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NEW DIGITAL COMPACT DISC REVIEWS

SPECIAL SPEAKER ISSUE

Three Subwoofer Cabinet Projects

Summing Crossover for Low Distortion

TESTED

Digital Disc Pl[illegible]m Ky[illegible] M[illegible]

Au[illegible]ol R[illegible]ale

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CAMEL

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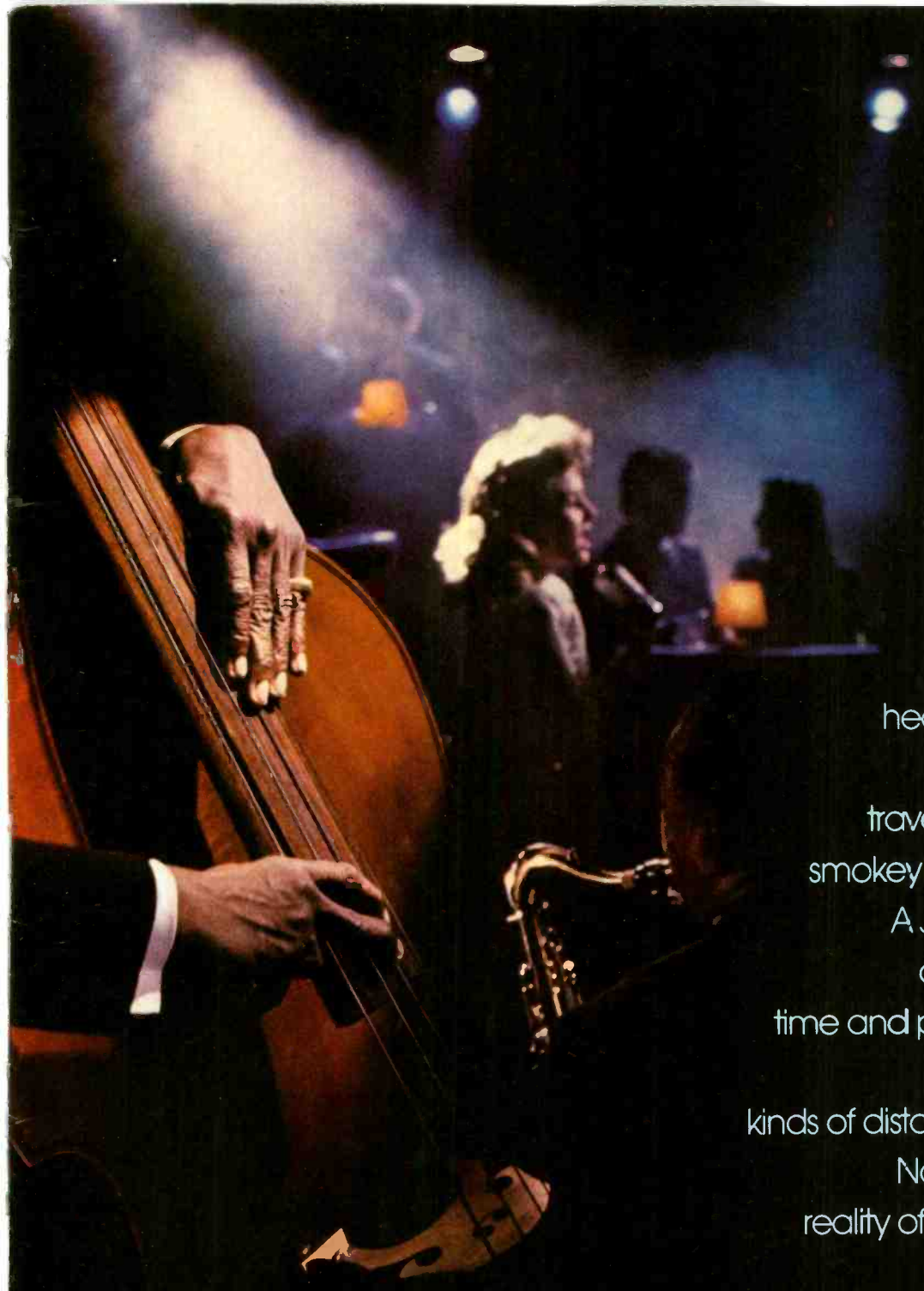

"That night
I was listening to
the bass player cook.
As his hands went
spidering up and down
the strings
his thum-thum-thum
became the group's
heartbeat – and mine too.
In my living room, I had
traveled once again to that
smokey little jazz club long ago."
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can take you to another
time and place, with components
that reduce six different
kinds of distortion down to inaudible.
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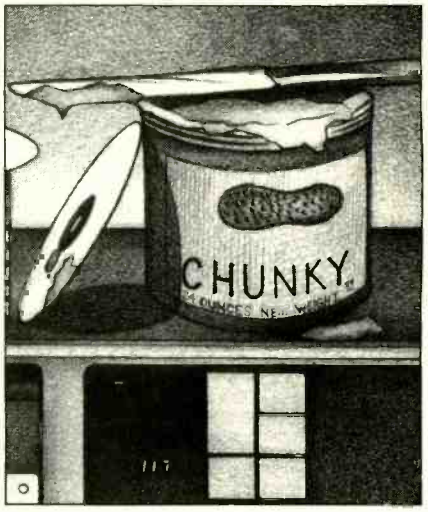
Audio

AUGUST 1983 VOL. 67, NO. 8

See page 25.

See page 20.

See page 47.



See page 12.

FEATURES

EQUIPMENT PROFILES

MUSIC REVIEWS

DEPARTMENTS

The Cover Equipment: Mitsubishi DP-101 and Kyocera DA-01 Compact Disc players.
The Cover Photographer: Vittorio Sartor.

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...and then came the SE-9.

35 years ago, to satisfy listening preferences, serious music lovers had to redesign their listening rooms. Remove the drapes. Add a rug here. Rearrange the upholstered sofa there. Get rid of that crystal chandelier!

Bass and treble tone controls came later, and they helped—but only a little. When you needed a boost in that lowest bass region, you had to accept boosted upper bass and mid-range tones as well—whether you needed them or not.

By 1958, the first equalizers appeared. They allowed you to alter specific bands of tones to suit the needs of the listening room—and the music program. With special mics, a pink noise generator, and a real-time analyzer, you could electronically adjust your system to your listening preference. If—that is—you didn't mind spending several thousand dollars and a half hour adjusting and readjusting controls to enjoy a half hour of listening.

Then came Sansui's remarkable SE-9 Compu-Equalizer. It takes the guesswork and the frustration out of equalization. At the touch of a button, the SE-9's built-in pink noise generator feeds its signals first to one speaker, then the other. Sounds picked up by the SE-9's calibrated microphone are then analyzed by its microprocessor. Sit back and watch in amazement, as the SE-9's motorized system moves each of its 16 fader controls (8 per channel) to create the curve that yields precisely flat response at your preferred listening location.

Touch another button, and the curve is memorized for future, instant recall. Move to another location—even another room—and the SE-9 can create and store a new curve—up to four of them.

At last, after 35 years, a perfect equalization system without errors or frustration. And, at a price that makes perfect equalization affordable for all serious music lovers.

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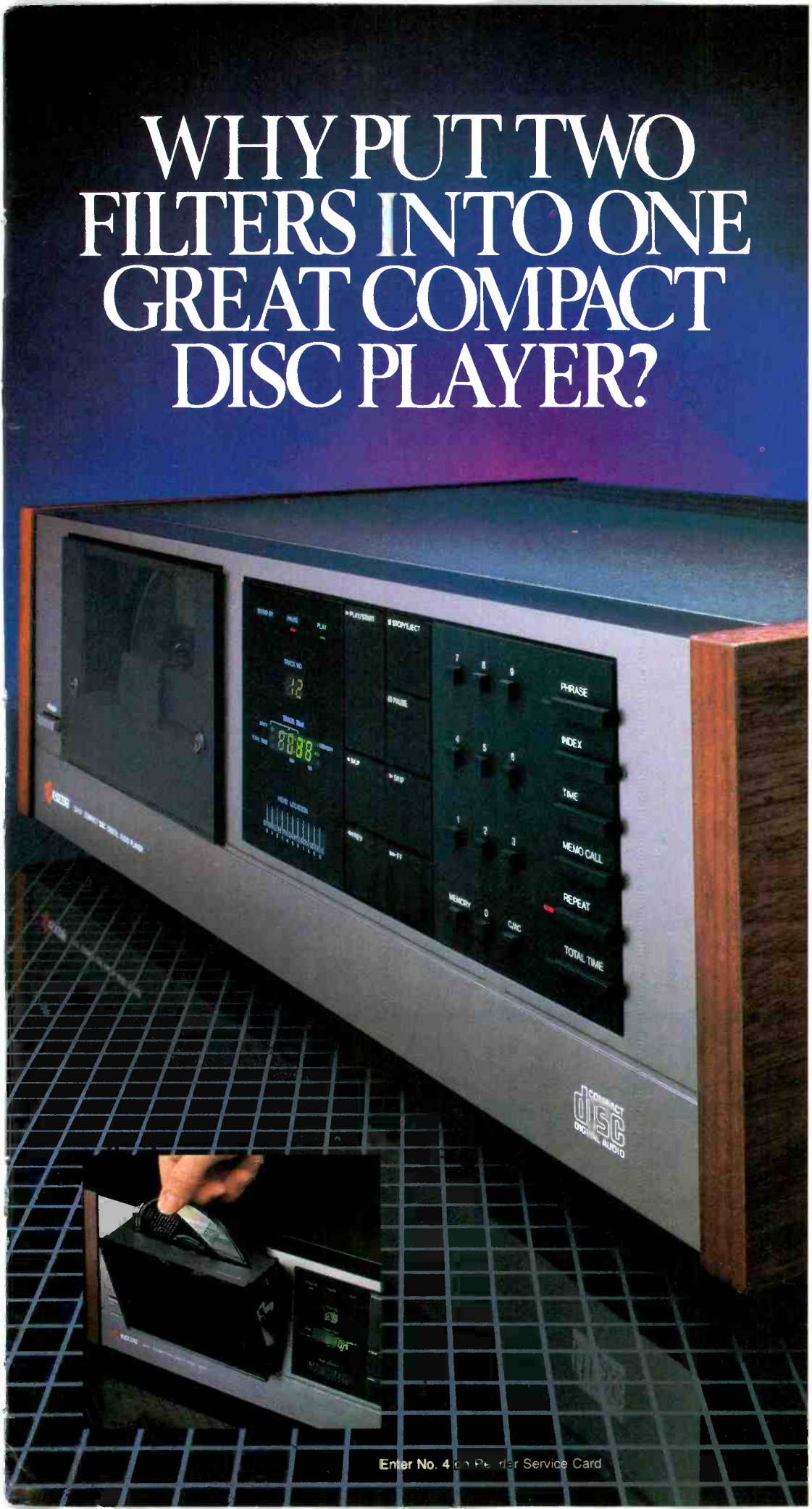
WHY PUT TWO FILTERS INTO ONE GREAT COMPACT DISC PLAYER?



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.

Admittedly, our DA-01's are carried only by selected dealers. If you have trouble finding one, contact: Kyocera International, Inc., 7 Powder Horn Drive, Warren, NJ 07060 (201) 560-0060.

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The result of all this is a car that responds precisely to hills, curves and straightaways because it responds precisely to its driver.

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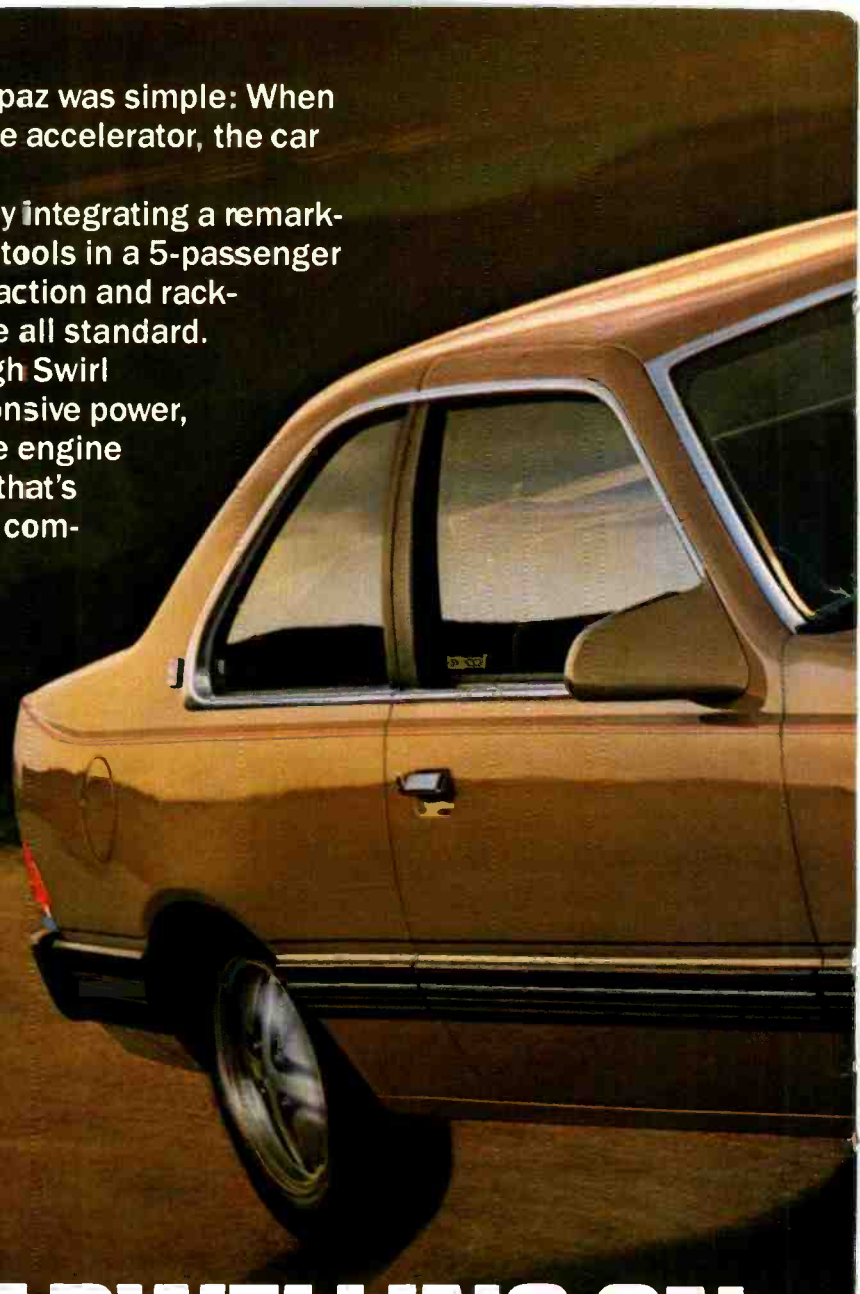


INSTEAD OF DWELLING ON HOW YOU'LL RESPOND TO IT, LET'S DISCUSS HOW IT RESPONDS TO YOU.

Get it together–buckle up.

1984 MERCURY TOPAZ

LINCOLN-MERCURY DIVISION

Ford

Mike Line

Dear Editor:

I would like to offer additional information to Bert Whyte's "Behind The Scenes" column in your March 1983 issue.

Bruel & Kjaer has recently introduced a completely new line of studio microphones. These microphones are a totally new design, from capsule to connector. They have no parts in common with the 4133 or any other B & K instrumentation microphone.

There are two acoustical designs available. One has characteristics very similar to the 4133. The other has a lower self-noise level because it has a slightly larger diaphragm. Both designs are available either for standard P48 phantom powering or for use with a special power supply which results in a transformerless system.

A complete description of these new studio microphones can be obtained from B & K Instruments, Inc., 185 Forest St., Marlborough, Mass. 01752.

John R. Bareham
Applications Engineer
Bruel & Kjaer Instruments
Marlborough, Mass.

Superbstation

Dear Editor:

I am writing in response to your February 1983 article, "WFMT: Satellite Superstation." I live in Snowmass Village, Colorado, a small town about eight miles away from the infamous Aspen, and receive cable TV through Canyon Cable. I am currently receiving WFMT via cable at 98.1 FM frequency. The sound is superb! In the stereo mode, which is the mode I constantly listen to WFMT, the cable quality is better than that of the local radio station, KSPN 97.7 FM. Of all the stations on the cable, WFMT is by far the best.

I was impressed with the coverage and inside story that Rich Warren and Daniel Queen presented in the article. In short, the story and the station are nothing short of superb.

Derrick DeCarlo
Snowmass, Colo.

Gleaming Insights

Dear Editor:

"WFMT: Satellite Superstation" by Richard Warren and Daniel Queen in the February issue of *Audio* provided an excellent insight into the engineering considerations that have gone into building one of the world's best fine-arts FM stations. There is much food for thought and also practical solutions to audio problems faced by any station attempting fine-arts programming.

We at Leaming Industries appreciate being noted as pioneers in stereo transmission by satellite. It should be noted that the original "deviation enhancement" system designed by Leaming Industries also delivered WFMT with a 68 dB signal-to-noise ratio, and did so on a completely linear (non-companded) system with both superior frequency response and lower distortion. This transmission system is still in use to transmit stereo TV audio for [cable networks] HTN Plus and Bravo!, as well as transmitting many stereo programs on thousands of miles of microwave systems, both here and in Canada.

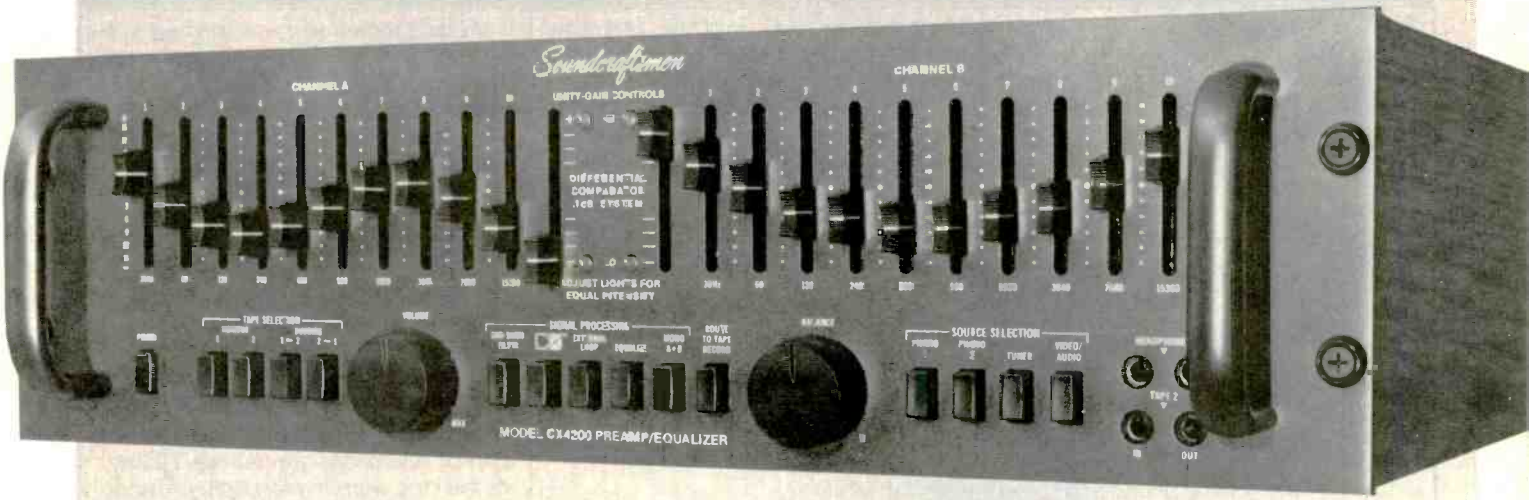
Unfortunately, the article failed to note that Leaming Industries also manufactures a stereo processor that can receive WFMT as well as the host of new radio services that now use the Wegener sliding de-emphasis "compansion" system.

Information on stereo and monaural programs transmitted on subcarriers above video on satellite transponders is difficult to come by. We have assembled a list of these programs that may be of interest to readers of *Audio*. There are new additions and changes of assignment taking place from time to time, mostly without prior announcement, so this list is based on the best information available at this time. It should also be noted that there are many subcarriers being transmitted that carry facsimile or data signals or even no signals at all, so this is not a list of all transmitted subcarriers, but only those of interest to *Audio* enthusiasts.

F. F. McClatchie
Marketing Agent
Leaming Industries
Costa Mesa, Cal.

Satellite	Transponder	Channel Frequency Left	Right	Format
F3	3	7.38	7.56	Bonneville Easy Listening Music
F3	3	5.94	6.12	Country Coast-to-Coast
F3	3	5.4	7.92	Moody—Religious
F3	3	7.695		Seeburg Lifestyle Music (Monaural)
F3	3	8.055	8.145	Stardust, Traditional M.O.R.
F3	3	5.58	5.76	Star Station, Contemporary Music
F3	3	6.3	6.48	WFMT, Fine-Arts Programming
F3	3	6.8		WGN-TV Audio (Mono)
F3	6	5.40	5.94	Music-in-the-Air, Country Western
F3	6	5.58	5.76	Music-in-the-Air, Broadway Hits
F3	6	7.695		Music-in-the-Air, Comedy (Mono)
F3	6	7.785		Music-in-the-Air, Big-Bands Hits (Mono)
F3	6	6.435		Music-in-the-Air, '50s/'60s Hits (Mono)
F3	6	6.8		WTBS TV Audio (Mono)
F3	16	6.8		HTN Plus Stereo TV Audio (Multiplex Process)
F4	3	7.695		Georgia Radio News Service (Mono)
F4	3	6.435		Music-in-the-Air, Nationality Broadcasting (Mono)
F4	3	7.38	7.56	Music-in-the-Air, Rock-A-Robics
F4	3	5.40	6.30	Music-in-the-Air, Rhythm & Blues
F4	7	5.58	5.76	Family Radio, East Feed
F4	7	5.94	6.12	Family Radio, West Feed
F4	7	7.38	7.56	Sheridan, News & Sports
F4	17	5.58	5.76	Satellite Jazz Network
F4	6	5.8		Bravo! Stereo TV Audio (Multiplex Process)

The World's MOST VERSATILE Stereo Preamplifier



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THE SIGNAL-PROCESSOR PATCH BAY: Allows you to use any combination of Sub-Sonic Filter, **CX** Decoding, Equalizer, Mono A&B and any External Signal Processor, either for listening or tape recording, by simply pushing buttons—no cable switching!

THE EQUALIZER: Probably the finest octave-band equalizer available, due to the employment of Precision Wire-Wound Inductors in the octave-filter circuits, instead of ordinary IC "chips." The result is greater gain, lowest possible noise and distortion and completely neutral sonic qualities. Only Soundcraftsmen Equalizers feature the exclusive **Differential/Comparator®** circuit which allows you to instantly adjust the Equalizer for Maximum "Headroom" so necessary with **CX**, dbx, Digital and Dolby-encoded recordings—regardless of the EQ curve selected! This adjustment is accurate to a phenomenal **0.1 dB** readout and employs balancing LED's for visual verification.

THE CX4200 has been called **"The Ultimate Preamp,"** yet it is a superb value at only **$699.**
Other Soundcraftsmen Preamps with similar features and performance start at **$419.**

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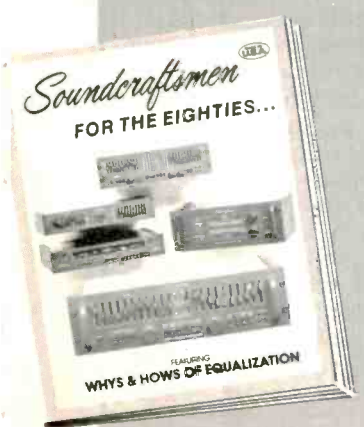

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"I contend that the sound of music is also dependent upon harmonic content, etc., calling for frequency responses way above 20 kHz."

Shy on Samples

Dear Editor:

I was interested to read Leonard Feldman's test report on the new Sony compact digital disc player (*Audio*, November 1982) and noted his enthusiasm for the concept. There is no doubt that there is a requirement for a system to relieve us of the problems associated with record handling, dust and static pops and all the other drawbacks of the present LP disc. In years to come, people will be amazed at the quality which was achieved with what in effect is a mechanically coupled system (stylus riding in a groove).

My disappointment with the new system lies, however, with the low sampling rate of 44 kHz. For speech telecommunications, the accepted sampling rate is twice that of the highest frequency, i.e., in a speech telephone channel of 200 to 3,400 Hz, the sampling rate of 8,000 Hz gives satisfactory speech reproduction.

However, music is not speech. Agreed, few people can hear as high as 20 kHz (half the compact digital disc's sampling rate), but I contend that the *sound* of music is also dependent upon harmonic content, transients and rise-times calling for frequency responses way above 20 kHz. My feelings were reinforced by hearing a radio interview with a well-known conductor who said the low frequencies of the new discs are radically improved "but they still haven't got the higher frequencies right."

There is no doubt the lower frequencies are considerably improved; bass drums now have a tonal quality and no longer just a "boom." A frequency of 20 Hz or so, which can be difficult to reproduce on a master tape, can be perfectly reproduced when sampled at the 44-kHz rate, but the transient of a cymbal or the harmonics of a violin cannot be accurately reproduced by encoding the amplitude of just two or three samples of its waveform. I would like to see a sampling rate closer to 100 kHz adopted before the system becomes too standardized.

In conclusion, I would like to add how much I enjoy *Audio*, and have done so for many years. Keep up the good work!

Keith L. Robinson
Mt. Royal, Quebec
Canada

Editor's Note: Readers should note that the upper limit of human hearing is the upper limit, whether we are talking about primaries or harmonics. Now if Mr. Robinson is saying that digital recording does not properly handle the range where normally only harmonics exist because of too low a sampling frequency, then he has a very strong argument, one where the jury is still out. However, the sampling frequency has been standardized, at 44.1 kHz, and it is just such standardization which allowed disc and player makers to bring the system to market.—*E.P.*

AUDIOPHILE FILE™ XL-S

GREATER DYNAMIC RANGE

Maxell XL I-S and XL II-S are the ultimate ferric oxide cassette tapes. Precision engineered to bring you a significant improvement in dynamic range.

XL I-S provides exceptionally smooth linear performance characteristics with high resolution of sound and lower distortion.

While XL II-S has a greater saturation resistance in higher frequencies resulting in an excellent signal to noise ratio.

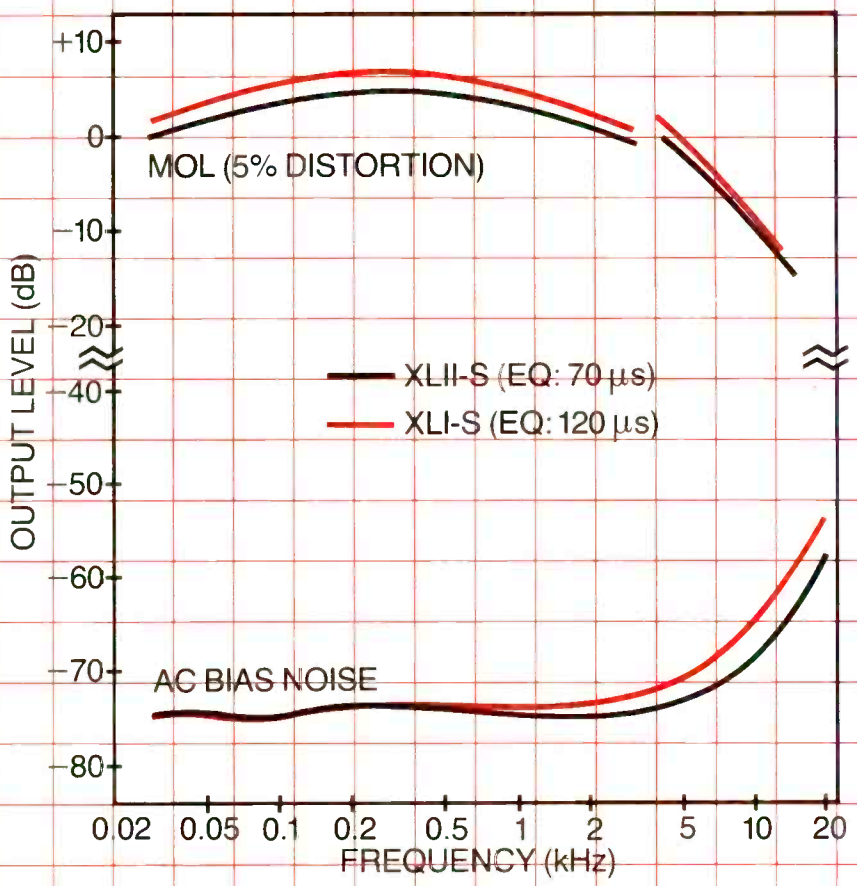
How did we achieve this?

IMPROVED EPITAXIAL PARTICLES.

Maxell engineers have managed to improve the Epitaxial magnetic particles used on both tapes.

By developing a crystallization process that produces a more compact, smoother cobalt ferrite layer on the gamma ferric oxide core, they've been able to pack the particles more densely and with greater uniformity on the tape surface.

This increases maximum output level and reduces AC bias noise which in turn expands the dynamic range.



So you get a better signal to noise ratio, greater resolution of sound and higher output levels.

Of course, greater dynamic range isn't the only reason to buy Maxell high bias XL II-S or our normal bias equivalent XL I-S.

Both tapes have more precise tape travel and greatly reduced distortion levels.

You'll see both these improvements covered in detail in future Audiophile Files. In the meantime, we suggest you listen to them.

For technical specification sheets on the XL-S series, write to:

Audiophile File, Maxell Corporation of America, 60 Oxford Drive, Moonachie, New Jersey 07074.

IMPROVED EPITAXIAL PARTICLE CHARACTERISTICS:

MORE UNIFORM COBALT-FERRITE LAYER | SMOOTHER PARTICLE SURFACE

GAMMA-FERRIC OXIDE | 470A

COATING THICKNESS: 10-11A (1A = 1/10,000,000 mm)

IT'S WORTH IT.

BERT WHYTE

TAKING CD IN STRIDENT

Illustration: Robert Jordan

Contrary to the expectations of many nay-sayers, the Compact Disc players and discs have been accorded an enthusiastic reception by consumers. As a consequence, both are in short supply. However, that may soon improve here: *Billboard* recently quoted Hans Gout, senior CD director at Polygram, as considering it an "overriding priority" that the Compact Disc substantially penetrate the U.S. market.

Even though the software shortage is particularly acute, enough discs have come to hand to demonstrate that although there is much to admire, many of them have sonic anomalies which are very off-putting. I refer most especially to the shrill and strident sound of the first and second violins in classical recordings. In my CD reviews, which first appeared last issue, I made particular note of this problem. I took pains to point out that the objectionable sound is not an inherent fault in digital recording, but rather a consequence of close multi-miking techniques and the use of microphones which many feel have an overbright, "tizzy," high-frequency response. In the past, the bright top end of these microphones may have been attenuated by the processing loss and noise masking of analog recording. In digital recording no such losses occur, and therefore any sonic imperfections are starkly revealed.

Apparently, many of those who bought CD players and discs have discovered the problem of the strident strings and other sonic aberrations. Miraculously, the negative comments of these people seem to have reached the right ears. The following excerpts are from an article by Jim Sampson which appeared in a recent issue of *Billboard*: "The superior sound quality of the Compact Disc is leading to changes in recording technology, away from a dry studio acoustic and from elaborate multi-miking. That's the opinion of Dr. Andrew Holschneider, president of Deutsche Grammophon Productions. . .

"Several critics felt the digital sound of the Berlin Philharmonic in large orchestral works was 'harshly' brilliant. And the English Concert Compact Disc of Vivaldi's 'Four Seasons' features very bright string tone and 'background street noise.'

". . . As producer of The English Concert on DG/Archiv, Holschneider agrees that the CD medium demands new technical standards: 'It is a real challenge and we're learning. . . .'

"The choice of a hall has become much more critical, he says. 'It cannot have too dry an acoustic, because the CD sound is itself clearer.' And Holschneider will reconsider locations poorly isolated from the outside, such as London's Kingsway Hall or Henry Wood Hall, where his 'Four Seasons' was recorded.

"The multi-microphone techniques of the 1970s might soon be replaced by the twin-mike sound of the 1950s. Says Holschneider: 'A recording technology which tries to reproduce the music as simply and naturally as possible is the best.' He points to Gunther Breest's two-mike production of Verdi's 'Falstaff' under Giulini [conductor of the Los Angeles Philharmonic] as a good example."

Well, Hallelujah! That certainly is a step in the right direction, although even if only two microphones are employed for a recording, the use of the offending overbright microphone is to be avoided. Depending upon the acoustics of the recording hall, the engineers can use quite a number of two-microphone configurations such as the Blumlein coincident crossed figure-of-eights or the M/S (middle-side) with a forward-facing cardioid and the lobes of a figure-of-eight mike facing left and right.

The same story in *Billboard* states that "perhaps the most frequently heard critical complaint so far is the marketing of analog recordings as 'digital audio.' Indeed, the first mass-produced CD from PolyGram's Hanover plant last August was Claudio Arrau's analog Philips recording of the Chopin waltzes. Nowhere in the packaging is the recording's non-digital ancestry acknowledged.

"At DG Productions, however, there is a clear policy that, for the present, all CDs will come from digital masters. Holschneider says he expects that analog-mastered repertoire will appear on the yellow label sometime in the future, but not as part of the first year's releases."

Some English critics seem particularly annoyed with the mislabelling or non-labelling of recording origin on CDs. Some Japanese CDs have been made from analog recordings. I don't think this is necessarily reprehensible if the recording is of high quality. In fact, it would be extremely stupid to ignore the riches of analog recordings in the vaults of the record companies. Consider the fact that Dolby A noise reduc-

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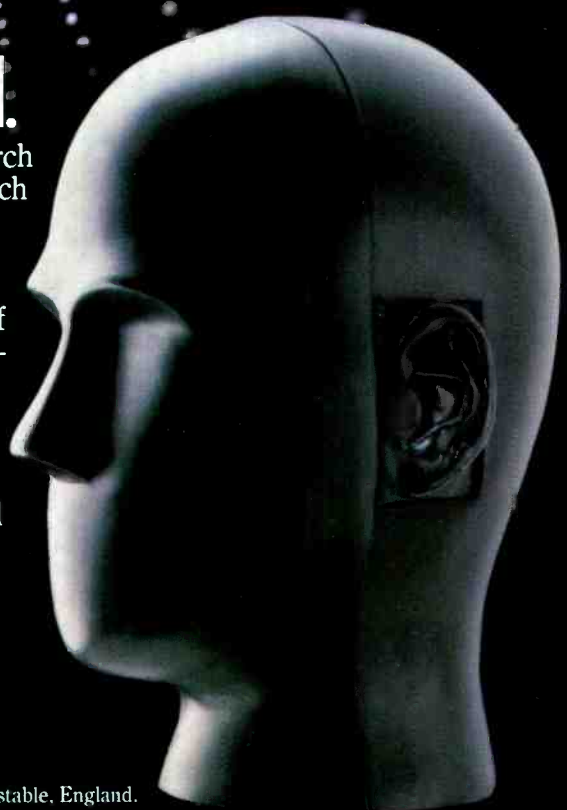
Introducing the finest listening instruments Acoustic Research has ever built. The AR9LS and 98LS. Two speakers that reach such shimmering highs and thundering lows they evoke a new experience in high fidelity. An intensified sonic experience in which listener, living space and speakers form an integrated relationship. Where optimum sound is achieved within the natural acoustics of the living space—not just in a scientific test chamber. This experience we call Space-contoured Sound.

