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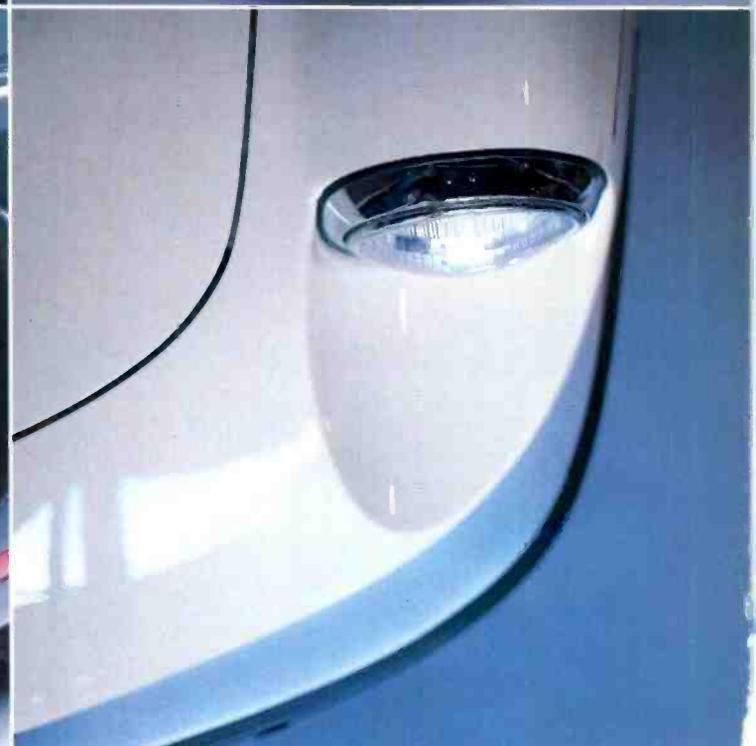
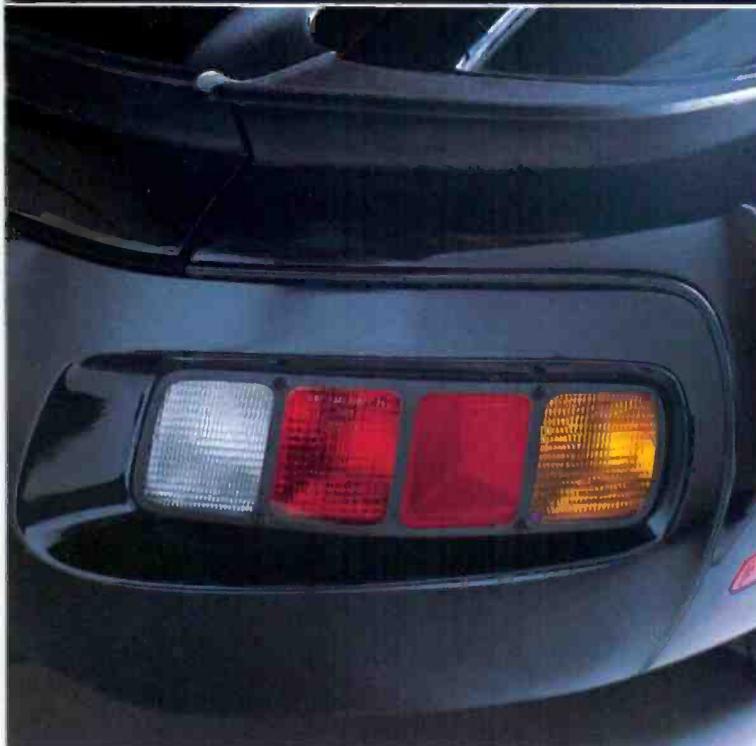
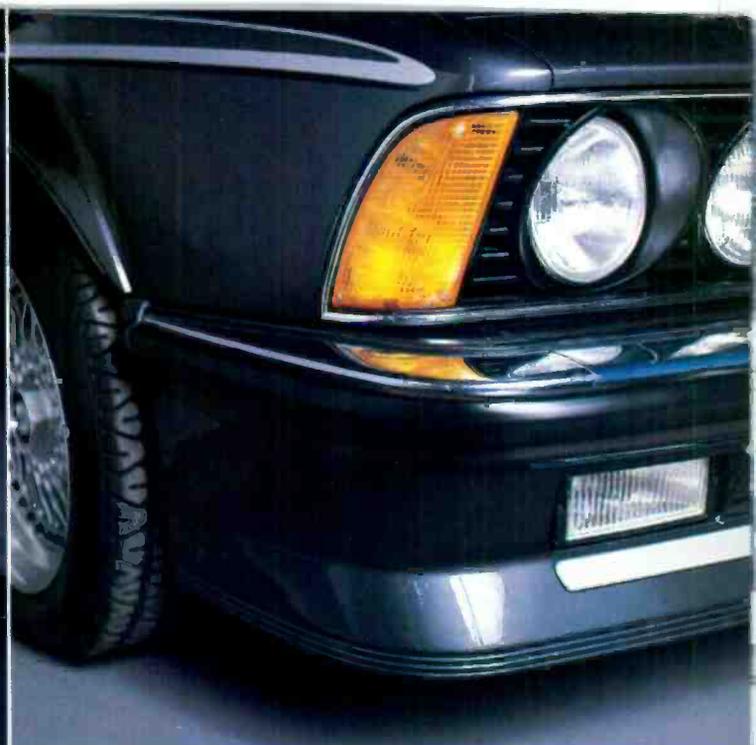
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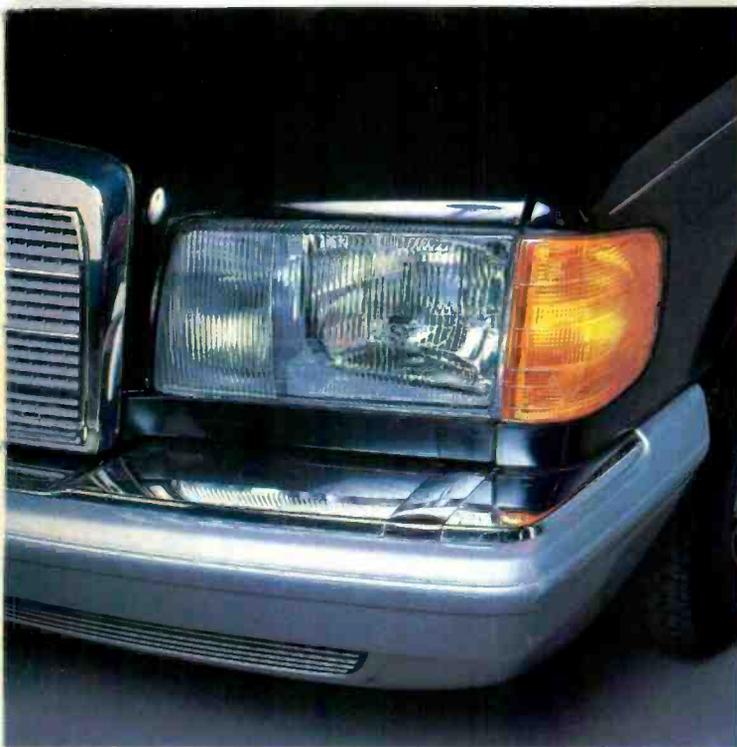
For example, the only audio components—home or auto—offering the level of circuit sophistication found on the new Denon Car Audio DCA-3250 Power Amplifier are Denon's own top-of-the-line receiver and separates.

Similarly, the Dynamic Range Expansion circuitry found on Denon's new Car Audio DCR-7600 AM/FM Stereo Tuner/Cassette Deck otherwise can be found only on Denon's DE-70 Dynamic Equalizer.

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# DENON



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# Audio

FEBRUARY 1985

VOL. 69, NO. 2



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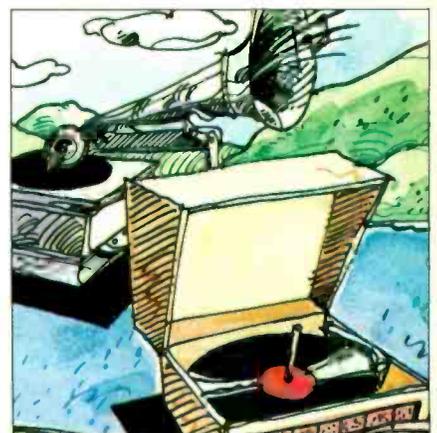
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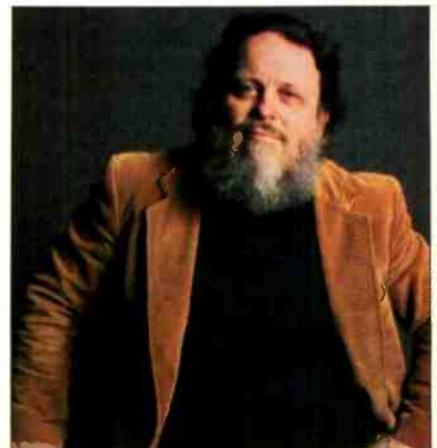
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See page 90.

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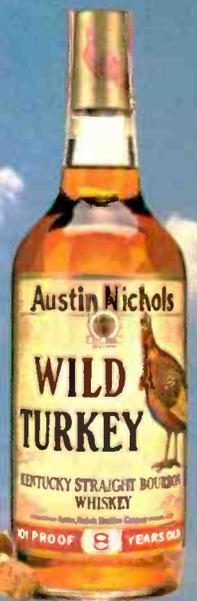
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## Vocal Elimination

*Q. During a recent visit to a popular bar, I noticed that the now-extinct "mechanical bull" had been replaced by a "sing-along" machine which played hit records, but which deleted the vocal, allowing the patrons themselves to sing the track. I have seen several ads over the years for such a machine, and I have always wondered how they operate. Do they use frequency filters? Do they respond to transients? Please enlighten me so that I can know the sing-along machine as well as I knew the mechanical bull!—Scott Hampton, De Kalb, Ill.*

A. The odds are that you were not listening to hit records with deleted vocals, but to specially made records with no vocal tracks, intended for just this purpose. The Japanese call this "karaoke" (which means "empty orchestra"). It's quite popular in Japan, and many karaoke recordings already exist.

However, you may be correct in assuming that these were ordinary records whose vocals had been deleted electronically. This is usually done by wiring one channel out of phase with the other, then combining the channels. Vocals are usually centered in the mix, with equal amplitude in both channels, and so will be cancelled out. All other center-channel or monophonic information will be cancelled out as well, including most of the bass. Instruments which are recorded primarily in one channel or the other will still be heard.

The process usually results in a thin sound, monophonic and bassless. (If the vocalist is female, however, it is often possible to boost the bass in one channel, increasing bass response while still keeping the voice out of the mix.) Any reverberation added to the voice in the recording will be stereophonic, and therefore won't be cancelled by this system. Though blurred, the vocal is still audible. But in a noisy environment such as you describe, this echo of a voice is not likely to be all that annoying.

## Tuner Loss of Highs in Mono

*Q. After removing my tuner from its equipment cabinet in order to clean and dust around it, and, after reattaching it, I noticed something strange.*

*When I switch my tuner from stereo to mono, the highs seem to disappear on certain program material. When programs are broadcast in mono, the switching between stereo and mono has no effect on the highs whatsoever.*

*I have also noticed that some instruments disappear almost completely when I set my tuner switch to mono, and this is not just a loss of highs. Please let me know what's happening, in case I should have to return my tuner for alignment during the warranty period.—Larry Cook, Albany, Ga.*

A. The symptoms you describe are those of phasing problems, either in your system or, more likely, at the broadcasting stations.

It's a bit puzzling why a tuner new enough to be under warranty should need to be removed for cleaning and dusting. If the tuner is new, and if your previous tuner did not show these symptoms, then perhaps you should have it checked. The same holds true if the tuner is not new, but you are certain the problem did not exist before.

However, it's more probable that you are more aware of this situation now because, having rearranged your system, you are doing much more critical listening than you normally would if you were not trying to be certain that you have your system properly reassembled. Tuners are subject to far greater mishandling during shipping than you have subjected yours to during your cleaning. You definitely did not misalign it.

So what is causing these phenomena? The loss of highs you have described is quite common and is to be expected. This phenomenon depends upon the program source the station is using. If the source is a phonograph record, you may not hear this effect at all. If, however, the source is a tape—and this is possible even when you believe it is a record—you will hear this loss of highs because of phase differences between the channels of the playback head of the machine reproducing the program with respect to the recording head of the machine on which it was recorded.

The fact that some instruments virtually disappear or lose luster is a matter of the way in which they were mixed during the original recording. If they were so placed as to represent a dif-

ference signal (vertical modulation, on a disc), these instruments will disappear when your tuner is switched to mono. This is reasonable when you recall that mono implies that only information common to both channels will be reproduced.

## Phase Inversion

*Q. There is an amplifier specification which describes whether or not there is phase inversion in a given piece of audio equipment. What is the sonic significance of this?—Jeff Horowitz, Poughkeepsie, N.Y.*

A. In general, whether a piece of equipment inverts phase or not makes little difference to the sound it produces. The only time the phase relationship between input and output absolutely must be taken into consideration is when bi-amplifying a speaker system. If one of the amplifiers inverts phase and the second one does not, the upper and lower frequency drivers will be out of phase with one another, even when they are "properly" connected. Even then, swapping the two connections to one of the speakers should solve the problem.

If an amplifier does not invert phase, then positive-going signals applied to its input will produce positive-going output signals; if it inverts phase, then positive-going inputs produce negative-going outputs, 180° out of phase.

