cooler, allows very easy access to the rear of the components, and does not reflect the sound coming from the speakers. In effect, the cabinet is nearly "invisible" to sound waves. Metal stands, with their weight and density, tend to perform better than wooden stands. Remember, vibration is detrimental to sound reproduction. The more vibration you can control, the better.

–Scott Cray
Hawkeye Audio Video
Iowa City, Iowa

hawkeye audio video

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

If you would like to submit questions to dealers in your area please write to :
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Q How *good* does my center channel speaker need to be?

A Well, times have changed since Dolby Pro Logic's inception several years ago. Initially, it was understood that a center channel speaker's purpose in the Pro Logic scheme was to reproduce primarily the dialog portion of a film. Therefore, a speaker of limited size and marginal quality would suffice in most cases. Today, the center channel speaker plays a far more critical role. Film producers are progressively putting greater demands on the center channel by "steering" dynamic special effects from side to side as well as relying on this speaker for dialog. These production techniques can be quite entertaining, however, a "wimpy" center speaker could result in "clouding" of dialog and annoying inconsistencies throughout. We suggest that the center speaker be high quality and as closely matched to the left/right main speakers as space and budget will allow. If you purchased your center channel speaker some time ago, consider this component when upgrading your system. By cutting back here, you could be missing half of the fun that the film makers have cooked up for us!

–Joe Freppert and Brian Bowen
Audio King
St Louis Park, Minnesota

AUDIO KING

Q They told me I could put my subwoofer anywhere in the room because bass is non-directional, but I hear midrange sound and voices coming from my subwoofer, how come?

A In order to make a subwoofer truly non-directional, you must use a steep high pass filter. Most subwoofers have a shallow filter slope which allows audible information at 200Hz and above. This degrades the systems' overall sound quality and allows you to identify the location of the subwoofer. Some companies make high quality subwoofers that use steeper filters, thus making them truly non-directional. There is also an outboard filter that you can use with your powered subwoofers, assuming you are using the low level inputs. This high pass filter is available in both 2 and 3 channel versions.

–David Wexler
The Little Guys Home Electronics
Glenwood, Illinois

THE Little Guys INC. HOME ELECTRONICS

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AURICLE

ANTHONY H. CORDESMAN

THETA DIGITAL DATA III CD TRANSPORT AND DS PRO GENERATION V-a D/A CONVERTER

Photo: Michael Groen

Both the Theta Digital Data III CD transport (which can also be used as a laserdisc player) and DS Pro Generation V-a D/A converter are improved versions of components well known to many audiophiles. The new iteration of the DS Pro is the first D/A converter I've reviewed that offers both a separate computer and algorithm for digital processing and the option of an HDCD filter; this makes it possible to compare HDCD with Theta's fundamentally different type of digital processing. The Data III, a far more advanced transport than the earlier Data II, utilizes Pioneer's top-of-the-line laserdisc mechanism, with separate loading drawers for CD and laserdisc. It now automatically plays both sides of a laserdisc and offers a wide range of control features for movie buffs who like to dissect films frame by frame. By itself, the Data III can play only the analog tracks on a laserdisc; to hear the digital soundtrack, you need to add an external D/A converter.

THETA'S DATA III COMPARES FAVORABLY WITH STATE-OF-THE-ART CD TRANSPORTS AS WELL AS LASERDISC MACHINES.

Company Address: 5330 Derry Ave., Suite R, Agoura Hills, Cal. 91301; phone, 818/597-9195; fax, 818/597-1079.
For literature, circle No. 94

The Data III transport, which sells for $4,500, has three digital audio outputs (RCA coaxial, BNC coaxial, and AES/EBU balanced), with the option of adding an AT&T ($300) or Theta's proprietary Laser Linque ($800) glass-optical output. There is also an RF output jack for AC-3, BNC and RCA composite-video outputs, and two S-video outputs. Loading time for CDs and laserdiscs is much faster than in previous Theta transports, and the ergonomics are very good. The front-panel controls are relatively simple, and the remote is reasonably easy to understand. (Any experienced Starship captain should be able to operate it after only a year of training at the Academy.) A switch turns off the panel display to avoid any interaction between the display circuitry and the audio and video signals; another switch can disable the video circuitry during CD playback. Both of these switches make slight, but noticeable, improvements in low-level detail and transparency and in the definition of depth and imaging.

In the Data III, Theta Digital has done a great deal more than simply adding digital outputs to a laserdisc player. One whole side of the interior is filled with five isolated, separately regulated power supplies for the video and audio sections. The digital audio output board contains a voltage-controlled crystal oscillator that is hand-calibrated, through the use of a high-resolution time-interval counter, to reduce jitter. All of the electrical digital outputs are pulse-transformer isolated and are driven by high-speed C-MOS logic gates. The Data III's video circuitry carefully isolates vulnerable video lines to ward off pollution from nearby digital audio signals, and all of the

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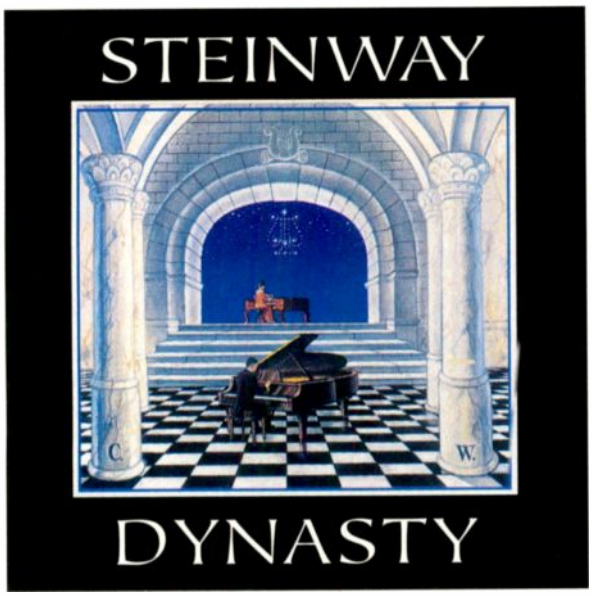

He sits raptly in the pews of the old church while snow falls silently on the roof. Though midnight nears, the walls are painted with the hews of sunrise by light from golden chandeliers. The critic listens to the silence.

At a vast and ancient piano sits the artist. Almost imperceptibly, the maestro moves, and the stillness is gently probed by a shimmering rivulet of music. That stream becomes a brook, a river, a gulf and then a boundless concordant ocean. This is the sound that the composer Rossini said was "a nightingale cooing in a thunderstorm." The critic listens, not for an hour, not for an evening, but for many nights.

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units are hand-tweaked to improve picture quality.

The result is a truly outstanding transport. The Data III offers far better video performance than its predecessor and equals that of any laserdisc player I have used. It provides excellent tracking, low-noise playback, and fine resolution and color. I usually preferred the picture without the Data III's digital noise reduction, but this is true of such circuits in all of the laserdisc players I have used. Its sound was consistently better than that of laserdisc players that had only low-quality Toslink outputs, even when I used an Audio Alchemy or a Theta Digital jitter-reduction device. The Data III also produced cleaner sound than I have heard from stock laserdisc players that have coaxial digital outputs. The improvement showed up largely in low-level sonic detail, which affects depth, imaging, sweetness, and apparent dynamic range.

THE MAJOR CHANGE IN THETA DIGITAL'S DS PRO GENERATION V-a D/A CONVERTER IS ITS OPTIONAL HDCD FILTER.

I also compared the Data III's performance in reproducing CDs with that of the Mark Levinson No. 31 and PS Audio Lambda transports and the Krell KPS-20i CD player used as a transport. The audible differences were slight and highly dependent on the D/A converter, cable, and interface I used. It seemed to me that each manufacturer had optimized its transport to sound best with its own D/A converter. But all four transports performed well with other brands of converters, particularly when I used a top-quality cable and the AES/EBU or AT&T interface. The Mark Levinson No. 31 did a slightly better job on CDs so badly made that any sane audiophile would discard them. But you'll seldom hear a musically meaningful difference between today's best transports, particularly with recent audiophile-quality CDs.