To contour sound to human living spaces, both the 9LS and 98LS feature a revolutionary driver. A Dual Dome™ mid-high-range configuration that eliminates crossover interference and achieves totally coherent dispersion. In the 9LS, we've introduced a down-firing woofer coupled with a Bass Contour Chamber. When you hear it, you'll know why Acoustic Research is more than our name.



AR Hear what you've been missing.

TELEDYNE ACOUSTIC RESEARCH 10 American Drive, Norwood, MA 02062, USA. Dunstable, England.

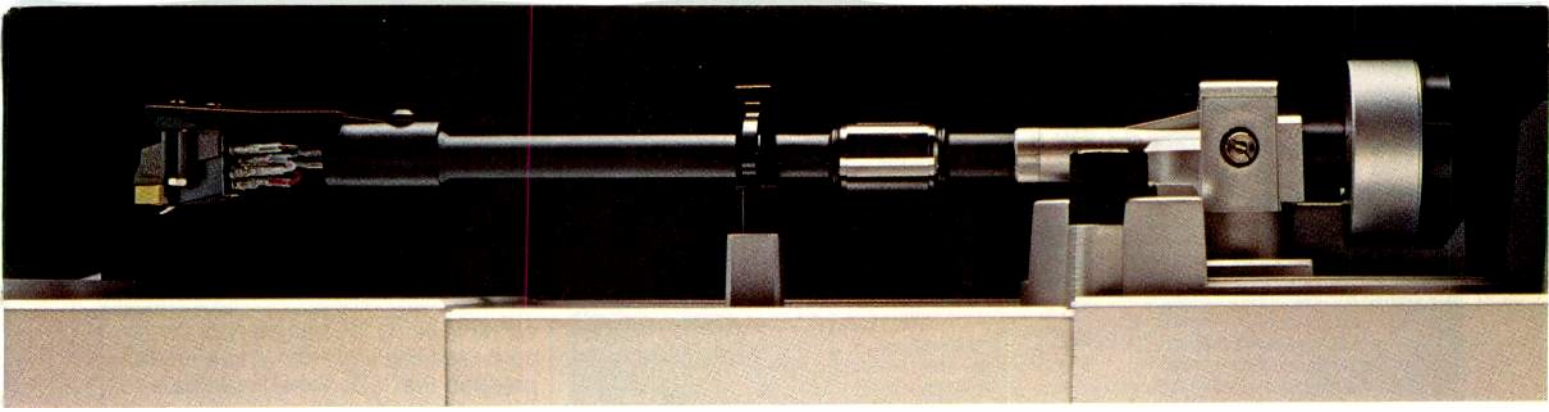
"It's not reprehensible to make CDs from analog recordings of high quality. It would be stupid to ignore the riches of analog in the record-company vaults."

tion has been in general use for over 15 years. Given the various tape oxide formulations over these years and the technology of analog tape recorders, the average signal-to-noise ratio on the master recordings should be around 70 dB, and a bit higher in more recent years. If the original tape master is used—not the cutting master (which quite often has undergone various forms of signal processing, so the original sound quality may be degraded)—it will transfer very nicely to a CD. With a 70 to 72 dB S/N, noise will not be totally inaudible, but it will be very quiet indeed. Imagine what this could mean: There would be no degradation, no transfer or incremental noise, no increase in distortion, and a wow and flutter specification equal to the original. You could get one of your favorite recordings in what would be tantamount to having the master recording itself! You would hear that favorite recording with no ticks, snap, crackle or pops. Further, with the non-contact caress of the laser beam playback, the CD will remain in master tape condition forever!

There is a veritable treasure trove of analog recordings which are great performances and sonic masterpieces. A smart, forward-looking record company will put a good classical A & R man to work, mining their vaults for outstanding analog recordings suitable for transfer to digital disc. When I think of the glorious music tucked away in the vaults of EMI, Decca, Deutsche Grammophon, Philips, et al., my mouth waters!

[*Editor's Note:* Analog masters are, in fact, less likely to sound overly bright on CD than are digital masters made with analog mike techniques. And it might be possible to make two-hour transfers from treasured monophonic performances.—*I.B.*]

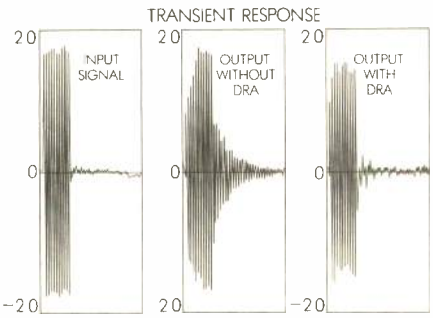
One thing I have noticed with various CD recordings is that, under the instructions for cleaning digital discs, each company seems to have its own idea of how this should be done. Most warn against the use of solvents such as benzine, gasoline, carbon tetrachloride, etc. Some warn against the use of any liquid. Yet others tell you to use ethyl alcohol or warm, soapy water! Most seem to agree on one point: The discs should be cleaned from the



HERE'S A TECHNOLOGY STORY THAT'S TRULY ABSORBING.

Every story has a protagonist and an antagonist. And this one's no different.

The hero, in this case, is an unassuming, little technological breakthrough from Pioneer called the Dynamic Resonance Absorber™ (DRA).



And the arch-villain, the ever-present Resonant Tonearm Vibration.

What the Dynamic Resonance Absorber does, to make a long story short, is to absorb the resonant frequency of the tonearms on all of our new turntables.

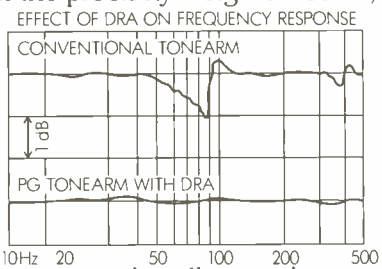
Thereby eliminating distortion which causes music to lose clarity and accuracy of reproduction.

As if this weren't thrilling enough, there's also an exciting subplot. The DRA eliminates acoustic feedback that results when the turntable is too close to speakers played at high volume.

How the Dynamic Resonance Absorber causes all this to happen is actually quite simple, as most acts of genius usually are.

The DRA is composed of a damper made of extremely dense butyl rubber enclosed in a weighted collar on the tonearm.

Working within the precisely weighted collar, the butyl rubber acts just like a spring. When the pipe of the Polymer Graphite™ (PG) tonearm vibrates, the "spring" compresses and simultaneously soaks up vibrations.



That's why Pioneer can virtually promise that muddy reproduction is an out-of-date story. And why transient response is far more accurate. In fact, as you can see on the chart, the cartridge output (with DRA) closely resembles the original input.

Furthermore, frequency response, as you can also see, is tremendously flat.

But, while the Dynamic Resonance Absorber is a real blockbuster, it's not the only story here.

Every Pioneer turntable also features a Stable Hanging Rotor™ that improves stability by reducing friction which decreases wow and flutter.

A zero-clearance dust cover allows you to place the turntable flush against a wall, yet still open it all the way.

And another convenience item: all controls are located outside the dust cover.

In addition, the PL-S70 (shown here) has two other ease-of-operation features: an automatic disc size selector (ADSS) and auto repeat function.

Naturally, you'll want to audition each new Pioneer turntable with Dynamic Resonance Absorber at your earliest convenience.

If only to convince yourself that this story falls in the non-fiction, not the science-fiction category.

PIONEER®

Because the music matters.

"I've seen a CD gunked with peanut butter, then washed with a mild detergent, and another slashed with a penknife. Both played back flawlessly."

center towards the periphery of the record. You say you were under the impression that CDs were impervious to dust, dirt, fingerprints, and scratches? Well, I've seen a CD actually gunked with peanut butter, then washed with a mild detergent, and it played back flawlessly. I've also seen a CD slashed with a penknife, and it also played back with nary a pop or click! In spite of this apparent immunity to such mistreatment, most companies urge, quite properly, that a CD be accorded the same care and respect as analog LPs. Believe it or not, I have only encountered two CDs with glitches, and I followed directions to blow on the disc and wipe off the condensation with a soft cloth (not in a circular motion, but across the disc's surface from the center outwards). It worked. The glitches disappeared, and several friends who have tried it report similar success. One absolutely cast-in-concrete piece of advice in the handling of CDs is that they must never be subjected to heat or anything else that could cause warpage. With a warped CD, the laser beam can be de-focused and render the disc unplayable.

As far as most people are concerned, digital discs are strictly a playback-only medium. Some of you may have heard vague rumors that one day there might be a *recordable* digital disc. Well, it is not going to show up at your friendly local hi-fi dealer any time soon, but early research has actually taken place. As you might expect, some research was undertaken by Philips in Eindhoven, Holland, as well as by 3M in the U.S. and by Panasonic's parent, Matsushita, in Japan. In very simplistic terms, the Philips technique is a thermomagnetic process on a pre-grooved disc, with a track spacing of 1.7 microns. Amorphous layers of a special alloy are vacuum-deposited on the grooves, and cutting is accomplished with a laser essentially the same as that used in the CD player. Sufficient density and S/N ratio have been achieved to permit 30 minutes of music recorded on one side of the 12-cm disc. The same laser plays back the recording, and with only slight modification, the experimental recorder can play back normal CDs. A great idea, but where will the high-quality source material come from?

What the world's most critical listeners think of JBL is a matter of public record.

To capture the excitement, intensity, and creativity of today's popular music, recording engineers use some of audio's most sophisticated equipment. From computerized mixing consoles to advanced digital recording systems. And to get the most out of these components, recording professionals rely on equally advanced monitor loudspeakers—JBL.

In fact, a recent Billboard magazine survey revealed that over 66% of the major recording studios in the U.S. use JBL speakers. But that's only part of the story. Because, of the top 25 albums recorded in 1981, 22 were mixed or mastered in studios equipped with JBLs.*

So if you'd like to hear your music the way it was meant to be heard, visit the audio specialists at your local JBL dealer. JBL loudspeakers are available at selected AAFES-Europe Sound Centers and other (military or audio) retail outlets.

And now for studio quality sound in your car, JBL introduces its new line of automotive loudspeakers.

*Equipment information compiled from *The Mix* and *Billboard* directories and phone surveys.

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Amazing but true! You can win the incredible Nakamichi Mobile Sound System gift wrapped in a 1983 BMW 318i! Just drop into your nearest Nakamichi Mobile Sound dealer and fill out an entry form. That's all there is to it! But bring your favorite cassettes along. This system will amaze you! It's unlike *any* other mobile-sound system ever created.

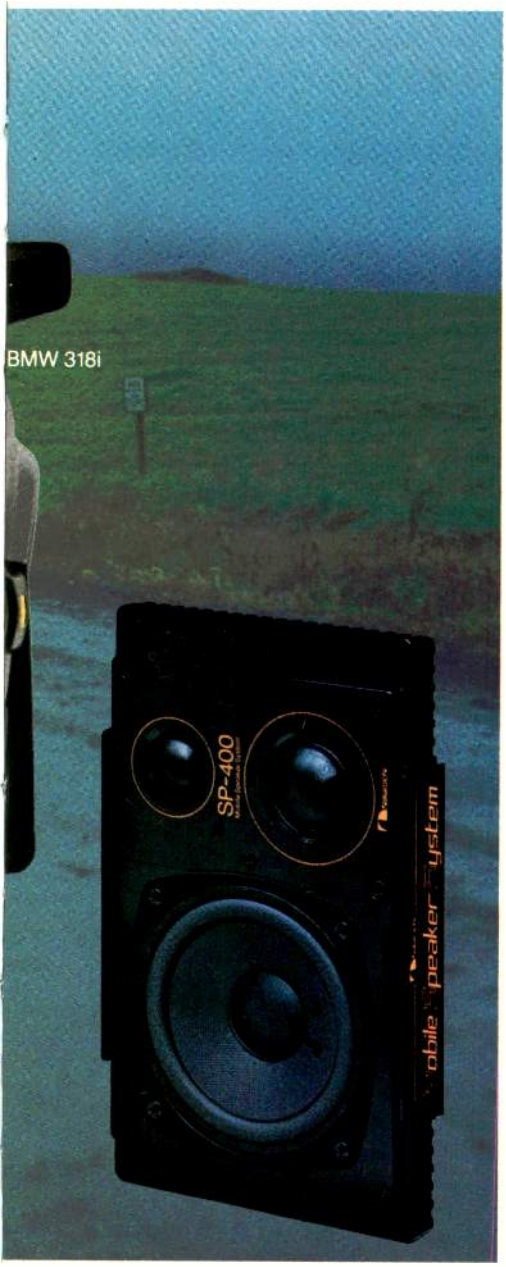
Only the TD-1200 Mobile Tuner/Cassette Deck has NAAC—the unique Nakamichi Auto Azimuth Correction system that automatically aligns the playback head in *each* direction to extract the last iota of performance. Only the TD-1200 senses when the music has stopped and fast winds to the end of tape for quick reversal. Only the TD-1200 is powered by the unique Nakamichi SLT motor that virtually eliminates wow and flutter. And, the TD-1200 gives you a choice of EQ and Dolby* B or C noise reduction to accommodate the many tapes in your collection.

That's not all. Tone controls are specifically designed to compensate for *automobile* acoustics, and the TD-1200's 10-preset quartz-PLL synthesized FM/AM tuner has the pulling power, selectivity, and immunity to multipath that you *need* on the road.

The PA-300 Mobile Power Amplifier is incredible—70 watts per channel continuous power, with a dynamic range of more than 115 dB and distortion under 0.003%! Matched with the Nakamichi SP-400 3-way Mobile Speaker System, the TD-1200 and PA-300 bring home music fidelity to the road!

The Nakamichi Mobile Sound System—it not only *rivals* the finest home equipment, it *outperforms* most of it!

Nakamichi



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First Prize
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SOUND DISTRIBUTORS: Huntsville

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SHIMEK'S: Anchorage
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Arizona
CLASSIC CAR SOUNDS: Tucson
JERRY'S AUDIO EXCHANGE: Phoenix

Arkansas
CUSTOM AUDIO: Little Rock, North Little Rock

California
ANDY'S AUTO RADIO: Sherman Oaks
AUDIO VISION: Santa Barbara
BEVERLY ELECTRONICS: Los Angeles
BEVERLY HILLS AUTO RADIO: Los Angeles
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HOUSE OF NATURAL SOUND: Monterey Park
JONAS MILLER SOUND: Santa Monica
KAR TUNES: Seaside
KUSTOM HI FI: Burlingame
MARIN AUTO STEREO & ALARM: San Rafael
MESATRONICS: Costa Mesa
MONTEREY STEREO: Monterey
PAN AUTO SOUNDS OF SAN MATEO: San Mateo
PARIS AUDIO: Los Angeles
PETER'S AUTO RADIO: San Francisco
THE RADIOMAN: San Diego
REUS AUTOSOUND: Villa Park
SOUND COMPANY: San Diego
SOUND FACTOR: North Hollywood, Encino
SOUND ON WHEELS: Glendale
SOUND STATION: Northridge
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TALKING MACHINES: Providence

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AUDIO CONCEPT: Austin
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ONE IF BY LAND, TWO IF BY CD

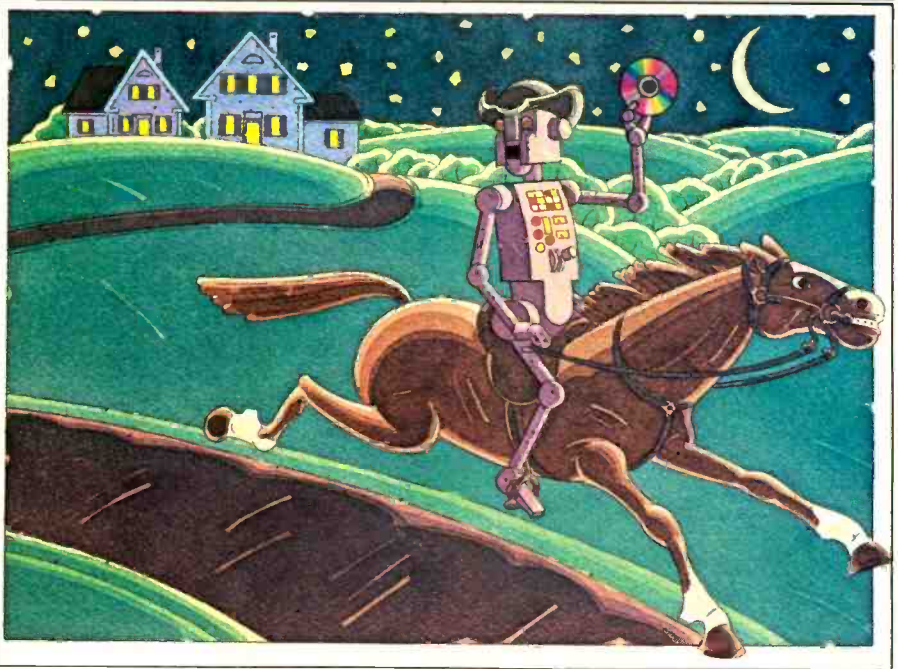

Illustration: Philip Anderson

It's about time now for some direct thoughts in this space on that absolutely remarkable phenomenon, the CD. No—*not* the Certificate of Deposit! I mean the Compact Disc, so named originally by Philips to parallel the Compact Cassette.

The CD is, well, *almost* here. Though not yet quite in a practical way, so you can go out and buy it in any old place where you happen to live. But the noise of its coming, like Paul Revere's warning about the British, is overwhelming. You will find descriptions and tests in the most exquisite detail in every mag around, including this one. Still, I find it hard to believe. At last, the New Technology in its total audio fulfillment! Almost too much to grasp.

Actually, I haven't heard a CD in the flesh, myself, since the new system was first announced more than four years ago. *Four years?* You thought it was the latest? Not exactly. I was at the premier demo, way back then, and I was instantly bowled over. Astounding, no less. Thereafter I have considered the matter closed, from the technical viewpoint. You couldn't buy a CD, after all, nor any player to play it on, so why bother. Leave the CD to the experts, and that's where it has been. It was testing-testing time.

I find myself perversely practical-minded in this respect. Interest soars in my breast on two occasions: (a) The launching of some really radical new product idea and (b) the concrete embodiments of same. There is apt to be a large gap between these, and sometimes, alas, it extends to infinity. Nice idea, but . . . Remember the bird in the hand? Well, the bushes around here are increasingly full of *discus compactus* lately, and a handful—soon maybe a flood?—are actually visible and audible. The time has come! On my graph of response you may now see that second peak rising. After four years, plus or minus flat.

Great promise, even greater promises—*what now?* Let us look at the ball-point pen. We *always* look at the ball-point pen when something revolutionary starts going practical.

On October 29, 1945, only weeks after the end of the Big War, the pen was launched for all & sundry at Gimbel's in New York. At a price that made us gasp, as I can easily remember. I did a bit of calculating: In our little dollars I figure it came to maybe 80 or 100 bucks for each and every pen. That's exactly the way it felt. And yet at the end of the very first day, some 10,000 pens had been sold. No time wasted on promises; it was bang-bang, launch it, sell it. To be sure, the ball point had an advantage over our CD—it created its own softw—er, softgear.

Then, the aftermath. I don't remember, speaking of price, whether the ball-point pen actually got down to the 1¢ level, but it came awfully close. Five cents apiece? It remains bottom cheap today, right in with the old lead pencil, and those early thousands have become many millions. Price? Does it matter?

Is this to be the approximate shape, in proportion, for the CD's coming future? Is it to move from the top towards the bottom of the market, mushrooming in reverse, hundreds into millions? *Is it technically capable of it?* A potent question, but at this point not easy to answer. Surely it will replace, eventually, ALL analog discs now on the market, but with what? Wholly new formats, more than likely. Keep in mind the transistor radio, the pocket calculator; look at the digital watch—month, date, hours, minutes, seconds, special price $3.93. (That's from an actual ad.) For a few more dollars, stopwatches, games, weather reports, the works. The CD system looks dreadfully complex and expensive right now, and costs it. But who knows? Remember the room-size ENIAC—and Be Prepared. Can we even begin to imagine what the CD may do in its fullest development? It's our first wholly modern disc (not counting the floppy sort), and it's a natural—unimaginably able.

Just remember that the original disc, back before 1900, had in its way this same sort of potential and has had it ever since. Low cost and wide diversity, through its inherent ease of mass production. Emile Berliner, whose idea it was, knew perfectly well that the cylinder sounded better, but it was inherently unadaptable, clumsy in mass production even with much ingenuity. The disc was a better bet, and so it happened. It isn't far-fetched to suppose that the CD developers have that sort of future-aptitude in mind, for all the complications of the system.

Right now, the only thing that is factually positive about the CD is its emerging hardware, first-generation. It's being tested—you've been reading about it for months. It is all it ever was supposed to be (four years ago) and more. Nor is there the slightest doubt about the absolutely enormous technical gap between this all-digital (up to

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"Is this CD to be mainly an audiophile device for a while, restricted to the upper crust? And if so, how thick a crust?"

the final D/A element) system and the once state-of-the-art LP and 45. No need for argument! Granted. So let's start moving on.

We're still talking performance. That's the beginning, but we are past the beginning. Now it is: What will it play, where will it fit, what will it replace, and, more important, what will it NOT replace? What new areas will it create, at least for starters? Is this CD to be mainly an audiophile device for a good while, restricted to the upper crust? And if so, how thick a crust? Or will it swallow the whole pie, deep-dish included? Phew, that's a lot of questions and you won't find many answers to them yet.

Needless to say, we'll be keeping tabs here on player and disc performance via ongoing tests. Unless by some unlikely chance the CD just disappears. But indeed it is time for additional thoughts and speculations. It's a wide open field. Your guess might be as good (or bad) as mine—or even that of the CD promoters'.

Hey, how about price? Well, you know, prices don't matter much. Prices will take care of themselves, thank you, as other things get sorted out. That's not a thought for slim pocketbooks and wallets, I know. But it is a fact of life that has been digging into my brain these last years. The relation between price and quality doesn't go up and down like the two ends of a seesaw, as we've always thought. (You pays your money and . . .) Not any more. Instead, there is a sort of Index, or Quotient, Price/Quality, which, more and more, seems to come last of all, the result of many other determinants. Crazy, but true. Price itself isn't really important. (Except in your business account books.)

Can we even begin to look ahead? Well, at *any* price, I do not envision, for instance, a Walkman-type CD player for joggers, bikers, et al. (Though there is, oddly, such a player now on sale for analog standard discs.) For this, the cassette is inherently more natural—and how about a digital cassette? On the other hand, I do see a CD car player, even an expensive one, that being reputedly a reason for the CD's somewhat arbitrary size, 4½ inches. It would work okay—no skipping. And we tend to splurge cash on car audio, so why not expensive? After Bose and Delco (and Nakamichi . . .), can CD be far behind? Where Chrysler's car disc failed (way back), the CD should make it fine. Maybe.

Am I implying that the ball-point pen might have generated about the same amount of business at either $1.00 or 1¢? Yes, I suppose that is what's in the back of my mind. Price is a very flighty thing these days.

A first factor in any product success, you see, is what is best called natural aptitude. Like athletes, like artists, products seem to have inherent natural abilities, you could almost say talents. As well as inherent areas of, shall I say, reluctance. They go along but aren't entirely happy. Ahead of time, though we often deliberately engineer for talent, we can't be sure. We aim to exploit the talents, whether they are what we intended or purely unexpected. But we often end up working with the reluctant areas instead, and with a lot of success, even when older talents no longer seem to match newer conditions. The LP, as I've often pointed out, is not really apt for our present automated controls; it was and is basically a manual-type disc. Yes, it works okay with present equipment, thanks to much ingenuity, but it remains clumsy. The CD in this respect is going to be another story—it is a natural for automation. It will fly where the LP crawls! The LP wasn't at all apt for four channels, either, as we sadly discovered. The LP almost made it, the Tate II did, but too late. Again, all that sort of thing is effortlessly taken care of, when desirable, by the CD digital approach. Extra channels right now, not even being used.

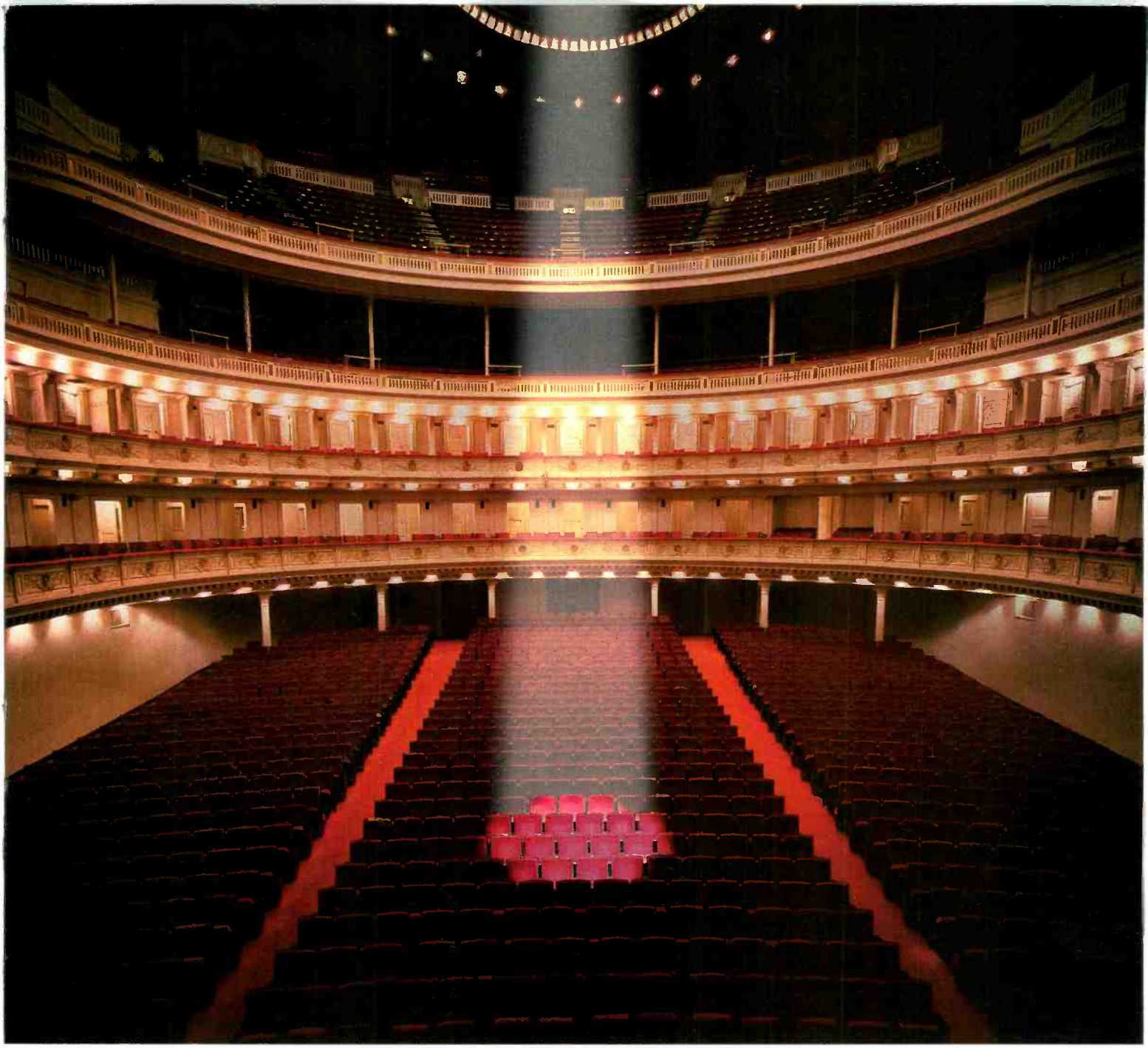
And look at the reluctant cassette. One of the more surprising stories in audio, and not yet finished. Think of the reluctant phono arm and the spiral analog groove, reluctantly hi-fi. Triumphs against natural adversity.

But there are also those spectacular product talents that suddenly appear out of the blue and fit effortlessly into some unforeseen niche. How little we know ahead of time! The VCR? Video games? How unsure we must be, then, as to this astonishing CD with its micro-reading laser, its billions of digital numbers, its continuously varying speed, never fixed (it runs inside to out, turning slower and slower for a constant groove speed), its utterly lavish audio parameters, its wealth of extra channels. What sudden development will come from these? We can just shrug helplessly.

One further theory of mine, pretty obvious to anybody, is that new ideas, new ways of doing things, tend to come long before the ideal equipment is at hand, or even conceivable, to fulfill their promise. Then suddenly—a great blossoming. Tom Edison again—acoustic-powered movies with sound, around 1913. Too soon! They worked, but just barely, as the New York section of the AES recently heard. (The sound, from large cylinders, was restored on tape, the sync worked out by modern methods.) Then suddenly, it all fell together. There were color photographs in the 19th century; I took Agfa starch-grain color plates (one-minute exposure in bright sun) in my youth. Suddenly it was Kodachrome. (I also tried Dufaycolor—remember that?) We tried to fly for centuries and millenia—then came the gasoline engine. Very quickly, we flew. Ideas whose time had come. Calculators back centuries ago. Digital codes from Morse—what else are those dots and dashes? The essential vacuum tube long before the transistor, and that before the IC. And then the chip.

So the CD (the Compact Disc) comes at the top of an enormous wave, in audio surely the highest yet, the most essentially advanced product so far—among so many other miracles that are, even so, encumbered by earlier technology that won't go away. I don't mean to stir up any rivalry. That wave includes too many hundreds and thousands of other product elements, in our field and everywhere else, to bicker over who comes first. But we must understand the sheer enormity of it, this now-blossoming development in so many areas.

So double-cross your fingers, read all about the latest CD promises, keep an eye on the ball-point pen. I expect we'll have a "ball point" CD player before too long, if all goes well, and at a nice popular price. Maybe in the hundred dollar range—not bad. But if you want your CD right now, better count on a thousand dollars or so. That's a lot, as Pepsi put it. A



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BERT WHYTE

PACKAGE DEAL

At this point in time, the marriage of audio and video technology has been consummated, and one of this union's most popular offsprings can be seen in component audio/video systems.

Jensen, a respected loudspeaker manufacturer since the pioneering days of high fidelity, has now diversified their product lines and introduced several quite comprehensive component audio/video systems. Their top-of-the-line system consists of the AVS-3250 25-inch video monitor and the AVS-1500 audio/video receiver. An AVS-4400 videocassette recorder is also available, as are two different models of matching loudspeakers.

I have been evaluating a combination of the AVS-3250, the AVS-1500, AVS-5250 loudspeakers and a JVC HR-7650 VCR. The AVS-3250 monitor is housed in a silver-painted wooden cabinet. Its 25-inch tube has a 110° deflection angle, and horizontal resolution is an exceptionally high 430 lines. The rear panel has two video input terminals (one has a level adjust control to attenuate input signals) which accept the outputs of VCRs, cameras, videodisc players, etc. There is a control for horizontal hold, a 3.58-MHz trap switch (for use with computer graphic displays), a remote-control input jack, a video output jack for connection of a second video monitor, a multiple/normal terminating switch (position dependent on number of video monitors), and an a.c. outlet. On the front of the monitor is a hinged panel behind which are various controls and switches. In the operational position, the "Preset Color" button affords a picture that is set to factory reference standards for intensity, hue, contrast and brightness. In the off position, manual adjustments of these parameters are possible by using the "Black Level" control (essentially a brightness control), "Picture" control (which adjusts brightness, contrast and color intensity at the same time), "Color" control (to adjust intensity), and "Tint" control (for hue adjustment on skin tones). These manual controls are quite interactive. While the overall picture quality in the "Preset Color" mode is really quite good, I found I got the best picture with careful use of the manual controls. The quality of the picture is outstanding, with superb resolution, bright, crisp images, and very pure, well-saturated colors. On a test pattern, the spectrum colors were vividly delineated and black and white was very clean. Comb-filtering and other circuit embellishments have been used to provide images with a significantly higher quality than on ordinary color TV sets.

Jensen's audio/video component system consists of the AVS-3250 monitor, AVS-5250 loudspeakers, and the AVS-4400 stereo VCR atop the AVS-1500 audio/video receiver.

A video monitor has no TV tuner, so one must use either the tuner in a VCR or a separate outboard tuner. In this Jensen system, the AVS-1500 unit is designated an audio/video *receiver*, as it also includes a power amplifier. This is probably the most versatile and sophisticated audio/video control unit on the market, with a most comprehensive array of features. First, the AVS-1500 is a 133-channel, cable-ready TV tuner. It is also a quartz PLL FM tuner, an AM tuner, an amplifier with 50 watts of power per channel, and an audio/video switcher. It also has a signal processor and headphone facilities with separate amplifier and control. A wireless infrared remote control duplicates many of the functions on the receiver.

The AVS-1500 is a clean, functional-looking unit with light-pressure touch switches for mode selection. There are digital displays for TV channels and for AM/FM stations. Behind a hinged panel are a multiplicity of switches and controls. The rear panel has various antenna connections plus video and audio inputs and outputs, speaker output terminals for two pairs of stereo speakers, and two a.c. outlets. The best way to describe this complex unit is by function grouping.

The video input and output facilities of the AVS-1500 permit connection to the video monitor via 75-ohm coaxial cable. Other interconnections allow the monitor to be turned on and off by the receiver's remote control. The receiver also has both r.f. and direct video and audio inputs (the latter in stereo) for signals from computers and video games. A 3.58-MHz trap can be switched in for greater picture stability with computer graphics or video games.

With the audio section of the AVS-1500, one can listen to AM (a built-in ferrite antenna is provided) and FM broadcasts. The display panel shows signal strength and station frequency, and both AM and FM can be scanned up or down in frequency, with the receiver locking onto the strongest signals. A memory system permits presetting of six AM and FM stations. One

very valuable feature of the AVS-1500 is its ability to receive simulcasts. In simulcasting, you can view the TV program while simultaneously listening to the stereo sound broadcast of a participating FM station. This feature will be even more useful when Beta (and VHS) Hi-Fi videocassette recorders reach the market, which will allow audio recording with near-digital quality.

The AVS-1500 has a phono input for moving-magnet cartridges and inputs for a cassette or open-reel tape deck. The headphone facilities are extensive. The signal at the headphone jack is from a separate amplifier with its own volume control. The headphone mode selector gives a choice of TV, other video sources, FM, tape and phono. Bass, treble and balance controls are furnished, as is a loudness control. There are buttons for "Synthetic Stereo" and "Acoustic Enhance" (ambience). These features work on simple phase-manipulation principles and are about as effective as most of their type—in other words, a marginal improvement. A definite plus for the AVS-1500 is the inclusion of a National Semiconductor DNR noise-reduction circuit. Used judiciously, a useful amount of hiss can be removed without unduly attenuating high-frequency response. There are input terminals for a pay-TV decoder and a button on the front panel to activate same, with a status indicator light as well. The remote control lets you punch in the number of a desired TV channel or scan up or down; for AM and FM, you only have the choice of manual up/down tuning or up/down scan, selected by a switch on the receiver. The remote also has a power switch for the entire receiver/monitor system, a mute control, numbers for individual channel selection and AM and FM memory presets, and buttons to activate the pay-TV decoder and for simulcasts.