*(Editor's Note: In a recent demonstration of an amplifier with a phase-reversal switch, I noted that sounds seemed to move forward or back depending on the switch position, and that there also seemed to be some slight, subjective frequency response effects. The same effect can be obtained—though less dramatically, because of the delay involved—through reversing both sets of speaker connections, plus to minus and vice versa. Phasing also varies from record to record, so no amplifier will be "correct" all the time; if you care about correcting it for individual records, you'll have to set up a switch to reverse the phase of both channels at once.—I.B.)* 

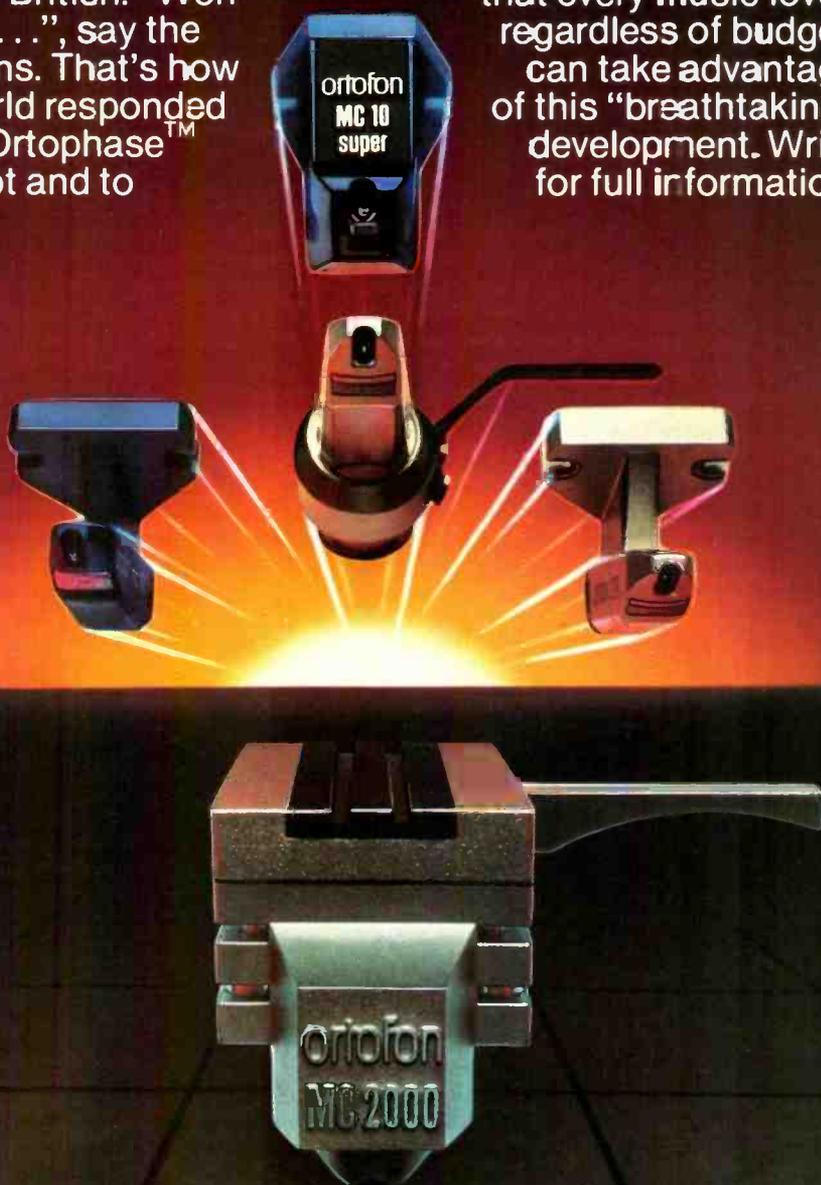
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# TAPE GUIDE

HERMAN BURSTEIN

## Tape Hiss

*Q. I have about 95 cassette recordings made from FM on an old deck. Although recorded with Dolby NR, they have considerable tape hiss. They still sound pretty darn good, except for the hiss—my main problem. Some of these tapes are priceless to me, so I am not disposed to just forget about them, as one person suggested. What is the best way to get optimum fidelity but with a reduction in tape hiss? For example, should I dub my tapes onto new tapes, perhaps metal? Would I dub with Dolby C NR on the recording deck? If you say I shouldn't dub, would I play my tapes on a new deck with Dolby B or Dolby C? Which produces less hiss?—William R. Charmack, Miami, Fla.*

A. Once noise is on the tape, there is no way to reduce it by means of dubbing. However, one can often get more or less satisfactory results by using a dynamic filtering noise-reduction unit. This is sometimes called a single-ended NR system because it operates only in playback, in contrast to double-ended systems, such as Dolby and dbx, which encode in recording and decode in playback. (See the October 1984 issue of *Audio* for a directory of NR units, both single- and double-ended, and the plans elsewhere in this issue for building both types.)

If you don't mind losing some of the music's treble, you could play your tapes with Dolby C, which would provide more treble cut than Dolby B, thus reducing noise at the same time.

## EE Open-Reel Deck

*Q. I am considering the purchase of an open-reel tape deck and would like to know whether one equipped for EE tape is worth it. Can these particular tapes be played on a deck without EE equalization?—Conrad Szablewski, Flushing, N.Y.*

A. Yes, EE (extra efficiency) is worth it if you obtain a deck with proper equalization and bias for EE tape. Such tape takes advantage of the technological developments that have given us greatly improved cassette tapes. EE tape makes it possible, using an open-reel deck, to obtain performance virtually as good as regular tape, but at half-speed; for example, as good at 3¾ ips as regular tape at

7½ ips. This would be particularly true with respect to frequency response and signal-to-noise ratio. Azimuth problems, however, would not be alleviated; that is, they would be the same at a given speed (say, 3¾ ips) no matter whether EE or conventional tape is employed.

EE tape calls for playback equalization of 35  $\mu$ S at 15 ips, 50  $\mu$ S at 7½ ips, 90  $\mu$ S at 3¾ ips, and 120  $\mu$ S at 1½ ips. The respective turnover frequencies (points at which bass boost is up 3 dB) are 4.547, 3.183, 1.768, and 1.326 kHz. Most open-reel decks will come reasonably close to these playback requirements if they don't exactly match them; that is, the effect on frequency response will not exceed about 3 dB. To illustrate, if you operate at 15 ips and have to use 50- $\mu$ S instead of 35- $\mu$ S playback equalization, this will result in a mild treble boost reaching a maximum of about 3 dB.

## Abrasive Tape?

*Q. Will using metal tapes wear out the heads faster than would ferric, chrome, or ferricobalt tapes?—Gary Haymov, Forest Hills, N.Y.*

A. I have come across no evidence or authoritative claims that metal-particle (Type IV) tapes are more abrasive than the other types. Perhaps the term "metal" is suggestive of greater abrasive power. However, the other tapes also have metal coatings—iron or chrome or a combination of the two—except that these coatings are in oxide form, that is, combined with oxygen.

In the early days of chromium dioxide tape, there were reports that it was more abrasive than ferric oxide tapes. However, these reports were disproved; in fact, if anything, the chrome tapes were somewhat less abrasive. Now, in the case of metal-particle tapes, it seems that history is repeating itself.

## Treble Deficiency

*Q. I have an open-reel deck with EE tape capability and dbx noise reduction. I have been using ferric tape at slow speed with dbx on. But some of the highs seem to be lost; the recording seems compressed. When I use EE tape or increase the speed or turn off the dbx, the situation improves, but not enough. Also, when dbx is off, the tape*

*hiss is much too noticeable. I have recorded FM interstation noise and compared the tape playback with the source; the playback FM noise seems about one-half octave lower in pitch than the original FM noise. Do you have any idea what the problem might be?—Kevin Beauchamp, APO, N.Y.*

A. It is not clear to me whether you are using ferric tape when the deck's switches are set for EE tape. Substantially more bias is employed for EE tape than for ferric tape, and, because an increase in bias reduces treble, this could be a partial cause of your problem.

If you are correctly using the normal settings for ferric tapes and the EE settings for EE tapes, it sounds as though the bias in your deck is misadjusted and is excessive for both kinds of tape. Another possible cause of your problem is azimuth misalignment of the record head with respect to the playback head. Noise-reduction systems tend to best maintain flat frequency response when response is flat with NR off; departures from flat response tend to be exaggerated by NR systems. This could explain why your problem is partly reduced with dbx off. Still another possibility is that you are recording at excessively high levels, which would tend to reduce treble response because of tape saturation at the high end.

It seems advisable to have your deck checked out, and adjusted, by a qualified technician, preferably at an authorized service shop.

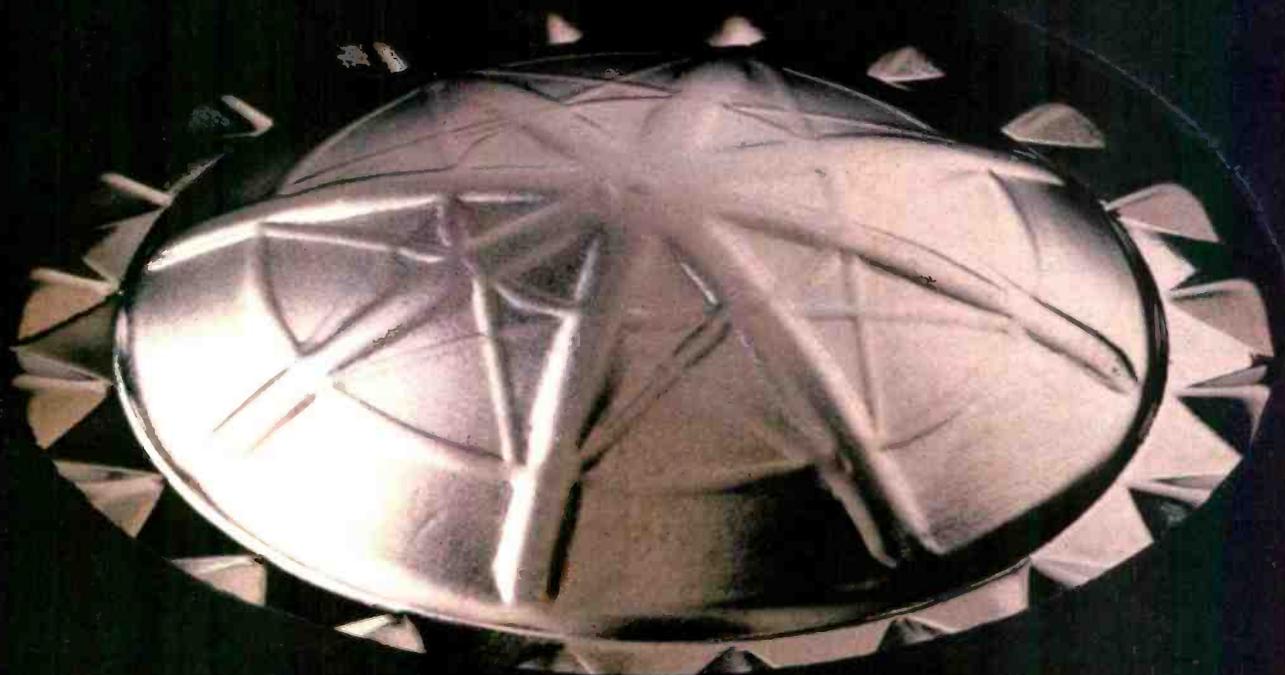
## Pro vs. Amateur

*Q. What is the difference between "professional" open-reel tapes and those ordinarily bought by consumers?—A. Yirsa, Brookfield, Ill.*

A. Tapes of professional quality are made to top standards in such respects as freedom from dropouts, uniformity of sensitivity throughout the reel and from reel to reel, absence of splices, accurate dimensions, lubrication, uniform frequency response, low noise, etc. 

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.

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KEN POHLMANN

## KEEPING YOUR DISTANCE

Last month we examined the pickup used to generate laser light and read the light reflected from the Compact Disc surface. I find the pickup's design truly elegant—from the semiconductor laser to the beam splitter to the photodiode, hard-nosed and pragmatic engineering is evident throughout. Of course, the pickup is but one component in the larger system, and just as a phono cartridge is useless without a tonearm, the laser pickup's success rests on two other subsystems, the automatic focus and automatic tracking circuits. This month, I'd like to look at the design of the auto-focus system.

As we saw last month, the controlling optics for both systems are designed into the pickup; sophisticated servo systems, however, are needed to guide the pickup itself. The various manufacturers and their engineers differ as to exactly the best approach (and this is where patent lawyers enter the design process), but every CD pickup employs some kind of auto-focus, all of them constructed along basically similar lines.

A Compact Disc has in the neighborhood of 10 billion bits arranged over its 8,600 square millimeters of data area. Given that kind of density, and a laser reading beam whose diameter is 1.6 to 1.7 micrometers when it hits the reflective data layer, the beam must be kept tightly focused, within  $\pm 2 \mu\text{m}$ . Any unfocused condition would result in inaccurate data reading. Of course, even the flattest disc isn't perfectly flat; the disc specifications acknowledge this by allowing for a deviation of  $\pm 0.6 \text{ mm}$ . Thus, the objective lens must be able to refocus as the disc surface wanders. A servo-driven auto-focus system manages this, utilizing the center laser beam, a four-quadrant photodiode, control electronics and a servo motor to drive the objective lens.

The unique properties of astigmatism are used to achieve automatic focusing (Fig. 1). Specifically, the cylindrical lens just prior to the photodiode performs the essential trick needed to detect an out-of-focus condition. As the distance between the objective lens and the disc reflective surface varies, the focal point of the system also changes, and the image projected by the cylindrical lens changes its

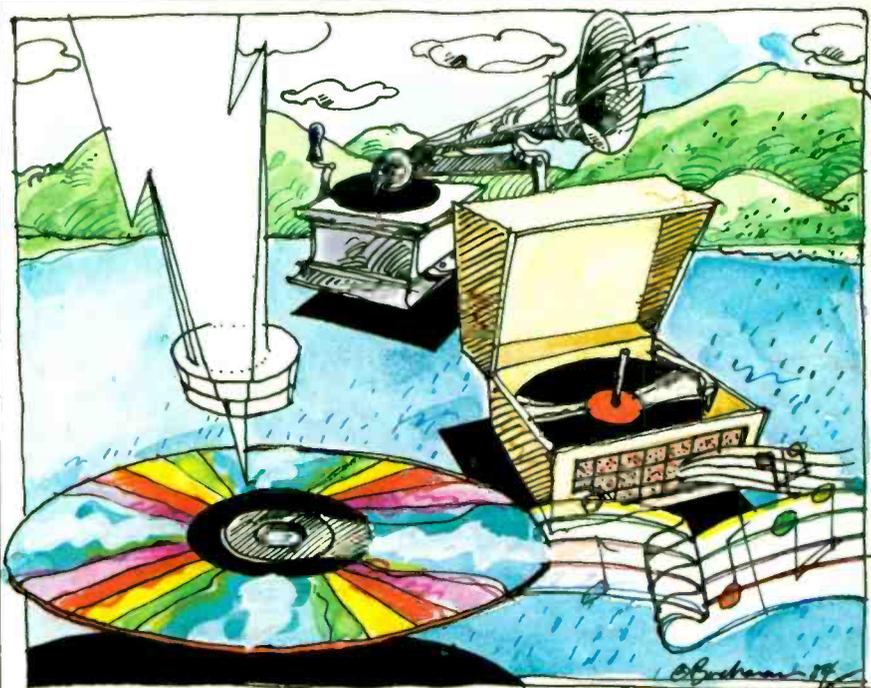


Illustration: Yvonne Buchanan

shape. That change in the image on the photodiode generates the focus error-correction signal. When the disc surface lies precisely at the focal point of the objective lens, the image reflected through the intermediate convex lens and the cylindrical lens is unaffected by the astigmatism of the cylindrical lens, and a circular spot strikes the center of the photodiode. When the distance between the disc and objective lens decreases, the image projected by the objective lens and convex lens and the cylindrical lens moves further from the cylindrical lens, and the pattern becomes elliptical. Similarly, when the distance between the disc and the objective lens increases, the image moves closer to the lens, and an elliptical pattern again results, but rotated  $90^\circ$  from the first elliptical pattern.

The four-quadrant photodiode reads an intensity level from each of the quadrants to generate voltages (Fig. 2). If a focus-error signal is mathematically created to be quadrants (2 + 4) minus (1 + 3), the output-error voltage is a bipolar S curve, centered about zero. Its value is zero when the beam is precisely focused on the disc; a positive-going error-correction signal is generated as the disc draws too near, and a negative-going error-correction

signal as the disc moves away. As in any closed-loop system, such as the phase-lock-loop systems which keep motor speeds constant and accurate, the difference signal continuously corrects the mechanism towards a zero difference signal and thus, in this case, a focused laser beam.

CD players use a servo system to move the objective lens up and down to keep depth of focus within the  $\pm 2 \mu\text{m}$  tolerance. An electronic circuit deciphers the error-correction signal and generates a servo-control voltage. This circuit uses comparators and amplifiers to generate the servo control. The four photodiode quadrants are divided into pairs (2 + 4, 1 + 3) such that greater intensity in quadrants 2 and 4 indicates the disc is too near, and in 1 and 3 too far, and these voltages are applied to the inverting inputs of two comparators, C1 and C2, whose non-inverting inputs are referenced to ground. (The photodiode quadrants share a common ground.) The outputs are split to the inverting and noninverting inputs of two more comparators, C3 and C4. The output of C3 generates a check signal that indicates reflected light is being received at the photodiode. The output of C4 is the error-correction S-curve signal.



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# *Introducing one brilliant idea on top of another.*

Unmatched FM Stereo/AM Stereo reception and video control makes them fantastic. X-Balanced circuitry makes them phenomenal. Sansui's 130 watt S-X1130 and 100 watt S-X1100 Quartz PLL Audio/Video receivers are so far advanced, they even have a special decoder that lets you receive broadcasts of all AM stereo systems. What's more, their unique X-Balanced circuitry cancels out external distortion and decisively eliminates IHM, for the purest all-around listening pleasure.