In short, I believe the Data III competes with the state of the art in CD transports. It may *be* the state of the art for those looking for the best possible sound from laserdiscs.

Theta Digital has made fewer improvements in its top-of-the-line DS Pro Generation V-a D/A converter. (I reviewed the previous version in the February 1995 issue.) The analog section now uses six hand-selected sets of eight matched transistors, which Theta feels will improve sweetness and imaging detail. The company has also eliminated the inductors in its output filters, in an effort to reduce sibilance, tighten the focus of the imaging, and improve tonal quality.

The most important change in the Generation V-a is the availability of an HDCD filter/decoder as an option. This option adds $459 to the price of the DS Pro Generation V-a D/A converter, which sells for $3,795 with unbalanced connections and $5,600 with balanced ones; an AT&T optical input costs an additional $300, and Theta's Laser Linque input is $800.

I auditioned two samples of the DS Pro Generation V-a, one with HDCD and one without, so I could analyze the value of the HDCD option. The unit without HDCD revealed a number of subtle but important improvements in sound quality. It was sweeter than its predecessor and more detailed. The noise floor seemed slightly lower, which improved the apparent dynamic range and soundstage detail. The upper midrange was more harmonic and musically natural with strings and woodwinds. Brass had a more musical bite, with less trace of digital edge, and good recordings of cymbals had a more natural shimmer and decay.

The DS Pro Generation V-a was not quite up to the Mark Levinson No. 30.5 in its ability to resolve upper-midrange and treble detail or to extract very low-level musical information. Yet it was richer in the midrange than the 30.5 and had more powerful and dynamic bass. Its bass was excellent, surpassed only by that of the converters in the Krell KPS-20i player. The Generation V-a was also slightly more dynamic than either the Mark Levinson or the Krell. It seemed state of the art in terms of depth and front-to-back imaging. Overall dynamics and soundstage perspective were typical of what you might hear on the main floor of a concert hall, about one-third to halfway from the stage.

The HDCD filter, which automatically decodes HDCD discs, proved a mixed blessing. It did reveal that HDCD recordings are getting better: Reference Recordings' Leos Janàcek (RR-65CD) and George Whitefield Chadwick (RR-64CD) discs, for example, are two of the finest recordings I have heard. But the HDCD setting forces you to use the digital filter in the HDCD chip and bypass the filtering system that is the heart and soul of the Generation V-a.

My listening panel and I mostly preferred to listen to HDCD recordings using the Generation V-a's native digital filtering rather than the HDCD option. Although the HDCD filter provided a bit more upper-octave detail, it was less musically natural and less warm; it spotlighted right-to-left imaging relative to depth. Blind listening tests with non-audiophiles produced roughly similar results. Opinions among my "guinea pigs" were divided, but most preferred the Theta filtering.

More broadly, I found no reason to prefer the sound of HDCD discs over others. Reference Recordings makes some of the world's best recorded CDs, but playing its HDCD recordings back through an HDCD decoder didn't yield sound better than that of well-made non-HDCD recordings played through conventional converters. I listened at length to Reference Recordings HDCD-encoded CDs and other audiophile CDs through the Theta DS Pro Generation V-a, with and without HDCD. Recent recordings from Chesky (Oregon's *Beyond Words*, JD130, and *O Magnum Mysterium*, CD83), Sheffield Labs (*The Art of Fuguing*, 10047-2-G, and *Earth Chants*, 10049-2-F), and Telarc (Oscar Peterson's *The More I See You*, CD-83370, and Jim Hall's *Concierto*, CD-83365) did not have the same sound character as the Reference Recordings CDs but were equally musical. The differences among discs from these labels seemed to be more the result of production values and microphone choice and placement than of anything to do with HDCD. I also played good "extra-bit" recordings, including a Sony Classical Super Bit Mapped CD (two Mozart string quintets, SK-66259) and a Deutsche Grammophon Authentic Bit Imaging disc (Vivaldi's *The Four Seasons*, 43 9933). These recordings roughly equalled the HDCD recordings in most musically relevant aspects of sound quality. Consequently, I would buy the Generation V-a without the HDCD option and put that money toward something more useful. In the Generation V-a, HDCD not only doesn't gild the lily but tends to diminsh its bloom.

THERE'S A SUPERB SYNERGY BETWEEN THE DATA III AND THE DS PRO GENERATION V-a.

The Data III is a tempting A/V crossover product. I occasionally use it in my A/V reference system, and I look forward to using it with AC-3 processors. I cannot, however, end this review without stressing the synergy between the Data III and DS Pro Generation V-a, using Theta Digital's Laser Linque glass-optical interface. The stereo sound from this combination is truly musically involving and offers an outstanding mix of musical nuances. A

AURICLE

JOHN SUNIER

NuREALITY VIVID 3D THEATER SRS PROCESSOR

Despite the growing popularity of multichannel home theater systems, there are still many listeners who want surround effects yet don't want extra speakers. Realizing this, many companies have developed processors that attempt to create surround-like sound fields with just two front speakers.

One of the oldest, best-established techniques for doing this is the Sound Retrieval System (SRS), used by NuReality in its series of Vivid 3D processors. Invented by Arnold Klayman, SRS is said to use processing based on the psychoacoustics of head-related transfer functions. These functions help the brain localize sounds precisely, in all directions, because the spectral characteristics, or frequency content, of those sounds vary according to the direction of the sound source. Sounds from different directions strike different areas of the head, shoulders, and pinnae (outer ears), all of which act as frequency-selective baffles. It's like having separately tuned bandpass filters for the azimuth and elevation of each sound we hear. Our brains use the resulting minute shifts in frequency spectra, phase, and level to augment the primary timing and level cues in order to localize sounds. We use these aural abilities to enjoy music in a space; our ancestors used them to avoid attacks by tigers.

If moving a sound source in space changes its apparent spectral content, then changing its spectral content should make it seem as if it's moved in space. Klayman says he has capitalized on this to "move" specific sounds out of the two stereo loudspeakers. By equalizing certain portions of the ambient field (the L – R component of the stereo signal), SRS can place some sounds off to the sides of the listening area or even to the rear of it in some cases. The result is a seamless soundstage that wraps around much of the room and makes the pair of speakers seem to "disappear" sonically.

THE SWEET SPOT, WHERE SOUND AND SPATIALITY ARE MOST ENJOYABLE, WAS VERY WIDE WITH THE VIVID 3D.

The first SRS processor was made by Hughes Corporation (*Audio*, April 1992). Klayman's SRS circuitry is now being used in high-end TVs by Thomson (RCA) and Sony, in home audio and home theater components by Nakamichi and Paramount, and in computer multimedia gear. NuReality's line of home SRS units ranges from a bare-bones computer multimedia model (the Vivid 3D Plus, $79.95) to the Vivid 3D Theater processor reviewed here ($249.95).

Like most sound processors, the Vivid 3D Theater is normally connected to the tape-monitor loop of a preamp or receiver. About 8 pounds in weight and 16½ inches wide x 9¼ inches deep, the processor has its own rear-panel jacks for a loop connection, so an SRS unit plugged into your system's tape jacks won't keep you from using an equalizer, expander, or other processor. Since the output to the loop is SRS-processed when the circuit is engaged, you can also use a tape deck plugged into these jacks to make SRS-encoded tapes.

On the Vivid 3D Theater's front panel are buttons to switch on power and the SRS effect (the only controls duplicated on the supplied remote), a display, and then three more buttons. These are used to select mono or stereo, defeat the display (which uses amber and green arcs to show the extent of the center and surround images), and select or deselect the signal from the loop jacks on the rear panel.