The speakers for the Jensen component A/V system are small, acoustic-suspension types with fairly smooth response and surprisingly good bass output. They are specially fitted with internal shields so they can be placed close to each side of the TV monitor, thus preventing the magnetic field of the speakers from distorting the TV picture. I tried using higher quality loudspeakers, and while I got a much

"Jensen's AVS-1500 is not just a TV tuner, but an audio/video *receiver*, probably the most versatile and sophisticated on the market."

better sound, I did have to move them at least 3 to 4 feet from the sides of the monitor to avoid picture distortion.

The question naturally arises, does the individual looking for a high-quality component audio/video system really need all the facilities offered by these Jensen units? I think the system is really first-class in its video aspects—it would be hard to fault the quality of the TV images. The audio system certainly is a vast improvement over conventional TV sound, and I must say everything worked very well. However, I have a feeling that some people would prefer their own audio system to match up with Jensen's excellent video. Perhaps a simpler video tuner would be a good idea.

Admittedly, my thinking may be too ingrained by the ways of the audiophile. Looking at the other side of the coin, I can understand that the type of customer who might consider the purchase of a typical rack system could very well be attracted to these components. The Jensen A/V system would afford essentially the same facilities of most good rack systems, plus a superior video system, all brought together in a neatly integrated package.

Flash: JVC VHS Hi-Fi Introduced

JVC has just unveiled VHS Hi-Fi at the Consumer Electronics Show in response to the Beta Hi-Fi introduction six months back (*Audio*, May 1983). But it will be more than six months before product is available. Audio specs are the same as for Beta Hi-Fi: response of 20 Hz to 20 kHz, 80 dB S/N, 0.3% THD, 0.005% wow and flutter, and 60 dB channel separation.

The new audio tracks are recorded directly *under* the video ones. Unlike Beta, the VHS Hi-Fi system uses separate audio heads on the video head drum. At 1 to 2 MHz, the new signals are lower in frequency than the video luminance (2.4 to 4.4 MHz, though apparently only the upper half is used). Lower frequencies penetrate the tape more deeply, allowing the audio tracks to be read through the overlying video in playback. Head azimuth differences (±6° for audio, ±30° for video) minimize crosstalk between the overlapping sidebands of the two signals.

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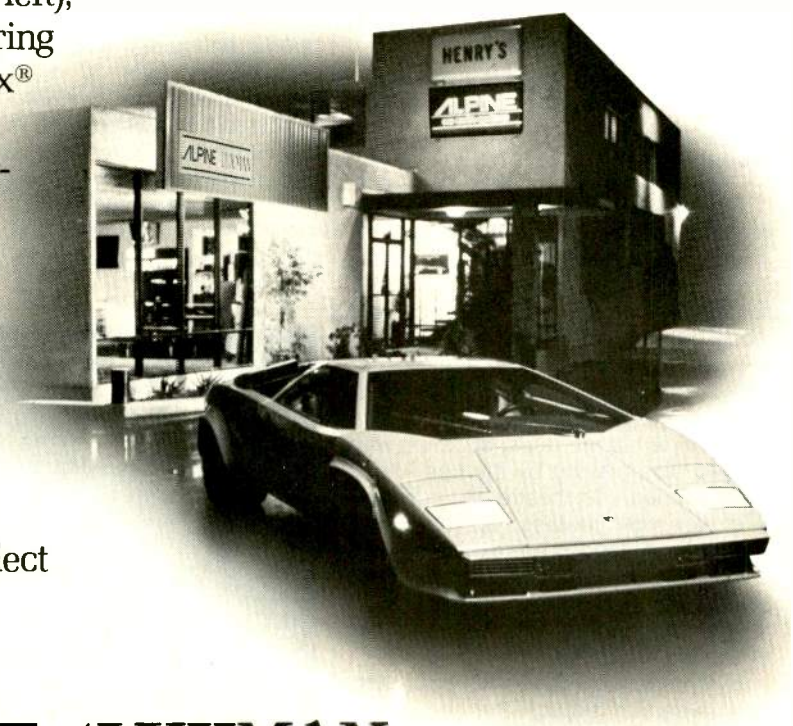

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BERT WHYTE
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THE EIGHT SEASONS

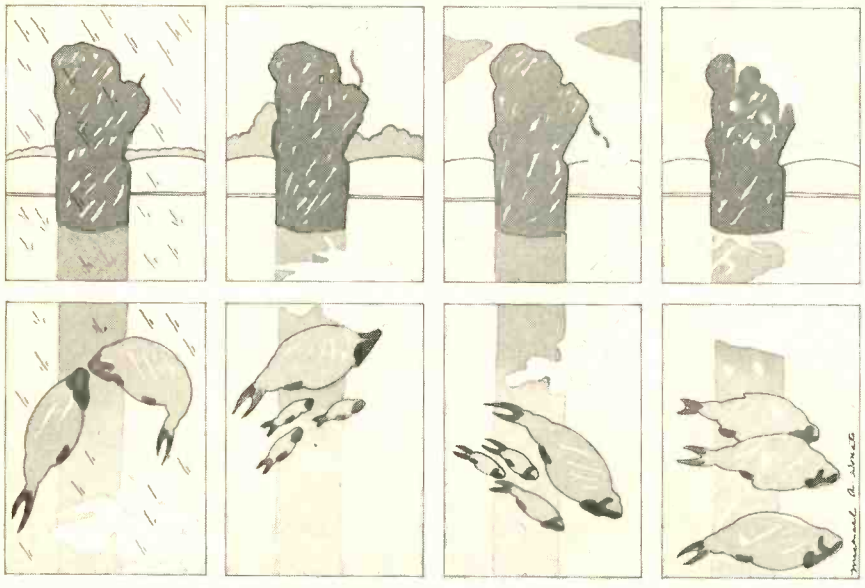

Illustration: Michael A. Donato

Vivaldi: The Four Seasons. Los Angeles Chamber Orchestra, Elmar Oliviera, violin; Gerard Schwarz.
Delos D/CD 3007.
Vivaldi: The Four Seasons. The English Concert, Simon Standage, violin; Trevor Pinnock.
Archiv 400 045-2.

Duplication of the standard repertory is already obvious in the pattern of initial CD releases, and reviewing these two *Seasons* side by side makes for interesting musical and technical observations.

First, the Schwarz/Oliviera collaboration is a thoroughly modern one which treats the solo instrument in a virtuoso role. The tempi are brisk, but in no way rushed. The playing by the Los Angeles Chamber Orchestra is polished and well-nigh flawless. Sonically, the orchestral balances are excellent, with a warm, but not overly reverberant, ambience. The solo instrument is in natural perspective with the rest of the ensemble.

By comparison, Pinnock's approach is to recreate, through the use of ancient instruments and performance practice, what might have actually taken place in Vivaldi's day. Even the playing pitch has been lowered a halftone to the standard of that day. Instead of the suave sound of modern strings and bowing practice, The English Concert produces a sound that takes a bit of getting used to. The loosely strung bows and slight vibrato produce a much thinner texture. The overall timing for Pinnock's performance is just over 37 minutes, compared to 39:21 for Schwarz, and this indicates that some of the movements are quite fast—which the leanness of the ensemble seems to support quite well. Standage is no measure for Oliviera, but then Pinnock's conception of the work does not put the soloist in a virtuoso role.

Musically, take your choice. In sonic terms, though, there is no denying that the Delos version gives the listener a better idea of what the potential of CD really is.

One last note: The Delos program booklet recreates the facsimiles of the original sonnets which were published with the concertos, just as was done in their LP release. *John M. Eargle*

Tchaikovsky: Symphony No. 5. Philadelphia Orchestra, Ormandy.
Delos D/CD 3015.

This second item in Delos' initial CD release presents the Philadelphia Orchestra under fairly simple miking conditions (three omnidirectionals). The sound is quite free of the business that often results from multi-miking—especially when followed through digitally to the final playback step without intervening analog stages. The strings have a natural sheen that will convince many diehards that there is no demon in digital, and I heartily recommend this disc to them.

Contrasted with Maazel's recent CD reading with the Cleveland Orchestra, Ormandy's reading is a more personal one, and much of the real power is saved until the last movement.

Overall, this CD is a pleasant surprise and an important addition to the catalog. *John M. Eargle*

Eugene Ormandy

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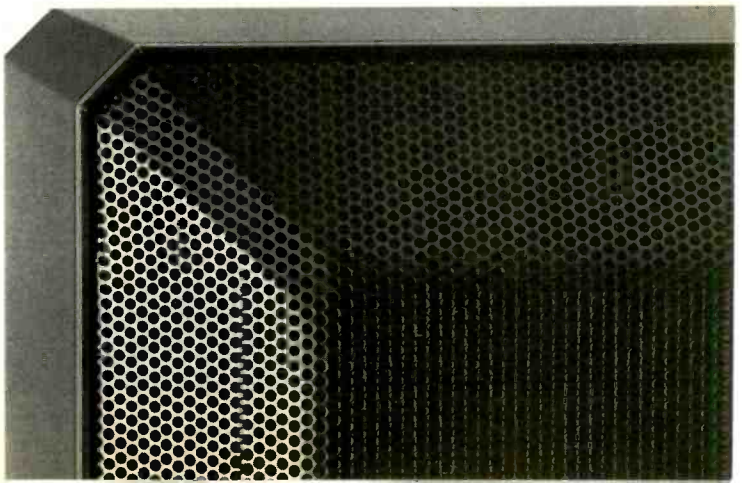
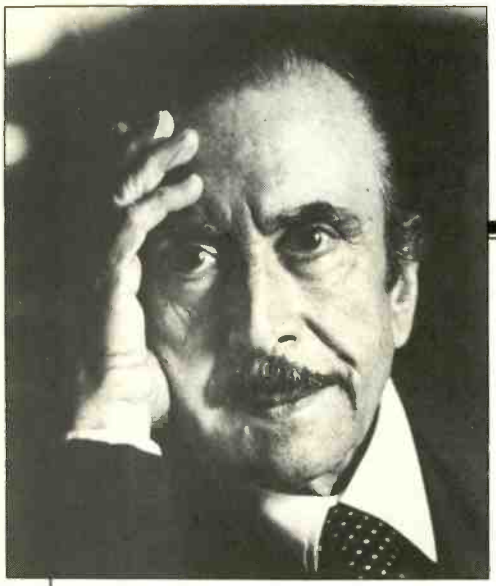




Claudio Arrau

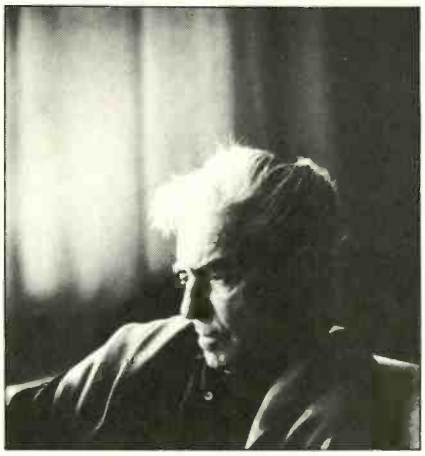
"On this CD, one can even hear Claudio Arrau's often agitated breathing and the minute clicks of his fingernails on the keys."

Chopin: Fourteen Waltzes. Claudio Arrau, piano.
Philips 400 025-2.

Arrau's piano is somewhat bright, but of excellent timbre and regulation. The uncanny clarity inherent in CDs seems to elucidate piano recordings more than almost any other kind. One hears all the trappings of live performance, including the performer's often agitated breathing and the minute clicks of fingernails on the keys. These are details which are perfectly natural, but which are so often lost through traditional LP processing.

For my tastes, the playing is too monochromatic, with not enough exploration of contrasts. In anyone's hands, however, all 14 of these works are too much for one sitting.

John M. Eargle



Herbert von Karajan

Johann Strauss: The Blue Danube. Various waltzes, polkas, marches and overtures. Berlin Philharmonic Orchestra, von Karajan.
Deutsche Grammophon DG400026-2.

This disc presents the Berlin Philharmonic Orchestra in its "Pops" role. These works are characteristically done, and von Karajan lavishes more care on them than perhaps they deserve. The sound is broad, cohesive, and luminous, and there is no objectionable "spotting" of instruments in the miking approach. I was surprised by careless editing at the end of "The Blue Danube." This is the kind of thing that CDs expose mercilessly—and the kind of thing that one rarely detects in a DG recording.

This CD represents fleshing out of the catalog with the potboilers that have always been at the core of the

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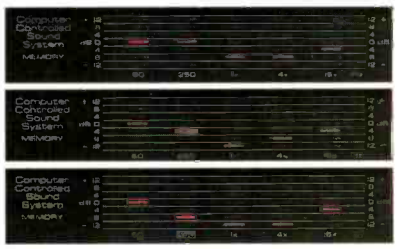

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"Lacking adequate engineering support, Barenboim and the Chicago Symphony Orchestra do not come across."

Daniel Barenboim

standard repertory. As beautifully recorded as these works are, there is much more important literature to be explored in this wonderful new medium before settling down to this level of light music. *John M. Eargle*

Tchaikovsky: 1812 Overture; Capriccio Italien; Marche Slav. Chicago Symphony Orchestra, Daniel Barenboim.
Deutsche Grammophon DG400035-2.

The musical values inherent in these works have long ago faded, as they have become the big demo pieces of our high-tech audiophile age. The current benchmarks have clearly been set by Telarc, and any recording that does not come across with equal panache is likely to be an also-ran.

As well as the orchestra plays, there is little music to probe here. One might argue that Barenboim plays them with more traditional musical understanding than his counterparts on Telarc, but without equal engineering support, they do not come across. Better wait for the Telarc CDs. *John M. Eargle*

Luciano Pavarotti: Arias
London 400 053-2.

These arias are drawn from a variety of analog sources dating from 1971 to 1974. They are mostly from Italian operas, with one contribution each from Bizet and von Flotow. Overall, these performances show the singer in his finest form, years before he became a superstar.

The London analog sources hold up quite well, and one is aware of only slightly higher background noise when the disc is played at elevated levels.

The dedicated Pavarotti fan will want this CD. Others will find in it the beginnings of the overblown, athletic style that the singer has adopted today. *John M. Eargle*

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Beethoven: Symphonies Nos. 5 & 6. Philharmonia Orchestra, Ashkenazy. **London LDR 72015,** two discs, digital or **LDR 5-72015,** double-play cassette. Introductory offer, $12.98. Available individually: Symphony No. 5, LDR 71040 (album) or LDR 5-71040 (cassette); Symphony No. 6, LDR 71078 (album) or LDR 5-71078 (cassette), $12.98 each.

A wonderfully interesting record and a super bargain at half price, two digitals for the cost of one (while supplies last). The big Russian world performers these days are suddenly becoming conductors, and they bring a somewhat new and at times startling perspective to the old familiar Western-style concert works—the ones that are not written for their own instruments. This is both subtly Russian, in the long tradition going back to the 18th century, and also fresh and new, as such works must be to a specialist instrumental player, who perhaps only does concertos and sonatas in his own solo performing.

The Fifth, which I played first, had me somewhat bothered—but then every performance of that enigmatic work bothers. It is the most changeable of all symphonies, and who knows Beethoven's exact thoughts? The overlay of a certain Russian fullness and, shall I say, Romantic blur, didn't sound right at all. Surely, this smooth, not very articulate style must have been specifically imposed on the British Philharmonia by "The Ash Can" himself—who else?

So I put off the Sixth for a few days And what a surprise. This is the toughest symphony of all the big ones for any conductor. Its relaxed, pastoral moods are simply not for today with its hurry and bustle—that is, it simply will not be modernized to fit. Yet most conductors try. Or just flounder. Wow—Ashkenazy, being Russian, has the music down to perfection, utterly relaxed, smooth and slow and gentle (so the thunderstorm really sounds like one, in contrast). I have not heard such a good Sixth Symphony for many years.

Finally, I have often noticed that the big British orchestras tend to respond wonderfully to a real Romantic conductor, whether their own or someone from outside. Never was there a better example! This is a dedicated performance, to use the usual cliché. Far above the call of duty and commercial professionalism.

Is it Ashkenazy or London? An added nicety in this pair of recordings is the inner detail of the music, all sorts of minor but interesting bits that are not often heard so clearly. None is overblown, too loud, too close. Just *there*, in digital clarity. Could be a bit of London's old multi-mike pickup—so what? It works for the music. P.S. On second hearing I liked the Fifth better. Guess I had by then gotten used to the Ashkenazy style.

John Kitzman, trombone; Janice Kay Hodges, piano. Hindemith, Defaye, Creston, Pryor. **Crystal S386,** $8.98.

Sound: A– Recording: C– Surfaces: B+

Here is a flawed crystal, one of the few and so worth noting. Crystal, you may remember, is a company which specializes in recordings of various solo instrumentalists, garnered from the vast numbers of competent performers in schools, colleges, and conservatories the country over. Few of these performers get into big-time star-system operations—which does not mean that they will disappoint you, by any means. We should understand that not all the good musicians sport TV-size international reps.

This is a typical Crystal recording, a musical survey of trombone music. Fine! Why not? The problem here is strictly in the engineering, which, I might say, is the essence of the music when it comes to communication. No, not the fi. Nothing wrong there.

What is wrong is absolutely fundamental. The trombone is *very* close and *very* loud. It dominates the sound; it is obstinately persistent, practically blowing down your neck. The piano, which should certainly be equal in sonic importance, is relegated to an ineffectual background, weak and nerveless. Travesty!

I got through side one (Hindemith managed to keep me on the track) but I quit at side two. A waste of time. Too bad, because the performers are both very competent. I do not like a trombone breathing down my neck, no matter how beauteous. Nor will you.

The Malcolm Forsyth Trombone Ensemble. Crystal S224, $8.98.

Sound: B+ Recording: B+ Surfaces: B+

I wish I could review more of Crystal's voluminous offerings. This compa-

"Crystal caters primarily to musicians themselves, giving them stylish, top-flight recordings which are gracefully produced and packaged."

ny caters primarily to musicians themselves, in particular the young and ambitious though not yet super-stellar sort. Big companies generally won't touch 'em, and more is the pity with so much tremendous talent around. Crystal gives them stylish, top-flight recordings, gracefully produced and packaged, which must indeed be a pleasure for all concerned.

You and I, too, are concerned, out beyond the musicians' world, and Crystal knows this also. The company apparently imposes a sort of artistic discipline, evident in most of its offerings. In our recordings, it says in effect, our artists venture out into the great public arena; they must play for a larger, more varied audience than their own musical associates and this means programs of more general interest and stimulus—not mere recitals on disc or tape. Even in such specialty areas as solo offerings of tuba or trombone.

Thus, these youngish trombonists cover an interesting stretch of wind-music history. The first side is all older music, not really meant for the modern trombone but playable on it, with due care and respect. Generally, these people make a good job of the old brass stuff, erring perhaps on the side of too much restraint on their admittedly high-powered instruments, much more potent than the older sackbut. Side two gets into *real* trombone music and in a way this is a relief—at least the music was written for these instruments. Nice tidbits, including the shortest Bruckner I've ever heard (he of the enormous symphonies!), lasting a minute or so.

The players show their age neatly at one point. Not enough trombones for one piece? Simple. Just do a mixdown and you have all you want.

Music for the Baritone Voice and Symphonic Winds. Antonio Perez; Univ. of Kansas Symphonic Band, Foster.
Golden Crest CRS-4187, $9.98.

Sound: B+ Recording: B+ Surfaces: B

Better late than—. I put this aside way back as a marvelous freak record and managed to mislay it. Just did a replay and, wow, it's great. Of its sort. Better buy quick before the prices go sky-higher.

The cover tells all. Incredible. Our soloist in mid-bellow, mouth wide open. Bald head, gray hair to the sides, natty tuxedo and black tie, neat black moustache and, bulging out on either side, an incredible set of human air tanks, right where the normal neckline should be. Just looking, one can imagine the rafters quaking, the chandeliers coming down in shards—and that is what you will hear, at least in the voice itself. Biggest, best trained baritone I've heard for years, and why isn't he somewhere more important? Mr. America of the vocal cords.

"The Cambridge Buskers have compressed operatic originals so naturally that not once was I unpleasantly aware of 'cuts' or unfortunate jumps."

Yet, with this slightly out-of-tune symphonic band as a background (it includes a harp), he sings itty bits, encore stuff, everything from Mozart and Rossini to Copland, Percy Grainger, *Fiddler on the Roof* and something called "The Roosters Lay Eggs in Kansas." I will forgo the inevitable pun on *that*. In every one of these trifles (as here presented, with a lot of put-on schmaltz), this gorgeous voice wheedles, charms, and bellows its golden sound. Well, Caruso managed to end virtually every one of his famed recordings with his unique vocal trumpet call! And he often had merely a piano, upright, in a hotel room. So who's complaining? But this man should get into a better musical framework. Antonio Perez has a voice in a million.

Spotty recording, though OK—the voice isn't always the same distance. Surfaces are good, American made; but, alas, there are ticks in bunches. And a very audible low-bass cutting-table rumble. (No, *not* my table.) Don't let these minor faults bother you a bit.

Soap Opera: The Cambridge Buskers **Deutsche Grammophon 2532072-10,** digital, $12.98.

Sound: A Recording: A Surfaces: A–

Buskers in British English are street musicians, a tradition going back centuries. These two, Michael Copley, who plays flute-type instruments, and Dag Ingram, accordion, started more or less as the real thing. Now, of course, they have graduated to the international concert/recording scene—this is not their first record, though a first in digital, if you can tell the difference.

But what music? You'll be astonished. Grand opera! The real thing, no fake. They specialize in the great Italian items, from Mozart to Verdi and Rossini, but there's a "Can Can" by Offenbach and even a bit of Richard Wagner, of all totally unlikely composers for street music.

Absolutely unlikely, but by some musical magic, absolutely convincing. The mere length of the various items, most in the standard pop size of three minutes or less, indicates a drastic compression of the vast and time-consuming operatic originals; this is done so naturally and easily that I was not once unpleasantly aware of "cuts" or unfortunate jumps or transitions. Remarkable.

All these enormous opera excerpts are done on one flute, or alternatively a soprano recorder, and one rather small accordion with buttons for harmony on one side and a very short keyboard on the other. You won't believe it. And especially you will not believe the astonishing virtuosity of Michael Copley, who plays the somewhat clumsy, finger-holed soprano recorder even faster and more accurately than the much larger modern flute with all its fancy keys and levers.

MICHAEL TEARSON
JON & SALLY TIVEN

MILESTONE

Star People: Miles Davis
Columbia FC 38657.

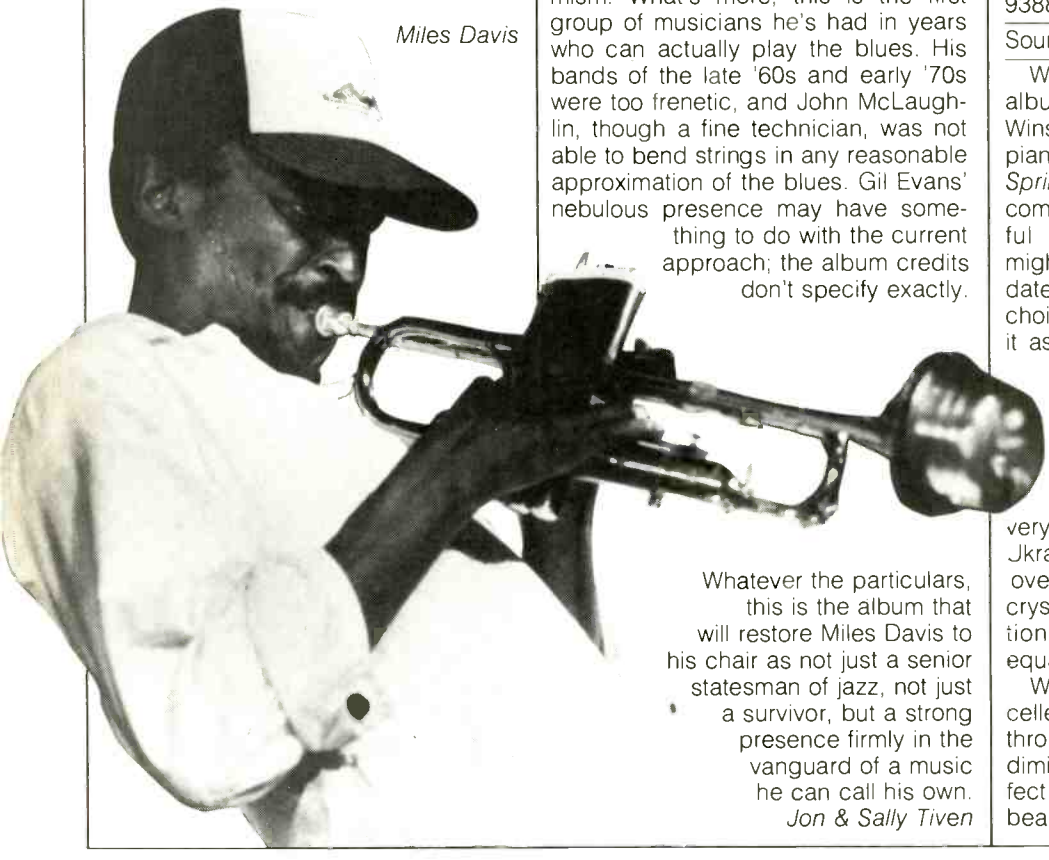
Sound: A– Performance: A

There are few living legends around the world of jazz still in their working prime—the improvisational world waits for the hot new soloist, while last year's news is today's burn-out case, trying to reprise past glories. Miles Davis found himself too close to the edge and took some time off, returning two years ago via *Man With a Horn*. Although it had magical moments, *Man* was not the album the world was waiting for. Some said the ensemble just didn't live up to former Miles Davis groups; others thought that despite the title, Mr. Davis' trumpet was blasted out by over-distorted guitars. *Star People* should be a relief to those Miles Davis fans who felt betrayed by *Man With a Horn*. It is a very sparse, almost simplistic record that sounds like a throwback to the pre-rock Miles Davis. The main themes include a pervasive blues slant, but, more than that, there is a reliance upon melody and a loose unconcern for being contemporary. The new Miles meets the old Miles, and the listener wins. The only real tip of the hat to 1983 music/technology is the Oberheim synthesizer that Miles plays (to good effect).

Of course, much can be said for the contributions of the band members—Marcus Miller (who currently has his own record on the charts and is coproducing saxophone virtuoso David Sanborn), Al Foster (a fine drummer whose sound is enhanced by distant-miking techniques), and guitarist John Scofield (debuting in the Miles Davis Band on this LP, playing some wild stuff).

What distinguishes this album, among other things, is the spacious texture of the music which embellishes Miles' trumpet playing rather than fighting it. His phrasing, his choice of notes, and the tone he achieves lend themselves to music with lots of breathing room, rather than the density he sometimes chooses. The blues provides the skeletal frame from which he can leap, without losing any dynamism. What's more, this is the first group of musicians he's had in years who can actually play the blues. His bands of the late '60s and early '70s were too frenetic, and John McLaughlin, though a fine technician, was not able to bend strings in any reasonable approximation of the blues. Gil Evans' nebulous presence may have something to do with the current approach; the album credits don't specify exactly.

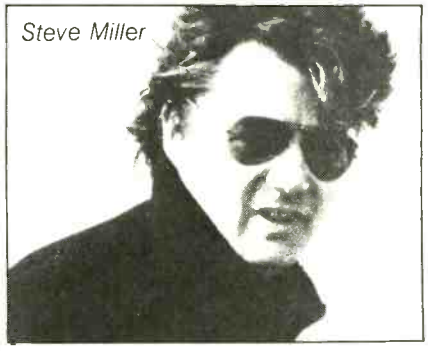
Miles Davis



Whatever the particulars, this is the album that will restore Miles Davis to his chair as not just a senior statesman of jazz, not just a survivor, but a strong presence firmly in the vanguard of a music he can call his own.

Jon & Sally Tiven

Steve Miller



Live! The Steve Miller Band
Capitol ST-12263, $8.98.

Sound: B– Performance: C

Actually a greatest-hits collection in concert clothes. The band turns in well-oiled if mechanical readings with precious little spontaneity. Had they taken a chance or two, this album would have been far more involving.

Michael Tearson

December: George Winston
Windham Hill C-1025, $9.98 (P.O. Box 9388, Stanford, Conn. 94305).

Sound: A Performance: A+

Windham Hill Records specializes in albums of peaceful music. George Winston's previous recordings of solo piano music, *Autumn* and *Winter Into Spring*, have been the label's most commercially and artistically successful albums. His latest, *December*, might prove the most fascinating to date. The timing of its release and choices of material might have pegged it as just a Christmas album, but the extraordinary beauty of Winston's interpretations make *December* an album for all seasons. Winston has avoided obvious selections, and has written half the album and chosen the rest very wisely. "The Carol of the Bells," a Ukranian melody, is one of the most lovely pieces anywhere and here is crystallized into pure beauty. His variations on Pachelbel's "Kanon" are equally so.

Windham Hill's attention to sonic excellence and superb pressing, evident throughout their line, is certainly not diminished at all for *December*, a perfect late-night album for guaranteed beautiful dreams.

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Richard C. Heyser, *Audio*

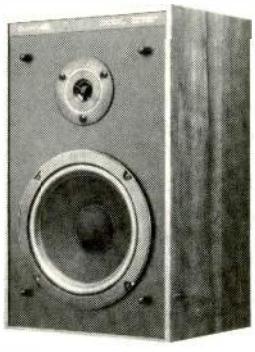
Boston Acoustics' A40 would be hard to beat for dollar value . . . In music of a lighter texture—chamber music and jazz—this speaker holds its own against larger models costing far more and even in symphonic music the sound is enjoyable, if not overpowering. In particular, the treble dispersion of this little speaker is so good that it attains an aura of spaciousness surpassed only by some of the far more expensive multidirectional speakers.

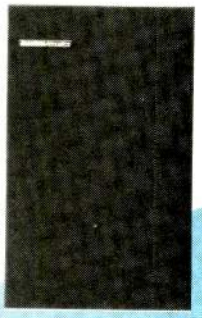
Hans Fantel, *The New York Times*

The Boston Acoustics' A40 . . . delivers exceptional performance at a very low price . . . the overall balance and smoothness of the A40's sound are those of a *good* speaker by any standard . . . Very few forward-radiating systems we have seen can match its dispersion. Extended listening to the A40 has shown us that there is nothing about its sound to identify it as coming from a smallish, inexpensive speaker . . . The A40 comes surprisingly close to matching the essential sound quality and character of the best and most esteemed speakers for a small fraction of the cost, and it is hard to imagine a room unable to accommodate a pair of them . . . With respect to sound quality per dollar, the A40 is surely one of the most cost-effective speaker designs we have seen in recent times; we are impressed.

Julian Hirsh, *Stereo Review*

Although the A40 is the smallest and lowest priced speaker system we make, its performance is the equal of any other Boston Acoustics speaker system within the frequency range it covers.





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cut here

Incidentally, should George Winston's music be to your liking, you might enjoy checking out these other recent Windham Hill releases: Darol Anger and Barbara Higbie's violin/piano duet album, *Tideline* (C-1021), and Ira Stein and Russel Walder's piano/oboe duets on *Elements* (C-1020).

Michael Tearson

Pete Townshend

Scoop: Pete Townshend
Atco 7-900631F, two discs, $10.98.

Sound: B+ Performance: A

After his recent universally dismissed solo effort, *Chinese Eyes*, and the general downward trend of The Who, one might expect little from a new Pete Townshend album, particularly a two-record set. The surprise is that Townshend's latest effort is a collection of his personal song demos. Some were recorded by The Who, but the majority have remained obscure. If the choices on this album are a fair indication (and there's no reason to suspect that they are anyone's except Townshend's), it is easy to see where The Who have gone wrong. Despite popular opinion to the contrary, The Who are/were not a vehicle for Townshend's songs so much as an organization to perform the most pedestrian of his compositions, and not necessarily to the betterment of the songs. Townshend the singer destroys Daltrey, and Townshend the songwriter is infinitely more creative and capable than the last 10 years of The Who's records would have you believe. In short, with the exception of the occasional good novelty from Entwistle and Kenney Jones' ability to propel a song, everything good about The Who is Pete Townshend.

Not that it's always been this way: Townshend's "So Sad About Us" (done simply as a vocal and guitar demo here) misses the crucial harmony that became a trademark of The Who sound, and "Circles" without the rhythm section is a bit flat. But songs of a recent vintage, which when performed by The Who were painful ("Squeezebox"), are positively inspired. And "Dirty Water," a reject from *Face Dances*, easily outdistances anything which showed up on that album.

But the real gems on this two-record set are the early Townshend experiments rejected by or never submitted to The Who, songs like "Melancholia," "Politician," "Things Have Changed," and "Cookin'" to name a few. Townshend's versions of "Bargain" and "Behind Blue Eyes" are lovely for a listen or two. But the work this guy did for its own sake—without worrying whether it would be acceptable to Who fans—that was the Pete Townshend who earned the reputation as some sort of genius/conscience of rock 'n' roll. Once he entered into the relationship with his fans and considered The Who as a separate entity greater than himself, his songs were, for the most part, different and not necessarily better. The most objectionable and self-conscious traits seemed to show up on The Who albums, and *Scoop* is, in Townshend's own words, innocent of this crime.

Pete Townshend shouldn't leave his home to record. He should resist the temptation to employ other musicians to communicate a music and a message that is uniquely his, and of the moment. Or if he insists on making conventional albums like *Empty Glass* and *Chinese Eyes*, he should couple them with music from his vaults, such as is found here, as he brags that there are hundreds more where these songs came from. This is the music of which legends are made. Regardless of whatever ostensible commercial value it may have, *Scoop* is the real thing.

Jon & Sally Tiven

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"Joan Armatrading's *The Key* is a wonderful musical experience, both despite and because of its split-personality production."

The Key: Joan Armatrading
A&M SP-4912, $8.98.

Sound: B Performance: C+

How anyone as special as Joan Armatrading could have escaped popping out a massive hit record is one of life's mysteries. She has always written songs that can startle you with how vivid her thoughts and ideas are. She has a strong personality and an infectiously positive outlook to which self-pity and whining are absolutely alien. Plus she makes terrific records.

The Key is loaded with songs rife with sexual tensions and reversals and yearnings. "(I Love It When You) Call Me Names" is about a "big woman and a short, short man" who loves the abuse she gives him. "Tell Tale" is about losing a lover to both boys *and* girls. "What Do Boys Dream" is a song only a woman could write, wondering if boys long for the same stuff girls do and guessing they don't. "Foolish Pride" is a lovely reflective ballad that ends with a fade about a minute too early.

Steve Lillywhite, who produced Joan's previous album, *Walk Under Ladders*, has produced all but two tracks of *The Key*. His work is filled with daring, angular sounds and lots of surprises. Val Garay did the others, and his tracks are smoother, in L. A. pop style. Clearly there is an effort here to try for that elusive pop hit. The Garay tracks are well-done for the genre, but though Joan is game and gives her all, these just aren't as convincing as the Lillywhite tracks and sound rather tame by comparison.

The Lillywhite tracks are stylistically not far removed from his work with Peter Gabriel and XTC. They share both artists' venturesomeness. Additionally, they employ many of the same players Gabriel uses, notably bassist Tony Levin, drummer Jerry Marotta, and synthesizer whiz-kid Larry Fast. Other contributors include King Crimson's startling guitarist Adrian Belew, Genesis guitarist Daryl Stuermer, and ace hornman Mel Collins. Police drummer Stewart Copeland cameos on "Tell Tale."