But the advantages don't stop there. Both receivers are complete Audio/Video control centers that are radically different—and significantly more versatile—than any others on the market. The S-X1130 delivers all the highly advanced audio and video performance of the S-X1100, with the added bonus of sharpness and fader controls for enhanced video art functions. And both units offer additional audio dexterity with "multidimension" for expanded stereo or simulated stereo, plus sound mixing capabilities.

For more brilliant, innovative ideas, check out our full line of superior receivers. You'll know why we're first, the second you hear us.

There's more worth hearing and seeing from Sansui. Write: Consumer Service Dept., Sansui Electronics Corp., Lyndhurst, NJ 07071; Carson, CA 90746; Sansui Electric Co., Ltd., Tokyo, Japan.



*Putting More Pleasure in Sound.*

Enter No. 40 on Reader Service Card

Even the flattest disc isn't perfect, and the standard allows for a deviation of  $\pm 0.6$  mm. Therefore, the laser beam must be refocused constantly.

When the laser beam is accurately focused, comparators C1 and C2 see identical voltages at the inverting inputs, and their corresponding output voltages likewise are identical. Since there is no difference at C4, its output is zero, or set to a d.c. reference voltage. If the beam goes out of focus, a positive or negative deviation from the reference will occur, resulting in the S curve. The error-correction signal is amplified by A1 and A2 and passed through an analog switch, which has been turned on by the focus-check signal. The error-correction signal is then amplified at A3, which provides the proper drive current to the push-pull amplifier circuit (transistors Q1 and Q2). The actuator thus moves the objective lens to maintain the proper depth of field. Once this is achieved, the beam is focused, the error-correction signal is zeroed, and the actuator holds the lens position.

When a disc is first loaded, initial focus is obtained through a square-wave signal generated by the system microprocessor. This signal consists of two square pulses, each with a period of 1 S. The square wave is integrated by a resistor and capacitor and causes the push-pull amplifier to move the actuator coil up and down twice. The laser is turned on as the actuator moves up the first time, and the actuator stops in a focused state when the focus-check signal is obtained. If no disc is detected the first time, the actuator tries again with the second pulse. The system microprocessor will shut down if no disc is detected. When the auto-focus is not operative (if the door is open, the laser inoperative, etc.), the analog switch remains off and the inverted focus-check signal pulls the objective lens back, to prevent damage to the lens or disc.

The objective lens itself is displaced in the direction of its optical axis by a coil and permanent magnet structure (similar to that used in a loudspeaker, with the objective lens taking the place of the speaker cone). A two-axis actuator is used to accomplish this. The top assembly of the pickup is mounted on a base with a circular magnet ringing it. A circular yoke supports a bobbin containing both the focus and tracking coils. Control voltages from the focus-circuit drive transistors are applied to

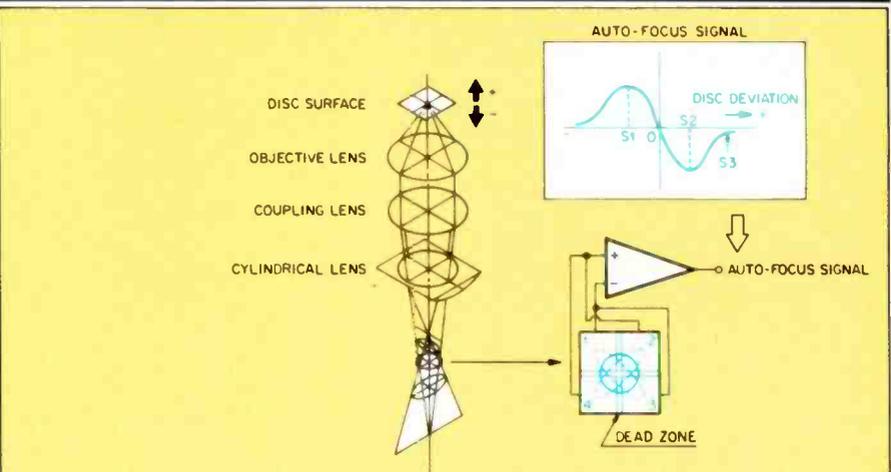


Fig. 1—The optics of a typical CD player's automatic focusing system. The cylindrical lens turns the circular image into ellipses above and below the point of correct focus, creating differences in beam intensity over the four quadrants of the photodiode.

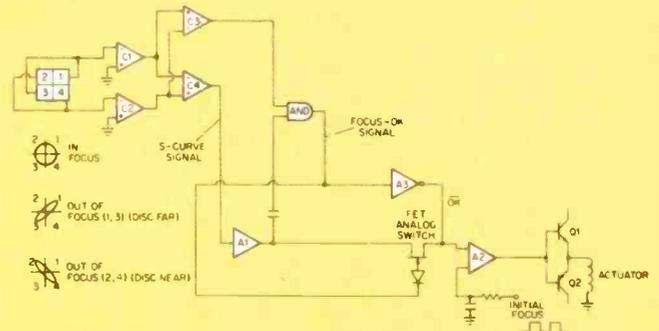


Fig. 2—Auto-focus control circuit.

the bobbin focus coil, and it moves up and down with respect to the magnet. The objective lens thus maintains its proper depth of focus. The other axis of movement, from side to side, is used to achieve tracking accuracy.

After last month's praise for the virtues of simple engineering solutions, the auto-focus system might at first glance appear too complicated to qualify for an award. But when the problem's difficulty is considered, how concise the system is becomes evident. Consider that a Compact Disc revolves  $3\frac{1}{2}$  to 8 times per second; any deviations from flat literally fly past the pickup, yet the objective lens must

stay within  $4 \mu\text{m}$  of that varying surface, floating underneath, as it were. I think this auto-focus system satisfies that demanding criterion with true economy. And consider the benefits of such a feature. In the past we had to be content with a diamond needle dragging through a vinyl groove, whereas now, thanks to auto-focus, only light touches our medium—no pickup wear, no medium wear. I haven't dared to put a Compact Disc in my microwave oven to see just how much warpage my player will tolerate, but I think under normal use my player's auto-focus should keep the laser beam admirably focused on the music. **A**

## ON THE PRO TOUR

**A**s evidenced at last fall's 76th AES Convention in New York, many audio manufacturers are beginning to realize the great sales potential of the burgeoning professional market. David Hafler has made an auspicious start in this direction with his new line of professional power amps. These range from the Model P125 (60 watts/channel into 8 ohms, useful in bi- and triamplification setups, and costing \$350), through the P220 and P225 (rated at 150 watts/channel into 8 ohms and priced at \$600 and \$510 respectively), to the flagship P500, a brute of an amplifier delivering 250 watts/channel into 8 ohms. The P500 can also be bridged for 800 watts into 8 ohms, and, at \$950 each, that's a lot of power for the money. All Hafler pro amplifiers have MOS-FET output transistors, can be hooked up in balanced configuration, feature a num-



Hafler P500 amplifier

ber of input connectors (including XLR), and are available in kit form.

Crown has already established their credentials in the professional amplifier market. Their Micro-Tech 1000 is something of a departure, with new circuitry permitting as much as 1,000 watts/channel into 4 ohms in bridged mode, in a relatively small unit measuring 19 x 3½ x 16 inches. In stereo mode, the Micro-Tech 1000's normal output is 250 watts/channel into 8 ohms, with as much as 500 watts/channel at 2 ohms. Price is \$995.

The world of amplifiers is full of acronyms. Perhaps the best known is TIM (transient intermodulation distortion), coined by Matti Ojala. Next came IIM (interface intermodulation distortion),

Crown Micro-Tech 1000 amplifier



also originating with Dr. Ojala, and now Sansui has come up with IHM—interface hum modulation. This is said to be the result of interaction between ripple current created by the power supply and counter-electromotive current created by speaker cones in motion. To combat IHM, Sansui has introduced a



Sansui B-2301 amplifier

series of X-Balanced amplifiers; in these units, all circuits are balanced—input, output, power supply, circuit drive, and even the negative feedback. The internal circuits transfer and amplify signals without reference to the ground potentials. Thus, the X-Balanced amplifiers are claimed to be completely immune to ground-related problems. The top-of-the-line model, the B-2301, offers 300 watts/channel into 8 ohms and has a signal-to-noise ratio of 120 dB. Its slew rate, 400 V/μS, and rise-time, 0.5 μS, are very fast.

As a recording engineer I have long endorsed the use of simple microphone techniques and have variously used three-channel omni spaced array, classic Blumlein, ORTF, M-S, and other similar configurations. These days, most classical digital recording is done on two-channel units—the ubiquitous Sony PCM-F1, Sony PCM-1610, JVC 900 series, or Mitsubishi X-80. In spite of this, there are occasions when a simple digital mixer would be very helpful. At the AES Convention, Sony gave a paper on such a unit, the K-1105. A number of these mixers have been built and apparently used for mastering of Compact Discs. The K-1105 is an eight-channel mixer with two main and two auxiliary outputs. There is a signal processing unit, an eight-channel A/D unit, an eight-channel D/A unit, and a remote control. The signal processor has low-cut and high-cut filters, plus a four-band equalizer and emphasis/de-emphasis equalizer for each channel. The remote control

has faders and pan pots as in an analog mixer. The whole setup is transportable, and, of course, the big advantage is that all mixing and signal processing remain in the digital domain. No availability or price information as yet.

As you can imagine, there was plenty of activity related to Compact Disc players. Studer introduced a \$1,550 professional/broadcast player. The Model A725 has balanced high-level line outputs as well as fixed and variable unbalanced outputs, and a host of special cueing functions that studios have requested. For example, it has fader start, for use with mixers which have cueing switches connected to their faders; when you raise the fader, the mixer signals the player to start. Audible cueing lets you scan the disc while listening for your cue point (most CD players are mute in search mode). There's automatic re-cueing, so you can cue up a passage, play it to check



Studer A725 pro CD player

your cue point, and return to that point at the touch of a button. (On most players, cue points disappear from memory once they've been played.) There's also a "Loop" function—automatic repeat of the music between any two user-marked points.

An LCD panel shows track and index numbers, elapsed and remaining times for the current track, and status of the pause, auto-stop and loop functions. During programming, the display shows the number of steps to be executed and the track numbers or timings of both start and end points. Other features of the Studer Model A725 include a peak-level calibration tone and remote control.

Sony also introduced a professional CD player system, consisting of the CDP-3000 and CDS-3000. This system is a lower-priced version of their big professional player/analyzer, the CDP-5000 and CDA-5000. The CDP-3000, at \$2,100, is a high-precision, front-loading CD player which features an aluminum die-cast chassis and exten-

# audio-talk from audio-technica®

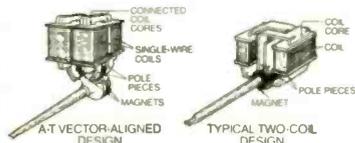
Number 12 in a Series

## COILED FOR ACTION!

The coils in a moving magnet phono cartridge are important in determining the ultimate quality possible from the unit. Their design can affect frequency response, output level, sensitivity to hum and noise, and other critical aspects of cartridge behavior.

### Two or Four Coil Design

Most modern moving magnet cartridges use either two coils (one for each channel) or four coils (a connected pair for each channel) to pick up the tiny magnetic field changes from the magnet(s) at the end of the cantilever. Inside each coil is a metal coil core which extends toward the magnet as a pole piece to sense the magnetic field and transmit its fluctuations to the coil windings. In two-coil designs the pole pieces extend from either end of each coil, while four-coil designs use a pole piece at one end of each coil, plus a metal strap to connect the two coil cores together.



### A-T High-Efficiency Design

Most Audio-Technica Vector-Aligned™ cartridges use FOUR coils, with two to pick up each stereo signal. To achieve the highest sensitivity, A-T uses a single U-shaped part to create the pair of pole pieces and coil cores, plus the connecting strap for each channel, with both coils wound directly on the same part. This eliminates the need for soldering or welding the pole pieces, coil cores, and connecting strap together, thus reducing losses. In addition, A-T winds both coils from a single, unbroken wire which is directly connected to the output terminals, again to reduce losses by eliminating unneeded internal connections.

### Hum is Cancelled

Each pair of A-T coils is also wound so that external hum and electrical fields are rejected without reducing the sensitivity to magnet motion. In this "hum-bucking" design the coils in the pair are wound in opposite directions, so that any hum appearing in one coil is cancelled by the same (but opposite) hum in the other coil. A-T cartridges are also carefully shielded to lower the strength of any external hum fields reaching the coil assemblies.

### Attention to Detail

By simplifying the internal construction of Audio-Technica cartridges and eliminating usual sources of loss, high sensitivity is assured. This, in turn, provides A-T engineers greater freedom of design to provide better performance in terms of tracking, frequency response and distortion.

Good listening.

*Jon R. Kelly*

Jon R. Kelly, President  
Audio-Technica U.S., Inc.  
1221 Commerce Dr., Stow, OH 44224



audio-technica.

The World's Favorite Phono Cartridge

Despite its diminutive size, the Sony D-5 has the same specifications and many of the features of full-sized Compact Disc players.

sive vibration damping for tracking stability. The CDS-3000, at \$1,200, is an elaborate control unit, with all the usual displays and features concerning track and timing indications. It affords direct access to any point on a disc within 2 S and has a search dial permitting bidirectional scanning while listening to the reproduced sound. Two CDP-3000 players can be controlled by the CDS-3000, and up to eight selections can be programmed in any sequence and intermixed between the two players.



Sony D-5 portable CD player

Sony scored another first by introducing a portable CD player. The D-5, which costs \$299.95, measures 1½ in. H x 5 in. W x 5 in. D and weighs a mere 1 pound, 5 ounces. Such miniaturization was made possible by incorporating most of the primary digital functions on one high-density VLSI (very large scale integrated) chip and the development of a special semiconductor for the laser pickup, making it less than one-third the size of previous pickups. Six C cells will provide 5 hours of playing time, and an optional rechargeable battery is available. An optional carrying case/battery pack, costing \$49.95, permits portable use. Via a supplied a.c. adaptor, the D-5 can be used as a home CD player or, with the DCC-120 car battery/cigarette lighter type of adaptor, which costs \$36.50, in a car.

### Sony D-5 and its accessories



Despite its diminutive size, the D-5 has the same specifications as full-sized players and many of their features. It can locate a desired selection by rapid forward or backwards scanning and will also permit high-speed scanning, but with the program remaining audible at normal pitch. An LCD shows battery condition, track being played, elapsed time, and number of tracks and time remaining on a disc. A CD is inserted after pushing the "Open" button on the top corner of the unit, and a special power-off safety switch automatically disengages all mechanisms during loading.

I was under the impression that the D-5 would have to be placed on a level surface in order to play properly. Incredibly, it can be played in any position, even slung over one's shoulder. Using headphones, you can really have a sort of super Walkman or, as Sony bills it, "Discman."



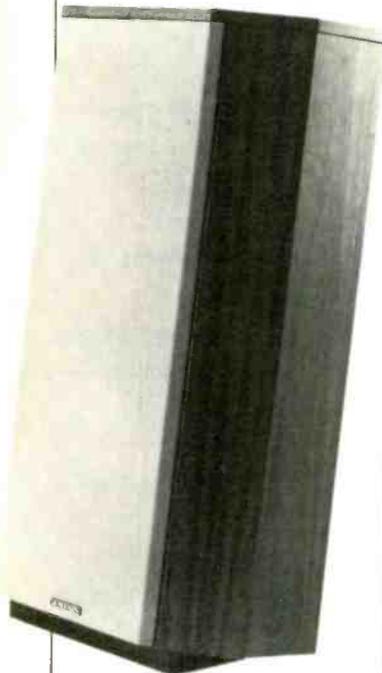
Components of JVC DS-4000 system

JVC demonstrated the DS-4000 automatic CD player/changer system, which includes an amplifier and has a capacity of 130 discs. (So far, it is only available in Japan.) The main player unit measures 22¾ x 18¾ x 11⅞ inches and weighs 60 pounds. It is controlled by a five-digit keypad connected to the player unit by a cable which extends up to 200 feet. The selections are made by pressing the five-digit code and then the entry key. JVC figures an average of about 15 selections per Compact Disc; with a 130-disc capacity, this affords a total of 1,950 selections. Each selection on each disc is individually selectable, i.e., tune 6 on disc 12 or tune 3 on disc 110, etc. The numbers of the selected tune, the tune being played, and the next tune are displayed. All "normal" CD specifications apply.