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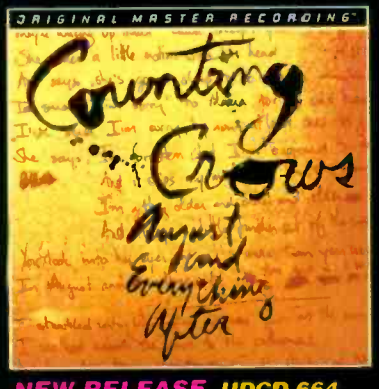

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At the far right are two small knobs, "Center" and "Space," and a large "Volume" knob. The "Center" and "Space" controls affect the level of the sum (L + R) and difference (L – R) signals, respectively, before those signals undergo further processing. Turning "Center" up gives you a stronger center image, while turning "Space" up gives you more ambience. Turning "Center" all the way up and "Space" all the way down gives you an almost monophonic signal, while reversing those settings fades centered soloists out almost completely. I usually preferred the "Center" setting almost full up, with the "Space" knob at about the 3 o'clock position. However, I had to readjust these settings for almost every CD or FM program. Ironically, the smaller knobs needed frequent readjustment, while I normally set "Volume" once, for the highest level that left peaks undistorted, and then left it alone.

I evaluated the Vivid 3D Theater using my main audio system, a more modest home theater system, and via pairs of extension speakers throughout my house. Making A/B comparisons of the enhanced and unenhanced signals was difficult, even with the remote control, because the sound almost always became louder when the SRS function was on.

The SRS circuits are optimized for use with speakers spaced fairly close together. Luckily, I already had two mini-monitors spaced only 3½ feet apart—the center pair of a four-speaker array used with a Cogent Research SP1 processor. When I switched from the Cogent processor to NuReality's SRS box, I first thought that I was still hearing all four speakers. Not so; the two outside speakers were mute. Nevertheless, sitting 9 feet away, I heard a seamless soundstage that started almost directly to my left and ended almost directly to my right. The two speakers were even harder to localize than the four speakers used with the Cogent processor.

The SRS enhancement varied with different CDs and often required readjustment of the "Center" and "Space" controls from the approximately 2 o'clock settings recommended by NuReality. But that enhancement was impressive. Though frequent readjustment is an inconvenience, I especially appreciated the "Center" control and used it to modify overly aggressive multimiked recordings of solo instruments. The Cogent processor can make grand pianos seem 30 feet wide, but turning up the "Center" control on the NuReality processor reduced pianos to their proper size.

NuReality promises that SRS widens the "sweet spot," where sound and spatiality are most enjoyable. The Vivid 3D Theater delivered this, and very successfully. Many very expensive speakers have very small sweet spots, as do most binaural and "three-dimensional" audio processors. But if you are sitting at the far right of the room, SRS still enables you to hear a fairly good balance from the left side of the soundstage. This may be particularly noticeable when you're moving around. The wide sweet spot might even let you get away without a center-channel speaker in a modest home theater setup, since viewers at the sides of the room should still hear the opposite speaker quite clearly.

To determine how well the Vivid 3D Theater created pseudo-stereo from mono sources, I pressed its "Mono" button and played a CD reissue of some old jazz 78s. The

soundstage was spread widely, but bass was exaggerated (as was rumble, presumably from the original 78s) and distortion increased. A symphonic recording from the pre-stereo '50s worked better. However, on a concerto from that period, the piano sounded as if it were across the street. Unfortunately, the "Center" and "Space" controls are inoperative in mono mode, so I could not turn up the "Center" knob to place the piano on the stage with the other instruments.

After using the Vivid 3D Theater with the two front speakers alone, I turned on my matching rear-channel speakers. These are fed via a PhaseAround passive processor, which derives an L – R signal from my preamp. With the preamp getting its signal from the NuReality processor, the most noticeable effect on the rear channels was a significant bass boost. Since the bass from these speakers did not need boosting, I preferred the sound with the surround-channel information tapped from a point upstream of the Vivid 3D Theater.

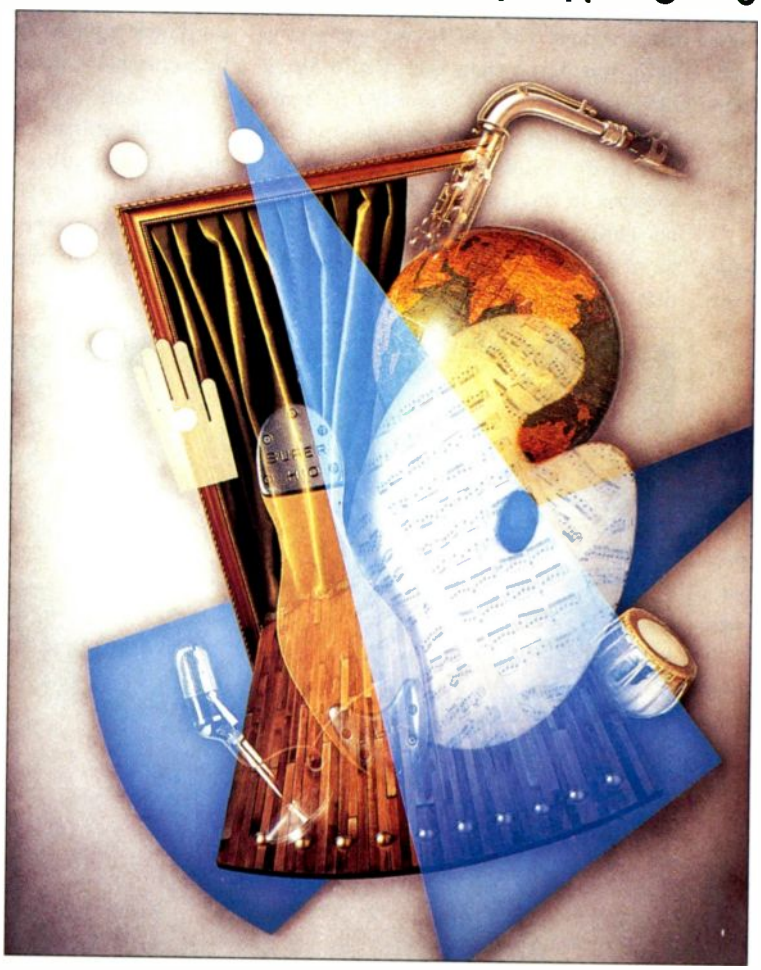
After more extensive A/B listening through my main audio setup, I began to notice changes in the front channels' frequency content. Literature from SRS Labs states that "the enhancement does not rely on encoding or decoding and it does not alter the original program material" except for the sound-field enhancement. I disagree: There were definite timbral changes on all recordings. And on a high-quality system, those changes muddy the sound.

Results were better with my home theater system (which uses Cambridge SoundWorks speakers); the pleasing spread of sounds throughout the room made up for a slight loss of transparency. Again, the bass level (in this case, from my subwoofer) had to be reduced when SRS was on. Using SRS with the "70mm" setting of a Fosgate/Harman Kardon Dolby Pro Logic processor achieved excellent surround effects from music and movies on laserdiscs and from telecasts. The signals were fed to the Vivid 3D Theater before going to the Pro Logic processor; Klayman says that SRS processing gives Dolby Pro Logic more information to use in steering sounds to the various speakers. Once, when I accidentally turned off the surround-channel amp, I was certain that the side speakers were still operating. On some video material, if "Space" was advanced too far or "Center" turned too far down, all sounds moved away from the screen and dialog no longer seemed to come from there.

The 3D Theater also proved a boon in other rooms. The sound coverage on my patio was better than ever. Radio Shack Minimus 7 speakers, mounted near my kitchen ceiling, gained enough bass and spread to sound nearly as good as the speakers in my home theater. In fact, my one ideal use of the Vivid 3D Theater would be to process the signal feeding the amp that powers my remote speakers.