Magical musical flourishes liberally dot the Lillywhite productions: Belew's solo in "Call Me Names," Fast's symphonic-sounding synth solo and Stuermer's guitar riff in "The Game of Love," the Stuermer/Belew guitar interplay in "The Dealer," the drum/synthesizer opening kick in "The Key," Armatrading's achingly hopeful vocal tone in "Foolish Pride."

Joan Armatrading is an exciting, often thrilling artist who is forever trying out unusual sounds and is unafraid of taking risks. These factors have limited her mass appeal, as she tends not to fit into anyone's categories, but they also make her records challenging and exhilarating. *The Key* is a wonderful musical experience, both despite and because of its split-personality production. *Michael Tearson*

Fame and Wealth:
Loudon Wainwright III
Rounder 3076, $8.98.

Sound: B– Performance: A

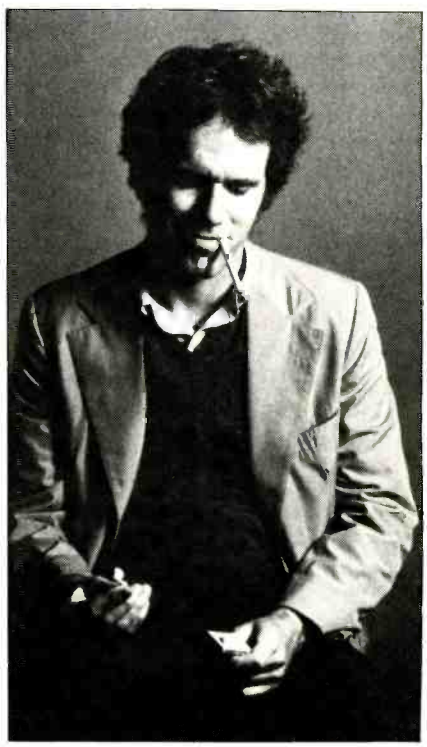
For a long time, Loudon Wainwright III has been writing vivid and ironically drawn songs about people caught in the act of living or dreaming. The pictures aren't always pretty, but they are often very funny or touching, or both.

Fame and Wealth is his first studio album in five years, and, boy, is it welcome. Produced simply and mostly acoustically, the songs and Loudon are the focus. Unadorned with the trappings and pretensions of commerciality, this might be Loudon's best album.

He sings about growing up in affluent Westchester County, getting drunk and partying disastrously for April Fools Day morn, watching cartoons on Saturday mornings, not being able to get to his daughter's fifth birthday party, winning the Grammy and everything else, revenge and more. Mostly he performs solo here, his natural element. Four tracks do have additional musicians; Richard Thompson, the brilliant British guitarist, is on two of them. "Five Years Old" gets a tasty little rock band to support it, and "IDTTYWLM (I Don't Think That Your Wife Likes Me)" gets a wonderfully silly cocktail piano and percussion.

Loudon Wainwright III might never find fame and wealth with his delightful songs, but don't let that stop you from discovering *Fame and Wealth*, a most human album. *Michael Tearson*

Loudon Wainwright III



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IVAN BERGER

SAAB STORY: PROJECT CAR, PHASE I

It all started simply enough: I heard and liked the ADS 320i speakers, and got a pair to install in my car. But where it ended up, well. . . .

The 320i speakers are unusually easy to place, in most cars. The 1-inch dome tweeter surface-mounts independently of the flush-mounted 5¼-inch woofer, and finding mounting spots for the two crossover modules was just a minor problem.

But my Saab 99 is unlike most cars, which posed a problem. Some of the best speaker positions were already preempted. There was no room for speakers in the dash, and the front top corner of the doors was already occupied by the window crank. Just below the crank and its finger-clearance area was a swoopy, molded bulge in the door's interior panel, able to hold only speakers smaller than the 320i woofers. Below that was the map pocket, but I needed that—not to mention wanting to avoid having my legs and the upholstery soak up the highs from speakers so low mounted.

I already had tried speakers in the top rear corners of the door (ADS 300i two-way plates and AFS Kriket separates). The problem there was that the spot was so far back that my body would block my tweeter's treble from the passenger, while a passenger's body would block his tweeter's treble from my ears.

At the same time, I wanted to upgrade the rest of my system. My old Alpine 7136 cassette receiver was to be replaced by an Alpine 7347, with better specs plus dbx and Dolby C noise reduction and a Programmable Music Sensor to locate selections on the tape. I had also been talking to Rockford-Fosgate about replacing my old, low-power Alpine amplifier with

"The biggest problem, as always with car stereo, was speaker placement. The solution was custom-made enclosures, just below the dash."

To the right of the Alpine 7347 receiver and AudioMobile SP-300 equalizer are a Philips SBC-177 ultrasonic alarm, and an Audax midrange and tweeter in a custom housing. The open shelf under the radio console will hold other receivers under test; power connections are on the terminal strip just visible to the left. Switches shown control Alpine auxiliary amp. The blue plug on the console's right and the flat, Poly-Planar speaker atop the dash are for a Radio Shack CB transceiver.

Photographs: Bill Ashe

one of their Punch series, and mentioned my installation problem to them. They recommended New England Radio and Moon Roof, in New Haven, Conn., pointing out that one of the firm's principals had 320i speakers in a Saab already. ADS thought New England Radio would be a good bet, too.

Enter Mark Weir, of New England Radio. His Saab, alas, turned out to be the later Model 900, a far easier car to mount speakers in. In place of my 320i system, he suggested a far more ambitious layout (see accompanying Table), somewhere between a stock installation and an all-out custom job. (I've seen some as high as $16,000!) That would also help me better evaluate stereo units I was to road-test for *Audio*, so I agreed.

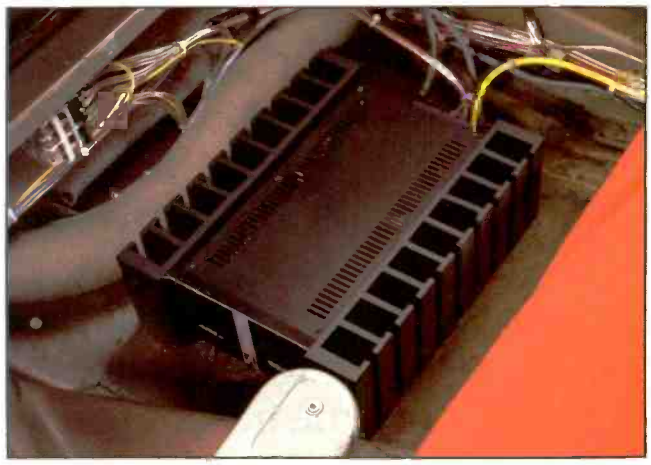
The biggest problem, as always in car-stereo jobs, was speaker placement. Ideally, the speakers should be far forward of the driver and front passengers, to be roughly equidistant from both occupants. In practice, that's not possible. You can approximate it with speaker enclosures in the footwells or flush-mounted speakers in the kick panels lining those wells, possibly equalizing to get rid of any well resonances. But in the Saab, the footwells are too small, and the kick panels rest directly on the inner liners of the fenders. Besides, in that position, knees and the radio console would block high frequencies.

Weir's solution was to mount custom-made enclosures just below the outer edges of the dash, with an Audax soft-dome tweeter and 4½-inch midrange driver in each. Bass was to be provided by KEF B-139 subwoofers in the rear deck. The system was to be triamplified, using AudioMobile crossovers and a mixture of Philips and Rockford-Fosgate amps, plus an AudioMobile preamp (for additional tone control, additional gain, and to power the crossovers). Triamplification let Weir adjust the crossover points to match the way these drivers worked in this particular installation. The AudioMobile unit's plug-in crossover modules made the crossover points especially easy to adjust.

I added a few items to the list. Since the system draws about enough power for light welding, I suggested a low-powered secondary system (based on

The amp rack on the back of the subwoofer housing. From left to right: Rockford Power VI amplifier for woofers, Rockford Power II amplifier for midrange, Philips EN-2200 amp for tweeters, and two AudioMobile CX-E2 crossovers.

This custom-built enclosure holds an Audax midrange and dome tweeter, each powered by a separate amp.



This Alpine 3502 amp, beneath the back seat, can be switched from the dash to handle ADS 320i speakers in the doors or rear-deck speakers under test. It's the only amplifier powered with ignition in "Accessory" position—the amp rack is only on when the motor's running.

It all began with these ADS 320i speakers . . . installed at last.

Now that you've got your act together, take it on the road.

Now that you put so much style into so much of your life, it's no wonder you find the Alfa Romeo Spider Veloce so immediately appealing.

But then, if this car had only been intended to satisfy conventional tastes, it never would have needed a body by Pininfarina. Seats of fine Italian leathers. A double overhead cam aluminum alloy engine. And even a classic hand-finished steering wheel.

What you have here is a personal car that, quite simply, does not compromise on anything. Not appearance. Not performance. And most especially not the freedom and enjoyment a truly personal car should keep on giving you.

All in all, this car is tailored to fit you so well, you don't just drive it. You practically wear it.

The $15,500* Spider Veloce.

Let your Alfa Romeo Dealer know how ready you are now. To take it on the road.

Alfa Romeo

*Mfr's. suggested retail price at P.O.E. is $15,495. Actual prices vary by dealer. Destn. chrgs., taxes, dealer prep, if any, optl. equip. and license fees are extra.

"The woofer faced me with a conflict between practicality and sonics. The system looked and sounded good—but it took up more than half my trunk."

System Contents

Source	
Alpine 7347 FM/AM/cassette receiver	$ 599.95
Electronics	
AudioMobile SP-300 three-band equalizer-preamp	309.95
AudioMobile CX-E2 active stereo crossover networks (two, at $244.95)	489.90
Rockford Power VI four-channel power amp (bridged to stereo)	680.00
Rockford Power II stereo power amp	425.00
Philips EN-220 stereo power amp	199.95
Alpine 3502 stereo power amp	349.50
Speakers	
Audax HD-100-D25, 1-in., soft-dome tweeters (two, at $20.00)	40.00
Audax 12P25FSM, 4½-in. midranges (two, at $25.00)	50.00
KEF B-139, 13×9-in. subwoofers (two, at $120.00)	240.00
ADS 320i, two-way separates, with 5¼-in. woofer and 1-in. dome tweeter, per stereo pair	379.00
Equipment Cost	3,763.25
Labor (Design and Construction)	1,000.00
	4,763.25
Extras	
Hollandia SunSlider sunroof, installed	400.00
Philips SBC-177 ultrasonic alarm system	219.95
Total	$5,383.20

an Alpine 3502) that I could more safely run with my engine off and my ignition switch in "Accessory" position. Since the car will also serve as *Audio*'s test bed for road-testing car-stereo units, this amp can be switched between the ADS 320i door speakers and rear terminals I had built in (for testing deck-mounted speakers and for acoustical experiments). I also suggested a shelf below the console, to hold receivers or other electronics under test. Power terminals and in/out jacks were to be provided for test purposes, with the antenna jack to be left accessible for the same reason. Then I added a Hollandia SunSlider—a sliding, tempered, dark-glass panel to be inset in the roof; I felt this would let me drive comfortably with my side windows shut, eliminating a source of wind noise which otherwise drowns out the stereo at times. And I added a Philips SBC-177 ultrasonic burglar alarm.

The Shakedown Cruise

When I first heard the system, its frequency balance was artificially bright—fine for pop music, but not for classical; New England Radio fixed that before I left the shop for a test drive. The KEF subwoofers really subwoofed: Bass was deep and rich when it was called for, as demonstrated on two cassettes—the low organ notes on *The Fox Touch* (dbx EC-7002) and the thunder in the storm sections of *The Power and The Majesty* (Mobile Fidelity MFSL 1-004), but it was never heard when the music didn't call for it. Only by boosting the bass controls inordinately could I overload the woofer or its amp. This was no great surprise, as the Rockford-Fosgate Power VI, with each of its channel pairs bridged together, can deliver 150 watts to each 8-ohm woofer. (If they were 4-ohm speakers, the power would be twice that, of course.) The Power II, unbridged, delivers 75 watts to each midrange driver, while the Philips EN-220 can deliver about 11 watts per tweeter (again, only half what these amps would deliver into 4 ohms), all of which is plenty. In sum, the sound was better than I've ever had in a car of mine before (and with more bass than I have at home—gotta remedy that).

The speaker enclosures underneath the dash did not get in my way when I entered or exited the car, as I had feared, and though they did make the interior hood latch a trifle difficult to reach, I don't have to reach it often.

But there were, for the time being, problems. One was obvious from looking at the system—poor stereo perspective. Since each front-seat occupant sits about three times closer to the near front speaker than the far one, the only way to get stereo balance on most music was to crank the balance control way over towards the far side. That "solution" worked fine when I drove by myself, but it just exacerbated the problem for a front-seat passenger. Rock tapes worked okay, because they're really multi-channel mono, with many instruments appearing only in one speaker or the other; but tapes recorded in real stereo perspective wouldn't work with the balance control centered. Also, the front speakers still had a slight touch of high-end "tizziness," which sounded to me like a mild peak, or possibly a faint twinge of distortion somewhere in the tweeter region. (As the car was finished just in time for this issue, I haven't had the chance to check the frequency response on instruments.)

New England Radio had created a crossover notch between the midrange and the woofer, setting the woofer's crossover point at 100 Hz and the midrange's lower crossover at 200 Hz, to get rid of the upper-bass hump so common in car installations. (Being able to set both frequencies independently was one reason Weir had picked the AudioMobile crossovers.) Unfortunately, the 200-Hz midrange cutoff made it all too easy to hear the shift of bass to the rear woofer.

"The sound was better than I'd ever had in a car of mine before, and with more bass than I have at home—gotta remedy that."

The woofer also faced me with a conflict between practicality and sonics. For optimum bass performance, New England Radio had built an enclosure for the KEF subwoofers, divided into two 1.5-cubic-foot, damped compartments. They also built a new panel to go above the trunk of the Saab hatchback (the original slides out to make room for big loads), concealing the woofer beneath a layer of cloth that matched the car's headlining. (That's a nice touch—good-looking, and invisible to thieves.) The amplifiers and crossovers were mounted on a rack attached to the rear panel of this box. The system sounded and looked good—but it took up more than half my trunk, and a big trunk was one of the things I had originally bought the Saab for. From the bass I'm getting, I suspect one woofer will do, though.

When driving, I found that the system could easily be set loud enough to overcome road noise, without distorting. In fact, it was easier to drive my ears into distortion than the system, a sure sign that there's enough power and power-handling capacity on tap. The ultra-low bass needed a slight lift from the bass control under some driving conditions, because road noise is mostly low frequency, but most of the time, I ran the system flat, and liked it that way. There was some distortion on loud music when I turned the Alpine's volume control up and the AudioMobile preamp's down, due either to output overload on the one, or input overloading on the other. Lowering the Alpine's volume to mid-point, and raising the AudioMobile's up, fully solved that problem.

The sunroof did help the sound, as I had hoped. My car doesn't have air conditioning, and driving with the windows open for cool air increases wind noise terribly. With the sunroof and the dash vents open, I was able to run with the windows closed in warm weather, reducing wind noise by 3 to 10 dB, depending on the speed and crosswinds. Come summer, though, I suspect I'll still want those windows open. Allaying another worry of mine, the roof proved completely leakproof, even in a car wash.

There was one other, small annoyance: The 320i grilles tended to pop off when the doors were slammed—a common problem with speakers mounted at the rear of large doors.

Not to leave you in too much suspense, most of these problems have already been solved, as of this writing, and I will have more (perhaps even all) of them solved by next month.

I also hope to take this well beyond the stage of problem-solving. The next goal is to get the sound as good as we can, without getting much more extravagant. The goal after that—the final one—is then to cut back, bit by bit, to see how inexpensively we can realize our goal of sonic excellence.

HERMAN BURSTEIN

Reducing Disc Noise

Q. If I want all the sound available on a disc, must I accept any noise the disc might have?—August Yirsa, Brookfield, Ill.

A. If you want to reduce noise already present on a disc, your recourse would be to what is called a single-ended noise-reduction device, such as the Burwen or DNR. It works essentially on the principle of reducing high-frequency response when there is little high-frequency content in the program material; this cut in treble response simultaneously reduces the apparent noise. When there is appreciable high-frequency content, full treble response is restored, but then the program material masks the noise.

Bias Change in dB

Q. My cassette deck has a manual bias adjustment with five settings above and five settings below "normal" for a given type of tape. Do you have an idea of the bias range covered by these positions, and of how I can relate them to the bias adjustment required by given brands of tape of a particular type?—Name withheld

A. For a given type of tape, most brands fall within about 80% to 120% of "normal" bias. My guess is that each setting of your control produces about a 6% (0.5 dB) change in bias. Accordingly, the minimum and maximum settings of your bias control would respectively produce bias 2.5 dB below and 2.5 dB above the normal setting. This translates into 75% and 133% of normal bias, which is consistent with the 80% to 120% range referred to above.

Setting Record Level

Q. I would like to know at what signal level to record, as indicated by the meters of my cassette deck.—Jimmy Hunter, Fort Myers, Fla.

A. Generally speaking, record-level indicators are calibrated so that whether the indicator is average-reading or peak-reading, one obtains best results (high signal-to-noise ratio without excessive distortion) by advancing record level to the point where the indicator about reaches 0 dB but seldom goes above it. In calibrating the indicator, the manufacturer usually takes into account the characteristics of typical, good-quality tapes. For a peak-reading indicator, 0 dB tends to correspond to about 3% harmonic distortion on the tape. For an average-reading indicator, 0 dB corresponds to a recording level several dB lower, perhaps 6 to 8 dB lower; this provides a safety margin to allow for the fact that an average-reading device lags behind sharp transient signals.

However, tapes do not all have the same characteristics. Some allow a higher recording level than others before 3% distortion is reached. Then one can let recording level exceed 0 dB, typically by something like 2 to 5 dB. One may have to experiment a bit to find how high recording level can be set without encountering noticeable distortion. Further, one may find that maximum satisfactory recording level varies with program material.

"What Should I Buy?"

Q. I am considering the purchase of brand X, brand Y, or brand Z tape deck. Please help me decide which one is best for my needs.—John Q. Public, Main St., U.S.A.

Q. I have about $600 to spend on a tape deck. Please advise me which one is the best for the money.—Jane Q. Public, Elm St., U.S.A.

A. It is again necessary for me to issue my periodic reminder that the policy of *Audio* prohibits the "Tape Guide" column from recommending specific brands and models of audio equipment (except in unusual cases where there is only one of a kind on the market).

The first step in deciding what to buy is to become knowledgeable about the subject matter. One way to do so is by reading the tape deck reviews that appear in *Audio* and other periodicals. Consult the tape deck directory that appears annually in *Audio's* October issue to become familiar with the comparative features and specifications of the decks you are considering. Check with your audio store or library for a readable book on the subject of tape recording. LISTEN to the decks you are considering. Using a phono disc of good quality, notice how faithful a copy each of the tape decks can make and how faithfully they can reproduce interstation FM noise. See what parts and service warranties come with the decks; find out how far it is to the nearest authorized service agency. Try to find out which tape decks come in least frequently for service relative to the number sold.

Armed with all this information, determine your priorities regarding specifications and special features. Consider the amount of money you can afford to spend and also *where* to spend it—i.e., look around for a store whose reputation you can trust and whose personnel seem both knowledgeable and helpful. *Then* decide which brand and model offers you the most value.

Updating Heads

Q. Would it be possible to replace the heads on my TEAC 6010 with high-density ferrite heads? I have been told by a technician that the impedance of the new heads is different.—Chandler Ellis, APO San Francisco

A. This type of question is best answered by the manufacturer. He can tell you what replacement heads are suitable for his particular machine and what changes may be required in bias current, audio drive current, equalization, and record-level indication. Another source for such information is Nortronics, which makes replacement heads for a wide variety of tape machines. (You may wish to write Nortronics at 8101 Tenth Ave. North, Minneapolis, Minn. 55427.)

How Many Dubs?

Q. I sometimes wish to dub. How often should I be able to dub a cassette tape before a substantial quality loss is noticed?—J. Bill Such, Natrona Heights, Pa.

A. I do not know whether you refer to multiple dubbings from a master tape or to sequential dubbings from one tape to the next. In the case of multiple dubbings, if your master recording is on good tape you probably should be able to run the master tape several hundred times, perhaps 500 or more.

If you are making sequential dubbings—dubs of dubs—you probably

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.

"Every noise-reduction system has side effects, which may vary with the program material and may be audible to some people and not others."

can't go beyond the second or third generation without noticeable increase in noise and, quite possibly, alteration of frequency response. Each dubbing introduces about 3 dB more noise. Thus, the third generation (not counting the master tape) has about 9 dB more noise than the master tape. If you start with a fine deck having signal-to-noise ratio of something like 70 dB (with noise reduction), the third generation dubbing has S/N of about 61 dB, which is still apt to be satisfactory. But if you start with something like 60 dB, S/N of only 51 dB is unlikely to be satisfactory.

The "Ultimate" NR?

Q. I have been shopping for a cassette deck and find some that offer dbx noise reduction. If this is the ultimate in noise reduction, why are so many other decks using NR systems such as Dolby B, C, HX, etc?—Peter Ripley, Sebastopol, Cal.

A. Every noise-reduction system has some deleterious side effects, such as pumping (volume changes), breathing (bursts of hiss), and alteration of frequency response. They may vary with the program material and they may be audible to some persons and not to others. There tends to be a trade-off between amount of NR and amount of side effects. How far a deck manufacturer goes in NR depends on his judgment of the extent to which most consumers can accept the side effects. Hence, Dolby B NR provides less reduction than does dbx. I have heard some persons claim that they can hear dbx's side effects, while I have heard others claim that it works to their complete satisfaction. You have to decide for yourself, based on what *you* hear, as to which NR system to buy. Also keep in mind that if NR is not to introduce appreciable deviations from flat response, it is important that frequency response of the deck be very flat prior to NR.

Varying Base Response

Q. Why do I get more bass response with my cassette deck when recording from FM than from phono?—Kurt Schwab, Federal Way, Wash.

A. I see no reason why a cassette deck should provide better bass response for one signal source than for another. The reason appears to lie in the signal sources. The phono cartridge you are using may be deficient in bass and/or the phono preamp section of your amp may be deficient.

Head-Cleaning Tapes

Q. What is your opinion of head-cleaning tapes?—J. Bill Such, Natrona Heights, Pa.

A. I prefer to remain neutral on this; I cannot guarantee that they will do no harm, nor can I say that any of them will do harm. My inclination is to use a cotton swab with isopropyl alcohol or one of the special head-cleaning solutions available in audio shops.

"While the inroads made by cassette decks may well continue, they don't necessarily augur complete displacement of open-reel machines."

Line/Line Mixing

Q. I want to mix two line inputs down to one input. My cassette deck has microphone/line mixing. Can you suggest steps I can take to feed a high-level signal into the mike input so that I can use the mixing facilities of the deck?—Robert Martindale, Rich, Va.

A. The problem in using the microphone input is that of overloading the recording amplifier of your tape deck. Therefore, you have to greatly reduce the level of the signal being fed into the mike input. Possibly this can be done via a volume control in the component whose signal is fed to the mike input. [*Editor's Note:* Resistor cables, designed to solve just this problem, are widely sold for use with portable recorders lacking line inputs.—*I.B.*]

Another possibility is to combine the two input signals via a Y-adaptor, and feed the combined signal to the high-level input of your deck. You won't, however, be able to vary each one's level in the mix unless your two sources each have level controls. Worst come to worst, you could always buy an inexpensive, passive mixer.

Is Open-Reel Obsolete?

Q. I have accumulated a large number of recorded open-reel tapes. Do you foresee open-reel becoming obsolete 10 years or so down the road, giving way to cassette?—Robert Ehrentraut, Burton, Mich.

A. It seems unlikely that open-reel analog tape decks will become obsolete in as little as 10 years. While the state of the cassette-deck art, including developments in tape, enables a "super deck" to rival the performance of a quality open-reel deck, it costs a great deal of money to achieve this, sometimes well over a thousand dollars. The open-reel format has several advantages over the cassette format, such as greater ease of editing, longer recording time per reel side, more headroom (protection against tape saturation at high frequencies) because of higher speed, choice of speeds, etc.

Still, the cassette deck has made substantial inroads into the market position once enjoyed by the open-reel deck. While such inroads may well continue, they don't necessarily augur complete displacement of open-reel machines.

On the other hand, recognizing the marvelous progress of the electronics art, it is not beyond belief that both cassette and open reel may eventually be displaced as home recording devices. Considering that we live in an age where the equivalent of hundreds of thousands of transistors, capacitors, resistors, etc. may be packed within an area about the size of one's thumbnail or less, we may eventually arrive at solid-state devices of moderate size and with no moving parts that are capable of recording and playback in digital form. But within 10 years? I really can't say.

AUDIOCLINIC

JOSEPH GIOVANELLI

Image Rejection

Q. The specs supplied with my tuner boast of a 114 dB image rejection. The tuner was, however, tested by an independent laboratory whose findings were that the tuner only has a 92 dB image rejection.

Upon writing to this component's manufacturer, I learned that measurements of this kind, if not taken in a "screen" room, can be misleading. What is a "screen room"? What are your thoughts on this?—Lowell Knapp, Charleston, W. Va.

A. The question is almost academic. Your tuner's 92 dB image-rejection ratio is excellent in itself. Therefore, unless you are plagued by interference from overflying airplanes (when listening to a weak signal at the high end of the band), the matter of image suppression will be of little consequence.

It should also be taken into account that the better the specification for a piece of equipment, the harder it is to measure this high performance. This is true not only for image rejection but for signal-to-noise ratio, distortion, tuner input sensitivity, etc.

An r.f.-free screen room is a room, or perhaps a "cage" within a room, screened with copper and very well grounded. This keeps any external radio-frequency sources from entering the area and possibly finding their way into the equipment under test, thereby producing erroneous measurements. With external sources eliminated, the only source of signal is that fed to the tuner's antenna terminals from appropriately calibrated signal generators.

Pipe Organ Twice Over

In the February 1982 "Audioclinic," I think that you misinformed a reader when he questioned you on the subject of how low a pipe organ can play. You state that most pipe organs can produce frequencies down to 32 Hz, corresponding to a 16-foot pedal pipe, and that some other instruments can even get down to 16 Hz.

If the reader was attempting to determine what the lowest sound on a disc recording of an organ could be, the word "most" should not have been in italics; almost any concert organ worthy of being recorded will have 32-foot pedal pipes.

If he was simply requesting information about pipe organs in general, you should have also added that there are pipe organs that can create frequencies lower than 16 Hz—specifically, the largest organ in the world, housed in Convention Hall in Atlantic City, New Jersey. To really be accurate, the term "largest" is a toss-up between this instrument and the John Wanamaker organ in Philadelphia. The Atlantic City organ has a total of 33,114 pipes and plays in a room the size of four football fields. This instrument has a pedal stop whose largest pipe is an unbelievable 64 feet long; the frequency it produces is 8 Hz! (I will grant you that it is more "felt" than heard, but its effect is quite noticeable.)—Daniel J. Conrad, San Francisco, Cal.

As an organist and audio enthusiast who owns several hundred recordings of pipe organs around the world, I was interested in your response to reader James D. Gibbs in the February 1982 issue concerning the lowest frequency of an organ. Two minor points are here for your consideration:

To say that "most" pipe organs do not have 32-foot stops is a bit misleading because "most" pipe organs never get recorded at all. Of those deemed worthy and important enough to record, a substantial number will have one or more 32-foot stops.

Although I would not expect anyone but a specialist to be aware of it, there is at least one organ in the world that has an actual 64-foot stop! This amazing stop (part of an altogether amazing instrument) is in the Town Hall organ in Sydney, Australia.—Daniel E. Gawthrop, Orem, Utah

"Needle Talk"

Q. Please explain the cause of "needle talk" in record players. In one case I've encountered, the acoustical output from the pickup is very noticeable. Is it possible to reduce or eliminate it?—W. Moroney, Melbourne, Australia

A. The mechanical motion of a stylus in a groove sets up vibrations in the stylus and record. These vibrations in turn move the air, generating sound waves. Any empty spaces in the phono cartridge or headshell will act as resonators, making this "needle talk" or "stylus talk" more audible.

The lower the stylus mass, the less such sounds will be produced. [In my experience, the higher the compliance, the less "talk," too.—*I.B.*] So changing the cartridge may help.

I suppose one could fill air spaces in the shell with caulking compound [if you didn't mind the extra mass—*I.B.*]. I have known some cartridge manufacturers to advocate mounting their cartridges solely by such silicon caulking compound, reducing mechanical coupling between cartridge and shell. This can sometimes eliminate dips and peaks in the region of 4 to 6 kHz.

And, of course, closing the turntable's dust cover will muffle sounds.

Combined Use of Receiver and Amplifier

Q. If I upgrade to a better amplifier, can I run the tuner section of my present receiver to the tuner or AUX input of the new amp? Can I still use the amplifier section of the present receiver to power a time-delay system?—Roger Ross, Peshastin, Wash.

A. If you upgrade to a separate amplifier, you can connect your old receiver to the new amp as you have suggested. If you take your signal from the receiver's "Tape Out" jacks, only the new amplifier's tone and volume controls will affect the sound. If you take the signal from the receiver's "Preamp Out" jack, both the amplifier's and receiver's tone and volume controls will affect the sound from your tuner section.

You should be able to use the amplifier section of your present receiver to power the speakers used with a time-delay device. If you use the receiver's "Tape In" jacks and not its "Amp In" jacks, you will be able to adjust volume and tone to achieve the best sonic effect.

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.

THIS IS THE CAR STEREO TECHNOLOGY EVERYONE ELSE WILL HAVE FIVE YEARS DOWN THE ROAD.

SUPERTUNER™ III.

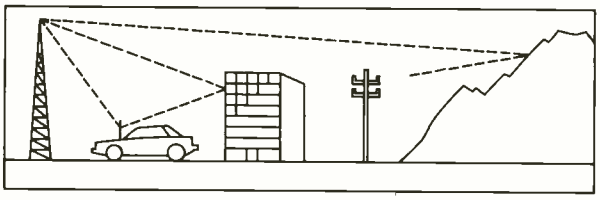
In 1976, Pioneer introduced the first Supertuner technology.

It elevated the car stereo tuner's ability to produce music.

And sent every other car tuner maker scrambling back to the drawing boards.

Now, just when they've finally caught up to the advanced technology of the original Supertuner, Pioneer introduces Supertuner III.

So long, fellas. See you down the road in another five years or so.

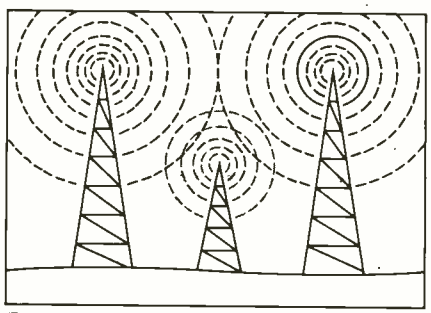


A lot of things stand in the way of clear reception. Like buildings, mountains, even telephone poles. Radio signals bounce off them like balls on a handball court. Creating static, signals cutting in and out. Unless you have a Supertuner III.

FM CAR STEREO RECEPTION SO CLEAR YOU'LL THINK YOU'RE LISTENING TO A CASSETTE.

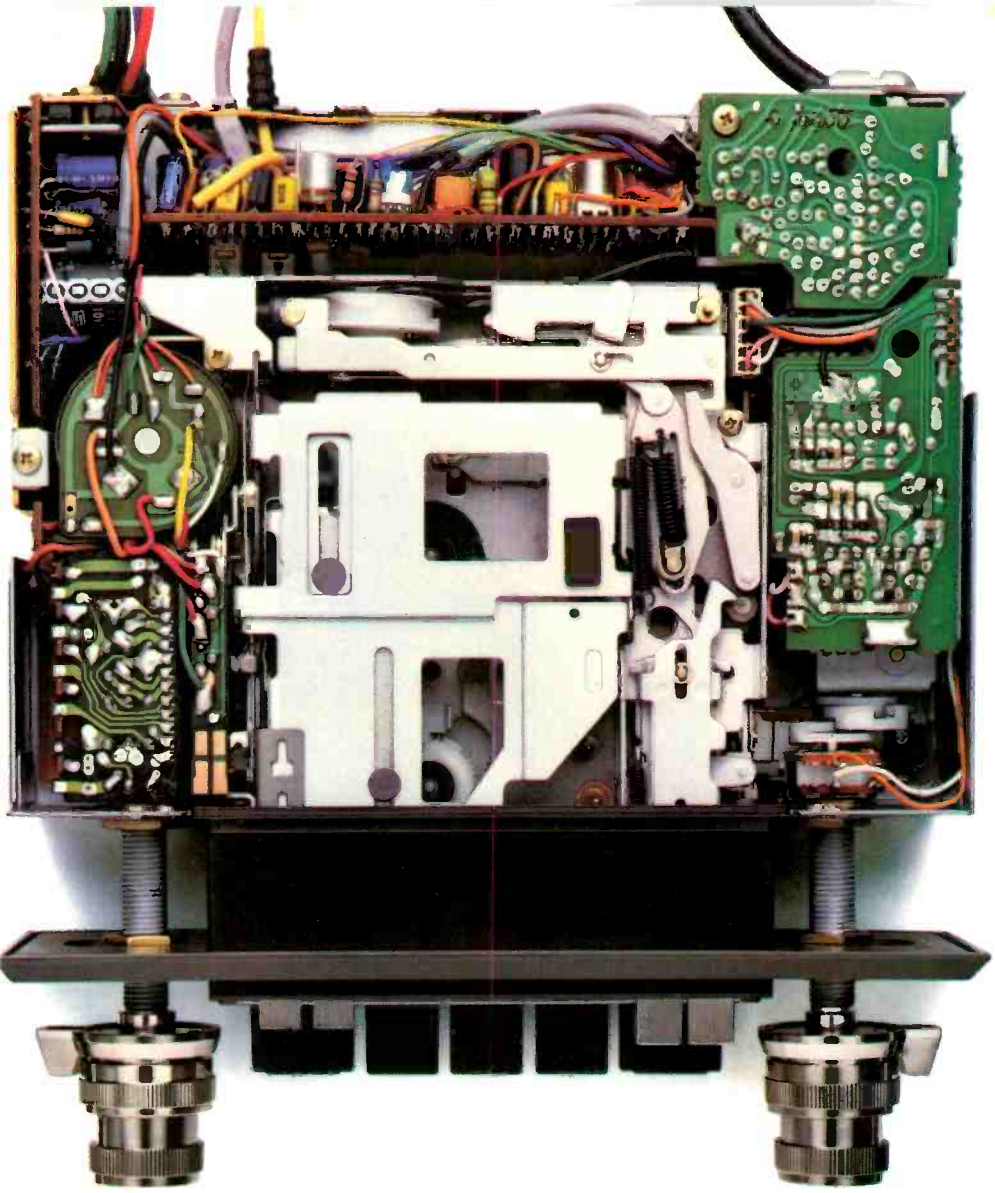
Because music and only music is important to the engineers at Pioneer, anything that gets in the way of the music is as annoying to them as it is to you.