## Genesis Speaker

The Genesis Model 44 is a three-way, floor-standing speaker designed by Winslow Burhoe, the company's new Director of Engineering. The 1-inch tweeter is said to operate from a crossover of 1.1 kHz up to 25 kHz, an unusually wide range for a tweeter of this size. Bass is handled by a long-throw, 8-inch woofer loaded by a 10-inch passive radiator. Price: \$700 per pair.

For literature, circle No. 100



## Monster Cable Cartridge

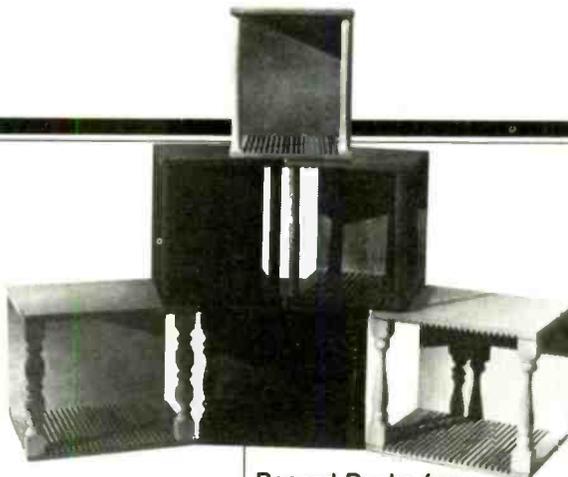
Monster Cable's second moving-coil cartridge, the Alpha 2, has a Micro-Ridge stylus mounted on a hollow-tube sapphire cantilever. The cartridge uses a "magnetic feedback control circuit" similar to that in the Alpha 1, which will remain available. Price: \$650.

For literature, circle No. 101



## Record Racks from The Accessory

The distinguishing feature of these record modular racks is the grooving of their top and bottom

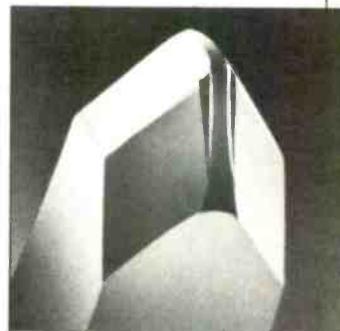


pieces, to hold records upright without warping. Each slot holds two single albums or one double album; the Mach I model has 14 such slots, the Elite has 18. Both are covered in unfinished birch veneer, and the Elite is available with Mediterranean, Provincial or Traditional styles of support posts. Both models require assembly. Prices: Mach I, \$29.95; Elite, \$49.95; \$2.50 shipping and handling for either model.

For literature, circle No. 102

## Shure Styli

Micro-Ridge replacement styli are now available for Shure's older V15 Type IV and Type III cartridges, as well as for the newer V15 Type V. The VN35MR and VN45MR styli are designed to reduce tip-related distortion, track high-frequency details more precisely, and improve play of worn records by scanning portions of the groove as yet unworn. The model for the Type IV also



incorporates Shure's Dynamic Stabilizer. Prices: VN35MR, for Type III, \$58; VN45MR, for Type IV, \$58. For literature, circle No. 103

## Soundcraftsmen Equalizer

Soundcraftsmen's DC4415 is a 21-band equalizer, with 15 bands spaced  $\frac{1}{3}$ -octave apart from 40 Hz to 1 kHz, and six bands spaced  $\frac{2}{3}$ -octave apart from 1.5 to 16 kHz. This concentrates

the third-octave controls where they are most useful, yet still provides finer than the usual full-octave equalization at the upper frequencies, without vast increases in cost. Filters are a "Smooth-Q" design, intended to minimize phase shift, and a gain-matching system is built in. Other features include a subsonic filter, an equalizable tape monitor loop, and independent controls for both channels. Price: \$599.

For literature, circle No. 104



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The PCR800X2 utilizes two completely independent power supplies, dual power transformers, 2-speed cooling fans, and even dual A.C. power switches.

This newest model to incorporate our highly-advanced Phase-Control-Regulation® technology, the PCR800X2 actually consists of two PCR800s and a PC-X2 front panel. The 19" rack mount panel converts the combination into a single stereo amplifier, when used with any Soundcraftsmen DX Series Preamp, or with any preamp plus our AB-1 Bridging Adapter.\*

It also converts into FOUR—205 WATT BASIC AMPS, for many other audio uses, such as bi-amping, etc.

Each channel, when operating in bridged mono mode, produces 555 watts at 8 ohms with no more than .05% distortion from 20Hz to 20KHz, and employs the latest in Power MOSFET output circuitry.

CURRENT-LIMITING IS COMPLETELY ELIMINATED in the design. Total weight is under 40 lbs. for the complete 555-watt per channel stereo amplifier.

The PC-X2 Front Panel is supplied separately. It requires only the 8 front panel mounting bolts to be removed and reinstalled through the PC-X2 mounting holes.

\*A Bridging Adapter, Soundcraftsmen Model AB-1, is available for use with other makes of preamps, at \$89.00.\*



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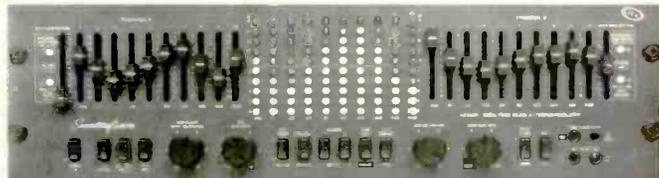
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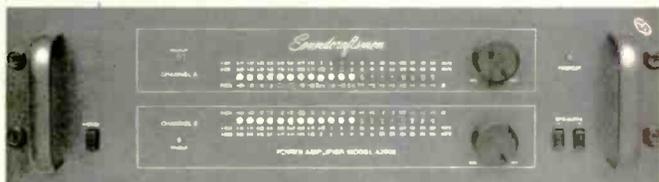
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## LECTURE NOTES

I seem to have skipped one story in my continuing, occasional audiobiography, from the time when I had my first job, teaching Music Appreciation at a very square University, Ivy League, which had just established a Music Department. That was in 1935; I got there in 1936. In two words, the place was abysmally unmusical, if just fine in other departments. But at the age of 24 I was about to change all that. Via recorded music—what else? So help me, almost a half-century ago.

You may remember from previous columns (February 1982 and May 1983) the record lending library I helped to establish at the University, thanks to the extraordinary Carnegie Collection of 78-rpm records. Also the Carnegie Phonograph, that state-of-the-art monster out of Federal Telegraph. Both the machine and the records came under my care, nobody else caring very much.

Then there were the "wooden needles," cactus and bamboo, which we required for all playing, and there was my homemade amp—6L6Gs in push-pull, thanks to my new friends in the Physics Department who often borrowed my records. And the huge, plywood, flat speaker baffle in my bedroom, their idea for better subwoofer bass. There was the Professor, my boss and head of the new Department, who hated mechanized music, like most of his generation, as the earlier farmers hated the horseless carriage. But let us proceed onward to the Phonoconcert.

I doubt if I had heard of the British experience with large public or institutional phonograph concerts ("gramophone"), then perhaps just beginning, but I had produced my own already, as a fervid reaction to the sonic cruelties of my college classroom experience. I knew I was right: Given the proper treatment, music from records *could* be good to hear, even on a concert scale. You may remember my account of my recorded concert on a moonlit summer night at the edge of a lake, with people listening from its glassy surface, in canoes, to the magical sound of a symphony. This was a new experience in those days and I was filled with joy. When I landed that first job I was primed to convert the academic world to music listening of



Illustration: George Blume

the same sort. And, being 24, I hadn't the slightest doubt that I would.

But the idea was not easy for my new boss, the Professor. Indeed, it was painful. His musical ways were already 25 years old and the Music Appreciation course, the same, had been given for years at another college. It was hugely successful, all those years, without the mechanical help of the phonograph.

Why should he change? From his viewpoint, his system worked well and worked again and again as new students came along. As I have said, his lectures were of the pre-phono sort, largely illustrated, if at all, by his own piano examples—that instrument serving to dish up all kinds of music from string quartets to symphonies and even madrigals. He was good at tossing off samples of all these, like adding a dash of pepper to a good salad. But his forte was lecturing. He could make you weep over a Mozart symphony that you never got to hear at all. Did you *have* to hear it? Not necessarily.

You understand, this was the tail end of a long, wordy tradition extending back to the great orators of the 19th century and to the fiery preachers who preceded them, all splendid masters

of the art of word persuasion. Did the preacher "illustrate" his Heaven and Hell with examples in 3-D, or hi-fi? He managed much better with the power of his voice alone. Should the popular lecturer on music do otherwise?

Ah, what a difference the electric phonograph was making. This poor professor was really at sea with a new technology, his distinguished career undermined at the peak of success, his piano skills rendered mostly superfluous, his ability to cope with the new equipment at the traditional artistic zero. I feel the same today when, after 30 years of analog tape editing, I now need a \$50,000 digital editor to do even the simplest "splicing" job for me. (Yes, I'm trying to cope with a digital tape of my Canby Singers.) So I send apologies to the Professor at this late date for so brashly pestering him in my innocence. He must be all of 115 years old by now.

I told the Professor, right away, that I would like to incorporate some phonograph concerts into our music course. Brash me! "That would be quite impractical," he said. The course was already set up to the last detail (it always had been), there was no time for extras, the regular work had to be



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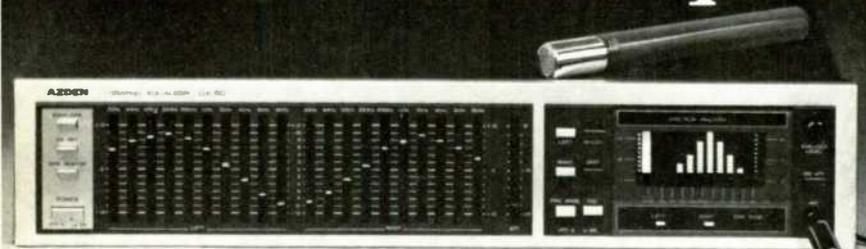


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Did the preacher illustrate his Heaven and Hell with examples in 3-D, or hi-fi? He managed better solely with the power of his voice.

done, quizzes, exams, taken and corrected, and so on. I was crushed. But not quenched. Okay, then, I'd put on my own concerts, for *anybody*—for the whole University! I would defy my own boss. (Did I know my humble place? Decidedly not.) That man was a saint. He should have fired me the next day, ideas or no ideas. But he didn't. Good soul at heart.



So I went ahead. I do think I was unusually perceptive, for that time, as to the needs of phonograph (read hi-fi) listening, as contrasted to live music. Most of my musical elders were still of the point-it-at-the-audience-and-wince school. I did know what I was doing. But I wasn't very tactful about it. I think I put on seven or eight of my Phono-concerts before I gave up. One does not reform a University in a day.

Mostly out of our classes, I collected a small and timid coterie of students who felt that maybe I had something for them, however arty the idea might seem. That "something" was actually *listening to the music itself*, rather than to lectures thereupon. We had the music, on records, all we could use. So why not? Those kids were right. They got the new idea. They were few but they were willing to brave social anathema, in that extremely "square" environment, to listen under good and pleasing circumstances. *Not* the classroom. I admire them in retrospect.

And so we were grudgingly given a sort of cooperation (they couldn't very well say no to anything that propagated the musical faith at the college). It was in the form of a classroom, fortunately an odd one and not bad for the purpose. We didn't get it for its special acoustics—it merely happened to be vacant in the evenings, and it had a phonograph.

This was a small, separate building, sort of Victorian and octagonal, all stone and wood casements with ivy on

A small and timid coterie of students felt that maybe I had something for them. That "something" was actually listening to the music itself.

the outside. It obviously was never meant for a classroom, which was all to the good. Inside the single room were a few dozen randomly placed seats (not fastened to the floor). Up front was a sturdy table phonograph of the Magnavox sort, a wooden box with lid. Inside was a skimpy turntable and a heavy pickup, plus volume and tone controls. Below that, in the remaining small space, were a few watts of amplifier and a 4- or 5-inch speaker, also the power transformer. The thing played reasonably well at lowish volume, but, as in most such instruments, if you turned it towards loud you got distortion in the upper (low) highs and growling breakup in the bass. So we mostly kept it soft. I taught classes for three years in that room in the mornings. Now we had it for our evening concerts. How to set up?

I knew that this would be crucial. You don't just play at your audience, right in a classroom. You must look for better. I figured, quite reasonably, that since classes were always in a brightly lighted and sterile environment, with rigid rows of uncomfortable seats, I should turn the lights down for effect and randomize the chairs. How about a bit of atmosphere? Like, say, some decor, maybe even flowers on the table? In a sense I was right. Atmosphere counts.

So we carried in lamps and a few extra chairs for comfort, rearranged the placement so that the phonograph was less glaringly visible and aimed, not straight ahead, but somewhat off, towards good reflecting surfaces like those casement windows and wood-paneled walls. I think I even set out plates of cookies.

No use! We had put up posters, which I made, all over the campus. They weren't at all academic—the idea being, so to speak, to break the ice. I did my level best. At the first concert maybe a dozen students showed up, stone-faced and ready to be embarrassed. It was sheer risk for them in that squarest of universities. When I turned the lights almost out at one point, they nearly perished. It was awful. I will never forget the faces. From that point on we had audiences of five or six or three. But being me, I would not give up. Music, I really believed, would do its own job.

The end was sudden. In desperation I had a bright idea. I would invite the great and beloved Professor himself, head of the Department, to take over a Phonoconcert. That would do it. They would flock to hear him. Yes, he said to my surprise, he would talk about the Bach "B-Minor Mass," which we had complete on records, its first recording. Wow! My favorite music. I had even sung it in college.

But I had not reckoned with the gentleman. I should have known. First, I discovered that the concert would have to be in a larger place—none other, of course, than our regular and hideous concrete lecture hall. And he was right. A huge audience appeared—the man was famous, remember. The lights were up to full brightness, the Carnegie Phonograph was poised, as usual, pointing straight at the audience, and all those nice people were ready to hear the Professor lecture—what else?

Talk he did. He was at his old-time best, and they loved it—the students, by the dozens, also the ladies and gents of the faculty community who were of the sort who loved culture and cultural events, especially when the lecturer was eloquent.

But the music—the concert? The Professor waxed so eloquent, indeed, that the little matter of the music quite slipped his mind, time and again. All we got were perhaps two minutes of the usual squawks and screeches as he tried, in his endearing way, to locate a musical theme with the volume control wide open. (The Carnegie Phonograph could mow down the ears like the biggest hi-fi system today.) For me it was a dreadful, devastating occasion and why labor the point? To make my usual pun. But everybody else loved it. Squawks? Didn't all phonographs make squawks like that, if maybe not quite so loud? But such a glorious lecture! It was the end.

I never tried another Phonoconcert, until I left the place two long years later. And thereby, just perhaps, future audio and hi-fi were set back in their later development by a few short months? Who knows. Could be. In any case, I no longer try to amend my professor's ways of operation, on the grounds that it is none of my business. Except, maybe, in this column. 