The better your speakers and audio system, the less I think you'll gain from using the Vivid 3D Theater. Listeners with high-end systems may find the timbral modifications unacceptable. True, these changes can be somewhat reduced by backing off the "Center" and "Space" controls, but this also reduces the enhancement, to the point that the NuReality processor might as well be out of the circuit. The more modest your speakers, however, the better I think you'll like the NuReality Vivid 3D Theater's SRS enhancement. A

CLASSICAL RECORDINGS



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Bartók: The Wooden Prince; Music for Strings, Percussion, and Celesta
London Symphony Orchestra, Antal Dorati
MERCURY LIVING PRESENCE
434 357, CD; ADD; 77:45
Sound: A, Performance: A

Janos Starker (Works by Chopin, Bartók, Mendelssohn, Martinu, Debussy, and Weiner)
Janos Starker, cello; Gyorgy Sebok, piano
MERCURY LIVING PRESENCE
434 358, CD; ADD; 72:53
Sound: A, Performance: A

Ravel: Gaspard de la Nuit; Debussy: Three Preludes and Pour le Piano Suite; Stravinsky: Three Movements from *Petrouchka*
Gina Bachauer, piano; John Gielgud, reader (in Ravel)
MERCURY LIVING PRESENCE
434 359, CD; ADD; 60:43
Sound: A, Performance: A+

Grofé: Grand Canyon Suite and Mississippi Suite; Herbert: Cello Concerto No. 2
Georges Miquelle, cello (in Herbert); Eastman-Rochester Orchestra, Howard Hanson
MERCURY LIVING PRESENCE
434 355, CD; ADD; 65:42
Sound: A, Performance: A

Popovers II (Carousel Waltz and Other Orchestral Favorites)
London and Eastman-Rochester Pops Orchestras, Frederick Fennell
MERCURY LIVING PRESENCE
434 356, CD; ADD; 64:42
Sound: A, Performance: A

These essays in audio archeology are not without their pitfalls, but by and large they offer an exciting and engrossing sonic window on the way we were in the late '50s and into the '60s. With that in mind, I've graded them all A for sound, despite some caveats; the grades you give them may differ, depending on your point of view and the degree to which you find certain anomalies disturbing. I've likewise given all but one of the performances an A. You may prefer Karajan or Bernstein to Dorati, for example, but all of the performers are acknowledged experts in the areas in which they are represented here. The one departure from an A rating is the A+ I've given to the Gina Bachauer disc, which, by a brilliant stroke of imagination, combines the Maurice Ravel suite with John Gielgud's readings of the Aloysius Bertrand poems (in English translations by Christopher Fry) that inspired it. The extra illumination that this sheds on the music demands the premium rating.

As a unique presentation of this often-recorded repertory, the Ravel elbows its way forward in the crowd, so to speak. To some extent the same might be said of Dorati's Bartók, though the presence of the relatively rare ballet score constitutes a stronger recommendation than the frequently recorded Music for Strings, Percussion, and Celesta. And Starker is Starker; what more need be said? From there it's downhill, musically. Ferde Grofé wears thin quickly (kudos to him for his brilliant orchestrations for George Gershwin, but his own music is decidedly shallow). The Victor Herbert concerto, though downplayed in the cover art and admittedly less colorful and bold, has somewhat more substance. And the Pops pieces are just that: fun, but less than great music.

The real focus of this Mercury series is on the sound, however. The orchestral pieces are captured with an extremely close-up perspective that appears to hover over the conductor's head. It enables you to hear the first-desk players plus the body of sound from behind them, almost as though each solo had its own touch-up mike. Actually, most or perhaps all of the tracks were captured with three mikes, each presumably feeding its own track on

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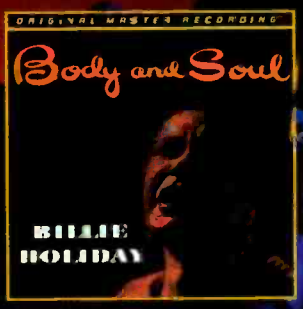

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half-inch, three-track tape. This technique can create a soundstage stability and believability that touch-up multimiking makes problematic. The tapestry of sound that is thus laid at your feet is what makes the orchestra recordings so exciting, but this sonic effect has nothing to do with the way you hear music in a hall. For that reason, it is radically unlike current recording technique, which seeks above all the "realism" of the ambience and listener perspective that the composer expected in creating the music.

That's not the only characteristic to which you may take exception. If you have the volume fairly high when you start the Dorati disc, for example, you will be reminded how noisy studio air-conditioning used to be. And the LP medium could barely contain a half-hour per side, even given fortuitous music timings, while these CDs all run more than an hour. Hence they combine material originally intended for issue on separate LPs. In the Pops, though two orchestras are involved, this makes little difference. But on the Bachauer disc, the disparity in her piano sound—between the London sessions and the *Petrouchka* transcriptions recorded in New York—is somewhat disturbing. In fact, only the Grofé/Herbert disc was recorded in a single venue, though the Herbert was originally on a separate LP. Finally, these are analog recordings that tend to lose clarity in the climaxes (notably on Dorati's Bartók) even when the pianissimos are deliciously captured.

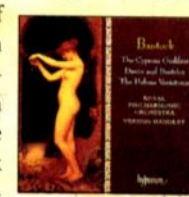
"Audiophile" these recordings certainly are, though they don't represent an unassailable sonic ideal. Taken for what they are—or were—these albums are quite fascinating. But don't expect them to outclass the best of today's recordings, particularly if music rather than sound is your overriding reason for listening. *Robert Long*

BANTOCK

The Cyprian Goddess, Helena, and Dante and Beatrice

Royal Philharmonic Orchestra, Vernon Handley
HYPERION CDA66810
CD; DDD; 69:17
Sound: A, Performance: A

Hearing Granville Bantock's extremely cinematic tone paintings caused me to wonder if there might not be a screen image to go with these colorful works, even though two were written before movies existed. Bantock creates the feeling of an unfolding story in "The Cyprian Goddess" and "Dante and Beatrice," where the programmatic style of Richard Strauss is wedded to French exoticism.



"The Cyprian Goddess" is really Bantock's Third Symphony. This British composer had a rather wide view of what a symphony is. The goddess is Aphrodite, and the work was inspired by two Latin verses dedicated to her. Bantock's wife is the dedicatee of "Helena"; he called his "Dante" score a psychological study rather than a depiction of various Dantean episodes in detail.

This sumptuous off-the-beaten-path musical journey is appropriately played and was cleanly recorded by engineer Tony Faulkner. *John Sunier*

Kuhnau: The Biblical Sonatas

John Butt, harpsichord, clavichord, and organ
HARMONIA MUNDI FRANCE 907133
CD; DDD; 72:23
Sound: A, Performance: A+

Any previous impressions of Johann Kuhnau (1660-1722) as a boring predecessor of J. S. Bach will be dispelled by this quirky collection of long-forgotten program music. This organist, writer, composer, theorist, language expert, church music director, and practicing lawyer created some of the first verbal/musical illustrations of Biblical stories.

Each of the six keyboard sonatas illustrates a different Biblical story. Kuhnau provided a German version of the verbal program, with details of the story prefacing each sonata, and written into the score is a text in Italian. He wrote that although music "directly parallels and affects the human emotions. . . the words in texted music make the primary emotional impression on the listener."

Organist John Butt chose three keyboard instruments, selecting the one he felt best fit each sonata. The organ of Hertz Hall at U.C. Berkeley is used for the First and Fourth Sonatas. The First, "The Combat Between David and Goliath," is a precursor of the many 19th-century battle pieces, with sounds of struggle verging on atonality, "travel music" as the Philistines are pursued, and victorious hoopla at the conclusion. There are even bird sounds, more expected from a Wurlitzer theater organ than from an authentic copy of a baroque organ!