So they've worked continually to develop technology so sophisticated and advanced it virtually eliminates the maddening interference common to all car tuners.



Three-signal-intermodulation is techno jargon for a weak signal that's surrounded by two stronger ones. This is what causes stations to cut into or bleed over others. Except in a new Supertuner III.

Like static. FM noise. Strong signals cutting in or bleeding



on top of weaker ones.

In addition, Supertuner III can capture weak signals from a great distance and lock them in.

So, while Supertuner III offers a great many convenience gadgets like other tuners, it offers something that none of the others can.

The clean, clear, FM stereo reception you should be getting in this day and age.

WHICH CAR TUNER GETS THE BEST RECEPTION IS NOW PERFECTLY CLEAR.

Of course, it's one thing to boast that no other FM stereo tuner eliminates the irritants to your listening pleasure like Supertuner III.

It's another to prove it. Which is just what Pioneer did.

By road testing Supertuner III against the highest quality stereo tuners currently on the market.

The test was conducted in Chicago, Illinois, perhaps the worst FM reception area in the country.

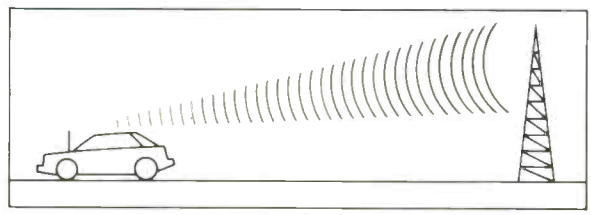
If Supertuner III outperformed the competition here, it would do it anywhere.

Using the same car, with the same antenna, and driving continuously around the same block on the Near North Side (where the world's tallest and third-tallest buildings create FM listening havoc), Pioneer put one tuner after another to the test.

And the clear winner, time after time, was Pioneer's Supertuner III. Downtown, only Supertuner III received stations that came across other tuners sounding like bacon sizzling on a hot griddle. And in the suburbs, only Supertuner III consistently was able to pick up weak stations located downtown, and hold on to them.

Of course, reading this now may impress you. But most likely you'd rather hear the real thing with your own two ears.

So, at your earliest convenience, visit your nearest Pioneer car stereo dealer and ask for a demonstration of Supertuner III.



Cars move and radio stations don't. So the further you drive from the transmitter of your favorite station, the harder it is to capture its signal. Unless you have a Supertuner III. Which is just another reason we should have the market all locked up.

And if, on the drive there, you get static and stations cutting in and out on your car stereo, don't just change stations.

Change car stereos.

PIONEER®

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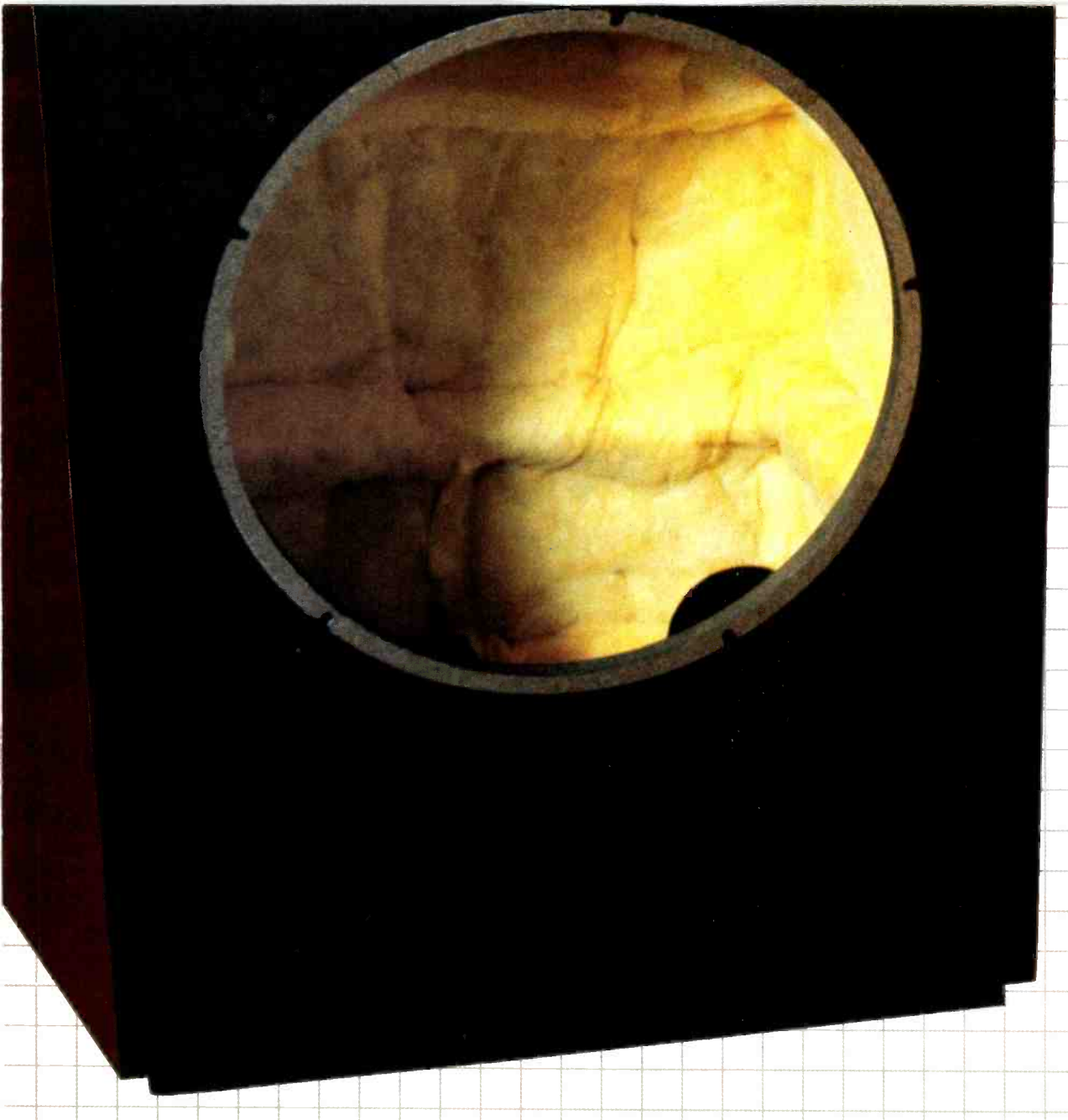

LORR KRAMER and GREG TIMBERS

NEW LOWS IN HOME-BUILT SUBWOOFERS

A good subwoofer offers increased output, lower distortion and frequency response extending below the lowest notes found on most records. Building it yourself merely adds to the fun. Here are several plans, one of which is certain to suit your particular needs.

A free-standing, low-frequency loudspeaker system, or subwoofer, is a proven method of enhancing or, more properly, completing a high-quality, full-range loudspeaker system. Simple in concept, the subwoofer provides an elegant solution to several acoustical problems simultaneously. It is the correct choice for the purist, and at the same time is a source of plain old fun.

This article provides the basic information necessary for building a very high performance subwoofer. Many choices are possible along the way; some of these are presented as options, but because this is a construction-oriented article, we have made specific driver and network recommendations to ensure that a properly engineered system will result.

Why a Subwoofer?

Obviously, one benefit is lower bass and more of it. If you have shopped around, you know that some devices marketed as "subwoofers" really don't go down very low, not even as low as some good bookshelf loudspeakers. This article is about the real thing, a box that really reaches into the nether regions of audibility. True, a few full-range loudspeaker systems reach down as deep, but with very rare exceptions they lack the dynamic capability for realism at moderate to high volume levels. Distortion or power compression get in the way—assuming the speakers survive at all!

Do the frequencies that are a subwoofer's specialty really exist in most recordings? Sometimes yes, sometimes no. Suffice it to say that more and more recorded material includes significant information below 40 Hz, and the trend is accelerating dramatically.

Being the real thing, our subwoofer is crossed over at low level and driven by a separate amplifier. It is possible to achieve this crossover at high level, but the large inductor required for a low crossover point has significant insertion loss and adversely affects the damping of the driver. More important, though, you want to biamplify for the distortion and headroom advantages it brings. Remember that the crossover from the woofer to the midrange, in most three-way loudspeaker systems, occurs above most musical fundamentals. (In two-way systems, of course, the crossover is even higher.) Bass excursions modulate a woofer's midrange output; removing the low bass to the subwoofers largely solves the problem. Amplifiers, too, like to be band-limited, and they likewise show their appreciation with lower intermodulation distortion. The net result is a dramatic improvement in midrange clarity, so significant that many listeners consider the lowering of midrange IM to be the primary benefit.

There's another nice byproduct of biamplification. Suppose you've never been able to decide between that sweet-sounding tube amp with the mushy bass, and that lots-of-feedback, solid-state workhorse you bought a few years back which sounds kind of harsh but sure has a tight bottom end. For once, you can have your cake and eat it too.

There's more. The balance of low bass, relative to the rest of the frequency spectrum, varies widely from recording to recording. (This is partly because of the limitations of some loudspeakers used inappropriately as control-room monitors. And with your subwoofer, you'll be better informed.) Compensation with tone controls or equalizers isn't satisfying because, by definition, they are rarely centered where you need them, and also because they represent added elements in the audio chain. With a subwoofer, you can raise or lower the bass amplifier level without affecting the rest of the system. This is particularly convenient when the biamp crossover has an LF gain control in easy reach. In our experience, while a "best overall" setting is quickly established for the majority of program material, other recordings cry out for a nudge more or less low bass, and this flexibility is really handy.

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Fig. 1—The JBL Model 2245H 18-inch, low-frequency transducer.

"If you own stock in the lumber industry and have a direct link to Hoover Dam, you might want to build the 12-cubic-foot, 20-Hz version."

Computer-generated table of the project subwoofer's performance limits.

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      * 8 CU FT SUBWOOFER USING JBL 2245H *

****************** DRIVER PARAMETERS *******************************
FREE-AIR RESONANCE FREQUENCY =   20.0 HZ
COMPLIANCE EQUIVALENT VOL.   =   29.000  CU FT
Q SUB TS                     =    0.270
EFFICIENCY (HALF-SPACE)      =    2.10   %
EFFECTIVE DIAPHRAGM DIAMETER =   16.00   INCHS
MAX. PEAK LINEAR EXCURSION   =    0.500  INCHS
PEAK DISPLACEMENT VOLUME     =  100.53   CUBIC INCHS
THERMAL LIMIT INPUT POWER    =  300.0    WATTS

****************** BOX PARAMETERS **********************************
NET INTERNAL VOLUME          =    8.000  CUBIC FEET
HELMHOLTZ BOX RESONANCE FREQ.=   26.0    HZ
BOX LEAKAGE Q  (Q SUB L)     =    7.0
MINIMUM VENT AREA            =   52.3 SQUARE INCHS

VENT LENGTH          VENT AREA
  INCHS            SQUARE INCHS
  19.87                52.3
  43.24               104.6
  91.43               209.1

****************** SYSTEM PARAMETERS *******************************
TUNING RATIO = N = FB/FS     =    1.300
ALPHA = VAS/VB               =    3.625

 FREQ.   RELATIVE  MAXIMUM      MAXIMUM   RELATIVE  MAXIMUM  LIMIT
 (Hz)    RESPONSE  ACOUST.       ROOM     MAXIMUM   INPUT    D=DISP.
         (dB)      CUT (W)      SPL (dB)  OUT (dB)  (WATTS)  T=THERMAL
 ----    --------  ---------    --------  --------  -------  ---
  1.0    -108.7    2.61E-12      -1.9     -123.8      9.2     D
 10.0     -32.8    3.56E-04      79.5      -42.5     32.5     D
 12.5     -26.4    2.60E-03      88.1      -33.8     54.6     D
 15.0     -21.4    1.47E-02      95.7      -26.3     97.6     D
 18.0     -16.6    1.02E-01     104.1      -17.9    223.9     D
 20.0     -14.0    2.51E-01     108.0      -14.0    300.0     T
 22.5     -11.2    4.76E-01     110.8      -11.2    300.0     T
 25.0      -8.9    8.06E-01     113.0       -8.9    300.0     T
 27.5      -7.1    1.24E+00     114.9       -7.1    300.0     T
 30.0      -5.6    1.74E+00     116.4       -5.6    300.0     T
 32.5      -4.4    2.26E+00     117.5       -4.4    300.0     T
 35.0      -3.5    2.78E+00     118.4       -3.5    300.0     T
 37.5      -2.9    3.26E+00     119.1       -2.9    300.0     T
 40.0      -2.3    3.68E+00     119.6       -2.3    300.0     T
 45.0      -1.6    4.34E+00     120.4       -1.6    300.0     T
 50.0      -1.2    4.80E+00     120.8       -1.2    300.0     T
 55.0      -.9     5.12E+00     121.1       -.9     300.0     T
 60.0      -.7     5.35E+00     121.3       -.7     300.0     T
 65.0      -.6     5.52E+00     121.4       -.6     300.0     T
 70.0      -.5     5.64E+00     121.5       -.5     300.0     T
 80.0      -.3     5.81E+00     121.6       -.3     300.0     T
 90.0      -.3     5.93E+00     121.7       -.3     300.0     T
100.0      -.2     6.00E+00     121.8       -.2     300.0     T
125.0      -.1     6.11E+00     121.8       -.1     300.0     T
150.0      -.1     6.17E+00     121.9       -.1     300.0     T
175.0      -.1     6.21E+00     121.9       -.1     300.0     T
200.0      -.0     6.23E+00     121.9       -.0     300.0     T
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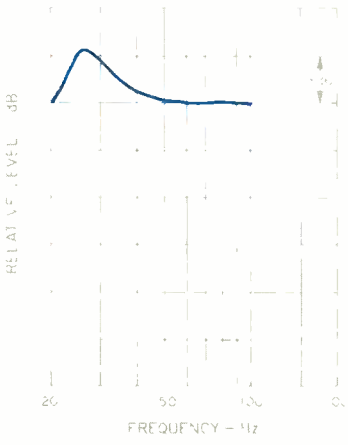

Fig. 2—Equalization required for the 8-cubic-foot project box.

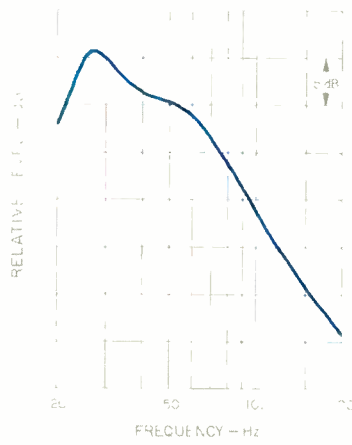

Fig. 3—Voltage drive provided to subwoofer amp by BX63 network. Note its similarity to Fig. 2.

If you intend to use a single subwoofer, summing the left and right bass channels, you will eliminate most record warp and any other turntable noise or feedback problems which express themselves as vertical stylus motion. Such motion appears out of phase in the two channels, and when left and right are summed, it disappears. We are recommending a low crossover point (63 Hz)—in part to minimize any loss of localization information when a single subwoofer is used. Aside from the difficulty in hearing directionality below 100 Hz, many recordings are deliberately summed at lower frequencies for disc mastering considerations. Nonetheless, stereo subwoofers have some credible adherents. Follow the requirements of your own ears, floor space, and pocketbook.

Speaking of floor space, though good subwoofers are not small, they allow the use of smaller satellite loudspeakers, and the total space occupied by all three enclosures could well be less than the space required by a pair of conventional loudspeakers of equivalent performance (assuming such an equivalent exists). There's an economic flexibility as well, in that the satellites and main amplifier can be purchased now, the subwoofer and its electronics later.

By now we hope you want to either buy one of these low-frequency contraptions or build one. Here's how to build one.

The Project Box

Many articles and technical papers have been written on the theory and design of vented-box bass systems, so we will not encumber these pages with the math and physics of the problem. We chose a vented box primarily because of its very low distortion and extended low-frequency cutoff. We did build and audition a properly designed sealed-box subwoofer using the same driver. When the vented and sealed systems were equalized for similar response, the dynamic performance of the vented system was judged to be significantly better.

The driver we chose is the JBL Model 2245H (Fig. 1), an 18-inch low-frequency transducer designed specifically for low-distortion, high-level professional bass reproduction. It has a

Fig. 4—The JBL Model BX63 dividing/summing network.

safe excursion limit of 1 inch, peak-to-peak. Extended bass at reasonable efficiency requires either very large box volume, or large amounts of amplifier horsepower—or both. We sat down with our friendly vented-box designing computer and came away with two interesting candidates. The first is a 12-cubic-foot box tuned to 20 Hz. This is a classic sixth-order alignment requiring 6 dB of boost at 20 Hz and resulting in a system f_3 (3 dB-down point) of about 21 Hz. The second contestant is an 8-cubic-foot box, quasi-third-order alignment, tuned to 26 Hz. With 6 dB of boost added at 26 Hz, it becomes a quasi-fifth-order system with an f_3 of 26 Hz. For this project, we chose the latter system because of its more moderate size. The 26-Hz cutoff was deemed low enough not to compromise sonic performance.

Our computer provided a table, included here, listing driver parameters and response of the 2245H, and maximum output with respect to thermal and displacement limits when installed in the project box. Note the extremely high output levels. This system is the acoustical equivalent of the JBL Model B460 low-frequency loudspeaker.

You might now ask, "Why equalize?" In order to keep the efficiency up and the box size down, we chose to take advantage of the driver's sizable power capacity and the relatively inexpensive price of amplifier power. Notice that the system has an unequalized f_3 of about 35 Hz, which means that the extra power demands of the boost only come into play when there is substantial signal below 35 Hz.

The equalization necessary to flatten the response is shown in Fig. 2. The 2245H can be crossed over as high as 500 Hz, because its midrange response is smooth. A number of low-level crossovers suitable for subwoofers are commercially available. Figure 3 shows the voltage drive of our recommended crossover, the JBL Model BX63 (Fig. 4), which was chosen for this application because it was designed specifically for the present combination of driver and enclosure. [*Editor's Note*: Plans for a crossover you can build yourself are elsewhere in this issue.] Figure 5 illustrates the combined subwoofer and crossover response with 3 dB-down points of 26

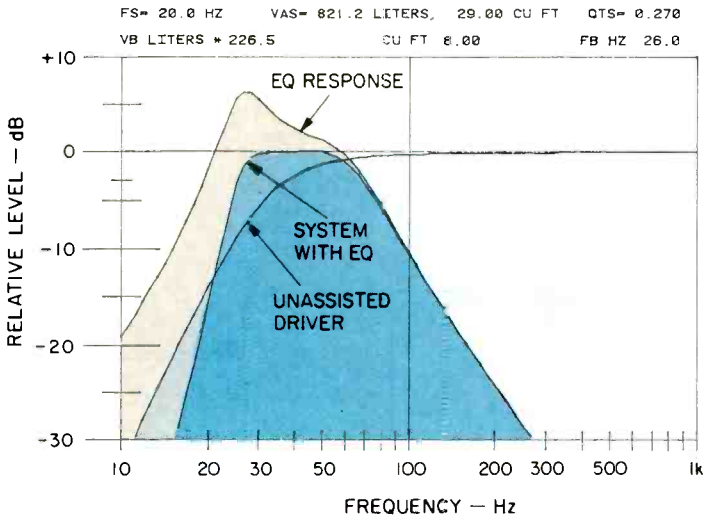

Fig. 5—Response of BX63 network (top curve) and driver's unassisted output (bottom curve) combine (middle curve) to produce flatter response down to 26 Hz and greater output above 20 Hz than unassisted driver. Data above diagram are driver parameters for free-air resonance, compliance equivalent volume, and total "Q."

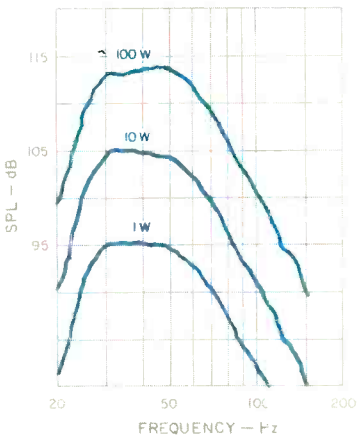

Fig. 6—Power compression of project subwoofer. Note lack of compression at levels below 10 watts, slight compression above.

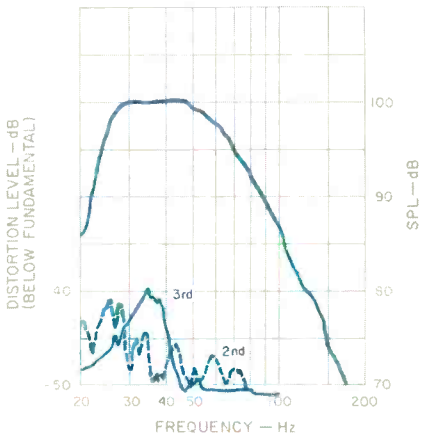

Fig. 7—Distortion at 100 dB drive level. Levels shown for second- and third-harmonic products have been shifted up by 20 dB to fit chart recorder.

Fig. 8—The 8-cubic-foot project subwoofer with 18-inch driver.

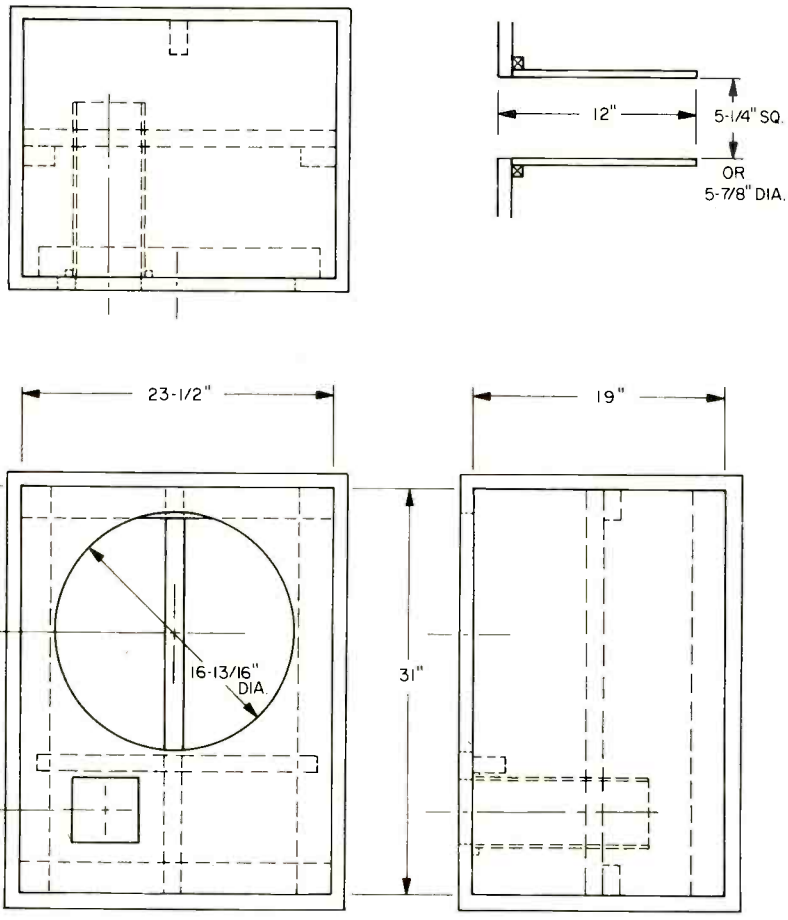

Fig. 9—Construction sketch for 8-cubic-foot enclosure. Dimensions shown are *inside* dimensions. Braces, cleats and port duct are shown as dotted lines.

and 63 Hz. The quasi-fifth-order alignment includes a subsonic roll-off to unwanted cone motion below 20 Hz.

The performance of the project box is summarized in Figs. 6 and 7. Figure 6 illustrates power compression. Note zero compression as input rises 10 dB from 1 to 10 watts; output tracks with the same 10 dB rise. Over the next 10 dB, from 10 to 100 watts, only 1 to 2 dB of compression occurs; most loudspeakers would never even reach this output level. Figure 7 shows second- and third-harmonic distortion at the 100 dB drive level; −40 dB represents 1% distortion. At this output level, distortion of less than 5% to 10% is very unusual, regardless of loudspeaker type.

Construction

We have built several different enclosure shapes for various visual considerations, with no problems acoustically. It is always wise to avoid interior dimensions whose ratios are 2:1, 3:1, 4:1, etc., because such integral ratios often promote severe standing wave problems. For the same reason, it helps to mount the driver approximately one-third of the way down the long side. Our project enclosure (Fig. 8) has internal dimensions of 31 × 23½ × 19 inches. Refer to Fig. 9 for construction details. We recommend 1-inch particleboard or fiberboard, 50-pound density or greater, for the requisite acoustical deadness. Plywood is acceptable, but generally not as dense as composition materials. The panels should be further stiffened by 2 × 4s run the long dimension on each side, top and bottom. These stiffeners should be offset from the panel centers slightly so that they overlap in the corners and can be glued together. A back brace runs from top to bottom and should be cut so that it just touches the top and bottom panels. A baffle stiffener, which should be kept clear of the side panels so that it doesn't buzz, is also used. All stiffeners should be securely glued to the panels with your favorite brand of white glue. The type of joinery used between panels will depend on your expertise and on the type of finish details you desire; simple butt joints using plenty of glue and an occasional glue block are completely acceptable for strength.

"We chose a vented box for its very low distortion, extended low-frequency cutoff, and significantly better dynamic performance."

The baffle can be permanently attached (glued in place) or removable (using screws and cleats). If it is to be removable, use caulking to make certain there are no air leaks. The box should be lined with fiberglass on the back, sides, top, and bottom. House insulation glass is fine; if it is foil-backed, be sure to place the foil side against the cabinet. The port area should be 27 square inches, and the duct length (including baffle thickness) should be 12 inches. We typically use thick-walled cardboard tubes for our ducts. PVC pipe also works well, as do rectangular ducts fabricated from ¼-inch masonite or ⅜-inch particleboard. (For a 27-square-inch area, a round tube's *internal* diameter should be 5.86 inches.) Remember that as long as the port area is maintained, the cross-sectional shape (round, square, etc.) is not important.

The enclosure proportions are equally suited to lowboy or highboy orientation. We advise you to finish all four sides so that you always have the choice. A non-attached kick base, about 1½ inches high, can now be fabricated so that the system will appear to hover above the floor. This treatment makes the cabinet appear more finished and less bulky. If you wish to build a grille, allow at least 1 inch clearance in front of the baffle for the 2245H frame thickness and forward suspension travel. Use an open-weave cloth, and stretch it tightly so that it doesn't flap. Too tight a weave will tend to damp port operation.

Considerable current will be flowing to the subwoofer at times, so use, at the very least, 16-gauge stranded wire or a high-quality loudspeaker cable for your internal connections. Use a good input connector such as a five-way binding post, and solder the internal wire to the back of the terminal. Your external wire run should be as short as possible; use premium cable.

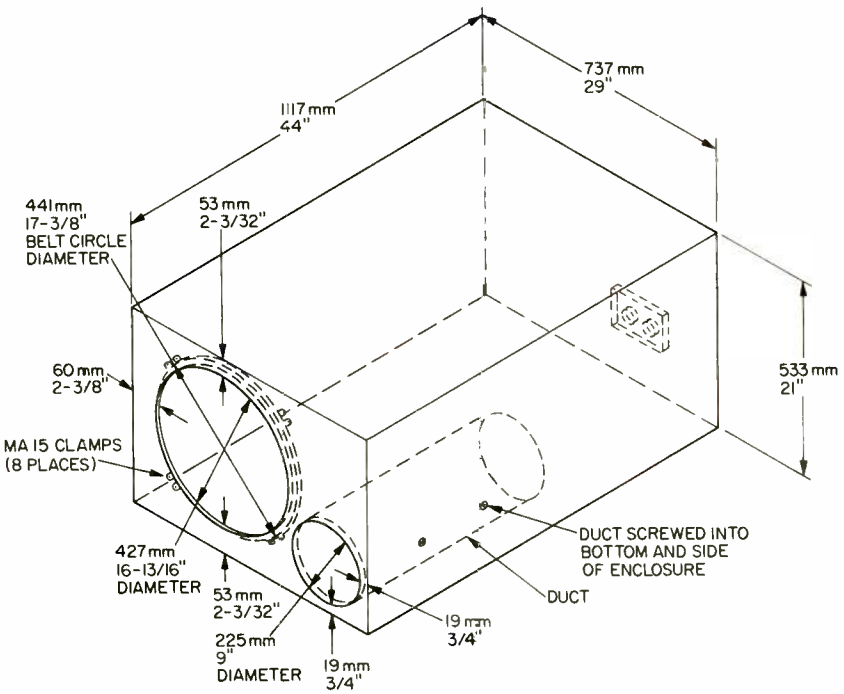

Fig. 10—Plans for a 12-cubic-foot subwoofer enclosure. Exterior dimensions shown produce correct interior volume when ¾-inch board is used for walls; for thicker walls, increase exterior dimensions accordingly. Internal bracing has been omitted from diagram for clarity (see text). All sides except the baffle panel are to be with 1 to 2 inch (25 to 50 mm) fiberglass. For the 25-Hz, unassisted fourth-order alignment, duct length should be 20 inches (508 mm), and a 15 to 20 Hz high-pass filter is strongly recommended. For the 20-Hz, sixth-order alignment, duct length is 30 inches (762 mm), and a low-level equalizer with +6 dB boost at 20 Hz and Q = 2 is required. It is recommended that this unit be used only below 80 Hz, with a monaural bass sum signal.

Alternative Designs

Some of you might be interested in the 12-cubic-foot box mentioned earlier; Fig. 10 gives the necessary construction details. Two systems are possible. The first is a 25-Hz, unassisted fourth-order alignment. The second is a 20-Hz, sixth-order assisted (EQ-required) alignment. The 12-cubic-foot unassisted design gives essentially the same response curve as our 8-cubic-foot project box, and does so without the 6 dB of equalization. Again, the trade-off is enclosure volume versus amplifier power.

If you own stock in the lumber industry and have a direct link to Hoover Dam too, then you can build the 12-cubic-foot, 20-Hz enclosure. It requires 6 dB of boost at 20 Hz, in addition to being huge, but will return a 3 dB-down point slightly above 20 Hz. We consider this box to be an interesting exercise, but overkill for almost all program material.

Fig. 11—The JBL B380, a 4½-cubic-foot subwoofer, using a 15-inch driver.

For the rest of you who consider 12 cubic feet way too large and 8 cubic feet a little too large, we have a 4½-cubic-foot offering intended for use with the JBL Model 2235H 15-inch driver. This subwoofer gives essentially the same curve shape as the 8-cubic-foot box, requires the same equalization, and is 4 dB less efficient. The 2235H handles a little less power, so this system has a 6 dB lower overall output capability (still very substantial, however). All of the construction details are the same as for the 8-cubic-foot project box, except that this enclosure was designed with ¾-inch material. The exterior dimensions are 27½ × 20¾ × 17 inches. The port area should be 13½ square inches, and the duct 12 inches long (including the baffle thickness). For the smaller panel sizes of this enclosure, 1 × 3-inch braces are sufficient. This system is equivalent in dimensions and performance to the JBL Model B380 subwoofer (Fig. 11).

Power Considerations

To provide adequate headroom, no less than 200 watts should be used with any of the subwoofers described. Significantly better dynamic performance can be achieved with larger amplifiers— assuming, of course, that the main loudspeakers and amplifiers can keep up. A meaningful maximum power limit is difficult to set because of the dynamic nature of music. The continuous sine wave power ratings of the 2245H and 2235H drivers are 300 and 150 watts, respectively. With music as a signal and with the drivers loaded into their enclosures, nominal maximum amplifier power guidelines of 800 and 600 watts, respectively, apply. But if you are willing to travel at your own risk, we'll reveal that, in our experience, the bigger the amp, the better. In our listening room, which is rather large and acoustically dead, our 18-inch, 8-cubic-foot subwoofer is connected to 2 kilowatts of power and has never shown any sign of distress even at peak amplifier output. In short, in most cases the bass amplifier will reach its limit before these subwoofers will reach theirs.

If you are using a single subwoofer and don't have a single-channel amplifier handy, a convenient way to get the power is to bridge a dual-channel amplifier. Depending on its power supply and current capability, a bridged amplifier can produce up to four times its per-channel rating. Most bass is transient in nature, so unless it's a sustained organ pedal or synthesizer, you will be able to get peaks of nearly four-times rated power even out of less robust amplifier designs. Of further comfort to the bass amplifier is the fact that, with the project subwoofer, maximum EQ boost occurs at vent resonance, presenting close to a purely resistive load to the amplifier at that point.

Some amplifiers bridge at the flip of a switch; at the opposite extreme, non-inverting designs with no bridging provision require that the input to one channel be inverted by additional circuitry. The BX63 network mentioned above includes both normal and inverted LF outputs, which will quickly bridge the vast majority of dual-channel amps available.

Setting Up

The optimum placement for a subwoofer is generally between the full-range systems, and within 3 feet of a line drawn between them (3 feet forward to 3 feet behind the line). Proper polarity is, of course, critical, and with all the inversions possible in the chain (especially with a bridged amplifier), the best way to check phase is by ear. Repetitive, percussive bass, such as kick drum or bass guitar, is the material easiest to use for this purpose. To the extent that your room allows, experiment with placement using recordings with deep bass content. Shifts in location of 6 inches can have a perceptible effect.

As a starting point for setting level, the bass gain should be advanced just to the threshold where sound *above* the crossover point begins to be affected by switching the subwoofer in and out. In any case, it won't take much listening to find the right setting subjectively. Typically, subwoofers are set highest when first installed, out of the owner's enthusiasm for his new toy. If the owner is also the builder, his enthusiasm can be described as maximal. After the intitial fun, the listener usually finds that setting most satisfying which provides the most realism—in other words, real life rather than larger than life. And once you've experienced a good subwoofer, properly set up, nothing short of that performance level sounds like real life.

Acknowledgements

The authors would like to thank W. J. J. Hoge of JBL for setting the stage with his very popular subwoofer article of 1976 in these pages. His work made our efforts quite straightforward. We would also like to thank D. B. Keele, Jr. (JBL) for his kind assistance with the computer. His efforts made the special voltage drive of the BX63 a reality. Finally, we would like to credit Douglas Warner of Warner Design, Berkeley, Cal. for the proportions of the 8- and 5-cubic-foot enclosures (and the industrial design of the 2245H, BX63, B460, and B380).

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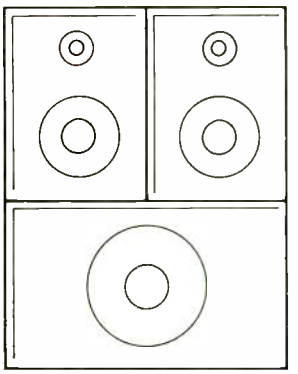


BUILD A CENTER-WOOFER CROSSOVER

M. J. SALVATI

Feeding low bass to subwoofers brings your system several advantages; using a single, center-channel subwoofer brings a few more. The electronics needed for this are easy to build, and can be used with either a mono or a stereo power amp.

In conventional systems, the right- and left-channel speaker systems must usually be either large or inefficient—and usually expensive—to get low bass. It's not always possible to place speakers (especially large ones) so as to achieve both optimum bass and optimum stereo imaging; it's also hard to design speaker cabinets for both low-bass output and optimum high-frequency dispersion.