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## MATTERS OF WHEEL IMPORTANCE

Once again, David L. Clark reports for us on Detroit developments (some of which come from Framingham, Kokomo, Eindhoven and elsewhere, but what the heck):

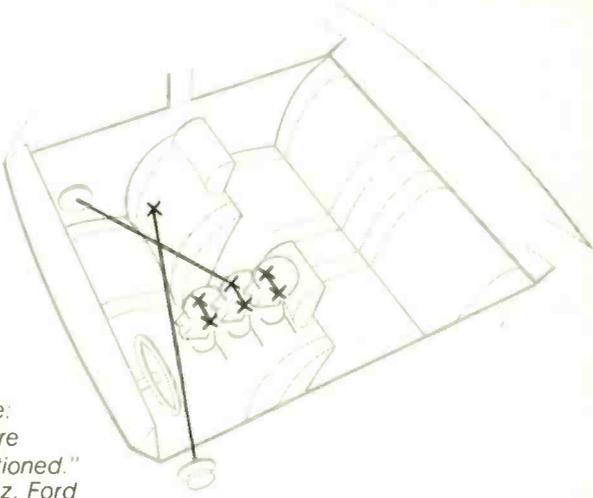
**T**o an out of town, vast areas of Dearborn, Michigan, could easily be mistaken for a Ford Motor Company theme park. In the midst of this automotive fantasyland, a stone's throw away from the "Glass House," Ford's corporate headquarters, is the elegant Hyatt Regency Hotel. This was the location for the Congress on Transportation Electronics, which took place October 22-24, 1984. It's an annual affair organized by the Institute of Electrical and Electronic Engineers (IEEE) and the Society of Automotive Engineers (S.A.E.). This setting is a contrast to the S.A.E.'s convention in February, which takes place in an exposition hall in downtown Detroit. Management is attracted to this October conference; they send the engineers to the S.A.E. in February.

The conference theme was New Horizons in Vehicular Electronics. With managers both presenting and attending the papers, there was much speculation about the future of entertainment systems, but with some sacrifice in technical accuracy.

Philips presented a paper that started with a progress report on the adaptation of the Compact Disc to the automobile, including the CARIN car-information system. This uses the CD as a read-only memory for vast amounts of data, such as road maps.

A surprise was the announcement of Philips' research and support of a consumer digital audio tape recording system (DAT). The car CD is not a true replacement for the cassette player, but the DAT might be. Imagine making a direct digital transfer from a CD at home to a cassette-size tape to play in your car. Compared to car CDs, tape has the potential of durability in the hostile car environment, is far less vibration-sensitive and can be easily inserted into the player while driving. The cost will be much less than a CD, and the tapes will be reusable.

A number of companies (including Philips) have agreed to devote DAT research efforts to two possible formats, from which one will be chosen. The S-DAT system uses a stationary



*"The automotive sound system designer has one important advantage: He knows precisely where the listeners will be positioned."*  
—Lawrence A. Lopez, Ford

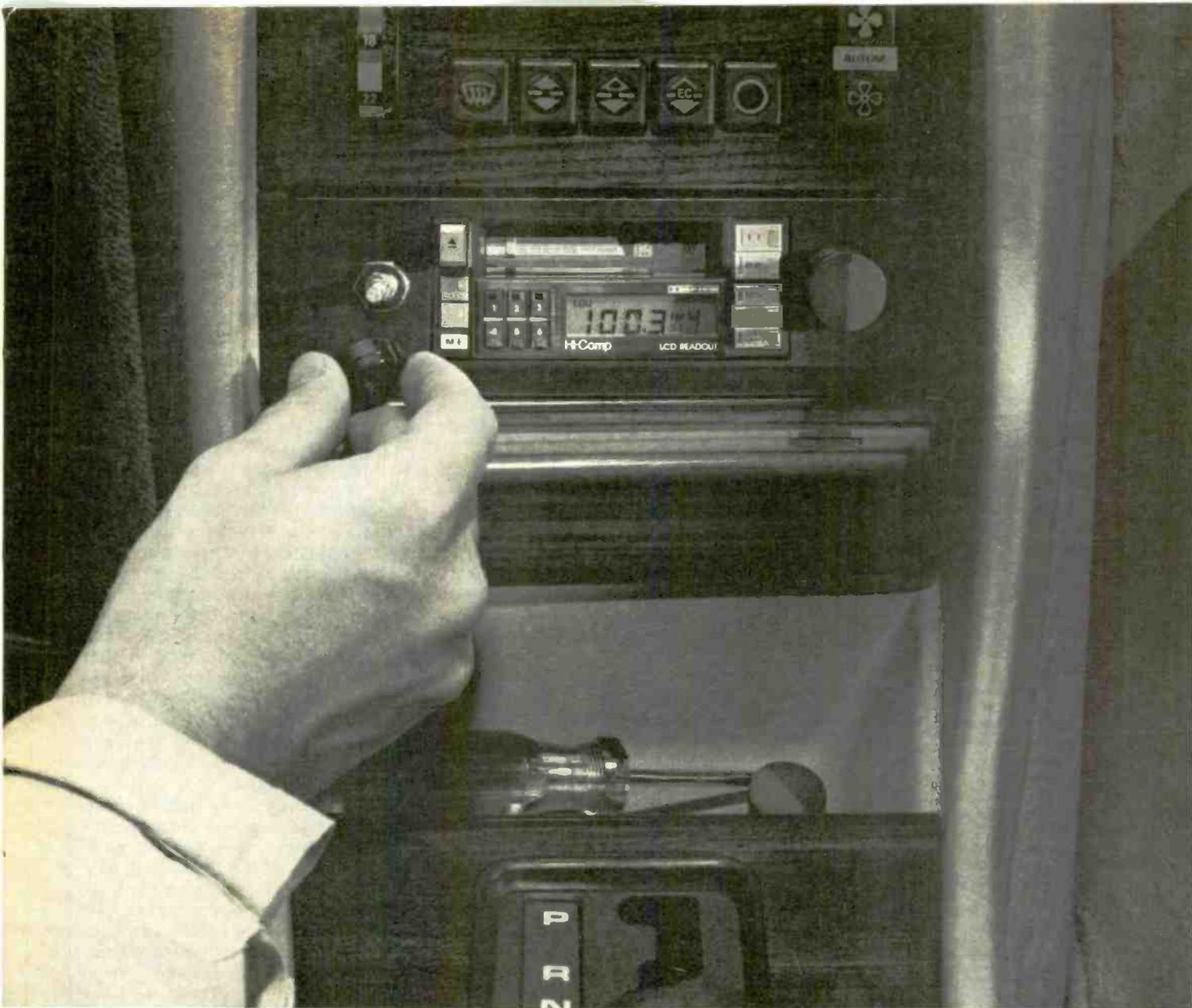
head with 20 tracks. The R-DAT system resembles a miniature videocassette recorder, using a rotating head in a helical-scan system. Both systems use 16-bit resolution of amplitude and 44.1-kHz sampling frequencies, the same as the CD standard. The choice between the formats is not an easy one. The 20-track S-DAT system (exactly the size of a conventional cassette) is mechanically simple but electronically complex. The R-DAT system uses scaled-down videocassette technology, making it mechanically complex. Since electronics has a history of coming down in price while mechanics does not, the S-DAT system may be less costly in the long run. In favor of the rotating-head DAT format is its small size—just over half that of a compact cassette, with over 2 hours of playing time. It could be argued that the compact cassette size and 1-hour time of the S-DAT system are just right.

A Clarion engineer maintained that new technologies are required for both DAT formats, not just scaled-down size. The S-DAT system's 20-track record head borrows integrated thin-film technology from the latest computer hard disk drives, and its playback head is a magneto-resistive type. Mechanics for this system are not that trivial, either. There are 20 tracks in each direction on standard 0.150-inch wide tape. A servo system is not required, but a new fixed-azimuth, edge-referenced guide system had to be developed. The rotary mechanics of the R-DAT system are required to lay

down a 12-micrometer track (that's one half of one thousandth of an inch wide) at a 6° angle to the quarter-inch tape (which runs at about 0.3 ips). The drum's scanning speed across the tape is 3.14 m/S with a  $\pm 20^\circ$  azimuth offset between adjacent tracks. Needless to say, servo tape guidance is required for this system. Clarion and others are hoping for a final decision to be made between the two formats by this spring.

"Hi-Fi GM Automobiles: Today & Tomorrow," presented by Richard Stroud, Audio Systems Engineering Supervisor of Delco Electronics, was a Delco chauvinist's overview of car audio. Mr. Stroud proudly listed a series of Delco "breakthroughs" from the '60s up to the Delco-GM/Bose system. In reality, this was a grim period for them, in which increasing numbers of customers bought their cars without radios so they could put in good aftermarket systems. When GM finally did come up with an innovative system, it was Bose, not Delco, that invented it.

The most interesting part of Mr. Stroud's talk was his estimated timetable for new developments. He sees new magnet materials, flat speakers, and 100 watt/channel amplifiers to meet the current design challenge of achieving full-range sound in the decreasing space available to loudspeakers. He sees these developments, and car CD players, as just ahead. Digital audio tape, he predicts, will coexist with CDs for a while in the late '80s. He feels that by the early



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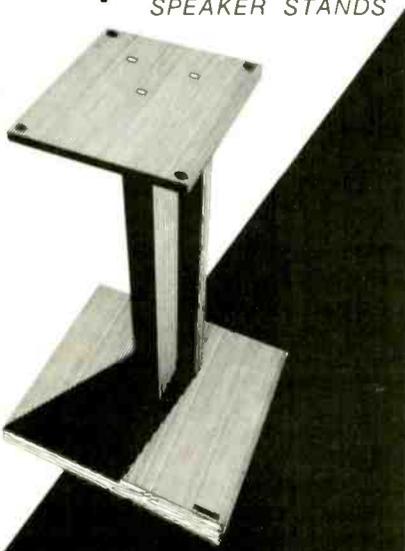
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The background noise spectrum of a "quiet" car at 55 mph resembles the maximum output of a good subwoofer.

1990s, semiconductor memories will have increased in capacity to the point where it will be practical to record a 1-hour program on a chip or two. Certainly, the elimination of all moving parts is an attractive goal, but the largest memory chip available today holds 10,000 times less than a CD. Many people doubt that this gap can close as quickly as Mr. Stroud suggests, if ever. Hopefully, we will be spared "inaudible" data compression techniques to fudge an hour of music into whatever memory is available.

Lawrence A. Lopez, Executive Engineer from Ford Motor Company, presented a somewhat less biased overview of car sound from its humble beginnings to now. He also commented on the lack of published data on psychoacoustic studies of perception in small enclosures like car interiors. Because of this, Ford has begun to direct considerable engineering effort to this subject. Lopez illustrated the unique engineering challenges of car audio with graphs of lab data from his engineering department. For instance, the background noise spectrum of a "quiet" vehicle at 55 mph was shown to resemble a good subwoofer at maximum output. Levels reached 105 dB SPL in the range of 20 to 80 Hz—something of a problem for a 6-inch woofer to speak over! Lopez ended by offering a timetable similar to Delco's but more conservative. He also gave a hint of an upcoming Ford satellite/subwoofer system.

Panasonic presented details of a newly developed, two-chassis car CD player which they hope to sell directly to car manufacturers. The player mechanism and controls are in a standard DIN package for instrument-panel mounting, with the electronics in a remote package. The disc is inserted into a slot near the bottom, with the label down. The machine takes the disc in and pushes it halfway out after playing. With the half-out disc at the bottom, the controls can still be accessed. If the disc is not removed within a short time, it retracts back in for protection. A variety of control functions are available, but not all of them are needed. This allows the car manufacturer to customize it as he sees fit.

Dr. Amar Bose, of the Bose Corporation, gave an enthusiastic talk on psy-

choacoustics, college-professor style, using a blackboard and much arm waving. He stated that audio product development takes place in three linked domains: Physical devices, measurement of those devices, and perception of the sound. Points within each domain represent observable differences, and designers try to map from one set of points to those in another domain. The ultimate goal is to design a device that maps to a "perceived as reality" point which is two steps away in the perception domain.

Physical acoustics and engineering link devices and their measurements, while psychoacoustics links measurements and perception. Bose noted that individuals are seldom trained in both physics and psychophysics. This prevents the typical design engineer from linking measurements and perception. The psychoacoustics expert can make this jump but cannot specify new measurements or equipment improvements. For product evaluation, Bose stated he has found no substitute for individuals who possess formal training in all four of the following areas: Electronics, physical acoustics, psychoacoustics, and music.

Bose stressed the need to continuously compare any sound reproducer being developed to live music. Music has evolved and stabilized over the centuries to preferred spectral, spatial, and temporal characteristics. When untrained listeners are asked which of two sounds they prefer, they will invariably choose exaggerated characteristics over the more natural sound. After an hour or so of listening, however, their ears tire and they will become annoyed. Thus, the untrained listener will select components on initial hearing that will ultimately produce listening fatigue. The solution is to have listeners trained in the four previously mentioned disciplines evaluate the components relative to the natural musical experience.

This was the first year for an Entertainment Systems session at this conference. It got off to a great start as a vehicle for manufacturers to express long-term goals and blue-sky thinking. It was also well-timed as a prelude to the nuts and bolts presentations of the Society of Automotive Engineers in a few months.

*David L. Clark*



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As with all renowned Harman Kardon products, the critical issues of the quality of the circuitry, construction and layout of components were expertly addressed. The VCD-1000 utilizes an advanced record / playback system which FM encodes the audio signal. This FM signal is recorded and played back via high speed rotating heads (1800 rpm), resulting in wide, flat frequency response (20Hz-20kHz,  $\pm 3$ dB), virtually non-existent wow-and-flutter (0.005%), and 80dB dynamic range.

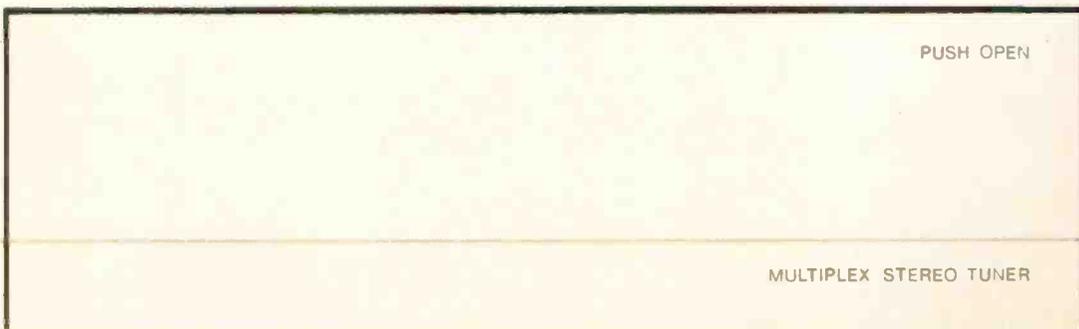
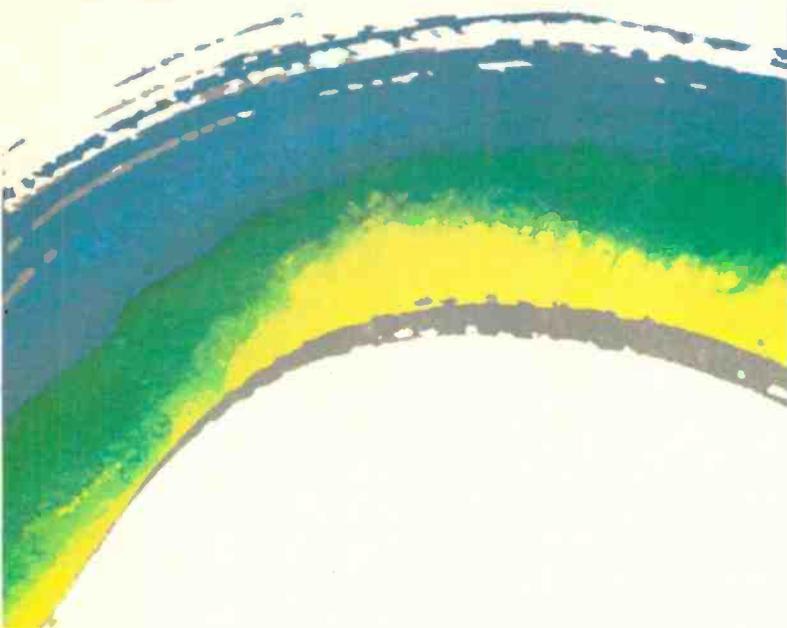
Custom-designed discrete filters are precisely tuned in pro-

duction to extend frequency response, critically align noise reduction and reduce high frequency distortion.