The happy feeling of The Third Sonata, "The Wedding of Jacob," is given to the harpsichord. The opening of the Second, "The Melancholy of Saul Assuaged by Means of Music," is a sentimental (in the best sense) depiction that calls on the clavichord's ability to "bend" notes. In the Fifth, "Gideon the Savior of the People of Israel," the clavichord conveys an unexpectedly wide range of sounds in another piece of battle music.

Don't raise the volume of the subtle clavichord sonatas, or the organ tracks will be excessive. Harmonia Mundi France is to be commended for keeping the level at a natural balance among the three instruments featured in this excellent collection of inventive keyboard gems. *John Sunier*

Where Shall I Fly (Mozart and Handel Arias)

Jennifer Larmore, mezzo-soprano; Lausanne Chamber Orchestra, Jesús Lopez-Corbos
TELDEC 4509-96800, CD; 63:30
Sound: A–, Performance: A–

This is a remarkable recording, if you can stand the constant emoting or plan only to dip into individual tracks. These high-power and devilishly difficult opera excerpts, many of them rarely performed these days, seem to hold no terrors for Jennifer Larmore. An occasionally intrusive flutter aside, her voice has all the qualities they demand: stamina, power, and flexibility. The accompaniments are fluent, lively, and precise. Somewhat annoyingly, the program intermixes Mozart and Handel. Sound balances and acoustics are fairly standard; Larmore's mezzo-soprano voice dominates preemptively. The booklet contains full texts and trilingual paraphrase/synopses. *Robert Long*

Pärt: Fratres; Cantus in Memory of Benjamin Britten; Summa; Festina Lente

I Fiamminghi, Rudolf Werthen
TELARC CD-80387, CD; DDD; 1:09:00
Sound: A+, Performance: A+

The Belgian chamber orchestra I Fiamminghi lends its rich string tone to Arvo Pärt's "Fratres." This work is based on repeti-

tions of an austere, hymn-like theme and is played in six different ensemble versions. Inspiration for this piece was a procession of monks moving through an abbey by flickering candlelight. Diverse aspects of the score are illuminated by the changing instrumentation.

The lengthy melody in "Festina Lente" is played simultaneously in three different time values, one of the 15th-century techniques borrowed by Pärt in his mystically introspective music. Velvety massed strings hallmark this meditative album; if even a hint of steeliness shows up, something in your system is likely at fault. *John Sunier*

Zelenka: Six Trio Sonatas, ZWV 181; Missa Dei Patris; Confitebor; Laudate Pueri; Three Capricci

Soloists; Virtuosi Saxoniae, Ludwig Güttler
BERLIN CLASSICS 0011502BC
Four CDs; DDD; 4:08:36
Sound: A, Performance: A

What distinguishes Jan Dismas Zelenka from the plethora of baroque mediocrity available on CD? Well, Bach himself esteemed the music of the introverted Bohemian Catholic musician, and today his music is finding renewed acceptance for its great beauty and originality.

Handel or Bach may come to mind, but one soon senses Zelenka's highly individual style, which is less predictable than that of other composers of the period. The technical virtuosity required of some of the instrumental soloists is very high; bassoonists must love Zelenka for the workout they receive. Like Bach, he absorbed the total compositional knowledge of previous musical generations and then put that knowledge to the test in his own works.

The Trio Sonatas, primarily for two oboes and continuo, are far from garden-party background music. Melodic and rhythmic patterns are varied and constantly changing. Italian opera was the model at the Dresden court, where Zelenka toiled, but in his 20 Masses he went his own way. The late ones, such as the "Dei Patris," go beyond opera influences, using a combination of mournfulness and ecstatic expression.

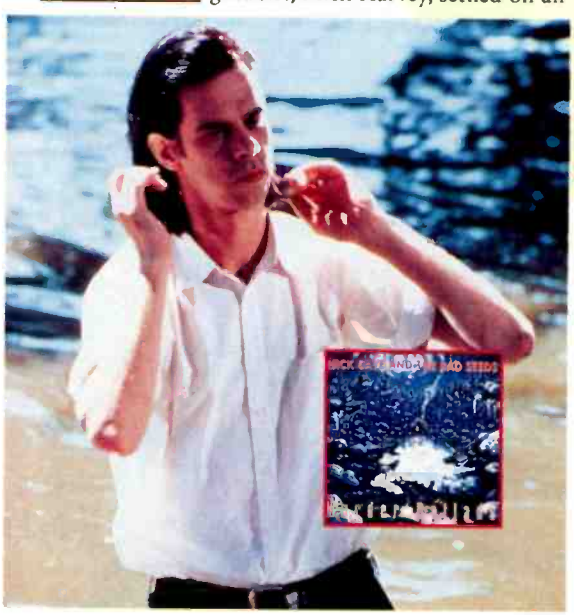
A single booklet, with all English notes in one spot, would make it easier for those wanting to learn more about Zelenka and his music. Otherwise, this CD set, with its attractive and very natural sound, is a commendable introduction to one of the most original composers of the baroque period. *John Sunier*

ROCK~POP RECORDINGS

Intoxicated Man
Mick Harvey
MUTE 9012-2, 44:46
Sound: B, Performance: B

Murder Ballads
Nick Cave and The Bad Seeds
MUTE/REPRISE 2-46195, 56:36
Sound: B+, Performance: A

Hey, they don't call 'em The Bad Seeds for nothing. Fishing around for album inspiration recently, bandleader Nick Cave chose the trusty old murder ballad; for his own album, his guitarist, Mick Harvey, settled on an English translation of obscure French hepcat Serge Gainsbourg's cabaret-cool material from the '60s. Needless to say, the two projects are equally grim and gloomy.



Employing a healthy dose of wheedling organ, plus the sultry vocal talents of Anita Lane, Harvey succeeds in capturing that smoky Gitanes feel of his bohemian subject, especially on the seedier numbers ("Sex Shop," "69 Erotic Year," and "The Barrel of My 45"). His voice is not always up to the task, but in a duet with Lane, "Bonnie and Clyde" (originally done by Gainsbourg and Brigitte Bardot), he achieves a perfect, murmured balance in a celebration of the rakish gangster lifestyle. And one fact repeatedly surfaces throughout these facile readings: The record was obviously a labor of love for Harvey, who seems bent on hipping the world to France's own tortured take on Leonard Cohen beat-dom. Les Misérables, indeed.

Even on his best, most sunshiny day, however, Nick Cave will always be the baddest of The Bad Seeds. His voice is as deep and final as a casket lid slamming shut on *Murder Ballads*' sinister centerpiece, "O'Malley's Bar." This 15-minute tale of sin and salvation is about a town nobody who finally gets attention by systematically blowing away every patron at his neighborhood pub. It's a splatterfest that could only have come from the black-humored mind of Cave, who plays somber piano on the track to underscore the grue. There are no reporters here crying "Oh, the humanity!" There's just this lyrical vulture, repeatedly pecking at society's carcass with his amoral parables. As in classic Appalachian traditionals like "Knoxville Girl" and "Pretty Polly," Cave's characters kill each other for no apparent reason and display no remorse over their deeds. In the gorgeous processional "Where the Wild Roses Grow" (a duet with fellow Aussie Kylie Minogue), the protagonist finally gets a date with his object of desire, and what does he do? He lures her down to the riverbank and bashes her skull with a rock. The draped beauty of the music works in startling contrast to the creepy wordplay.

This disc is perhaps the apex of Cave's enduringly gothic shtick. He even finds morbid humor in Dylan's religious treatise "Death Is Not the End," letting just about every musician involved in the session sneer out a verse before hammering his cynicism home in the final join-hands chorus. And his sendup of the traditional vengeance yarn "Stagger Lee" is positively feral, with the singer crowing like a spurred rooster over his foe's lifeless body—all to a funky, minimalist backbeat. Cave is not afraid to deal himself some rough justice, either: "Henry Lee" finds the fickle fiend hacked to death with the penknife of co-vocalist Polly Jean Harvey, who will brook no infidelity at all.