With the lowest tones directed exclusively to subwoofers, it does not matter if the right- and left-channel speakers have poor performance at those frequencies. Relatively small, full-range speakers, having excellent sound (from, say, 100 Hz up to 20 kHz), can be part of a first-class sound system despite their low-bass deficiencies. Those speakers can also be placed without regard for the effect on low-frequency reproduction—for instance, off the floor for more natural imaging and better dispersion. Only the woofer need be placed with bass in mind, and it can often be out of sight for aesthetic reasons.

With a subwoofer, distortion often becomes lower. If the subwoofer is fed from its own amp, distortion products from the bass cannot affect the mid-range and treble, which are powered separately. By eliminating low-frequency input to the main speakers, the chance of interfering with (or even damaging) high-frequency and mid-range reproducers in poorly sealed enclosures is eliminated.

Using a single woofer for both channels adds some more advantages First, a single woofer is easier to place (and to afford). Second, a center-channel woofer can reduce (or, some feel, eliminate) turntable rumble. The stylus motions produced by rumble are primarily vertical, producing equal but oppositely phased rumble components in each channel. In the usual stereo system, the rumble sound output from the right and left speakers will not cancel completely, due to inter-channel phase shifts and acoustic factors, and so can be heard. Even if inaudible, they make the speakers and amplifiers work harder (sometimes contributing to distortion from other causes). With a single, center-channel woofer, nearly all rumble is cancelled. Lastly, if only one big woofer and enclosure are required, you can get a bigger and better model for the space and money available.

If any of these advantages appeal to you, read on. This article describes the construction and use of the crossover filters and bass-summing mixer needed to implement a center-woofer system. This particular implementation operates between the preamp and power amplifiers (Fig. 1A), rather than between the power amplifier and speakers. This has several advantages. The mixing and crossover are made at negligible power levels, avoiding the huge and expensive components normally required for a very low crossover frequency, and the subwoofer can be driven directly by its own power amplifier. This results in a high damping factor for the woofer, and no loss of separation between right and left channels or interaction between speakers.

Notice that the basic setup (Fig. 1A)

Table I—Specifications.

General

Crossover Frequency: 100 Hz (selectable, see text).
Input Impedance: 100 kilohms per channel.
Output Impedance: 100 ohms per channel.
Input/Output Level: 1 V rms typical, 5 V rms maximum.
Power Requirements: 110 to 130 V a.c., 3 VA.

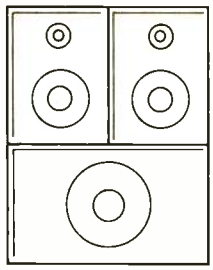
Center Channel

Passband: D.c. to 100 Hz, −3 dB.
THD at 1 V rms: Less than 0.015% at 20 Hz.
S/N Ratio, 10 Hz to 10 kHz: 120 dB below 1 V rms.
H.f. Roll-Off Rate: 12 dB/octave.
Maximum Output Level: 8 V rms.

Right and Left Channels

Passband: 100 Hz (−3 dB) to 150 kHz.
THD at 1 V rms: Less than 0.006% at 500 Hz, less than 0.015% at 20 kHz.
S/N Ratio, 10 Hz to 20 kHz: 114 dB below 1 V rms.
L.f. Roll-Off Rate: 12 dB/octave.
Maximum Output Level: 6 V rms at 20 kHz, 1 V rms at 100 kHz.

"The electronics needed for a single-channel subwoofer are easy to build and can be used with either mono or stereo amps."



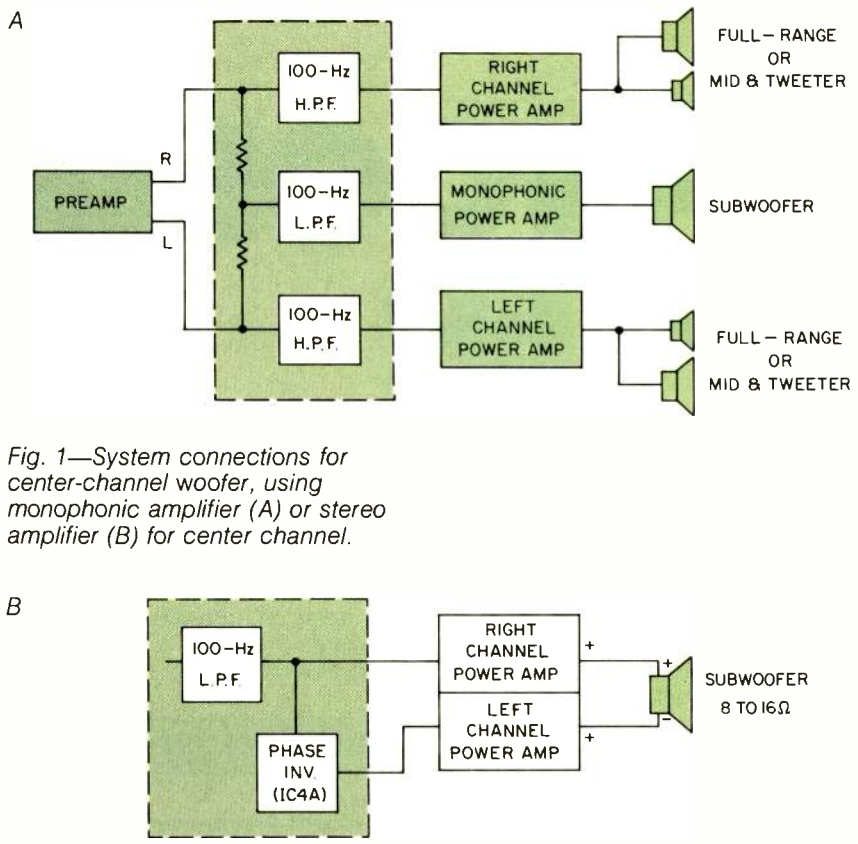


Fig. 1—System connections for center-channel woofer, using monophonic amplifier (A) or stereo amplifier (B) for center channel.

uses a monophonic power amplifier to drive the center-channel subwoofer. If you do not have a suitable mono power amplifier, no problem; Fig. 1B shows how to connect a conventional stereo power amplifier to drive the center woofer. A built-in phase inverter drives one channel of the stereo power amp, so the subwoofer can be differentially connected across the R and L output terminals to use the power of both amplifier channels.

The crossover is compatible with all standard preamps, power amps, integrated amplifiers, and receivers. The only requirement (of receivers and integrated amplifiers) is that the preamp/power amp chain can be broken for insertion of the device. As Table I shows, there will be no degradation of even the finest sound system when using this device. In fact, the distortion levels indicated are actually the residual levels of my test equipment.

The optional voltage monitor will flicker yellow when high-amplitude, sub-bass tones pass through the crossover unit. If a d.c. breakdown occurs, it will glow steadily (red for a positive fault voltage, green for a negative fault voltage).

Theory of Operation

This crossover network divides the stereo signal frequencies, providing a derived center-channel signal consisting solely of low bass, and right and left channels consisting of upper bass through treble. The frequency division is done prior to power amplification. A phase inverter stage is also provided so that a standard stereo power amplifier can be used as a center-channel monophonic power amplifier. The schematic diagram is shown in Fig. 2.

R and L Channels. Op-amp IC1A is a unity-gain buffer that provides a high input impedance for the right channel, and a low output impedance to drive the filter and mixing matrix. Op-amp IC1B is configured as a two-pole, high-pass filter with a 12 dB/octave roll-off and a fairly sharp corner. The values of resistors R12 and R13, and capacitors C1 and C2, set the −3 dB corner frequency (see Table III). The low output impedance of IC1B enables it to drive power amps with very low input impedances. Op-amps IC3A and IC3B, and R14/R15/C5/C6 perform the same functions for the left channel.

Center Channel. Resistors R2 and R3 form a mixing network that combines right- and left-channel signals to produce a derived monophonic or center-channel signal. Op-amp IC2A is a unity-gain buffer/driver for the low-pass filter consisting of op-amp IC2B and R4/R5/C3/C4. Like the filters in the left and right channels, this two-pole filter has a 12 dB/octave roll-off and a fairly sharp corner. Op-amp IC4A is a unity-gain inverter that provides an output signal at C(L) jack J5 that is equal in amplitude but opposite in phase to the output signal at C(R) jack J4.

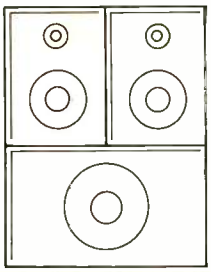
Op-amp IC4B is a voltage sensor that lights LED D3 if a significant d.c. voltage appears at either of the bass output jacks (J4/J5). This provides visual warning of a malfunction in either the preamp driving this crossover unit, or op-amps IC1A, IC3A, IC2, or IC4A.

Construction Notes

To get the highest possible S/N ratio, do not route the power transformer's wiring near the circuitry or connectors, and mount the transformer as far from the circuit board as your enclosure permits. For example, you might bolt transformer T1 to one end of a minibox, and use the opposite end to mount connectors J1 through J6.

Choice of Parts. There is considerable latitude in the ratings for some of the parts listed in Table II. For example, the low-power (100-mA, TO-92 case) versions of voltage regulators IC5 and IC6 will do nicely, although the equivalent higher power versions listed will work just as well. Similarly, any ceramic capacitor having a voltage rating over 20 V and a capacitance range of 0.02 to 0.1 μF can be used for C7 through C14. The most important consideration for these bypass capacitors is to locate them physically close to their associated ICs.

Although 10%-tolerance capacitors and 5%-tolerance resistors can be used for the filter networks, crossover accuracy may be improved by using high-stability, 5% capacitors and 1%



"If the subwoofer is fed from its own amp, distortion from the bass region cannot affect the treble and midrange, which are powered separately."

metal-film resistors. (Both 1% and 5% resistor values are given in Table III.)

The RC4739 (IC1 through IC4) is a dual op-amp specifically promoted as a low-noise amplifier. The RC4136, RM4136 and RV4136 made by Raytheon and by Texas Instruments have identical circuits and specifications. These, however, are quad op-amps in 14-pin packages, so the pin connections are different from those of the 4739, and the parts layout will be more difficult. Still, if you have trouble obtaining the 4739, the 4136 can be used; one for the R and L channels and one for the C channel and sensor. Just be careful in laying out the parts for the R and L channels, to avoid coupling.

The "B" and "Y" adjacent to LED D3 in Fig. 2 refer to the color-coding of the IDI 5100H1/5 leads. If you use a different LED, connect it so that pin 13 of IC4B gets the lead that produces a *red* glow in D3 when a *negative* current is applied to it.

Options and Modifications. To further reduce the amount of very low bass reaching the R and L speakers, you may wish to add capacitors in series with the R and L outputs (J3 and J6 respectively). These capacitors introduce additional roll-off, with a 30-Hz, −3 dB corner. Their value depends on the input impedance of the R/L power amplifier; typical values are 0.5 μF for 10 kilohms, 0.2 μF for 25 kilohms, 0.1 μF for 50 kilohms, and 0.05 μF for 100-kilohm input impedance. These capacitors will also protect main-channel power amplifiers with d.c. input coupling in the event of a d.c. breakdown of IC1B or IC3B. If your power amplifier is a.c.-coupled, it is probably not worth bothering with these additional capacitors.

The voltage sensor (IC4B and bipolar LED D3) for the center channel is just a bit of fluff added to "use up" the spare op-amp. If your crossover device is located where you can't see the LED, or if you simply do not want to bother with it, feel free to omit D3 and R17.

The crossover frequency specified in Table I is 100 Hz. If this frequency is too high for your situation, you can lower the frequency by changing the values of resistors R4 and R5, and R12 through R15. The nearest 1% and 5% standard tolerance values for various frequencies are listed in Table III; note that some 5% values are made by connecting resistor pairs in parallel or series. [*Editor's Note*: The values given in Table III cover not only frequencies from 100 down to 70 Hz, but also frequencies as high as 120 Hz. The latter are not recommended, as they make the separation between the main speakers and subwoofer too audible, but are provided where factors such as poor main-speaker performance below 120 Hz necessitate their use.—*I.B.*]

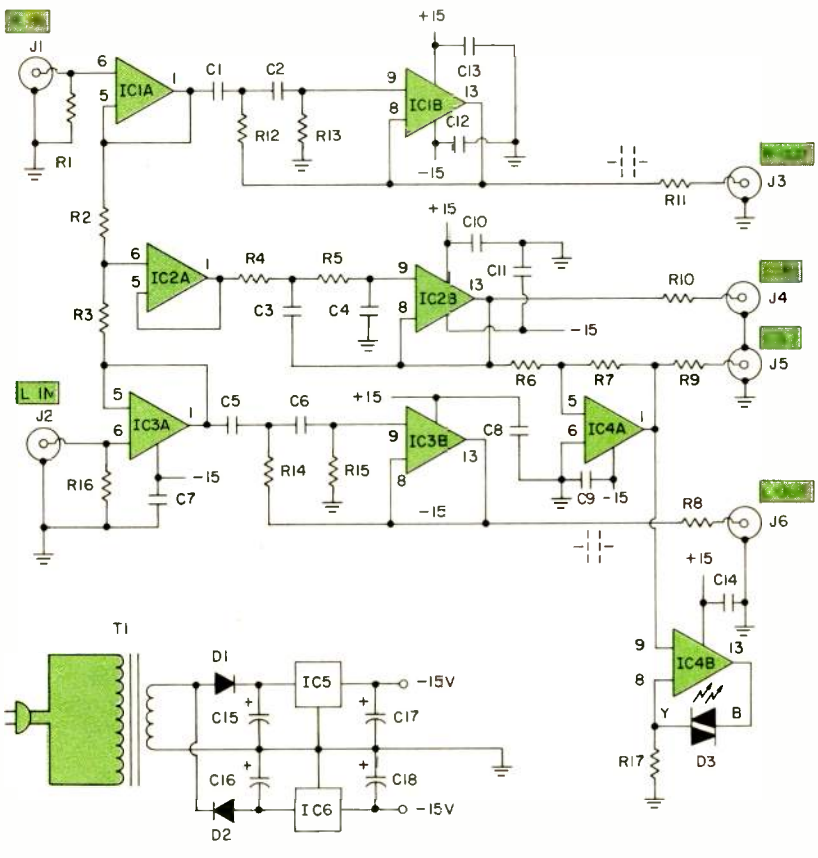
Parts Availability. All parts except for IC1 through IC4 and D3 are available from Digi-Key (Box 677, Thief River Falls, Minn. 56701). Their carbon-film resistors and Panasonic-brand capacitors are recommended for their accuracy and long-term stability. Digi-Key also offers 1%-tolerance, metal-film resistors. The op-amps and D3 are available from Jameco Electronics (1355 Shoreway Rd., Belmont, Cal. 94102; $10 minimum) and from Active Electronics (Box 8000, Westborough, Mass. 01851; $10 minimum). Order their catalogs first, to check prices and availability.

Operating Instructions

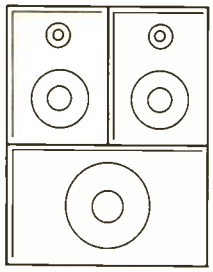
To be worth the effort, the center speaker should be a very high quality reproducer over the sub-bass, low-bass, and mid-bass ranges. This generally means a large woofer (or equivalent) housed in a large enclosure that is well coupled to the listening room. [*Editor's Note:* Plans for such a speaker are elsewhere in this issue.] To add a small, ineffective center-channel reproducer, even to a mediocre stereo system, is a waste of time and money. Like so many things in this world, the center-woofer technique must be properly implemented to be effective.

The choice of crossover frequency requires a little thought and a little

Fig. 2—Schematic diagram.



"Driving the subwoofer by its own power amplifier results in a high damping factor and no loss of imaging between speakers."



measurement for best results. If set too high, the listener can discern the direction of the sound coming from the center channel. If set too low, the R and L speakers might have to handle frequencies at which their performance is poor. The 100-Hz crossover frequency specified in the preceding text is merely an average suggested value. The ideal crossover frequency depends on several factors: The capabilities of the stereo speakers and the center woofer, the roll-off rate of the crossover filters, etc. You can and should use the lowest possible frequency consistent with the performance of the center woofer and the R and L speakers. For example, if your stereo speakers sound poor even at mid-bass frequencies, you should choose a relatively high crossover frequency, i.e. 120 Hz. However, if the stereo speakers sound reasonably well in the mid-bass, and only the low bass is deficient, a lower crossover frequency (i.e. 80 Hz) is better. A good choice in most situations would be 100 Hz, which leaves a reasonable margin for error.

After selecting the crossover frequency and soldering in the appropriate value resistors (per Table III), assemble the sound system as follows:

1. Connect the R preamp output jack to the R crossover in jack (J1). Connect the L preamp output jack to the L crossover in jack (J2).
2. Connect the crossover's R output jack (J3) to the R input jack of the R/L stereo power amplifier. Connect the crossover's L output jack (J6) to the input jack of the R/L stereo power amp.
3. If you are using a monophonic amp to power the center woofer, connect the crossover C(R) jack (J4) to the amplifier's input jack. If you are using a stereo power amplifier for the woofer, connect J4 to that amplifier's R input jack, and the C(L) output (J6) to the amplifier's L input jack.
4. If you're using a monophonic woofer amp, connect the subwoofer's "+" terminal to the amplifier's "+" connector, and the subwoofer's "−" terminal to the amplifier's "−," "Common," or "Ground" terminal. If you are using a stereo amplifier for the woofer, connect the subwoofer's "+" terminal to the amplifier's right "+" output terminal and the speaker's "−" terminal to the amplifier's *left* "+" terminal. (The amplifier's "Common" terminals are not used.)
5. Make the usual connections between the R and L speakers and the stereo amplifier driving them.
6. Plug the power cord of the crossover device into a switched outlet on the preamp or receiver.

As previously mentioned, the center speaker can be located nearly anywhere in the listening room, preferably in the general vicinity of the R/L speakers. If the center speaker is set too far away, you might notice directionality and/or phase delay between the fundamental bass tone reproduced by the center speaker and the harmonics of those bass tones reproduced by the R and L speakers. The siting of the R and L speakers should be as before, but they should be elevated off the floor a few feet to improve the high-frequency dispersion.

When all speakers have been placed, and everything connected, operate the system and balance the volume between the center channel and R and L channels by adjusting the level control on the center-channel power amplifier. Good listening!

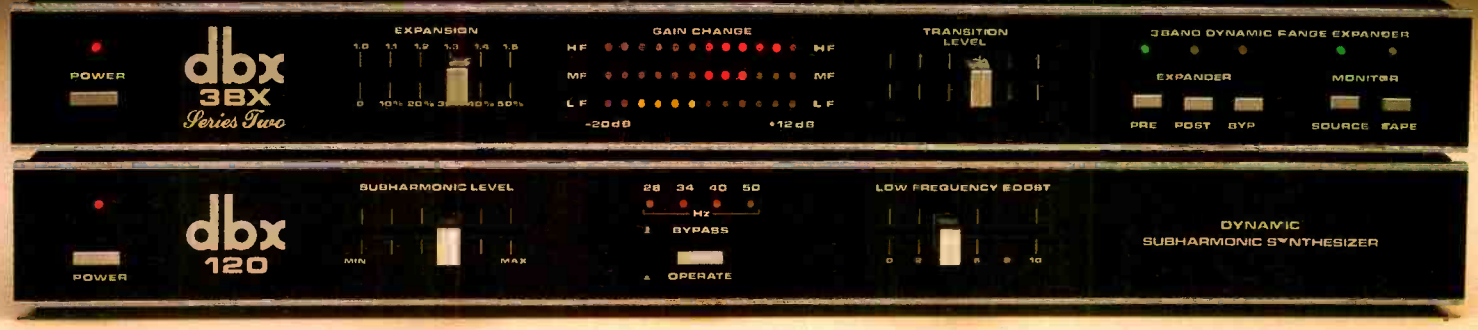
Table II—Parts list.

IC1 through IC4—RC4739 or XR4739 dual op-amps.
IC5—78L15, 7815, or LM340T-15 positive regulator.
IC6—79L15, 7915, or LM320T-15 negative regulator.
D1, D2—100-PIV silicon rectifier diodes.
D3—Bipolar red/green LED (IDI 5100H1/5 or XC/MV-5491).
C1 through C6—0.22-μF, ±10% metallized polyester capacitors (Digi-Key E1224).
C7 through C14—0.05-μF, 25-V ceramic disc capacitors (Digi-Key P4307).
C15, C16—220-μF, 50-V electrolytic capacitors (Digi-Key P6655).
C17, C18—2.2-μF, 25-V tantalum electrolytic capacitors (Digi-Key P2045).
R1, R16—100-kilohm, ¼-watt carbon-film resistors.
R2, R3, R6, R7—4.7-kilohm, ±5%, ¼-watt carbon-film resistors.
R4, R5, R12 through R15—¼-watt, carbon- or metal-film resistors (see Table III for values).
R8 through R11—100-ohm, ¼-watt carbon-film resistors.
R17—1-kilohm, ¼-watt carbon-film resistor.
J1 through J6—RCA-type phono jacks (Keystone 576).
T1—16-V, 0.25-A power transformer (Digi-Key T102).
Power cord and aluminum case.

Table III—Resistor values, ohms.

	R4 and R5		R12 through R15	
Hz	**1% Value**	**5% Value**	**1% Value**	**5% Value**
120	3.74k	3.75k (Parallel 7.5k)	9.09k	9.1k
110	4.12k	4.1k (Parallel 8.2k)	10.0k	10.0k
100	4.53k	4.55k (Parallel 9.1k)	11.0k	11.0k
90	4.99k	5.0k (Parallel 10k)	12.1k	12.0k
85	5.36k	5.4k (Series 2.7k)	13.0k	13.0k
80	5.65k	5.6k	13.7k	13.5k (Parallel 27k)
75	6.04k	6.0k (Parallel 12k)	14.7k	15.0k
70	6.49k	6.5k (Parallel 13k)	15.8k	16.0k

DBX GIVETH.



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1

KYOCERA DA-01 COMPACT DISC PLAYER

Manufacturer's Specifications
Frequency Response: 20 Hz to 20 kHz, ±0.5 dB.
Dynamic Range: Greater than 90 dB.
S/N Ratio: Greater than 90 dB.
Channel Separation: Greater than 90 dB at 1 kHz.
Harmonic Distortion: Less than 0.005% at 1 kHz.
Wow and Flutter: Unmeasurable (a function of quartz crystal tolerance).
Audio Output Level: 2.0 V rms.
Power Consumption: 120 V, 60 Hz, 30 watts.
Dimensions: 18¼ in. (46.4 cm) W × 5¼ in. (13.3 cm) H × 12⅝ in. (31.9 cm) D.
Weight: 18½ lbs. (8.4 kg.)
Price: $1,050.00.
Company Address: 7 Powder Horn Dr., Warren, N.J. 07060.
For literature, circle No. 90

The Kyocera DA-01 Compact Disc player is a substantial-looking machine, almost as large as an integrated amplifier or a complete receiver. In fact, equipped as it is with wood side panels and a very attractive, gun-metal colored front panel, the unit could easily be mistaken for a full-featured cassette deck or receiver. The unit has a swing-down hinged door which, when opened, discloses a narrow slot into which a Compact Disc is placed, label facing outward. On the Kyocera, unlike earlier models with similar loading techniques that I have tested, one pushes the disc all the way down into the door, then closes the door manually, much as one would with a front-loading cassette-compartment door. In this, and some other respects, the Kyocera DA-01 is similar in layout to the Phase Linear 9500.

The power on/off switch of this player is located to the left of the disc-compartment door. To the right of this door is a display area which provides a wealth of information about the disc being played. A ruler-like scale with a moving LED behind it tells approximately how far into a record the laser pickup has progressed. A digital readout displays time into the given track being played or total time from the start of a disc, depending upon whether or not a "Total Time" touch button (located elsewhere) is depressed. Surrounding this time display are tiny LED indicators which light up when total time is being displayed, when the programmed selections are being played in selected order, and when a separate "Index" button is touched. (More about the "Index" function in a moment.) A separate digital display shows the

current track being played or selected. Three more indicator lights along the top of the display area show whether the Kyocera DA-01 player is in "Standby," "Pause," or "Play" mode.

Basic operation of the player is handled by seven large touch-pads, the largest of which is labelled "Play/Start." A "Stop/Eject" button terminates play if a disc is playing or, pressed a second time, opens the disc door and ejects the disc from the door slot enough so that it can be removed. The "Pause" control interrupts play but keeps the laser pickup precisely at the point of interruption. Touching the "Pause" button again causes play to resume. Forward and reverse "Skip" buttons, when touched, move the laser to the start of the next or previous selection on a disc. Fast-forward and reverse buttons, when held in their depressed positions, move the laser pickup rapidly in either direction while the track and time displays follow the movement, allowing you to start playing at any predetermined track or time into the track.

To the right of these large touch-pads are smaller numbered keys, from 0 to 9, which, when used in conjunction with the "Memory" and "C/AC" (Clear/All Clear) keys, allow you to pre-program a sequence of selections in any order you choose. Some of the most innovative convenience features I have yet encountered on any CD player are activated by the last series of touch buttons, located at the extreme right of the front panel. When the uppermost of these, labelled "Phrase," is touched once, a "mark" is set for the particular location then being played. If the button is touched a second time later on in the disc, the player repeats the section from the first "mark" to the second one, over and over again, until the order is cancelled with the All-Clear button. This proved to be extremely useful in my study of the player when I wanted to hear a musical phrase (or section of a test tone) over and over again for careful analysis and study.

The second button in this row of switches is identified as "Index." I am told that, in the future, some Compact Discs (particularly classical works which have very long selections, such as complete movements as a single "track" number) may have additional "index" codes within each track. These codes would be listed on the disc's jacket and could be accessed when you want to hear a particular portion of a long track. If discs encoded with index points are played, and if these are called up by the user, the track display continues to indicate the selected track, while the time display switches from a "minutes:seconds" arrangement to a two-digit representation of the "Index" number called for.

The third button in this group, labelled "Time," may be used to access any amount of time into a given track of a disc. Using the numeric keypad, you first punch in the track number and then the time, in minutes and seconds. After that the "Time" button is depressed, to let the microprocessor know that you not only want a given track but a given amount of time into that track. Next, press "Play/Start"—or "Memory," if you want to program several such access points in sequence.

A "Memo Call" button reviews all of the track numbers you have programmed into memory for sequential programming, by flashing each of them on the track display for a couple of seconds. A "Repeat" button is used for playing any given track, or even a complete disc, over and over again. The last button in this group is the "Total Time" button whose function I have already mentioned.

The rear panel of the DA-01 is equipped with the usual left and right output jacks and an output level control.

Measurements

Beginning with this CD player test report, I am using two new test discs supplied by Philips. The first of these contains a wide variety of test signals which permit a much more comprehensive series of measurements to be made than is possible with the Sony test disc I have been using up

"This is the first CD player whose low-pass filter is so precisely adjusted that there's no attenuation of response at 20 kHz."

to now. (I'll explain the contents of this disc as I discuss the measurement results.) The second disc contains some 25 different classical and popular musical excerpts, but superimposed upon the surface of this second disc, between selection 3 and selection 9, is an opaque wedge which gets progressively wider towards the outer perimeter of the disc (remember, CD discs are played from inside to outside). This wedge is used to check a player's error-detection and error-correction facilities. A player that can play all the way through track 9, without interrupting play or repeating tracks over and over again with each revolution of the disc, can handle information interruptions that are 900 micrometers long (the widest dimension of the wedge).

Between tracks 10 and 15 are four black dots of increasingly large diameter painted on the surface of the disc. These are meant to simulate increasingly large dust particles on a disc. If the system can play through this sequence successfully, its error-correction system has managed to handle a "dust particle" that is 800 microns in diameter. Finally, near the outside edge of the test disc, there is a semi-opaque area that is supposed to simulate a fingerprint on the surface of the disc.

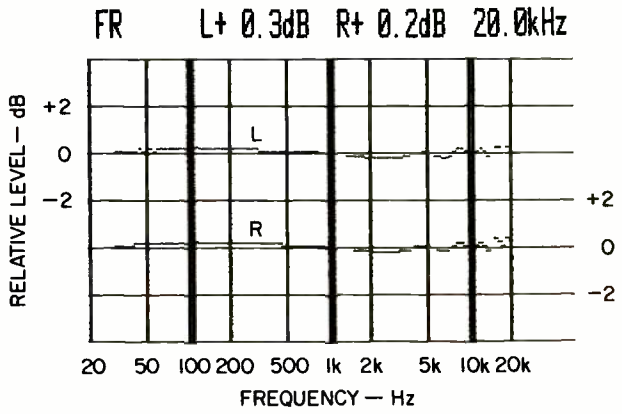

Fig. 1—Frequency response, left channel (top curve) and right channel (bottom curve).

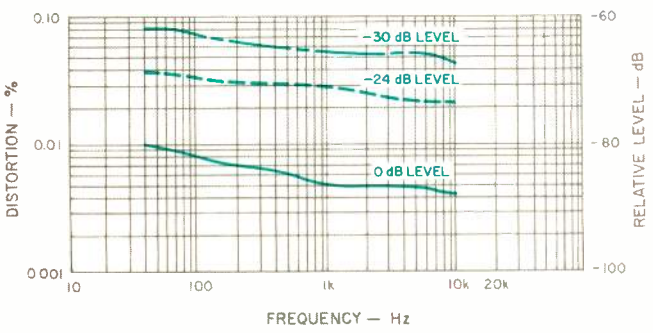

Fig. 2—THD vs. frequency, at three output levels.

The first test signals contained on the nonmusical disc are frequency response sweeps, extending from 20 Hz to 20 kHz. The sweeps are slow enough for my test instrument to "track" at all but the very lowest frequencies, which are never a problem on CD players in any case. Accordingly, I was able to "plot" response completely electronically, and to expand the vertical sensitivity of the resulting graph so that one division is equal to 2 dB, instead of the usual 10 dB. Both left- and right-channel responses are shown in Fig. 1. With the electronic cursor set to 20 kHz, I read a maximum deviation of only +0.3 dB for the left channel and +0.2 dB for the right channel. To the best of my recollection, this is the first CD player in which the low-pass filter was so precisely adjusted that not only was there no measurable attenuation of response at 20 kHz, but it actually exhibited a very slight rise in response at that frequency.

Several tracks of the Philips test disc are for measurement of total harmonic distortion, not only at mid-frequencies, but over a wide range of frequencies from 41 Hz to 20 kHz. Furthermore, recognizing that, in a digital audio system, best distortion figures are obtained relative to maximum (0 dB) levels, Philips supplies a series of test tones at −24 and at −30 dB so that the tester can measure how THD rises with decreasing signal levels. The three curves of Fig. 2 are therefore much more informative than any data I have been able to supply before. They show THD versus frequency at three different output levels from the player. At mid-frequencies, THD did indeed measure its claimed 0.005%, providing the reference was maximum output. At lower recording levels, however, notice that THD increases, although even at a −30 dB level it was still inaudible, with readings of 0.055%. Because results were virtually identical for the left and right channels, I have not shown two separate sets of curves.

Signals are provided on the test disc at 997 Hz for checking linearity of the playback system. (The odd choice of frequency has to do with avoiding sub-multiples of the sampling rate, 44.1 kHz.) Levels are 0, −1, −6, −12, −24, −60, −80, and −90 dB. I detected no significant deviation from perfect linearity until the test got down to −80 dB, which my instrument read as −77.6 dB. I suspect that this was not so much a matter of nonlinearity as my test setup beginning to combine noise readings with actual 997-Hz signal readings. Again, results were identical for both channels tested.

The Philips test disc includes two tracks for checking SMPTE IM. With these, I measured 0.016% IM at 0 dB level and 0.06% at a −20 dB record level. Signal-to-noise ratio measured exactly 90 dB with reference to 0 dB (maximum) output level, unweighted. With an A-weighting filter inserted in the signal path to the meter, S/N increased to 97 dB.

Much has been said in print about the effect of sharp cutoff filters in CD players. In the new test disc, Philips gives us several ways to judge the effect of the ultrasonic filters designed into any CD player. Square waves at frequencies of 100 Hz, 400 Hz, 1 kHz and 5 kHz are provided, as are various tone bursts, pulse signals and phase-checking pairs of signals. I found that the 1-kHz square-wave signal is a good one to display (see Fig. 3), since it clearly shows the degree of "ringing" that is produced by the sharp cutoff

"On the Kyocera, square waves show less ringing than usual—no doubt attributable to its double filtering, first digital and then analog."

filter found in this and other players. Judging by other CD players I have tested, it would be fair to say that the square waves of Fig. 3, as reproduced by the Kyocera DA-01, exhibit less ringing than usual. This is no doubt attributable to Kyocera's use of double filtering. A digital filter system is used prior to D/A conversion, thereby enabling the use of a more gentle, analog low-pass filter following the D/A converter in each channel's signal path. As you will see in future reports of this kind, there will be noticeable differences in the amount and nature of this ringing from one design to another.

One of the single pulses incorporated in the Philips discs consists of a single "sample" at full scale, followed by 127 samples at "zero amplitude." As you can see from Fig. 4, this test signal was reproduced with a fair amount of ringing, in both positive and negative polarity, following the unit pulse itself. Again, watch upcoming reports to see how this compares with pulse reproduction from other CD players.

Although there are several phase-check test signals on the new test discs (these are generally of a form where results from one channel are compared with results from the other), the most significant one, to my way of thinking, is one in which a 2-kHz signal is recorded on one channel while a 20-kHz signal is recorded on the other. The notes for the test record say that the positive-going crossing of the zero axis of the lower-frequency signal is supposed to occur at the same instant that the higher-frequency signal crosses the zero axis in the same direction. If you examine the two sine waves in Fig. 5 carefully, you will notice that, in fact, the low-frequency signal crosses the zero axis in a positive-going direction when the high-frequency signal crosses the zero axis in a negative direction. This means that the high-frequency signal is displaced relative to the mid-frequency signal by 180°, which works out to be a phase-error time delay of at least 25 μS (one-half the duration of one cycle of a 20-kHz signal).

Using the musical test disc with the opaque wedge, the "black dot" dust simulations and the fingerprint simulation, I was pleased to note that the Kyocera unit played right through all of the tracks covered by the wedge. In other words, error correction took place over linear distances as great as 900 microns. The system was bothered, however, by the third black dot (second from the largest one), which had a diameter of 600 microns. During the track containing this "defect," there was occasional "skipping," almost as if I was playing a record with a repeating groove, to use a familiar analog-y. As for the fingerprint simulation, the Kyocera DA-01's laser pickup ignored it completely, playing right through the selections that were marred by this defect as if it weren't even there.

Use and Listening Tests

Now that you've seen just how much phase shift takes place at high frequencies with a CD player of this type, and just how much "ringing" is evident in a 1-kHz square wave reproduced from a test disc, you are probably wondering if my unqualified enthusiasm for the CD format has in any way been dampened. Well, it hasn't! I still think that, all things considered, the sound I get from a digitally mastered CD reproduced over a high-quality audio system is better than I've experienced from any other program source in the three decades during which I've been involved with audio equipment. The Kyocera player is no exception. It performed reliably throughout the several days during which it became my primary program source. Its "access" features (ability to get to a certain point in the music) are well engineered and relatively easy to use and understand.