Applications of Harman Kardon acclaimed amplifier philosophies that are evident in the VCD-1000 are the use of discrete components for reduced distortion and the use of low negative feedback.

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MULTIPLEX STEREO TUNER

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Experience the Harman Kardon line of audio / video products... They're pure high fidelity for your eyes.

## harman / kardon

## MOURNFUL NUMBERS

Illustration: Philip Anderson



## Numbers, Needs, and Knowledge

*Tell me not, in mournful numbers,  
Life is but an empty dream!*

—Longfellow

There is a small war on among hi-fi reviewers, between the technocrats and esthetes—and a good thing, too.

The extreme technocratic right (like most extremes, largely imaginary) holds that once you've gotten the numbers that measure a hi-fi component's performance, there's no more to be said. The extreme esthetic left (a little less imaginary) holds that numbers mean nothing, and the listening is all. *Audio's* reviewers cluster near the middle of this spectrum.

There is reason on both sides of the issue. Most of us have heard, and all of us have heard of, components which did not sound as the numbers would predict, some sounding better and some worse. And we've all heard components which did sound exactly as the specs would lead us to expect.

Once upon a time, the numbers did tell us what we needed to know. When noise, distortion and frequency aberrations were common and gross, the numbers defining them could tell us at a glance which products were worth consideration. Now many of these errors have been refined away to the point where other differences stand revealed, and we have only our ears to find them with.

We wouldn't have gotten here so fast, though, if we hadn't had the numbers when we needed them. Listening to a prototype component to see if it has more or less distortion than your prior version is exhausting, and subject to subjective error. Measuring tells you relative distortion more quickly and reliably. That speeds progress—at least along the axes being measured.

We need to think about new axes of

measurement. *Audio's* Richard Heyser has given us some (such as energy-time curves and the crescendo test) in speakers. But while speakers are tricky to measure, their sonic differences are relatively gross. We need meaningful ways of measuring the subtler differences between such components as amplifiers and turntables.

By measuring, we make our judgments more reliable, and give each other some means of comparing judgments made by different reviewers. We also give designers a new tool, not just to predict how their designs will sound, but to predict how different components will interact.

And that gives listeners a useful new tool. It does little good to be told that speaker X sounds good with amplifier M but not with amplifier Q, if you happen to own amplifier Y instead. But if you knew that speaker X required an amplifier with parameters O and P to sound its best, you would know without lugging the beast home how the speaker probably would sound on your system.

What are these new numbers that we need to measure? Don't ask me. But *tell* me, if you have any to suggest. Write. Don't be afraid to offer off-the-wall suggestions if you have reasoning to back them up—just be sure to include your reasons. No prizes, except publication of the best suggestions and, if they work out, a further advance in the state of the art.

*Editor's Note:* One other thing, at which Ivan has hinted and which is never really spelled out in "one, two three . . ." fashion, is the relative distance between top and bottom of the quality ranking in the various categories of product. What's that mean, say you? Well, it means speaker systems sound enough

different, one from another, that no one would mistake one for another (well, hardly ever). With speakers, then, there is a large relative difference.

What product class has the next largest relative difference? Probably mikes, but most folks don't have or use them. And after that? Phono cartridges, where the difference in sound character has gotten very noticeably smaller in the past decade. Turntables are at about the same level, too, while preamps and amps have fairly small differences. Cables? Well, I've tried for about 5 years now and I've yet to hear *any* difference, though two respected listeners on our masthead cannot understand why I can't hear what is so plainly obvious to them. (I keep asking them to do their testing blind A/B . . .) On the other hand, I easily hear absolute phase and group delay with simple sources (as with Kaufman's Magic Box; see *Audio*, July 1984), where some other staff members have lots of trouble hearing any difference.

So what? Well, it means that speakers probably have more axes of measurement than any other component, that they are expected to do more things reasonably well than any other component, and that you should spend more time auditioning prospective speaker purchases than any other component and do so over a price range that may, at first, seem all too large. The quality per dollar spent varies most strongly with speakers, or—to put it another way—Beranek's Law operates most strongly in speaker systems.

For those who do not remember Beranek's Law, it states:

"It has been remarked that if one selects his own components, builds his own enclosure, and is convinced that he has made a wise choice of design, then his own loudspeaker sounds better to him than does anyone else's loudspeaker. In this case, the frequency response of the loudspeaker seems to play only a minor part in forming a person's opinion."—L. L. Beranek, *Acoustics*, McGraw-Hill, 1954, pg. 208. I am indebted to W. J. J. Hoge for calling this fundamental law of physics and human nature to my attention.—E.P.

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Much theater sound is worse than a TV set's, with voices muffled and the moving actors sounding stationary, in mono.

### Mike Fright

*Audio's* offices are in the heart of New York's theater district, but I take my entertainment elsewhere—in concert halls and small, Off-Broadway theaters. There, you hear real voices and real instruments; on Broadway, all too often, you hear the sound of body mikes and loudspeakers instead (and pay more for it, too).

According to an article in *Playbill*, the program magazine at Broadway shows, some theater owners are aware of the problem and have hired sound consultants to improve sound quality. The article cites Abe Jacob, audio consultant to the Shubert theaters, as saying that good sound is unnoticed sound. And Jacobs



knows: *db* magazine recently quoted another Broadway engineer as calling him "The person . . . responsible for bringing high quality [sound] to Broadway."

Unfortunately, much theater sound is less realistic than that from a portable TV set. Sound may come from almost anywhere in the theater if it does come from the front, the source stays audibly fixed (the sound is mono) while the actors visibly cross the stage. Body mikes, hidden under clothing, frequently sound odd or muffled and occasionally transmit strange rustles. (Do Broadway actors starch their underwear?) When two actors come together, their voices change character—probably comb-filter effects from being picked up by both mikes simultaneously.

What brought us to this pass? Perhaps we, the audience, did. The article quotes Richard Fitzgerald, of Sound Associates, which equips many Broadway shows, as saying, "Audiences are different from 10 years ago. They're noisier, they don't listen as well, they demand amplification." And Jacobs adds: "The audiences demand it. They're used to it from their stereo and TV sets. They don't want to strain to hear."

### Hum Ho

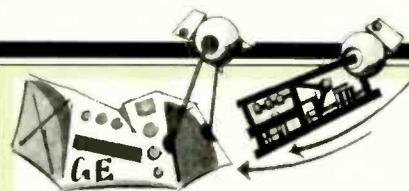
Acoustics can do funny things. For example, when I last moved, 15 years ago, I found that the AR-3a speakers I preferred for classical listening in my old home became my favorite rock speakers in the new, and vice versa for my Rectilinear IIIs.

I also discovered an acoustical peculiarity in my new apartment: With a long hall extending off to the left of the left-channel speaker, the best bass in the house was where the hall terminated, in my bathroom. Hum came through with special clarity—I guess the room resonated at 60 or 120 Hz—enough to make it obvious that the system was on, even when I couldn't possibly hear hum in the living room.

I'm probably about to move, to a new apartment with a different layout. I wonder how my system's sound will change this time.

### Live End, Cat End

I'd like to use live-end/dead-end acoustical techniques on my living room. The trouble is, I have two cats, complete with claws. Any suggestions as to how to keep them from clawing my room's dead end into liveness (and shreds)?



### Alphabet Soup

GE and RCA are going CD—a good omen for CD's popular acceptance. Neither company is actually making players, of course—about half the companies whose brands are on CD equipment buy them elsewhere—but they are marketing home players. (RCA's is part of their deluxe audio/video Dimensia system, and GE is even rumored to be readying a portable system with a player.)

Perhaps we may once again see America's big electronics companies get big in audio, too; GE, for instance was once a leader in magnetic cartridges, and Stromberg-Carlson (now producing defense electronics) had a complete component line, including a turntable which foreshadowed the AR turntable in several respects.

### Bachward, Turn Bachward

Part of the fun of P.D.Q. Bach concerts comes from the titles of the works—"Concerto for Horn and Hardart," "Iphigenia in Brooklyn," "The Stoned Guest," "Variations on an Unusually Simple-Minded Theme," and so on. But there are other P.D.Q. works which, so I understand, the renowned Prof. Schickele has not yet uncovered. Being no music scholar, I have not discovered these works either, but I have at least found an old reference work which lists some of the missing titles: *The Annulment of Figaro*; *Barbarous Seville*; *Cafeteria Rusticana*; *Counterrevolutionary Etude*; *Critical Mass in B Minor*; *Desecration of the House Overture*; *The Dessert Song*; *Dialogues of the Caramelized*; *Dristan and Isolde*; *Flight of the Bumblebee Tuna*; *Indecent Overtures*; *Juice of Three Oranges*; *Lakme or Leave Me*; *The Magic Fruit*; *Marche Millinaire*; *Moonshine Sonata*; *Music for Unprepared Piano*; *Parsifal, Sage, Rosemary and Thyme*; *The Pines of Nome*; *Weiner Blutwurst*, and *A Wife for the Czar*.

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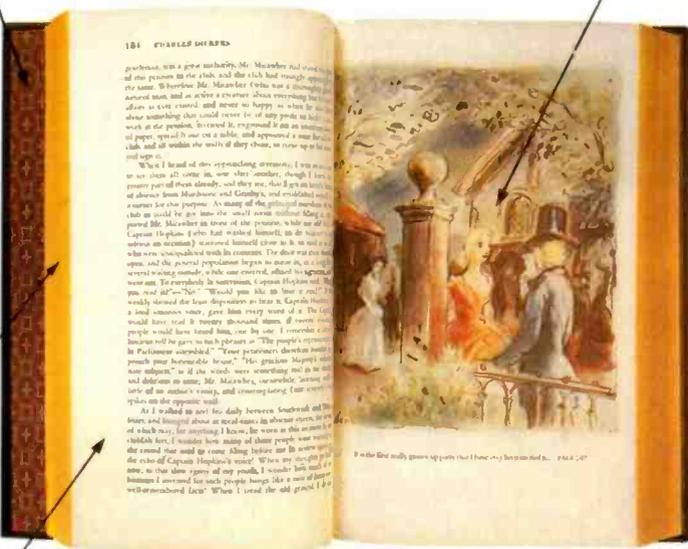
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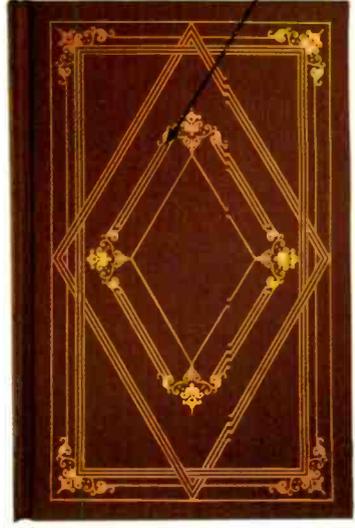
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# Frequency Contouring For Image Enhancement

Richard J. Kaufman

**The brain has more ways of locating sound than are usually made use of. Here's how to use one that is often neglected in commercial products.**

**T**he brain uses three major cues to determine the direction of sound. Relative loudness and phase (including arrival-time) differences between the sounds heard by the left and right ears are well known; they were mentioned in Blumlein's stereo patents of 1931. Stereo as we now know it depends on these two effects, but loudness predominates. Recording engineers generally use relative loudness alone to mix a "stereo" recording from multiple mono tracks, and some "image-enhancement" devices use phase differences to give a wider stereo image.

Frequency response is less well-known than phase or level differences in this regard, and has never, to my knowledge, been used by recording engineers to intentionally enhance the stereo effect. It was first brought to my attention by Denis Vaughan's article, "How We Hear Direction," in the December 1983 issue of *Audio*. Perhaps the effects of frequency response are more obscure than the other perceptual cues because the scientific work exploring this aspect of audio perception is relatively recent.

The fact is, the human ear's frequency response varies, depending on the direction of a sound's arrival. You can confirm this easily; listen to a source of

random noise, such as a fan, a running faucet or interstation hiss on an FM receiver. Block one ear, and listen with the other as you turn your head. The tonal quality of the noise will change, depending on the direction from ear to sound source. The implication of this effect suggests a definite limitation in the ability of two loudspeakers to give a realistic illusion of an acoustic event. However, it promises better sound reproduction if the principles behind the ear's localization of sound by frequency response can be refined and incorporated into the recording art.

My experiments along these lines indicate that not only is this possible, but that existing stereo recordings can be enhanced by the use of a relatively simple matrixing device and a 10-band graphic equalizer. This article will describe how to use frequency contouring to change the perceived source of a sound when played through a stereo system, and will show how to build the matrix.

Table I, reprinted from Denis Vaughan's article, shows how the ears' response varies at different frequencies, depending on the angle of arrival. (In front of your nose is 0°, directly to the side is 90°.) These response curves are said to vary little between individuals.





The sound stage need not be confined within the space between the speakers.

Table I—How the outer ear's response varies at different frequencies and sound-source azimuth angles. (After Mehrgardt and Mellert.)

Ear Canal (dB)	Frontal Spectrum (dB)	Frequency In Hz	18°	36°	54°	72°	90°	108°	126°	144°	162°	180°
0	-0.5	200	1.0	2.0	1.5	0.5	1.5	0.5	0	0	0	-0.5
0.5	0.5	500	1.5	3.0	4.5	4.5	6.0	5.0	4.5	4.0	2.5	0
1.0	1.0	700	2.0	3.5	4.5	5.5	6.0	6.0	5.5	4.5	2.0	0.5
1.0	-2.0	1k	0.5	2.0	2.5	4.5	5.5	5.0	4.5	3.5	3.0	2.0
2.0	10.0	2k	12.0	12.0	11.5	11.5	10.5	10.0	8.5	8.0	8.0	6.5
5.0	12.0	3k	13.0	14.0	15.0	14.0	11.0	10.0	9.5	9.5	9.0	8.5
12.0	5.0	4k	8.0	9.0	8.5	6.5	3.0	-0.5	-3.5	-3.0	-1.5	-0.5
12.0	-1.5	5k	2.0	2.5	3.5	3.0	2.0	-1.0	-7.0	-10.5	-9.5	-8.5
9.0	-0.5	6k	3.5	6.0	6.5	7.0	6.5	5.0	2.0	-3.5	-5.0	-5.5
5.0	1.5	7k	6.0	10.0	11.5	12.5	11.5	10.0	8.0	4.0	0.5	-1.0
4.5	-2.0	8k	2.5	6.0	9.0	12.0	13.0	12.5	10.0	5.5	1.5	0.5
8.0	-8.0	9k	-4.5	-2.5	-1.0	0.5	3.5	3.0	0	-3.5	-7.0	-8.5
11.5	-10.5	10k	-7.5	-5.0	-3.5	-3.5	-4.0	-3.5	-4.0	-6.0	-8.0	-13.0
2.5	-10.0	11k	-7.0	-6.5	-4.0	-2.5	-3.0	-2.5	-3.0	-3.5	-8.0	-12.0
-8.0	-7.0	12k	-2.0	-5.5	-3.5	0	1.5	1.0	-0.5	-3.5	-5.5	-9.5
-9.0	-2.0	13k	2.0	-2.0	-0.5	3.0	3.5	4.0	3.0	-1.0	-2.0	-6.5
-8.0	2.0	14k	8.5	4.0	4.0	4.5	4.0	3.5	1.5	-0.5	-2.0	-5.0
-7.0	3.5	15k	9.0	6.0	6.5	5.0	4.0	2.5	1.5	0	-1.5	-4.0

Fig. 1—Frequency contours for improved imaging with loudspeaker signals (see text and Table II).