And piano, either Cave's or Conway Savage's, is the signature instrument that inches this funereal pall along. There's so much of it that the uninitiated might think Nick Cave has grown soft over the years. Far from it. He and The Bad Seeds are simply finding more latent, insidious ways to be ghoulish. Mock them at your peril. *Tom Lanham*

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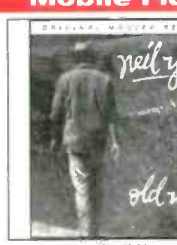

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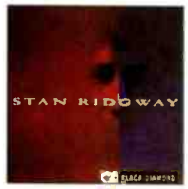
Black Diamond

Stan Ridgway
BIRDCAGE 11007, 50:59
Sound: B, Performance: B+

Stan Ridgway is the music world's version of a character actor. With his carnival barker's phrasing and sardonic demeanor, he's like the instantly identifiable second banana who brightens the screen for a few minutes before the leading man steps back to the fore. Of course, Ridgway has the same predicament as any good character actor—he's typecast. People remember that yowling voice from his early '80s hits with Wall of Voodoo, "Mexican Radio" and "Ring of Fire," and it's because of this distinctive instrument that his identity has frozen in time.



Black Diamond is Ridgway's conscious effort to stretch out and break ties with his history. His first post-I.R.S. album is a low-budget production that finds the Los Angeles singer/songwriter stripping down to spare guitar, keyboards, and percussion. In the process, he places greater emphasis on his songs, which he sings as straight as possible. Certainly "Luther Played Guitar" and "Wild Bill Donovan" don't fit with Ridgway's New Wave past. The former finds the singer inhabiting the mind of Johnny Cash as he wistfully recalls his early sideman, Luther Perkins. The latter, a Warren Zevon-meets-Bob Dylan folk ballad, chronicles the exploits of one of America's seminal spies. Speaking of Dylan, Ridgway revives "As I Went Out One Morning" from *John Wesley Harding*, giving a refined reading to an intriguingly cryptic but seldom-covered song. "Gone the Distance" is yet another Kurt Cobain elegy. *Black Diamond*'s seven other songs are less immediate but, in the long run, every bit as worthy.

This is the kind of album that's likely to slip through the cracks, which is unfortunate. Ridgway is by now a certifiable journeyman, but *Black Diamond* indicates his best work may lie ahead, even if he may be destined to be the rock 'n' roll Warren Oates. (Available from Birdcage Records, P.O. Box 784, Sierra Madre, Cal. 91024.) *Steven Stolder*

The Valentine Tapes

Sharkboy
NUDE 4CD, 39:33
Sound: B, Performance: B

Somewhere between the precious niceties of the 4AD label and the sleepy Gothic twang of Mazzy Star sits surreal U.K. combo Sharkboy. Wrapped around the unearthly moan of soulless sister Avy, the music bounces through Duane Eddy-ish guitar boom and a general feeling of country loneliness. But unlike Mazzy's dour Hope Sandoval, Avy and Sharkboy have a self-deprecating sense of humor, although the core of Sharkboy remains relatively shadowy. The band seems more concerned with pushing its parameters than settling on a recognizable style. Yet if you like your singers all dusky and magenta-hued, Avy's the gal for you. Like that old Halloween standby Elvira, she can chill your spine and tickle your funny bone simultaneously. *Tom Lanham*

FAST TRACKS

Rank & File: *Mark Germino* (Winter Harvest WH 3303, 57:43). Gruff-voiced Germino is one hell of a storytelling songman. On this "non-electric guitar album," as he calls it, his lyrics shine through the rock 'n' roll center stage. His melodies are toe-tapping catchy, and your attention will be rewarded by the stories he spins. **M.T**

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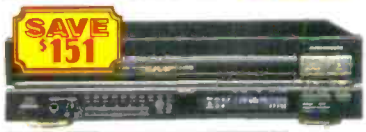

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JAZZ~BLUES
RECORDINGS

Saga
Randy Weston
VERVE 314 529 237-2, 74:48
Sound: B, Performance: B+

Randy Weston embodies jazz. His music is charged with the soul of African rhythms, his piano playing is stoked by boogie-woogie, and his arrangements are tinged with the air of Ellington. Weston is a musician who is informed by the past but who doesn't live in it.

On *Saga*, Weston gathers a veteran group of musicians who sound like they're still hitting their stride. Trombonist Benny Powell and saxophonist Billy Harper, in particular, are revelations as they find new life in Weston's blues-inflected themes. On "The Beauty of It All," Harper's smoke-charred tenor blows smoldering lines across Weston's open-ended phrasing. Another veteran, drummer Billy Higgins, teams up with the relatively young bassist Alex Blake, who plucks earthy pizzicatos and vamps furiously. Higgins can play at the edges of a rhythm while still making a band swing like furious pistons. Add to this alto saxophonist Talib Kibwe, who gives a wild, swirling solo on the samba-driven "Tangier Bay" and trades off with Harper on "Saucer Eyes."

Reminiscent of Thelonious Monk, Randy Weston is a transparent player who never calls attention to himself, even on the solo tracks. But suddenly you realize that he has taken you through some extraordinary harmonic changes. By extension, he rarely makes monumental albums. Instead, they insinuate themselves quietly, like Mona Lisa's smile. But she might have a slightly more joyous grin if she heard *Saga*. *John Diliberto*

TAB BENOIT

Standing on the Bank
Tab Benoit
JUSTICE JR 1203, 1203-2, 50:38
Sound: A, Performance: B+

On his third release as a leader, guitarist Tab Benoit draws heavily on the influences of Albert King and Freddie King. A stripped down affair recorded live to two-track, *Standing on the Bank* showcases the South Central Louisiana native's soulful vocals and razor-sharp guitar work in a collection of originals and blues classics. While certain covers (Leon Russell's "Me and My Guitar," Willie Dixon's "The Seventh Son," Blind Lemon Jefferson's "Matchbox Blues," and the classic jamming vehicle "Going Down") come off as ordinary bar-band fare, Benoit makes more personal, dramatic statements on the powerful title track, a lowdown Delta-flavored original that bears the unmistakable stamp of John Lee Hooker, and on his unaccompanied country blues original "Still Going Down the Road."

Willie Nelson adds a nice touch with his signature vocals and nylon-string guitar work on "Rainy Day Blues," an intimate duet with Benoit (whose steady toe-tapping sets the tempo). "If I Could Quit You" is a sultry slow-dance vehicle in the vein of Earl King's "Those Lonely Nights"; it is perfect for a hot August Saturday night at the Mid-City Rock 'n' Bowl, one of Benoit's favorite venues in New Orleans. And his heartfelt rendition of "Laundromat Blues" contains some particularly toe-curling licks and direct guitar quotes from Albert King himself.

With *Standing on the Bank*, the 28-year-old Benoit distinguishes himself as a strong contender on the new blues-rock scene; he's got chops, plays with conviction, and above all has heart—a necessity for a bluesman. *Bill Milkowski*

Photograph: ©Jimmy Katz

Jim Campilongo and The 10 Gallon Cats

BLUE HEN #1, 43:26
Sound: B, Performance: B+

Brisbane Bop: Western Swing, 1961-64

Jimmie Rivers and The Cherokees
JOAQUIN JR2501, 71:20
Sound: C–, Performance: A–

People tend to put jazz and country at opposite ends of the spectrum, but there's long been a junction where the two mix it up. The resulting fracas, whether you call it western swing or cowboy jazz, has maintained loyal adherents since Bob Wills and The Texas Playboys first rode the range more than 50 years ago.