My disc collection keeps getting better, and I'm beginning to weed out some of the poorer recordings which, I still believe, do not fully utilize the potential of the digital disc medium. As I find better and better discs with which to test CD players, the units themselves seem to sound better and better. I expect it won't be long now before the source material gets so good that I'll be able to hear the subtle differences between players that I'm now able to detect only by measurement. Until that time comes, I will continue to praise CD players as I encounter them, and not try to rank one above another except in terms of operating and convenience features. In those terms, and considering its price, the Kyocera ranks high on my list of favorites.

Leonard Feldman

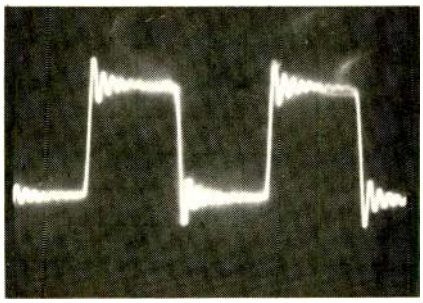

Fig. 3— Square-wave reproduction, 1 kHz.

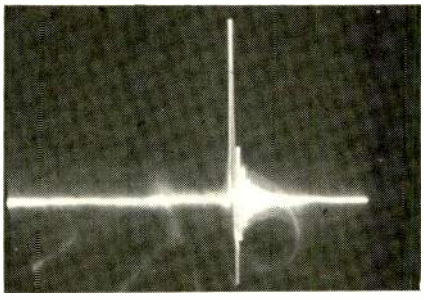

Fig. 4— Single-pulse test; note ringing.

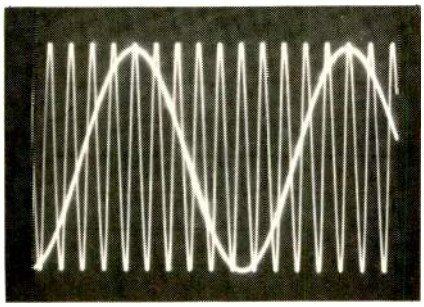

Fig. 5— Two-tone phase test (2 kHz in one channel, 20 kHz in the other; see text).

2

B & O MMC 1 PHONO CARTRIDGE

Manufacturer's Specifications
Type: Moving iron.
Stylus: Contact line, nude diamond, 0.1-mm square.
Radius of Curvature: Contact line.
Cantilever: Single-crystal sapphire tube.
Recommended Tracking Force: 1 gram.
Effective Tip Mass: 0.25 mg.
Compliance: 30 x 10^{-6} cm/dyne.
Frequency Response: 20 Hz to 20 kHz, ±1 dB.
Channel Separation: Greater than 30 dB at 1 kHz, greater than 22 dB from 50 Hz to 15 kHz.
Channel Difference: Less than 1 dB.
Output Voltage: Greater than 0.6 mV/cm/S; greater than 2.12 mV/5 cm/S lateral rms.
Recommended Load Resistance: 47 kilohms, minimum.
Recommended Load Capacitance: 400 pF, maximum.
Price: $445.00.
Company Address: 515 Busse Rd., Elk Grove Village, Ill. 60007.
For literature, circle No. 91

Bang & Olufsen (B & O) has recently introduced a new series of five phono cartridges, and the MMC 1 is the top of the line. They also seem to have refined their well-established moving-iron generating principle, called the "moving micro-cross" (MMC), which transforms mechanical energy to electrical energy. The X-shaped moving micro-cross armature moves within the magnetic field created by the samarium-cobalt ring magnet. The signal voltage is generated in the high-output, low-impedance coils surrounding the pole pieces. The entire magnetic circuit is enclosed in a Permalloy body shell. The single-crystal, hollow-tube, sapphire cantilever is claimed to be five times stiffer than aluminum and 40% stiffer than beryllium. Further, the velocity of sound in the single-crystal sapphire is twice that in

aluminum, reducing any phase distortions at high frequencies. The contact-line, diamond-stylus shank is 0.1-mm square and nude-mounted on the sapphire tube cantilever. The effective tip mass is reported to be 0.25 mg.

The physical appearance of the MMC 1 is not much different from its illustrious predecessors. I continue to be impressed by the fact that the entire generating system, with its relatively high output voltage, fits into a body that measures approximately 6-mm square and 12-mm long. The MMC 1 was designed primarily as a plug-in cartridge to fit the B & O tangential tonearms. However, a mounting bracket is supplied so that the cartridge can be fitted with any modern tonearm which has half-inch-spaced mounting centers. The MMC 1 is then inserted into the adaptor. The cartridge weighs 1.6 grams and the mounting bracket 1.7 grams, for a total of 3.3 grams. This is certainly one of the lightest cartridges I have ever tested.

The MMC 1 has an attached, hinged stylus guard to protect the stylus while handling the phono cartridge. The stylus is not user replaceable. The cartridge comes with a small stylus cleaning brush and an extra weight for tonearms requiring a heavier cartridge. Each cartridge comes with its own frequency-response curve and a computer-generated printout showing its output voltage, balance, tracking ability, separation, and 20-kHz output level.

Because of its low-impedance coils, the MMC 1, unlike most phono cartridges, does not have stringent loading needs. The usual 47-kilohm resistive load paralleled by a maximum of 400-pF capacitance is most satisfactory.

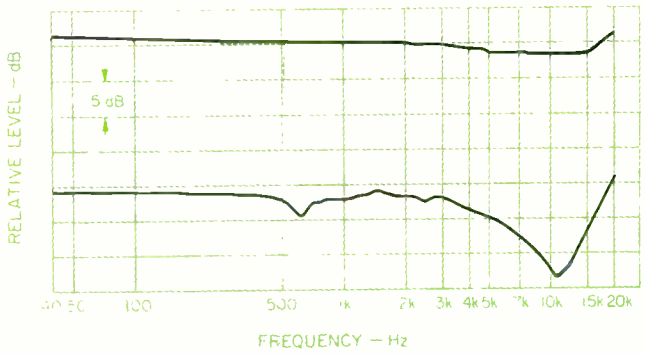

Fig. 1—Frequency response and separation.

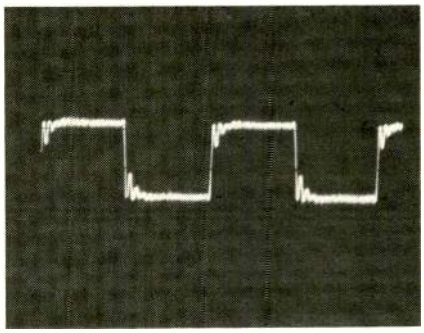

Fig. 2—Response to a 1-kHz square wave.

Measurements

The B & O MMC 1 phono cartridge was mounted in a Technics headshell and used with the Technics EPA-A250 (S-shape) interchangeable tonearm unit attached to the Technics EPA-500 tonearm base, which was mounted on a Technics SP-10 Mk II turntable. The cartridge was oriented in the headshell and tonearm with the Dennesen Geometric Soundtracktor.

Laboratory tests were conducted at an ambient temperature of 70° F (21.11° C) and a relative humidity of 72%, ±3%. The manufacturer's recommended stylus tracking force of 1.0 gram was not sufficient when tracking the higher velocities. It was necessary to increase the tracking force to 1.2 grams, with an anti-skating force of 1.4 grams. The load resistance was 47 kilohms, and the load capacitance was 250 pF.

As is my practice, measurements are made on both channels, but only the left channel is reported unless there is a significant difference between 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 and STR-112; Shure TTR-103, TTR-109, TTR-110, TTR-115 and TTR-117; Deutsches HiFi No. 2; B & K QR-2010, and Ortofon 0002.

Frequency response, using the Columbia STR-100 test record (Fig. 1), was +1, −1.75 dB from 40 Hz to 20 kHz. Below 1 kHz there was a gradual descent of the response curve starting at about 2 kHz, with a −1 dB level at 4 kHz, −1.5 dB at 5 kHz, −1.75 dB from 8 to 14 kHz, and then rising to +1 dB at 20 kHz. Separation was 22.25 dB at 5 kHz, 30.5 dB at 10 kHz, 26.5 dB at 14 kHz, and 20 dB at 20 kHz. These data indicate that the B & O MMC 1 phono cartridge has a relatively flat frequency response and a good high-frequency separation. The 1-kHz square-wave response, Fig. 2, was relatively flat, with a single well-damped overshoot followed by a very low ringing. After the arm's anti-resonance unit was disabled, the arm-cartridge lateral low-frequency resonance of the left channel was found to be 7.5 Hz at +6 dB; the right channel was also 7.5 Hz, but at +8 dB. Vertical resonance was measured at 9.5 Hz. The high-frequency resonant point was at 34 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 15.5 x 10^{-6} cm/dyne at the vertical resonant frequency of 9.5 Hz.

"Because of its low-impedance coils, the MMC 1, unlike most phono cartridges, doesn't have stringent loading needs."

The harmonic distortion components of the 1-kHz, 3.54 cm/S rms 45° velocity signal from the Columbia STR-100 are: 1.58% second harmonic and 0.25% third harmonic, with less than 0.25% higher order terms.

The vertical stylus angle measured 26°, using the Vertical Tracking Angle Meter (Inclination Meter), Model 3002, developed by the CBS Technology Center.

Other measured data are: Wt., 1.6 g, adaptor, 1.7 g, for a total cartridge weight of 3.3 g; opt. tracking force, 1.2 g; opt. anti-skating force, 1.4 g; output, 0.76 mV/cm/S; IM distortion (4:1): +9 dB lateral, 200/4000 Hz, 2.3%, +6 dB vertical, 200/4000 Hz, 5.0%; crosstalk (using Shure TTR-109), left: −27 dB, right: −23 dB; channel balance, 0.2 dB; trackability: high freq. (10.8 kHz, pulsed), 30 cm/S, mid-freq. (1000 and 1500 Hz, lat. cut), 31.5 cm/S, low freq. (400 and 4000 Hz, lat. cut), 24 cm/S; Deutsches HiFi No. 2, 300-Hz test band was tracked cleanly to 86 microns (0.0086 cm) lateral at 16.2 cm/S at +9.66 dB and 55.4 microns (0.00554 cm) vertical at 10.32 cm/S at +5.86 dB.

The MMC 1 phono cartridge played all the test bands cleanly on the Shure Audio Obstacle Course Era III musical test record. On the Shure Audio Obstacle Course Era IV, the cartridge encountered some difficulty in playing the highest level of the flute, harp and flute, and flute and orchestral bells test bands. The MMC 1 responded very well inasmuch as level 5 peak recorded velocities, particularly in the combined instruments, exceeds 45 and 50 cm/S, respectively. Generally, commercial records seldom exceed 15 cm/S peak recorded velocity. The Shure Audio Obstacle Course Era V test record was tracked without difficulty at all test bands.

Use and Listening Tests

More than 15 hours of listening was devoted to the musical evaluation of the MMC 1 using the following equipment: Technics SP-10 Mk II turntable, Technics EPA-500 tonearm base fitted with a Technics EPA-A250 (S-shape) interchangeable arm unit, Crown IC-150 preamplifier, Audire DM-700 power amplifier, a pair of Pentagram P-10 full-range loudspeakers, and the Audio-Technica AT666EX vacuum disc stabilizer. The 4PR Kimber Kable was used to connect the power amplifier to the speakers.

In the listening evaluation of the B & O MMC 1, I found the sound to be neutral in performance, not unlike its predecessor, imparting neither sound nor coloration of its own to the music. Sonic clarity was very good, and the bass was well-defined. Tracking ability, transient response, and transparency of sound were very good. I noted that the MMC 1 appeared to favor the human voice, particularly that of the soprano and tenor. Some exceptionally good records I used to audition the MMC 1 were Stravinsky's *The Rite of Spring* (Philadelphia, Muti, Mobile Fidelity MFSL 1-519), *San Francisco Swing Express* (Sonic Arts Corporation LS-30), *Symphonie Fantastique* by Berlioz (Cleveland, Maazel, Telarc DG 10076), and *Joe Marino Plays 28 All-Time Greatest Hits, Vol. 1* (RealTime Records RT-302).

The Bang & Olufsen MMC 1, the newly introduced top model in B & O's phono cartridge series, is an excellent performer, with good sound, fine tracking ability, and impressive engineering. *B. V. Pisha*

CREATIVE DISSATISFACTION...

. . . helped Tandberg engineers put memory in its place with the new Series 3000A

The Tandberg TPT 3001A Programmable FM Tuner, like all the other members of the Series 3000A, features discrete components — not integrated circuits — individually selected to meet ideal performance parameters.

Memory is one of the key elements that make computers tick. That's why Tandberg engineers include up to 32k of EPROM in the computerized operating circuits of the TCD 3014 Cassette Deck and memory for 8 preset stations in the Series 3000A Tuners.

But "memory" caused by electrolytic capacitors in the signal carrying stages of stereo components can produce audible distortion in the lower mid-range and bass frequencies.

Electrolytic capacitors used by most manufacturers tend to memorize signals passing through them and impress them on following signals.

This capacitor "memory," also called Di-Electric Constant, acts like a transparent curtain standing between you and the music, obscuring detail and precision.

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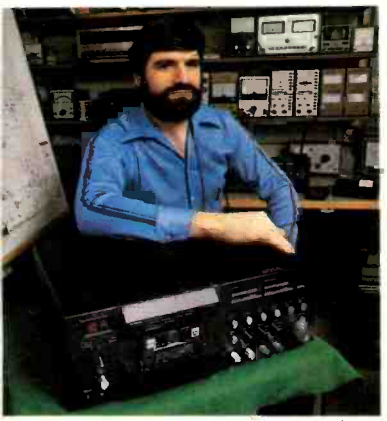
It's like listening to an orchestra composed of individual instruments rather than a mass of sound.

Tandberg engineers reduced this capacitor "memory" to a minimum by replacing electrolytics with more expensive polystyrene and polypropylene capacitors in all critical audio circuits.



Tandberg Senior Engineer Jens Werner Werenskiold with the TCD 3014 Cassette Deck. *"I designed the TCD 3014 to be good enough to please the most critical audience in the world — Me."*

Because this dramatic change only improves sonic quality not specifications, many manufacturers would not have bothered.

But Tandberg engineers share the "creative dissatisfaction" that inspired Vebjorn Tandberg to found the company in 1933. Like Mr. Tandberg, they will not be satisfied until the equipment they design produces sound to equal the reality of the original musical source.

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Finally, it meant hundreds of improvements in the Series 3000 — highly praised components with unprecedented performance specifications — to create the even more remarkable Series 3000A.

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Visit your nearest authorized Tandberg dealer and let the Series 3000A cure the "creative dissatisfaction" you feel about your present audio equipment.

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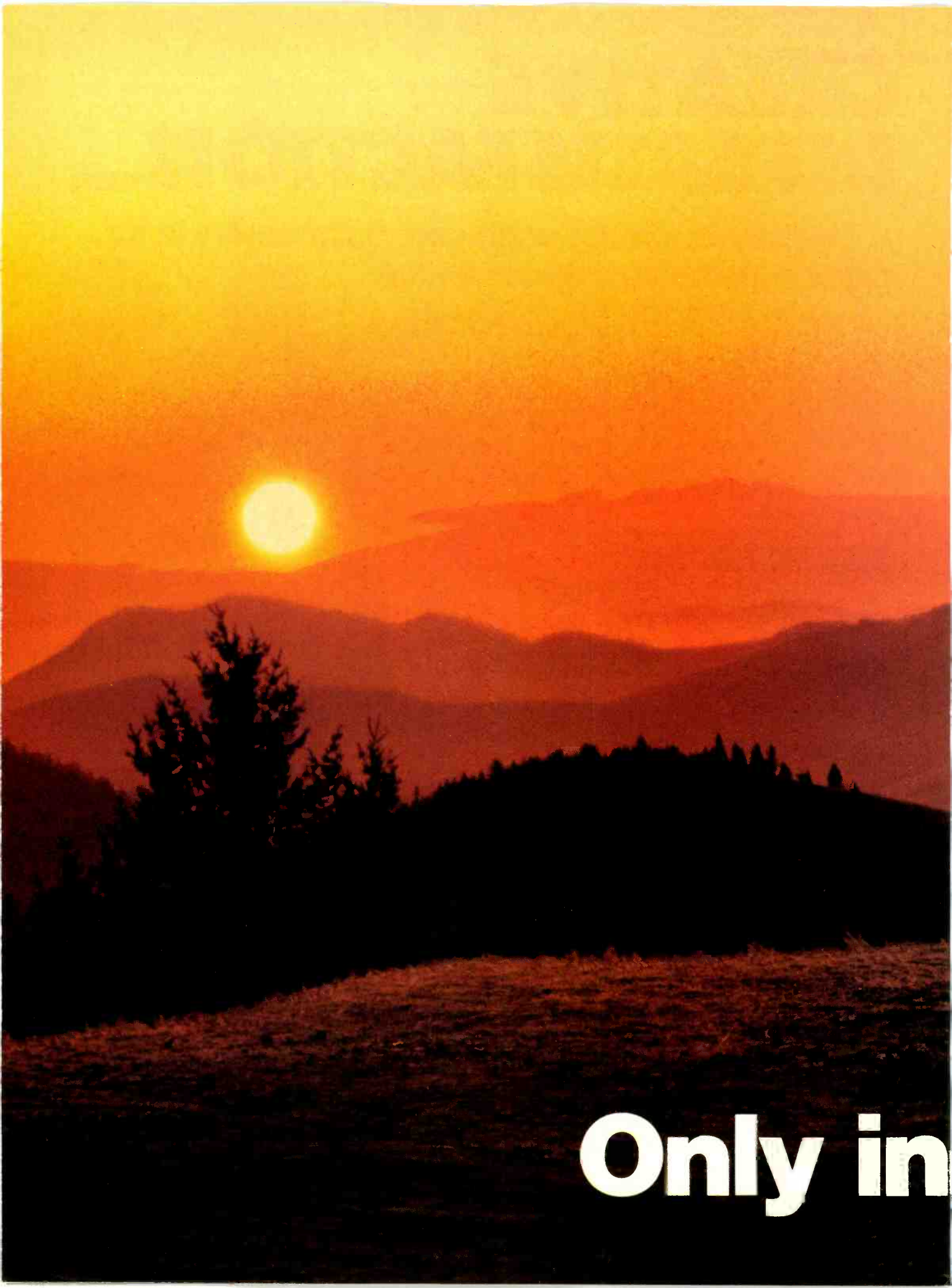
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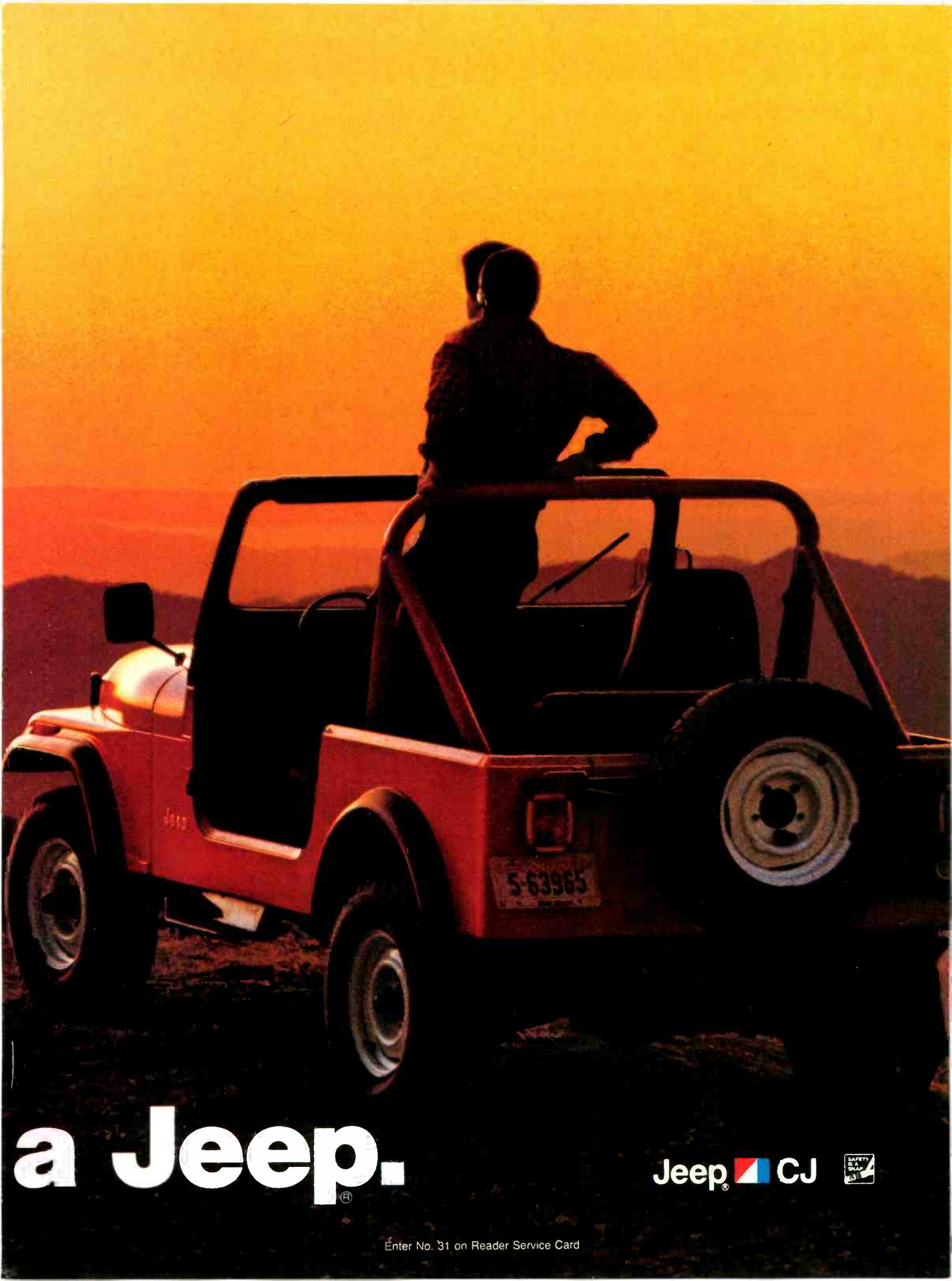


3

SCOTT 438A INTEGRATED AMPLIFIER

Manufacturer's Specifications
Power Output: 45 watts per channel, 8-ohm loads, 20 Hz to 20 kHz.
Rated THD: 0.04%.
Rated IM: 0.04%.
Damping Factor: Greater than 60.
Frequency Response: Phono, RIAA ±0.5 dB; high level, 20 Hz to 20 kHz, ±0.5 dB.
Input Sensitivity: MM phono, 2.5 mV; high level, 150 mV.
Phono Overload: 180 mV.
Tone Control Range: Bass, ±10 dB at 100 Hz; treble, ±10 dB at 10 kHz.
Subsonic Filter: −3 dB at 18 Hz, 6 dB/octave.
High-Cut Filter: −3 dB at 7 kHz, 6 dB/octave.
Loudness Contour (at −30 dB): +3.5 dB at 10 kHz, +7 dB at 100 Hz.
S/N: Phono (ref. 10-mV input), 80 dB; high level, 95 dB.
Power Requirements: 120 V, 60 Hz, 230 watts.
Dimensions: 16.9 in. (43 cm) W × 3.46 in. (8.8 cm) H × 7.95 in. (20.2 cm) D.
Weight: 13.64 lbs. (6.2 kg).
Price: $264.95.
Company Address: 20 Commerce Way, Woburn, Mass. 01888.
For literature, circle No. 92

H. H. Scott's 438A integrated amplifier includes many of the features of Scott's top-of-the-line models. Among them are dual fluorescent auto-range peak-hold power meters, two tape monitor functions, a d.c.-configured output-capacitorless power amplifier stage, loudness contour, electronic circuit protection, subsonic and high-cut filters, plus conventional bass and treble controls.

The power on/off pushbutton is at the upper left of the panel, and just to its right are the dual, peak-reading fluorescent power-output meters which, besides providing peak hold, offer extended dynamic indicating range. When listening to low-level outputs, maximum scale indications are 1 watt. When volume levels are increased beyond that level, full scale reading becomes 100 watts, automatically. A stereo phone jack is below the on/off switch, and just to its right are a pair of speaker-selector buttons. Rotary bass, treble and balance controls come next, followed by subsonic and high-cut filter on/off pushbuttons. Further to the right, seven rectangular pushbuttons handle mono/stereo selection, the two tape monitor loops (including dubbing from tape 2 to tape 1), program source selection (AUX, tuner, phono), and activation of the loudness contour control. A large, calibrated volume-control knob is at the extreme right end.

The rear panel is equipped with the usual input and tape-out jacks, a ground terminal for turntable chassis grounding, two sets of spring-loaded speaker-cable connection terminals, and three convenience a.c. outlets. Before considering the purchase of this amplifier, you should be aware of a notice that was affixed to the inside cover of the owner's manual. It states that the 438A is designed to drive a total loudspeaker load of not less than 6 ohms per channel. This rules out operating two sets of speakers at one time (one pair in each of two rooms) unless you use a pair of 16-ohm speakers. (Even two pairs of speakers rated at 8 ohms would yield a net impedance of 4 ohms if both pairs were connected to the output stages simultaneously.) This admonition also rules out using 4-ohm impedance speakers. However, as I found out during the bench testing, the limitation applies only if you operate the amplifier at or near its rated output level. At low listening levels, 4-ohm speaker loads caused no damage to the sample. Still, it seems to me that any integrated amplifier ought to be able to operate with

4-ohm loads these days, since so many good speaker systems have that rated nominal impedance. In fact, some manufacturers are making a point of the fact that their amps can handle 2-ohm loads safely.

Measurements

The Scott 438A delivered 48 watts per channel at mid-frequencies for its rated THD of 0.04% (Fig. 1). At the 20-Hz test point, it delivered exactly 45 watts, as specified, for that same THD level. At 20 kHz, however, the amplifier was able to deliver only 42 watts at 0.04%. When input signals were increased in level to produce the rated 45 watts at that high frequency, THD rose to 0.2%. SMPTE IM at rated output was also higher than specified, measuring 0.5%, though it did decrease to the rated 0.04% when output levels were backed off to 40 watts per channel. CCIF IM measured 0.01% at rated power output, while IHF IM was a satisfactorily low 0.035%. Figure 1 shows how THD produced by this amplifier varies with power output at low, mid- and high frequencies. Damping factor, measured at 50 Hz, was 40. Dynamic headroom measured 0.6 dB, which means that, at mid-frequencies, short-term power peaks as high as 51 watts or so can be handled without audible evidence of clipping. The 438A consumed 30 watts of power when idling and around 220 watts with both channels delivering rated power on a continuous basis.

Phono frequency response deviated from the RIAA playback curve by +0.6 dB at 15 kHz, by +0.4 dB at 100 Hz and buy a full +1.0 dB at 400 Hz (using 1 kHz as a zero reference point). Frequency response through the high-level inputs of the amplifier extended from 6 Hz to 40 kHz for a 1.0 dB roll-off and from 5 Hz to 55 kHz for the −3 dB cutoff points. Figure 2, a 'scope photo of a spectrum analyzer multiple sweep, depicts the maximum boost and cut characteristics of the bass and treble tone controls. The action of the gently sloping high-cut filter is also superimposed on this 'scope photo, and, as you can see, this filter does little more than could be accomplished by a moderate "cut" setting of the treble control. It was not possible to show the action of the subsonic filter, since its action begins below 18 Hz and this spectrum analyzer sweep runs from 20 Hz to 20 kHz. Separate meter measurements confirmed that the low-cut or subsonic filter behaved pretty much as specified.

Input sensitivity and signal-to-noise measurements were all made in accordance with EIA (IHF) Amplifier Measurement Standards, and results are not easily compared with Scott's published specifications. Specifically, phono S/N was measured with an input of 5 mV (at 1 kHz) and with the master volume control adjusted to deliver 1 watt of output. Under those conditions, A-weighted S/N was a satisfactory 77 dB. With a signal of 0.5 V fed to the high-level inputs and volume control once more adjusted to deliver 1 watt to the speaker loads, high-level signal-to-noise measured 81 dB while residual noise (volume control at minimum) was 84 dB below 1 watt. Input sensitivity for the phono input was 0.34 mV (for 1-watt output), and phono overload measured 180 mV, exactly as claimed. Input sensitivity for the high-level inputs was 25 mV for 1-watt output. The action of the loudness contour circuit is illustrated in Fig. 3 and is typical of this type of loudness compensation circuitry.

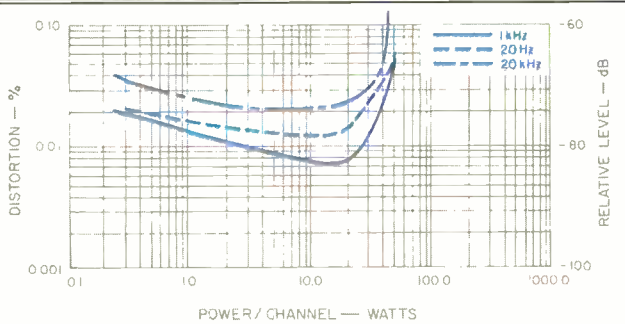


Fig. 1—Power output vs. THD.

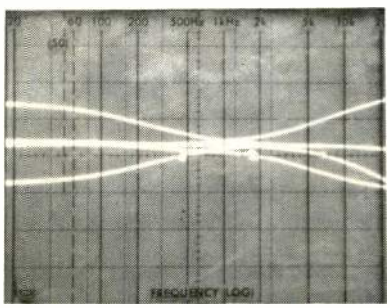


Fig. 2—Tone control characteristics. Vertical sensitivity: 10 dB/div.

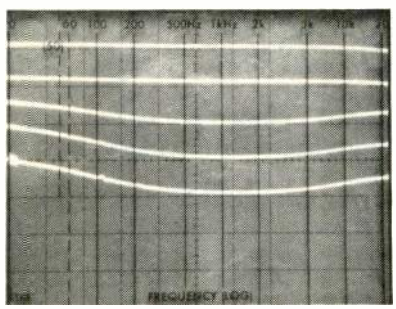


Fig. 3—Loudness contour characteristics. Vertical sensitivity: 10 dB/div.

Use and Listening Tests

While in my opinion the best thing that the Scott 438A has going for it is its price, the unit does offer a remarkable number of useful features and controls normally found on higher-priced, higher-powered models. Given a pair of high-efficiency speakers (having an impedance of 8 ohms), this amplifier will produce a surprising amount of clean sound, but don't try to push it beyond its limits. I did very much like the power meters, if for no other reason than that they gave me a good indication of just how far I could push the amp without running into overload. The auto-ranging feature was nice, too, especially since the 438A is likely to end up in systems whose owners are *not* looking to produce levels of 110 dB SPL in their listening rooms. Since the amplifier will be used most of the time for moderate levels (or, at least should be), it's nice to have a power metering system that is readable and meaningful even at such low listening levels. The amplifier would be an ideal basic component for a second system or for a system that's going to be used in a school dorm or a summer cottage.

Leonard Feldman

4

MITSUBISHI DP-101 COMPACT DISC PLAYER

Manufacturer's Specifications
Frequency Response: 5 Hz to 20 kHz, ±0.5 dB.
Dynamic Range: Greater than 90 dB.
THD: Less than 0.004% at 1 kHz, 0 dB.
Crosstalk: Greater than 90 dB at 1 kHz, 0 dB.
Wow and Flutter: Below measurable limits.
Output Level: 1.5 V rms at 0 dB.
Headphone Output Level: 20 mW into 8 ohms, at 0 dB.
Power Consumption: 120 V, 60 Hz, 40 watts.
Dimensions: 16¾ in. (42.4 cm) W × 5¾ in. (14.5 cm) H × 12¼ in. (31.2 cm) D.
Weight: 23⅛ lbs. (10.5 kg).
Price: $1,100.00.
Company Address: 3010 East Victoria St., Rancho Dominguez, Cal. 90221.
For literature, circle No. 93

In addition to being among the most expensive, the Mitsubishi DP-101 is, without a doubt, one of the more programmable and display-laden Compact Disc players I have examined to date. Among other things, you can go straight to your favorite track or item on a given disc or you can program playback to hear any tracks on the disc in any order, including repeat-playing of selected tracks. You can repeat any section of a single track, a selection of tracks, or the entire disc from start to finish. You can begin or end playback at any preselected moment within any preselected track or, if you wish, skip to the start of the next track or go back to the beginning of the track currently playing.

All of these programming functions are also controllable from the comfort of your easy chair, using an infrared, 24-function, wireless remote-control unit. The DP-101 also features one of the most elaborate display systems I have encountered in any CD player. Liquid-crystal display digits show the current track number, which section of that track is

being played, and how many minutes it has been playing. Alternatively, at the push of a button, the display will also show the number of items you have programmed and their total playing time. You can also run through a set of programmed instructions, checking the track numbers and playing times to make sure you have selected the right items in the right order. While the program is running, the number of the next track that is to be played is also shown.

The left- and right-channel level meters also double as "address" indicators, showing how many items there are on a disc, how long each item is (to the nearest minute), and the current position of the laser pickup.

Control Layout

The power switch and open/close button for the disc compartment are located at the extreme left of the front panel. The front-loading mechanism is motorized; it is only necessary to drop a Compact Disc into a slot in the door, at which point the door closes smoothly, positioning the CD in place for a rapid automatic scan of the entire disc. After a few seconds, several items of information appear in the large display area. These include the track number of the first item on the disc (since this is always "1," it may be a reminder that you've programmed nothing else in), total playing time of the disc, total number of selections and, on the double-purpose level/address display, the approximate length or location on the disc of all selections.

Beneath the digital display area are word blocks which illuminate individually, as required, during programming and playing of discs. These are labelled "Start," "End," "Prog," "Emph," "Repeat" and "Error." The "Emph" light illuminates when the system senses that a disc recorded with pre-emphasis is being played (suitable de-emphasis is automatically switched in, of course), while the "Error" light turns on when you make a mistake in trying to program the system. I made several mistakes in my first attempts at programming this player, simply because there are so many options available and, like most of you, I generally try to figure out a front panel without turning to the owner's manual. That's a mistake in this case: There are simply too many buttons and too many options to figure out on the first attempt. This is not to suggest that the unit is difficult to operate; it simply requires familiarization and time spent with it—and with the owner's manual.

"Play," "Reverse," "Forward," "Pause" and "Stop" buttons are all located along the lower edge of the front panel. The "Forward" and "Reverse" buttons advance play to the next track or return play to the beginning of the track currently playing.

All of the touch buttons used in programming the player are located behind a sub-panel door at the right. Also located behind this door are the "Level" and "Address" touch buttons (which determine what functions are performed by the two fluorescent bar-graphs—level metering or depiction of the location and time of each of the musical selections on a disc), a stereo headphone jack, and a headphone-output level control. Ten of the remaining buttons in this area, numbered from 0 to 9, are used for programming track numbers. Other buttons are used to put the program into memory, to define start and end times for repeat play, and for all the other programming options mentioned earlier. Fast-forward and fast-reverse buttons in this area of the panel let you move the pickup in either direction for any distance. It is relatively easy to determine where you want to position the laser pickup, since the multipurpose display continues to indicate both the track number and the elapsed time for each track over which the pickup travels when using the fast-forward or fast-reverse functions. In addition, when using these fast-search modes, you

"Arguments about the sound quality of CDs keep cropping up, but my tests convince me we are trying to lump together too many variables."

can hear the sound (at reduced level), making the job of locating a desired point in the disc even easier.