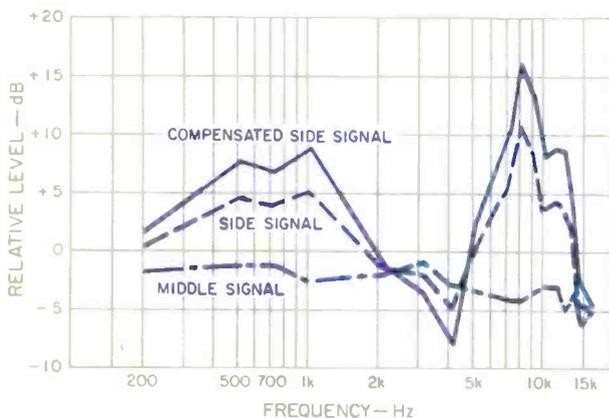
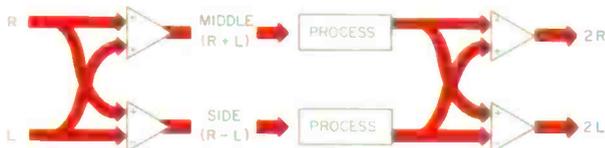


Fig. 2—Principles of the M-S (middle-side) matrix.



The usual angle subtended by a pair of stereo speakers in a normal listening configuration is  $\pm 18^\circ$ , or slightly greater. (This means that if the speakers are separated by 6 feet, the listener is about 9 feet from the plane defined by the speakers. A  $\pm 36^\circ$  angle would place the listener closer to the speakers than the distance between them, a situation that should be avoided. Although most setups place the listener somewhat closer than a 6-to-9 ratio, the difference does not appear to be significant in this context.) With the standard speaker setup, the stereo image is usually confined to the space between the loudspeakers, and it is most accurate for instruments whose apparent location is at the speakers themselves (i.e., monophonic information in one channel). With centered, or two-channel, monophonic information, amplitude clues tell you that the sound source is centered, but you are still constantly aware of where the loudspeakers are.

Therefore, my first experiment with frequency contouring involved altering the frequency response of a mono signal to make it appear to come from dead center, with no sense of speaker position, when played through a pair of speakers. (The same equalization can be applied in a studio mix-down, as when a vocal solo is mixed equally into the right and left channels. A vocal so mixed and equalized will seem to come from dead center.)

For these experiments, I used the equalization settings shown in the "Middle" column of Table II. As Fig. 1 (a graphic representation of the information in Table II) shows, a four-band parametric equalizer might correct the response exactly. A third-octave equalizer would also be very good. Pioneer was kind enough to lend me a 2/3-octave unit, the SG-90. It was almost as effective as a third-octave equalizer, and its controls were accurately calibrated. But even a 10-band graphic equalizer can give a fairly good fit to the desired approximation—all you need do is set its bands to the levels indicated for those (or the nearest listed) frequencies in the "Middle" column of Table II.

Your equalizer may well require different settings than shown in Table II for correct results. There are two rea-

**By using the proper frequency contouring, it is possible to make sound seem to come from overhead or even behind the listener.**

sons for this: First, you will have to take into account the degree of interaction between adjacent equalizer bands; your equalizer's manual should tell you the degree of interaction (if not, write the manufacturer and ask). Also, the dB scales on many inexpensive graphic equalizers are not accurately marked; corrections for this are shown in Table III. The relationship between indicated and actual response shown here is typical, and is caused by the common use of linear potentiometers for what is actually a logarithmic function. Note that the discrepancy is greatest at the center of the range, with indications becoming more accurate at the more extreme settings. For this reason, if your equalizer provides a maximum adjustment of  $\pm 15$  dB, it will still be fairly close to the figures shown, over much of its range. Using a spectrum analyzer would make these adjustments easier.

Again following Vaughan's data, I tried to contour a single-channel signal so it would seem to come from the listener's side, rather than from the speaker position, using the equalizer settings in the "Side" column of Table II. This also worked, though the apparent sound position was not a true  $90^\circ$ , probably due to either sound reflections in the room, arrival-time differences at each ear because of the  $18^\circ$  speaker placement, or both. At a friend's house, with Sonex acoustic foam behind the speakers, the sound did seem to be coming from the wall at my side, rather than from the front speaker wall. (The center image was already good without the Sonex.) This same equalization, applied to both channels of a stereo recording, gives a more spacious feeling to some material. With monophonic and some other stereo material, however, the "Middle" EQ settings give the best results—you'll have to experiment.

When mixing down multi-track recordings, apply the "Side" equalization to signals such as ambience or special effects to make them sound as if they originated at the extreme right or left. (This suggests that recording engineers will have a broad range of special effects available if they explore the uses of frequency contouring. It is even possible to make sounds seem to come from overhead, or behind the

Table II—Frequency contouring equalizations for shifting apparent positions of signals from normally placed speakers ( $\pm 18^\circ$  from listener).

Frequency, Hz	Contours dB		
	Middle	Side	Compensated Side
200	-1.5	+0.5	+2.1
500	-1	+4.5	+7.8
700	-1	+4	+7.2
1k	-2.5	+5	+9.0
2k	-2	-1.5	-1.0
3k	-1	-2	-3.1
4k	-3	-5	-7.6
5k	-3.5	0	+2.5
6k	-4	+3	+6.8
7k	-4.5	+5.5	+10.0
8k	-4.5	+10.5	+15.7
9k	-3.5	+8	+12.8
10k	-3	+3.5	+7.2
11k	-3	+4	+7.8
12k	-5	+3.5	+7.7
13k	-4	+1.5	+4.8
14k	-6.5	-4.5	-2.9
15k	-5.5	-5	-4.5

Table III—Indicated vs. actual settings of a typical home graphic equalizer.

Indicated Setting, dB	Actual Boost or Cut, dB
+12	+12
+10	+10
+9	+7.5
+8	+3.6
+7	+2.4
+6	+1.7
+5	+1.2
+4	+0.9
+2	+0.4
0	0
-2	-0.2
-4	-0.5
-6	-1.4
-7	-2
-8	-3
-9	-4
-10	-10
-12	-12

Table IV—Frequency contouring to prevent "in-your-head" effects in headphone listening, with and without M-S matrixing (see text).

Frequency, Hz	Center Simulation Contour, dB	Speaker Simulation Contour, dB	S-Channel Equalization	
			Normal, dB	Wide, dB
250	-2	+0.5	+2.4	+1.6
500	-5.5	-3	-1.1	+3.3
700	-5	-2.5	-0.6	+3.2
1k	-7.5	-3.5	-0.8	+4.0
2k	-0.5	+1.5	+3.1	+0.5
3k	+1	+3	+4.6	-1.1
4k	+2	+6	+8.7	-2.6
5k	-3.5	+0.5	+3.2	+2.5
6k	-7	-0.5	+3.2	+3.8
7k	-10	-1.5	+2.7	+4.5
8k	-15	-7	-2.9	+5.2
9k	-11.5	-6	-2.7	+4.8
10k	-6.5	-1	+2.3	+3.7
11k	-7	-3.5	-1.0	+3.8
12k	-8.5	-7	-5.7	+4.2
13k	-5.5	-5.5	-5.5	+3.3
14k	-2	0	+1.6	+1.6
15k	-0.5	+2	+3.9	+0.5



Frequency contouring can eliminate the "in-your-head" feeling common in headphone listening.

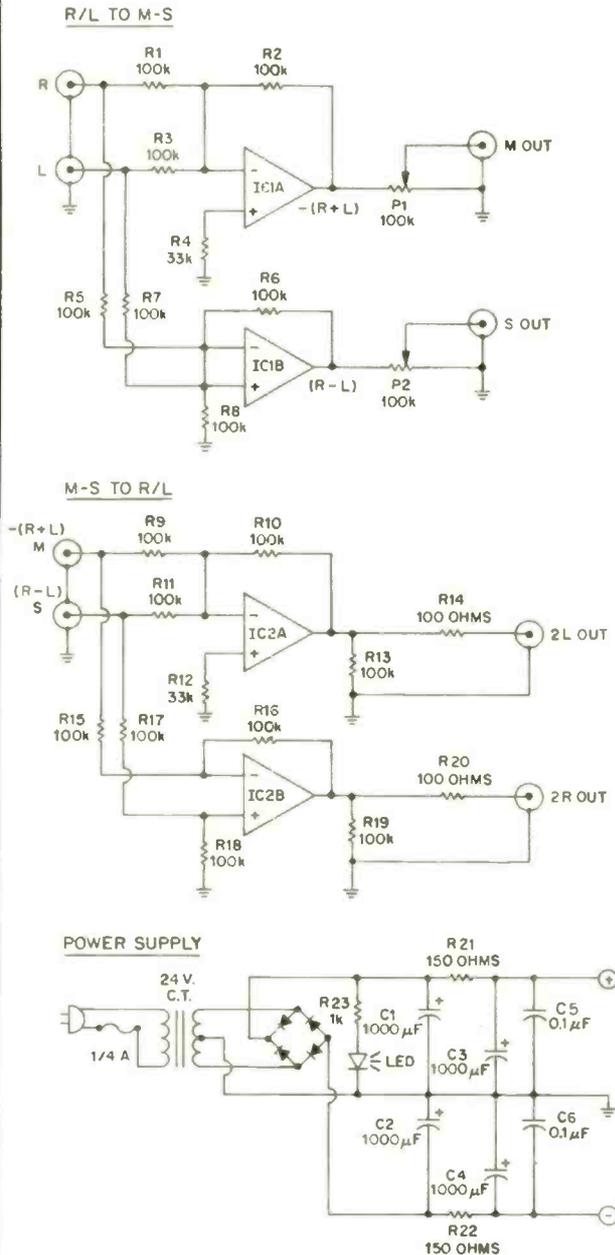


Fig. 3—Schematic diagrams for an active M-S matrix: Right-left to M-S encoder (top), M-S to right-left decoder (center), and power supply (bottom). Capacitors C5 and C6, shown in the power supply, should be mounted as close as possible to IC1 and IC2 and should be used even if a different power supply is connected.

listener, by using the proper response contouring.)

These effects are even better with headphones, although a different equalization is required (more on that shortly). Without room reflections or interaural interference, it should be possible to mix some stunning tapes for playback on headphone-equipped personal portables.

Most audiophiles do not mix their own music; a way to use frequency response contouring to enhance existing recordings is also desirable. This can be accomplished with a technique known as M-S (middle-side) matrixing (Fig. 2); Fig. 3 shows schematics for building such a matrix, for which a Parts List is also provided.

In M-S matrixing, the right and left signals are summed to give a middle (M) signal, the one we wish to contour to give the illusion of true center origination. Subtracting one channel from the other gives a side (S) signal, which we wish to shape so that it will appear to come at 90° from the sides. By properly remixing the M and S signals, separate right- and left-channel signals are again attained, but with a frequency response which provides more realistic ambience and wider imaging when played through a typical stereo system.

To do this, we apply Table II's "Middle" equalization to the M signal, and either the "Side" or "Compensated Side" contour to the S signal. Using the "Side" equalization will emphasize hall ambience but narrow the sound stage, while the "Compensated Side" contour will widen the sound stage.

What is being compensated for, in the latter case, is the interaction of the "Middle" and "Side" curves when the M and S channels are matrixed back into left and right stereo signals. Since each matrix channel includes both left and right information ( $M = L + R$ ,  $S = L - R$ ), the left-only and right-only signals are acted upon by both the M and S contours. When the signals are added back together, the results are not as desired. The "Compensated Side" contour includes a correction so that, when the M and S signals are added, side signals will have the proper contour for 90° localization.

If any required adjustment is beyond the range of an ordinary equalizer, use

## The build-it-yourself M-S matrix can also be used to reduce noise caused by multipath interference in FM reception.

the maximum cut possible at that frequency.

### Contouring for Headphones

Frequency contouring is even more effective with headphones and provides more normal sound perspective, without the typical "in-your-head" imaging problems. But headphones require different contouring than speakers, since the actual sound sources are at  $\pm 90^\circ$  rather than  $\pm 18^\circ$  relative to the listener. Table IV shows the contours for use with headphones to give the illusion of sounds originating from different angles.

One might expect that, due to the phones' contact with the outer ear, these figures might not be strictly accurate, because the sound is no longer acting on the entire pinna of the ear. However, for both over-the-ear and on-the-ear headphones, they work. In-the-ear phones are a different matter; a sound source in the ear would not interact with the contours of the outer ear (pinna), and would probably require a different sort of correction. (I've had no opportunity to experiment with these devices.)

For use without an M-S matrix, the "Center Simulation Contour" settings will make signals sound as if dead ahead (though with some loss of high-frequency information), while the "Speaker Simulation Contour" will place sounds as if coming from the normal  $\pm 18^\circ$  loudspeaker setup. To make recordings specifically for headphone use (an attractive idea, now that headphone portables are so common), apply the "Center Simulation Contour" to both channels.

With an M-S matrix, use the "Center Simulation Contour" on the M channel and the "Normal" equalization on the S channel. Contouring the S channel with the "Wide" equalization will produce a wider sound stage; information that appears only in one stereo channel will then sound all the way to the listener's side.

Results in all cases, for both headphone and speaker listening, will depend greatly on the microphone and mixing techniques used in the original recording. When listening through speakers, results will depend upon your speakers and your room acoustics as well.

## Parts List

R1 through R3, R5 through R11, R13, R15 through R19—100-kilohm resistors (exact value not critical, but must be matched within 1%).

R4, R12—33-kilohm resistors.

R14, R20—100-ohm resistors.

R21, R22—150-ohm, 1/2-watt resistors.

R23—1-kilohm, 1/2-watt resistor.

P1, P2—100-kilohm potentiometers.

C1 through C4—1000- $\mu$ F, 25-V electrolytic capacitors.

C5, C6—0.1  $\mu$ F, plastic-film (Mylar) capacitors. (Mount on same board as IC1 and IC2, as near to them as possible.)

IC1, IC2—TL072CP.

D1—Bridge rectifier.

T1—24-V, center-tapped transformer, 85 mA or more.

Miscellaneous—1/4-A fuse and holder; eight phono jacks, general-purpose p.c. board, LED, mounting hardware, and wire.

A kit of the required, 1%-matched resistors and op-amps is available from Brunswick Tape Media, 580 Eighth Ave., New York, N.Y. 10018 for \$8 (plus New York sales tax, where applicable). All other parts are easily purchased locally.

### Building and Using The M-S Matrix

Figure 3 is a schematic diagram of the M-S matrix. Construction is relatively simple, and the parts count is low. Anyone who has built one of the old Dynakits or anything similar should have no difficulty assembling the device on a general-purpose p.c. board. The hardware is available at Radio Shack. The resistors, however, must be 1% tolerance, to maintain the frequency response within 1 dB of that desired. (See Parts List for availability.) You may add 4.7- $\mu$ F decoupling capacitors at the outputs if you wish; I have not found the small amount of d.c. offset produced by this circuit to

cause a problem with any equipment I've used.

I installed my first prototype in the chassis of a graphic equalizer, hooking into its power supply. You can do the same, or you can use any suitable power supply that gives between  $\pm 6$  and  $\pm 8$  V instead of using the power supply shown in Fig. 3.

An added bonus of the matrix is that it allows you to change the relative amounts of middle and side signals, and so change the balance and perspective of a recording, improving some material where the original mixing was not ideal.