Jim Campilongo and The 10 Gallon Cats represent the genre's current state of the art. Campilongo, an accomplished and innovative guitarist, penned 11 instrumentals for the group's self-titled debut. (Stick around after the last track to hear "Ping-Pong," an unlisted bonus selection.) He and his sidemen—steel guitarist Joe Goldmark, bassist Chris Kee, and drummer Ken Owen—keep it clean, sweet, and snappy throughout. Only "Bully Cat," an intoxicatingly raunchy seven-minute roll in the mire, stretches out at length; the rest of the cuts clock in at an average of three minutes each. Nary a word is sung, but the tunes are so varied and lively that vocals would have spoiled the mood. Campilongo's playing reveals a range of influences stretching from Roy Buchanan to Chet Atkins. One highlight, "Swingin' with The Cats," pays homage to Jimmie Rivers, another Campilongo favorite, albeit one of considerably less acclaim.

Rivers was the leader of an eight-man, late '50s to early '60s house band at DeMarco's 23 Club, a Brisbane, California, nightspot. There, when they weren't backing Lefty Frizzell or Ernest Tubb, Rivers and the boys indulged their own whims. *Brisbane Bop* captures those flights of fancy, and it's a revelation.

Rivers is a sophisticated, fleet-fingered player with a fondness for Charlie Christian and Barney Kessel. His eclectic taste in material encompasses everything from pop standards to the odd Art Pepper cover. *Brisbane Bop* is culled from informal recordings made by Vance Terry, The Cherokees' steel guitarist. Although it's not clean by today's standards, the CD is eminently listenable and has its own kind of honky-tonk charm. The "whoops" from the crowd and on-stage announcements ("every Sunday we'll start at 7. . .so you can get drunk and go home early") gives the 19-song collection a roadhouse ambience.

The 70-year-old Jimmie Rivers doesn't play much anymore, but he sat in recently with The 10 Gallon Cats. Jim Campilongo, meanwhile, appears frequently at Rivers' old stomping ground, the 23 Club. What could be more natural than a collaborative album? We'll have to wait for that one, but in the meantime, these two collections should tide us over just fine. (*Jim Campilongo and The 10 Gallon Cats* is available from Blue Hen Records, 258 San Benito Road., Brisbane, Cal. 94005; *Brisbane Bop: Western Swing, 1961-64* is available from Joaquin Records, 254 Scott St., San Francisco, Cal. 94117.) *Steven Stolder*

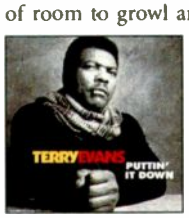
Puttin' It Down

Terry Evans
AUDIOQUEST AQ-CD 1038, 52:35
Sound: A+, Performance: A–

Maybe it's his Vicksburg, Mississippi, roots, or it might be that this "live"-in-the-studio recording presents such a clear portrait of a naturally gifted soul/blues singer. Whatever the reason, *Puttin' It Down* feels real. After 25 years on the L.A. club and session scene, Terry Evans has paid his dues through thousands of gigs and countless recordings as a backup vocalist. Now his deep, resonant voice is front and center, where it belongs.

To maintain the feel of his live shows, Evans used his touring band (smart) and added old buddy Ry Cooder (very smart), who contributes some of his best fretwork in years. Cooder's evocative guitar sound is more color and flavor than mere individual notes or chords. He's an intuitive player who bypasses the brain and heads straight to the spirit.

Evans and company pull out all the stops on "Down in Mississippi," a J. B. Lenoir tune that will send shivers down your spine. Evans preaches the potent southern imagery of the song as Cooder's guitar stings like a thousand bees and Jim Keltner's drums fuel volleys of thunder. The shuffle beat that percolates through "Rooftop Tomcat" gives Evans plenty of room to growl and howl. But the album's finest moment is the final track, "Blues No More." Evans begins the song with his voice pulled way down low, drawing you in. Slowly, very slowly, he lets the tension build, begging and pleading, but still manages to hold on to his dignity. It's a chilling performance.



Contemporary R&B artists rarely achieve the heights that Terry Evans and Ry Cooder have attained on *Puttin' It Down*. The interplay is magic. *Steve Guttenberg*

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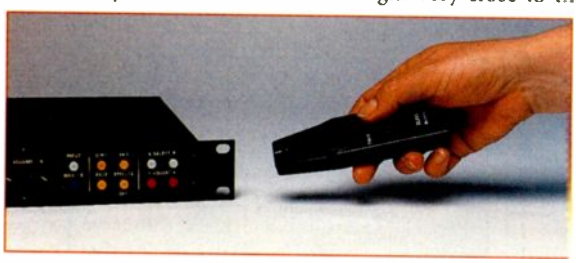
PlayBack

Audio Advisor ELFIX AC Polarity Tester

Audio Advisor's ELFIX polarity tester ($29.95) is a handy device that checks for AC potential between the chassis of your audio components. This enables you to orient the prongs of each component's AC plug for minimum potential, reducing leakage current between your components and keeping hum in your system as low as possible. The ELFIX also tells you when you have oriented each component's AC plug so that potential between chassis and ground is at its minimum, the safest condition.

As you hold the ELFIX near a chassis, a red LED glows when AC potential is present. Reverse the AC power plug, and watch the LED: It glows with either AC plug polarity, but one polarity will cause the LED to glow only when the ELFIX is brought very close to the component. This is the polarity to use, because the chassis has the lowest AC potential. You can check each component, one by one, as you plug it into an AC outlet. Some people contend that correct AC plug polarity improves perceived sound. Whether this is true or not, there's no disputing that it is the preferred AC polarity for safety.



GRADE: B

Edward M. Long

For literature, circle No. 120

Audio by Van Alstine
Ωmega III 440hc Amp and FET Valve EC Preamp

Frank Van Alstine has quietly made affordable, audiophile-quality gear for years. The Ωmega III 440hc power amp ($1,399) and the FET Valve EC hybrid preamp ($999, plus $199 for an optional phono stage) are two of his top-of-the-line products. Ergonomically, the FET Valve EC is a throwback to the days when preamps had abundant flexibility: It has defeatable tone controls, muting, a high-cut filter, and a stereo/mono/left-only/right-only channel switch. There are also two tape loops and a processor loop, six line inputs, and a headphone amp. The Ωmega III 440hc power amp is rated at 220 watts per channel.

GRADE: A-

Used together, the amp and preamp had excellent transparency and very good bass performance, and they revealed no harshness. With other amps, the preamp sound remained impressive on all kinds of recordings. Bass was a touch warm at times—but not "tubby," like the bass of other preamps I have heard that use tubes. The only anomaly from either product was an almost melodic noise from the speakers that I heard about 10 seconds after turning off the amp. Van Alstine said the noise is a side effect of the amp's regulated power supply; it occurs at 0.01 watt out and did not affect normal operation.

John Gatski

For literature, circle No. 121

Golden Sound DH Cones

DH cones are made of a ceramic material whose claimed hardness is surpassed only by that of diamond. Golden Sound says that placing three cones under your audio equipment, including loudspeakers, will make the sound more transparent, with tighter bass and better image stability. DH cones come in sets of three and are available in four sizes; a 1⅜-inch set is $70, a 1-inch set is $50, a ⅞-inch set is $40, and a ⅝-inch set is $20. The instructions tell you to place each cone's flat side under the equipment, with the pointed side against the floor or equipment cabinet.