The rear panel of this player is equipped with the usual left- and right-channel line output jacks and a slide switch which should be moved to its "On" setting when the remote control unit is used.

Measurements

In my report on the Kyocera DA-01 CD player (elsewhere in this issue), I describe the two new Philips test discs I have begun to use for measuring the performance of CD players and for evaluating their error-correction capabilities. Rather than repeat those details here, I'll discuss the test results and, where necessary, will briefly summarize the nature of the test signals used. In the case of the error-correction checking disc, I will merely mention the nature of the "defects" purposely incorporated in that test disc.

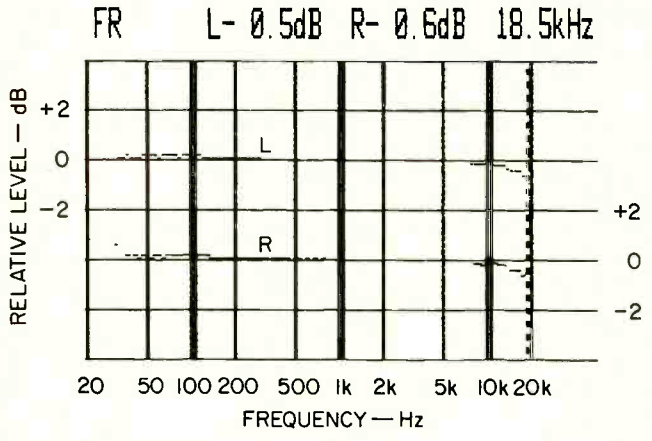


Fig. 1—Frequency response, left channel (top curve) and right channel (bottom curve).

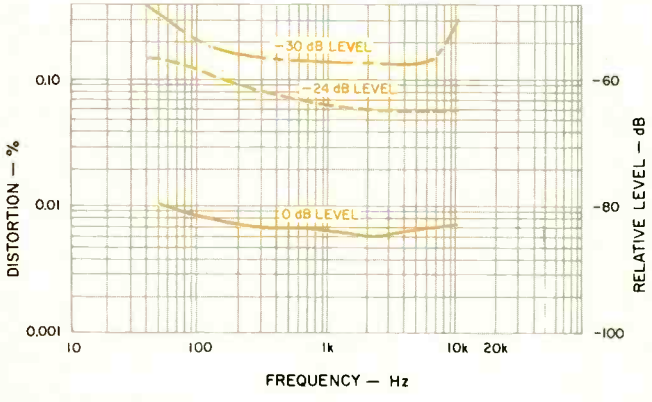


Fig. 2—Harmonic distortion vs. frequency at three output levels.

The first test signals contained on the nonmusical discs are frequency-response sweeps, extending from 20 Hz to 20 kHz. The sweeps are slow enough for my Sound Tech 1500A to "track" at all but the very lowest frequencies (which are never a problem on CD players). Vertical sensitivity of the resulting graph has been expanded so that one division is equal to 2 dB, instead of the usual 10 dB. Both left- and right-channel responses are shown in Fig. 1; I read a maximum deviation of −0.5 dB for the left channel and −0.6 dB for the right channel at 18.5 kHz.

Several tracks of the new Philips test record are devoted to measurement of total harmonic distortion over a wide range of frequencies, from 41 Hz to 20 kHz. And since the best distortion figures in a digital audio system are obtained relative to maximum (0 dB) levels, Philips supplies a series of tones at −24 and at −30 dB with which the tester can measure how THD rises with decreasing signal levels. The three curves of Fig. 2 show THD versus frequency at three different output levels from the player. At mid-frequencies, THD measured 0.006% referred to maximum output. THD increases at lower recording levels, as expected, although even at a −30 dB level it was still acceptable, with a reading of 0.14%. Results were virtually identical for the left and right channels.

Signals on the test disc at 997 Hz are used for checking linearity of playback. There was no significant deviation from perfect linearity until I got down to −80 dB, which my instrument read as −74.2 dB. This probably was my test setup beginning to combine noise readings with actual 997-Hz signal readings. Again, results were identical for both channels tested.

Two tracks are provided on the Philips test disc for checking SMPTE IM. With these, I measured 0.0065% at 0 dB level and 0.04% at a −20 dB record level. Signal-to-noise ratio measured exactly 97 dB with reference to 0 dB (maximum) output level, A-weighted.

Square waves at frequencies of 100 Hz, 400 Hz, 1 kHz, and 5 kHz are provided on the Philips test disc, as are various tone bursts, pulse signals and phase-checking pairs of signals. The 1-kHz square-wave display (see Fig. 3) clearly shows the degree of "ringing" that is produced by the sharp cutoff filter found in this and other players. If you refer to the report of the Kyocera DA-01 player, you'll notice a slight (but easily discernible) difference in the amount of ringing produced by that unit in response to the 1-kHz square wave, compared with the somewhat greater amount of ringing seen in Fig. 3 here.

The disc's single pulse, which I used to evaluate transient response of this player, consists of a single "sample" at full scale, followed by 127 samples at "zero amplitude." As you can see from Fig. 4, this test signal was reproduced with a fair amount of ringing, in both positive and negative polarity, following the unit pulse itself. Again, if you compare these results with those obtained for the Kyocera unit, you will note that the recovered audio from the Mitsubishi player is out-of-phase relative to the output of the Kyocera model. This arises from the presence of an additional phase-inverting stage somewhere in the post-D/A audio stages of the de-

"The DP-101 delivered superb sound—with discs which were well recorded. Features truly abound, but read all 13 pages of the owner's manual."

vice. Alternatively, the D/A converter used by Mitsubishi may, in and of itself, deliver an output which is inverted in polarity relative to the output obtained with the Kyocera unit. While I personally think that this inversion is of no consequence, there have been those who argue that the polarity of the reproduced sound should be the same as that of the original sound waves impinging on the microphones used in the original performance. Since I have no way of telling which of these two polarities of the pulse is "correct," I really can't tell you which of the two players inverts the signal (relative to the way it was recorded) and which does not.

The most significant phase-check signal on the Philips test disc, in my opinion, is one in which a 2-kHz signal is recorded on one channel while a 20-kHz signal is recorded on the other. In this test the positive-going, zero-axis crossing of the lower-frequency signal is supposed to occur at the same instant that the higher-frequency signal crosses the zero axis in the same direction. If you examine the two sets of sine waves in Fig. 5 carefully, you will notice that, in fact, the low-frequency signal crosses the zero axis in a positive-going direction a few microseconds ahead of the high-frequency signal's positive crossing. As closely as I can estimate the angle, the high-frequency signal is displaced relative to the mid-frequency signal by approximately 20°. That works out to a phase-error time delay of around 3 μS. Of course, it is also possible that what has happened is a 380° phase delay (a full 360°, plus 20° more), but I tend to doubt that, based upon the fact that the sharp cutoff filter is, after all, set for its −3 dB point to be outside the desired audio bandwidth.

Using the Philips musical test disc with the opaque wedge, the "black dot" dust simulations and the fingerprint simulation, I noted that the Mitsubishi unit played right through the 800-micron width of the wedge with no muting. It did mute a few times when playing selections that were covered by the thickest width of the wedge (900 microns), but resumed proper play each time, even though the wedge remained that thick. The system was also disturbed by the third "black dot" (second from the largest one), which has a diameter of 600 microns. During the track containing this "defect," there was occasional "skipping" (repeat-playing of the same track over and over again). As for the fingerprint simulation, the Mitsubishi completely ignored it, properly playing right through the selections marred by this defect.

Fig. 3—Reproduction of a 1-kHz square wave.

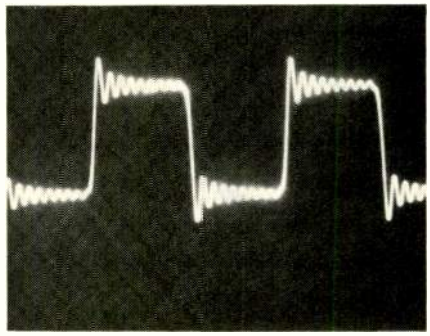


Fig. 4—Single-pulse reproduction.

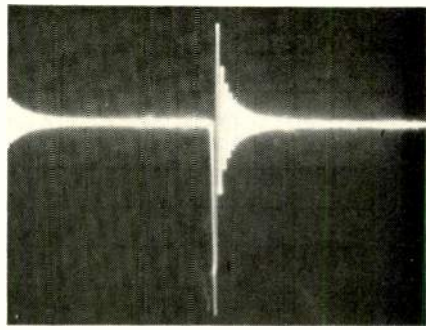
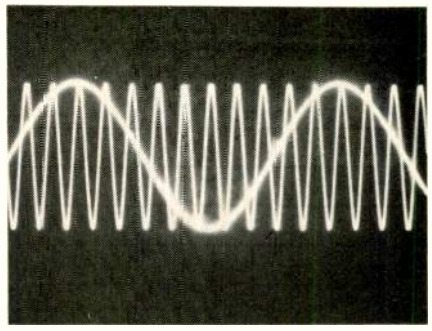


Fig. 5—Two-tone phase-test signal (2 kHz left, 20 kHz right).



Use and Listening Tests

Arguments about the "sound quality" of digital discs keep cropping up. Some people insist digital discs produce an unacceptable treble sound. This type of sound is variously attributed to "too low a sampling rate," to the fact that the 16-bit system is not enough and we should have standardized with an 18-bit system, and, of course, to phase linearity and the effect of that "brick wall" filter above 20 kHz. My experiments convince me that all of us are trying to take too many variables (the recording engineer's preferences for a certain balance of sound, the speakers used as monitors, the microphone placement, and many more) and lump them together as an explanation for why a given CD player with a given piece of CD software doesn't produce sound that's totally to our liking.

In point of fact, the Mitsubishi DP-101 delivered superb sound whenever it was called upon to play discs which, to my way of thinking, were well recorded in the first place. Was this sound any better or worse than the sound produced by the earlier-tested CD players? Not that I could honestly tell!

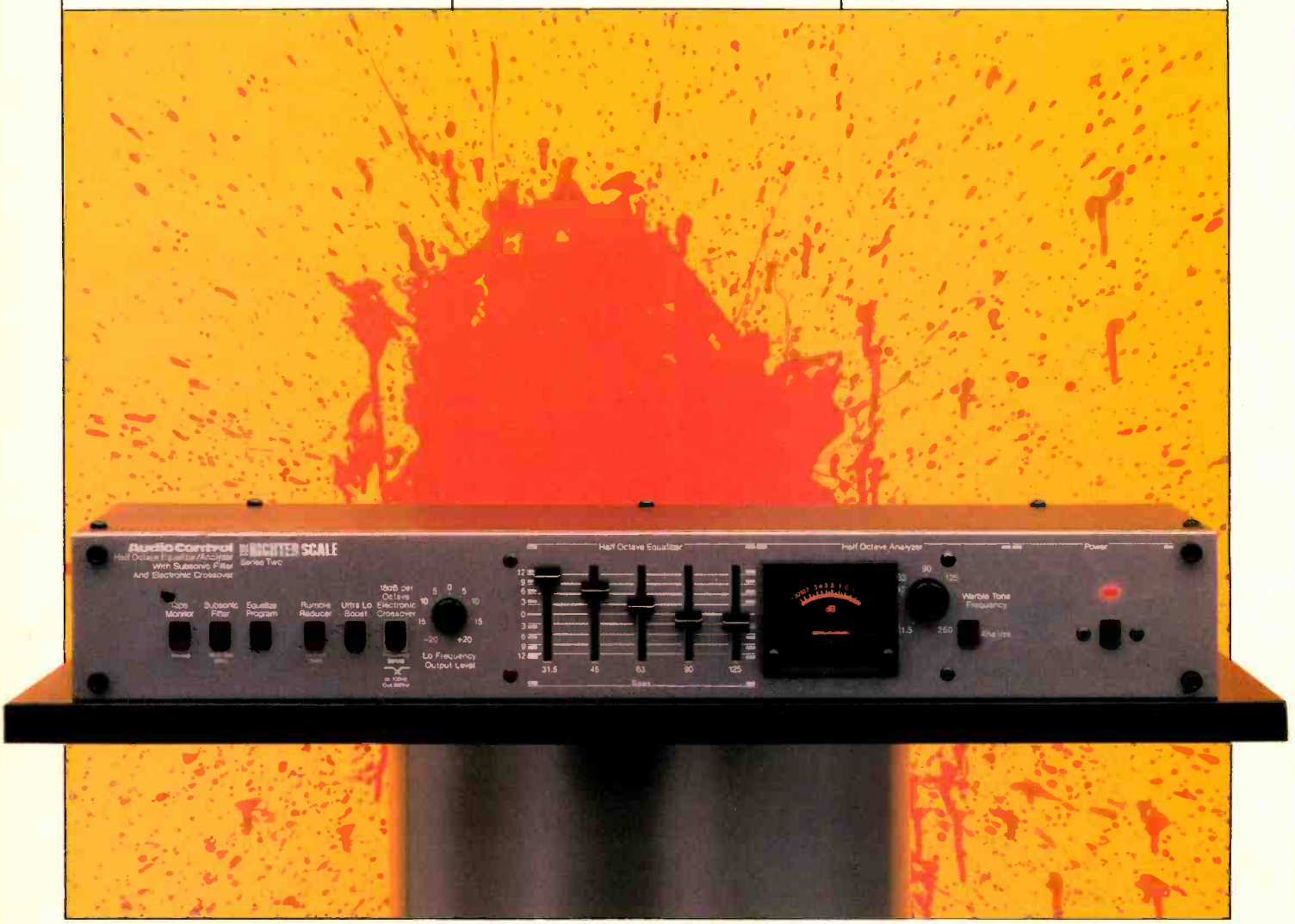
As I have already mentioned, the features truly abound, and if you read the 13 pages of the owner's manual telling you how to use all of them, you'll find that after a while the machine isn't difficult to operate. Add in the very handy remote control and the headphone amplifier, which lets you audition Compact Discs even if you don't own an amplifier and loudspeakers that have enough dynamic range, and the asking price for the Mitsubishi DP-101 seems just about right after all. *Leonard Feldman*

5

AUDIO CONTROL RICHTER SCALE BASS EQ and CROSSOVER

Manufacturer's Specifications
Frequency Response: 3 Hz to 100 kHz.
Distortion: 0.008%.
Input Impedance: 100 kilohms.
Output Impedance: 150 ohms.
Subsonic Filter: 18 dB/octave below 20 Hz.
Low-Frequency Summer: 12 dB/octave below 200 Hz.
Electronic Crossover: 18 dB/octave, 100 or 800 Hz.
Warble-Tone Output: 100 mV.
Signal to Noise: 108 dB.
Dimensions: 17 in. (432 mm) W × 2½ in. (64 mm) H × 6 in. (152 mm) D.
Weight: 4⅛ lbs. (1.9 kg).
Price: $249.00.

Company Address: 6520 212th S.W., Lynnwood, Wash. 98036.
For literature, circle No. 94



With the name Richter Scale, Audio Control's bass equalizer and crossover immediately gives the impression that it can be used for earthquake-type sound. An examination of the front panel provides the clues on how the user might be able to "play Mother Nature." First, there is a five-section, half-octave equalizer with filter centers at 31.5, 45, 63, 90 and 125 Hz. Each slider has a range from −12 to +12 dB. A pushbutton switch allows inserting a 15 dB boost at 34 Hz, *in addition* to any boost introduced by the half-octave equalizer.

The unit also has facilities for controlling unwanted low-frequency energy. Switching in the subsonic filter activates a roll-off at 18 dB/octave below 20 Hz, more effective than many filters with shallower slopes. Audio Control's exclusive "Rumble Reducer" also needs but the push of a button: A crossfeed between channels cancels out-of-phase signals below 200 Hz. In the low-frequency region, most of the music in the two channels of a stereo record is in phase (lateral movement of the stylus on a disc). Most rumble, however, is out of phase (vertical stylus movement), and the Richter Scale's rumble-reducer circuit cancels this energy out. The summing decreases at 12 dB/octave as the frequency goes up, and has no effect above 200 Hz. Thus, normal stereo imaging is maintained in the important mid and upper frequencies.

To help you adjust the half-octave equalizer correctly, the Richter Scale includes a half-octave analyzer (with extra-damped, VU-type meter), a warble-tone generator, and a plug-in condenser microphone. A push of the "Analyze" button turns on the meter lights, and then the supplied test microphone is placed in the normal listening position. A rotary pot sets the warble tone's center frequency anywhere from 250 Hz (for level reference) to 31.5 Hz, the lowest equalizer-filter frequency. The warble-tone outputs are fed into the stereo system through any high-level input (such as "AUX"). The procedure for using this handy system will be given later.

Another feature is the built-in, two-way stereo crossover, with either 100- or 800-Hz crossover frequency, switch selectable. The 100-Hz crossover frequency would be the choice for a subwoofer, and 800 Hz would be good when adding an external crossover to a three-way system. This would permit biamping for reduced distortion, driving mid-range and tweeter in each channel with one amplifier and using a more powerful amp for the two woofers. Audio Control notes that the 800-Hz crossover frequency could be changed if needed, increasing the attractiveness of this feature. The crossover design is the derived type, resulting in flat output in the crossover region with either voltage or pressure-wave addition (with the correct positioning of drivers), as opposed to flat total energy response. A center-detent control provides a range of ±20 dB of gain adjustment on the low-frequency output. This greatly facilitates matching the two sets of amplifiers and loudspeakers.

The usual switches for EQ in/out, tape recorder monitor in/out, and power are provided. The white panel designations are easily read against the gray background in all but glaring light, and the positions of the small, black pushbuttons are fairly easy to discern.

Along the back panel are in/out stereo pairs for intercon-

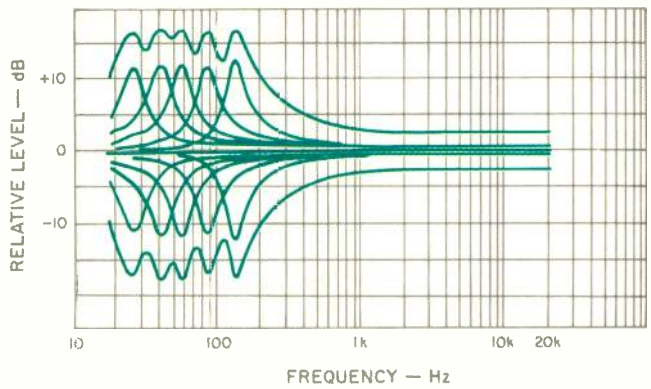


Fig. 1—Swept-frequency responses of each filter section at maximum boost and maximum cut, and with all sections at maximum boost and maximum cut.

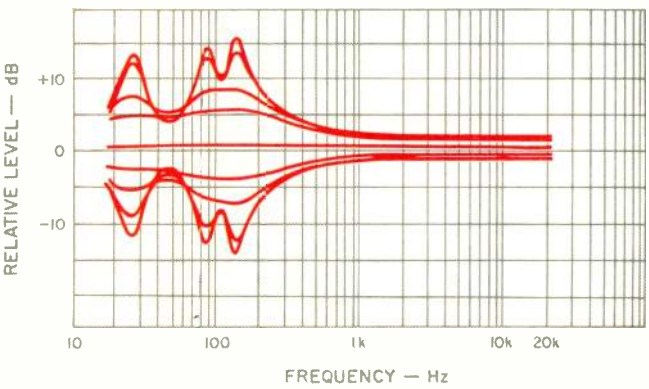


Fig. 2—Swept-frequency responses with 31.5-, 90- and 125-Hz filters set successively for steps of 3 dB from −12 to +12 dB.

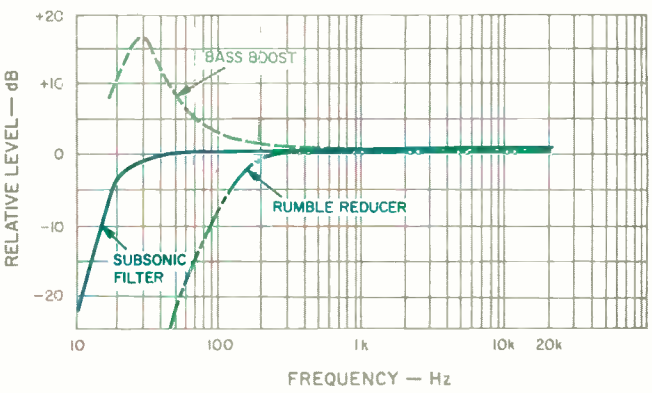


Fig. 3—Responses of the switch-selectable 15 dB boost at 34 Hz, the subsonic filter, and the rumble reducer with out-of-phase signals.

"For accurate adjustment, the Richter Scale includes a half-octave analyzer, a warble-tone generator, and a plug-in condenser mike."

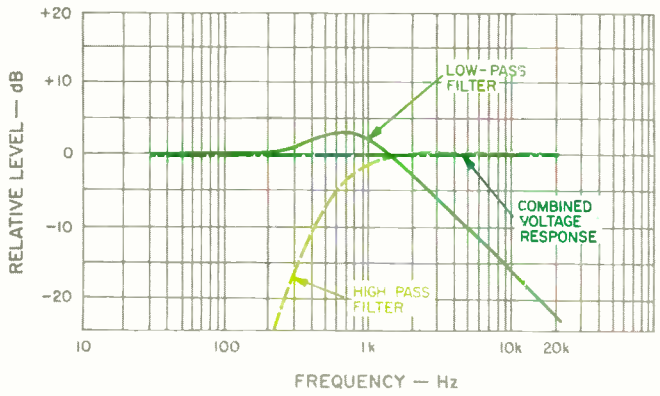


Fig. 4—Responses of the low- and high-pass filters, and their combined voltage response.

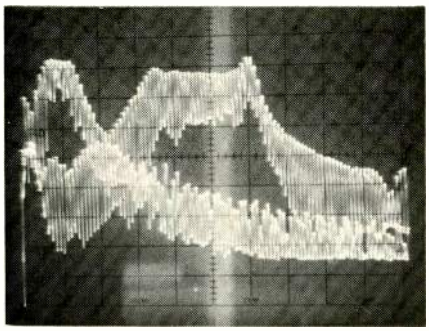


Fig. 5—Spectrum-analyzer sweep of 45- and 250-Hz warble tones (see text). Analyzer bandwidth, 30 Hz; sweep rate, 50 Hz/S; sensitivity, 10 dB/div. vertical and 50 Hz/div. horizontal.

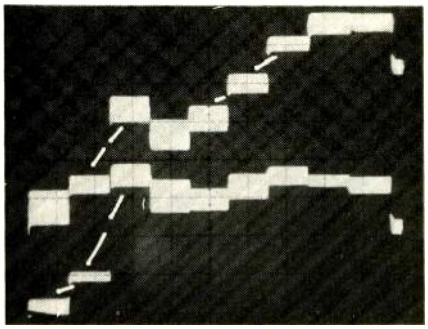


Fig. 6—One-third octave response of stage-monitor loudspeaker before (top curve) and after (bottom curve) equalization. Vertical sensitivity, 5 dB/div.; horizontal, ⅓ octave from 25 to 250 Hz.

nection with a preamp/receiver and a tape recorder. There are also stereo outputs for both low and high frequencies from the electronic crossover. The monophonic warble tone is fed through left and right outputs. The microphone input is also a phono jack.

Removing the top cover revealed that nearly all circuitry is on one chassis-size p.c. board. All jacks and switches are soldered directly into this board. The sliders are mounted on a small, vertical board, on which the soldering was very good. However, I could not see the soldering on the main card without further disassembly, which was not attempted. The DIP ICs (mostly 4136 quad op-amps) were soldered in place. Rack adaptors are available for those who would prefer rack mounting, but the manufacturer notes that the unit is not designed for professional use. [*Editor's Note:* The model shown is the Richter Scale II; we tested the original model, which Audio Control says is identical except for its case and the addition of an on/off switch.]

Measurements

With all special functions switched out and the five sliders in their center detents, responses were checked both with and without the EQ circuits switched in. With EQ, the response was flat within 0.7 dB from 20 Hz to 20 kHz. Without EQ, the deviations over the same range were within 0.3 dB. The 3 dB down points were at 3.3 Hz and 118 kHz with EQ and at 2.0 Hz and 113 kHz without EQ. Swept-frequency plots (Fig. 1) were made of individual filter responses and of response with all sliders in maximum positions. The measured center frequencies were within 3% of those specified (31.5, 45, 63, 90 and 125 Hz) except for the highest one, which was at 136 Hz (+8.8%), just fair in accuracy. The maximum boosts and cuts were all within 1.0 dB of the nominal ±12 dB. With an individual filter at a maximum, there was an across-the-band level increase of about 0.7 dB, and this increase grew as other filters were added, up to almost 3 dB with all filters at maximum. The last condition would be quite unlikely, and the major effect of any such shifts would be a need to readjust reference level for the equalization process.

Figure 2 presents the responses with the 31.5-, 90-, and 125-Hz filters set successively at the slider scale markings from −12 to +12 dB. There is a greater shift in "out-of-filter" levels than is desirable, but there is rough correspondence between the actual boosts and cuts and the settings. Many equalizers are much poorer in this regard. Tests with the 63-Hz filter showed that a boost of 5.7 dB (+7 scale) produced a "Q" of 1.0 (a practical limit to avoid ringing).

Figures 3 and 4 plot the responses of the other Richter Scale functions. The ultra-low boost was close to 16 dB at 34 Hz, but the net effect was less because there was an across-the-band level increase of 0.5 dB. The subsonic filter showed its 18 dB/octave roll-off between 3 dB down at 20 Hz and over 20 dB down at 10 Hz. The rumble reducer was checked by feeding matching-level, but opposite-phase, signals to the stereo inputs. The plot shows the 12 dB/octave reduction in level below 200 Hz. In-phase signals are not affected in this fashion.

The low-frequency output of the crossover, when set at 800 Hz, had a boost of close to 3 dB around 700 Hz, and a

"Another feature is the built-in, two-way crossover, switch selectable for 100- or 800-Hz crossover points. This permits biamping."

roll-off above 1 kHz of 6 dB/octave. The high-frequency output, on the other hand, had an 18 dB/octave slope below 800 Hz. The voltage addition of these two outputs generated the flat response trace that is the reference line for all of the curves in Fig. 4. This is the expected result with this derived-type crossover design. A tone-burst test at the crossover frequency was passed easily, showing that phase relationships were correct. In actual use, pressure waves from correctly aligned drivers would add similarily.

It was possible to get as much as 26.8 dB boost at 31 Hz using both the 31.5-Hz slider and the switch-selected extra boost. Adding the subsonic filter (recommended with the extra boost) reduced the boost to 26.4 dB, still a considerable amount. With this combination, the response was at +8.3 dB at 20 Hz. Control of subsonics remained, however, with response down 17 dB at 10 Hz and down about 29 dB at 7 Hz. The low-frequency output level of the crossover could be controlled from −19.9 to +20.0 dB.

With the equalizer sliders in detent, the EQ in/out level changes were 0.5 dB or less. The maximum input/output levels were at least 6.8 V from 20 Hz to 20 kHz open-circuit, dropping very slightly to 6.7 V with a 10-kilohm load. The input impedance was very close to 100 kilohms for most of the audio band, dropping to 25 kilohms at 20 kHz, plenty high enough. The output impedance was a low 320 ohms at the lowest frequencies, and it was even lower—close to 165 ohms—for most of the band.

The distortion at 2 V was very low: 0.0038% or less from 20 Hz up, rising at the highest frequencies to 0.017% at 20 kHz. At this same level, slew-rate limiting did not appear until 95 kHz (1.9-V output), so the unit had a good slew factor. The signal-to-noise ratio was at least 94 dBA relative to a 0.5-V reference. With various combinations of slider and switch positions, more noise appeared, so a figure of 89 dBA (re: 0.5 V) was judged to be more likely in normal use—and an excellent figure it is, slightly better than the spec, since Audio Control rates it relative to 6 V maximum output.

The warble-tone output was 115 mV on the average, with about 2 dB higher output at the lower frequencies compared to the reference 250-Hz level. Figure 5 shows spectrum analyzer sweeps made with the warble tone set at 45 and then 250 Hz. The vertical spread in the display is the result of the warble tone moving in and out of the analyzer bandwidth. The warble-tone level seen by the Richter Scale microphone and half-octave analyzer is indicated by the upper envelopes of the waveforms. The microphone was 0.32 inch in diameter, and it could not be calibrated acoustically because of its non-standard diameter. I did not feel this was much of a deficiency, and a couple of simple tests obtained the figure of 81.5 dB SPL for the required level at 250 Hz for a zero meter indication. This is in a good range for such tests—above normal background noise and below unnerving levels.

Use and Listening Tests

The owner's manual is more complete than most with such signal-processing equipment. Quite a bit of detail is included on the unit's many functions. The text has a humorous approach, which should not confuse most users, nor should a couple of errors along the way.

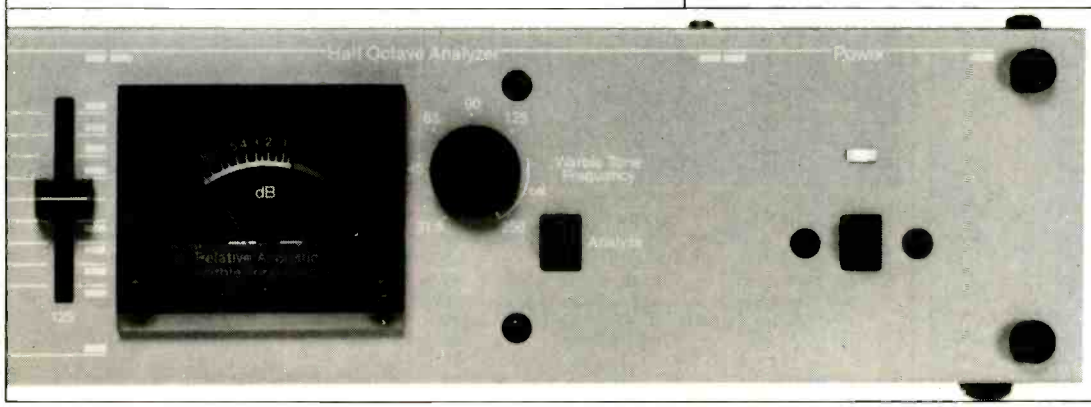
The controls were all easy to use and completely reliable, with the exception of the coupling for the low-frequency level pot, which slipped more and more with time. (Once set in normal use, it would not need adjustment.)

A custom stage-monitor loudspeaker was chosen for the task of improving the low-end response. The supplied microphone was placed in the normal listening position, the warble tone was set to 250 Hz, and the system output level was increased to get a zero indication on the analyzer meter. The tone was successively tuned downward to each of the equalizer frequencies, moving the slider in each case to take out half of the deviation shown, per instructions. After three runs, there appeared to be no basis for further adjustment. Figure 6 shows the before (top) and after (bottom) responses of the loudspeaker. It was not possible to bring up the 250-Hz band (shown partly at right of figure) relative to the others; there appeared to be a drop in the speaker's output for some reason. Do note, however, the great improvement in flatness from 200 Hz down to 31.5 Hz.

The improvement in sound was very obvious, especially with such material as "Also Sprach Zarathustra" by Strauss. The boost of 15 dB at 34 Hz was added at times, and I liked the change with some of the discs. I also appreciated the subsonic filter and the rumble reducer results.

The Audio Control Richter Scale is a very flexible and versatile unit for improving bass reproduction. Its general performance is excellent, and its many features (including the two-way crossover), coupled with an attractive price, should make it of interest to audiophiles and semi-professionals alike.

Howard A. Roberson



The analyzer section features a highly damped level meter and a warble-tone generator whose frequency is adjustable.

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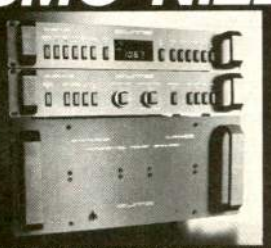

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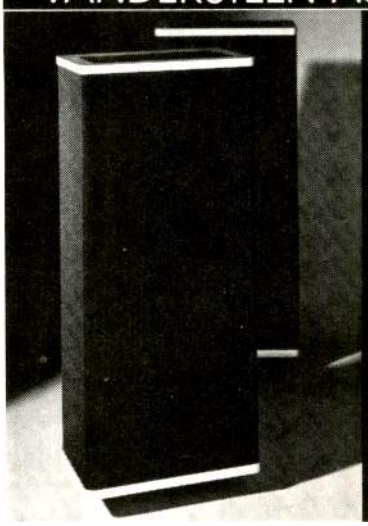

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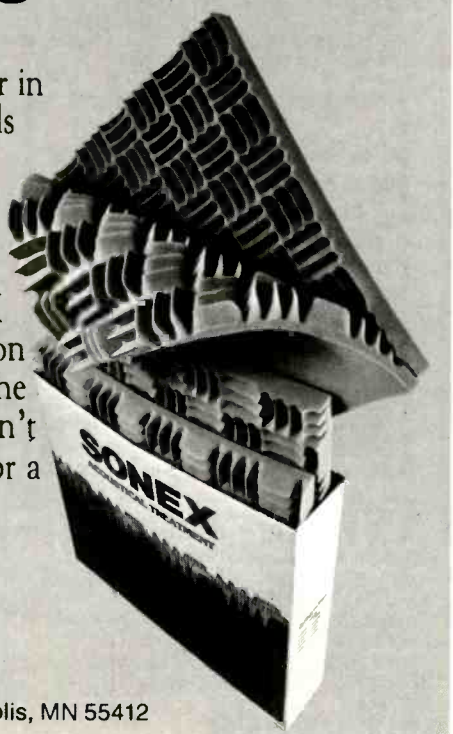

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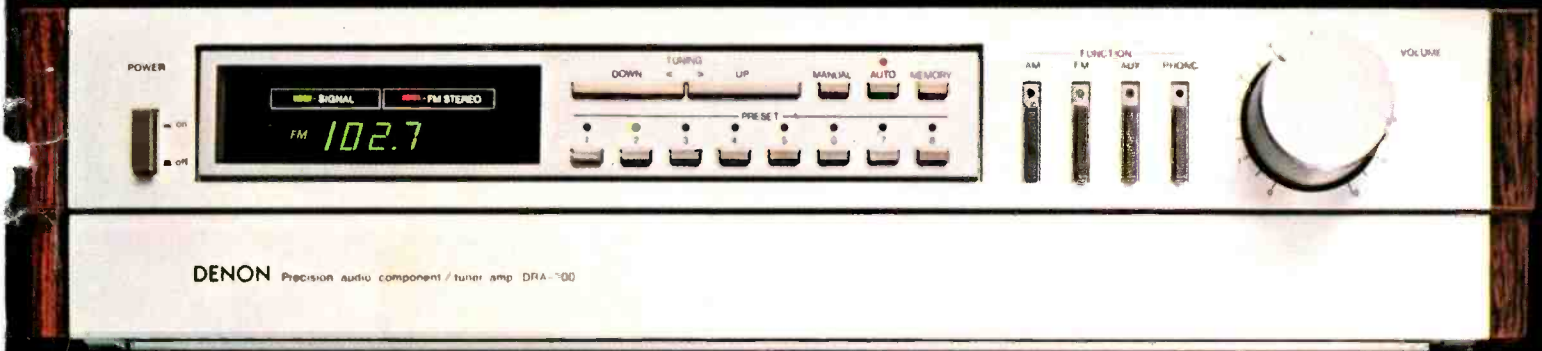

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