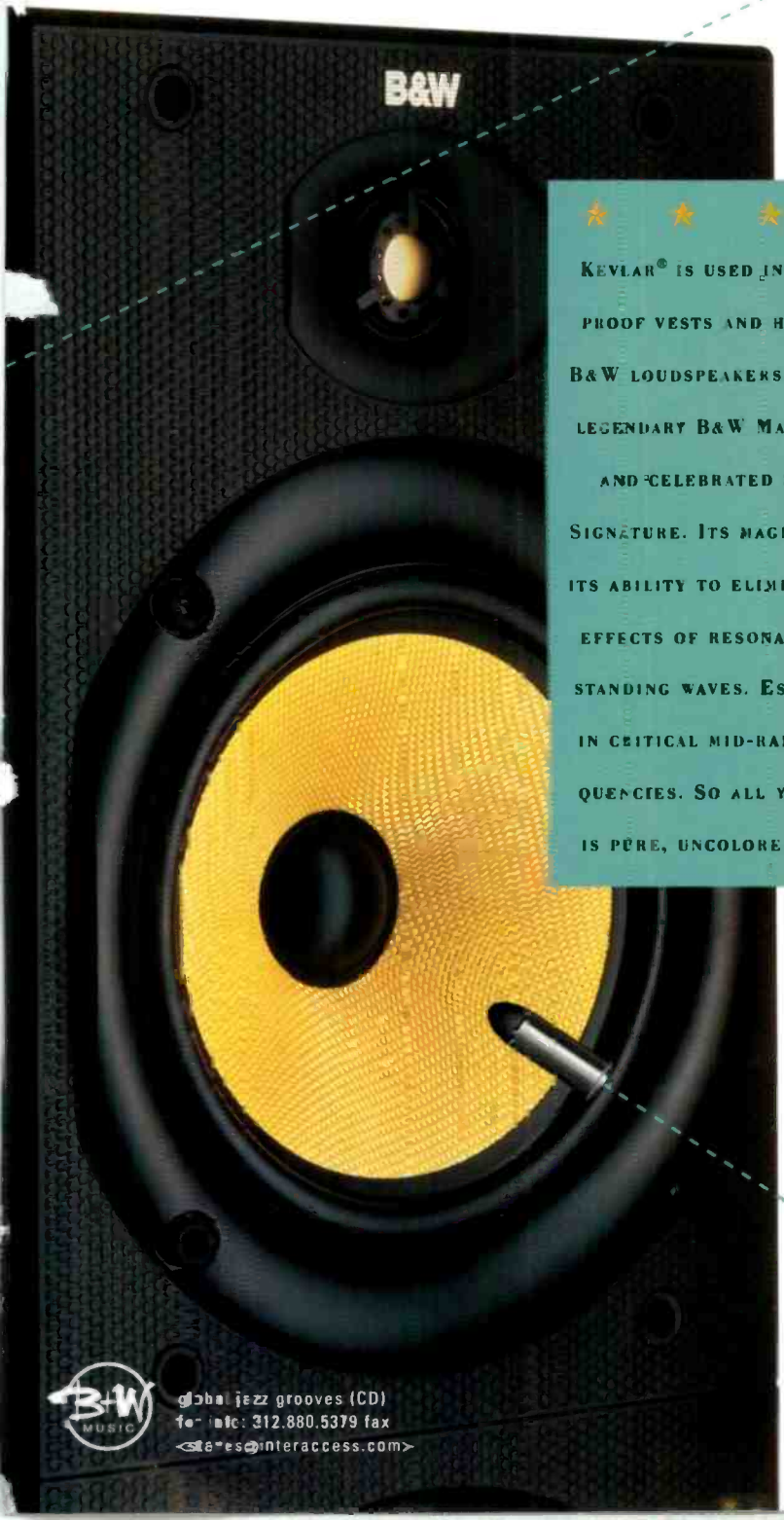
I have tested a number of isolation devices by applying mechanical impulses and measuring the results with an accelerometer connected to a digital storage oscilloscope and an FFT analyzer. I've found that conical feet, made of various materials, do affect the vibrational energy in both the time and frequency domains. They all cause a delay in energy transmission, but there are subtle differences between them. The Golden Sound DH cones do change the sound slightly; whether the sound is better or worse is a matter of subjective judgment. I suggest that you obtain return privileges if you buy them.

GRADE: C+

Edward M. Long

For literature, circle No. 122

A bullet-proof argument for the new B&W 600 Series.



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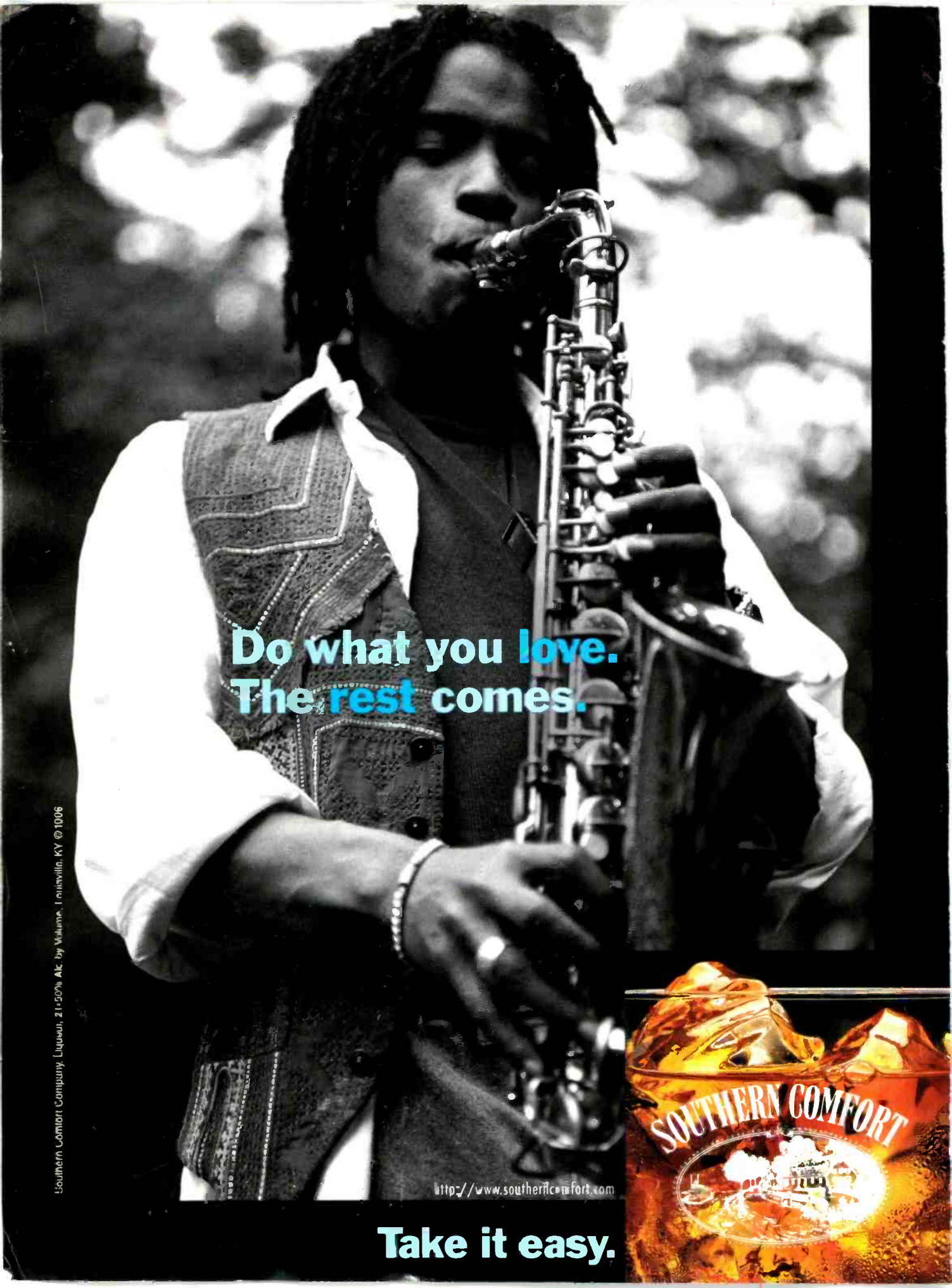
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