Another use for the M-S matrix is for noise reduction on FM stereo broadcasts. The M-S matrix is identical to that used for encoding FM signals; most of the noise due to multipath interference is in the R - L, or side, signal. By attenuating the frequencies above 4 or 8 kHz on the side signal only, it is possible to significantly reduce noise while maintaining stereo separation in the midrange, and preserving high-frequency information in the middle signal.

M-S frequency response contouring gives broader and more localized imaging with many recordings. Center information is less blurred, more sharply focused. Side information can be so sharply defined that one thinks there are extra speakers in use; some listeners have searched my listening room, attempting to find them. With headphones, the music no longer sounds as if it were inside your head, but moves out and toward the front where it belongs, while still retaining the detail and intimacy characteristic of headphone listening. While it may not be suitable for all material, the matrix was very effective with popular and rock recordings.

Perhaps the most exciting use for frequency response contouring is not enhancing existing music, but in creating new works. I have used a computer to develop an extensive series of tables and graphs to aid in such efforts. The results are available, together with a demonstration tape, from Brunswick Tape Media, 590 Eighth Ave., New York, N.Y. 10008. Please enclose a check for \$15 (plus sales tax in New York) to cover the cost of materials and handling.

**A**

**Leonard Feldman  
and R. Aryana**

# THE DNR

## How it works

**C**ompanding, noise-reduction systems, such as Dolby and dbx, may be the best-known noise reducers, but they're not the only ones. There is another type, referred to as noncomplementary or single-ended, with unique advantages of its own.

In companding NR systems, the signal must be encoded before transmission or recording, and decoded in re-

ception or playback. These systems can reduce the amount of noise a signal picks up within the encode/decode loop, but they can't reduce noise already present in the signal.

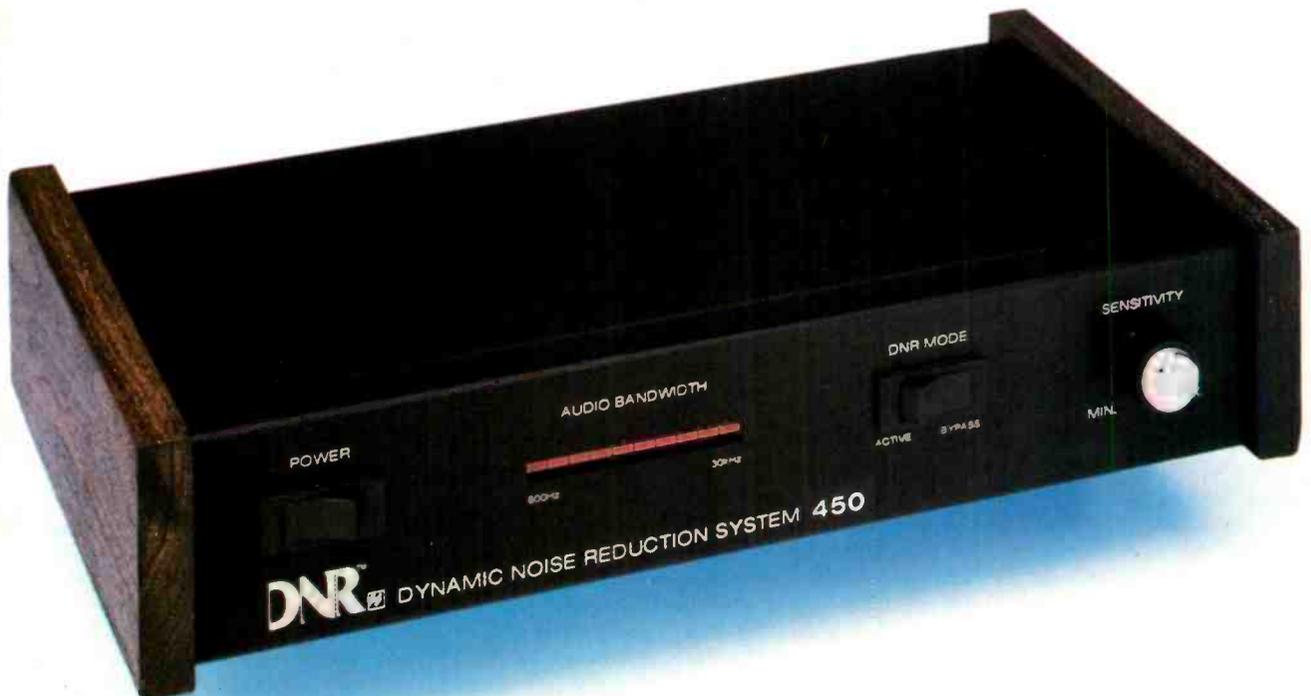
Companding NR systems (including Dolby B and C, dbx, and the one described by John Roberts elsewhere in this issue) have the most powerful noise-reduction ability, but they must trade power for compatibility. For instance, Dolby B-encoded tapes are compatible with systems lacking Dolby decoders—you need only turn the treble down to listen pleasantly—but this is the least powerful of the popular companding systems, with only 10 dB of noise reduction. Dolby C NR, with 20 dB of noise reduction, produces tapes which can be listened to reasonably well on systems equipped with Dolby B

decoders, but it is barely listenable on systems without Dolby B (again, with the treble turned down in each case). Tapes made with dbx encoding are the least compatible—they're unlistenable on systems without dbx decoders—but provide the most noise reduction (35 dB or more).

Single-ended NR systems work in playback only, requiring no special encoding of the signal. While they cannot prevent noise pickup like the companding types, they can reduce noise already present in the signal. And they can be used with any program source: AM, FM, tape, disc, VCR audio tracks, telephone, or even such nonaudio applications as medical electronics and data transmission.

Perhaps the best-known of these systems is the Dynamic Noise Filter,

*Leonard Feldman is a Senior Editor of this magazine. R. Aryana is Chief Engineer of Advanced Audio Systems International in San Jose, California. Portions of this article have been adapted from "A Dynamic Noise Reduction System," an article by Mr. Feldman which originally appeared in the October 1981 issue of Radio-Electronics.*



# NOISE REDUCER:

## and How to build it

developed by Richard Burwen. A single-chip noise-reduction system based on Burwen's, called DNR, is manufactured by National Semiconductor (See "National's New Noise-Reduction Chip" by Ralph Hodges, *Audic*, November 1981.)

### How DNR Works

The National Semiconductor noise-reduction system can provide up to 14 dB of noise reduction in stereo program material and is based upon two principles. The first of those states that noise output is proportional to system bandwidth. Suppose system noise is caused solely by resistive noise (noise added by the circuit resistors). In such a system, noise amplitude is uniform over the system's frequency bandwidth. Thus, if

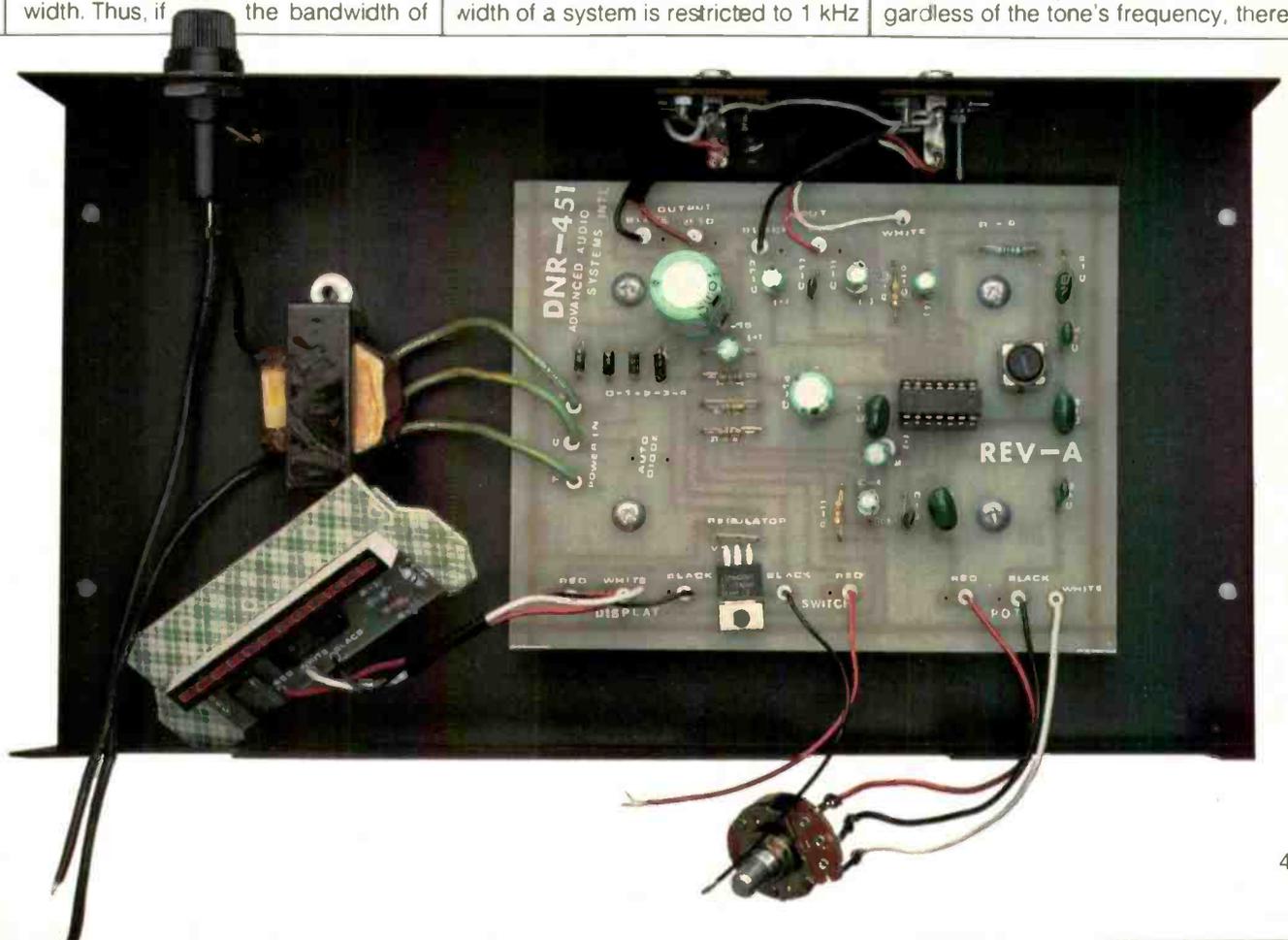
the system is reduced, the noise content is also reduced.

Unfortunately, there isn't a simple correlation between the amplitude of the noise signal and the amplitude of the noise perceived by the listener. As shown in Fig. 1, the ear is most sensitive to noise in the 600 Hz to 6 kHz frequency range. For this reason, when measuring noise content in a system, a weighting filter is usually inserted in the measuring instrument to give better correlation between the measured signal-to-noise ratio and the subjective impression of noise. When a CCIR/ARM weighting filter (commonly used when measuring signal-to-noise ratios of cassette tape and decks) is used, it will yield noise-reduction numbers of between 14 and 18 dB when the bandwidth of a system is restricted to 1 kHz

with single-pole and two-pole low-pass filters, as shown in the curves of Fig. 2.

### Auditory Noise Masking

The second basic principle behind DNR is masking—that hearing one sound decreases our ability to hear another. For example, white noise (random noise containing all the audible frequencies at equal amplitude) raises the threshold of hearing a pure tone by an amount that depends on the frequency of that tone, as shown in Fig. 3. The curve shows a general trend. At a higher frequency, a tone has to be increased in amplitude (compared to a 1-kHz tone) to be heard. That is because a wider range of noise frequencies contributes to masking as the tone's frequency increases. But regardless of the tone's frequency, there



# NR systems like dbx and Dolby only work on specially encoded recordings; the DNR system works on anything.

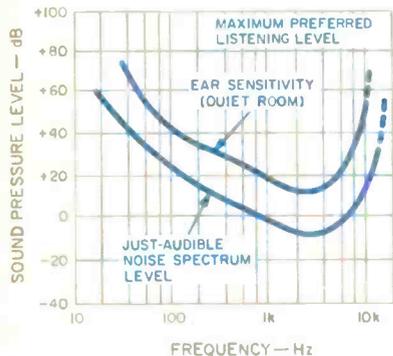


Fig. 1—The ear's sensitivity to noise varies with frequency.

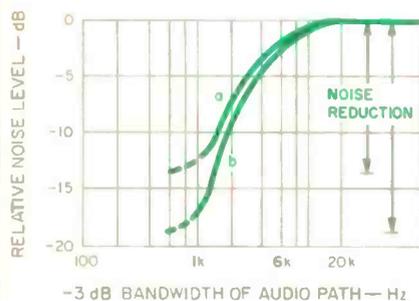


Fig. 2—How decreasing bandwidth affects noise reduction, with DNR configured as a single-pole (curve a) or double-pole (curve b) low-pass filter.

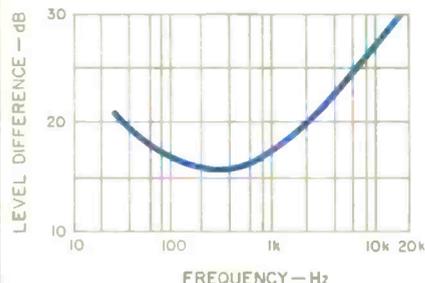


Fig. 3—Hearing thresholds above white noise for pure tone.

will be some range of noise frequencies that will be capable of masking that tone.

The results are not quite the same when we measure the ability of a single tone to mask undesired noise. Experimental results show that extremely high sound pressure levels of a single tone are required to provide masking. Even at the most effective frequencies (between 700 Hz and 1 kHz, near the natural resonance of the ear), sound pressure levels in excess of 75 dB are required to mask noise at a very low 16 dB SPL. Fortunately, those results apply only to *pure* single tones. With the complex signals that are a characteristic of music and speech, masking effects are much better. Most musical instruments produce broadband spectral components and a high concentration of energy around 1 kHz, which improve the noise-masking ability by more than 30 dB over a pure, 1-kHz tone.

From all of that, the designers at National Semiconductor concluded that if source material is at least 29 dB above the "noise floor," adequate masking can usually be obtained. Therefore, any noise-reduction system that dynamically restricts audio bandwidth will (by virtue of its previously calculated 14-dB improvement) insure a minimum perceived signal-to-noise ratio of 43 dB (29 dB + 14 dB) without audibly degrading the music program. A cassette tape recorded at a mean signal level of around -10 VU (volume units, as on a VU meter)—40 to 45 dB above the noise floor of the tape/system—will, with the aid of a bandwidth-varying noise-reduction system, be improved to a perceived signal-to-noise level of between 55 and 60 dB. If the recording was made at 0 VU, the improvement can be expected to provide an S/N ratio of better than 65 dB.

## The DNR Audio Filters and Control Path

The general arrangement of the DNR system is shown in the block diagram of Fig. 4. Two low-pass filters (one for each stereo channel) are placed in the audio-signal path, their -3 dB bandwidths controlled by the amplitude and frequency of the incoming signals. Each filter response is flat below its cutoff frequency, with a smooth, sin-

gle-pole roll-off above its corner frequency for any control setting. The resulting -6 dB/octave slope produces the most satisfactory results with modern and classical music having a wide frequency range. Steeper slopes can produce greater amounts of noise reduction for a given bandwidth, but are more suited to program material that does not have substantial high-frequency content. Cascading two filters will give a -12 dB/octave slope, with noise reduction as great as 18 dB (see Fig. 2).

As Fig. 4 shows, the LM1894 has three signal paths—right- and left-channel audio signal paths and a common bandwidth-control path. The main paths include audio low-pass filters whose cutoff frequencies vary in accordance with the control signal. A single control signal is used for both channels to keep the stereo image from wandering. That signal, in turn, is derived from the output of the summing amplifier, which is then filtered and rectified.

Since the spectra of musical instruments and the ear-sensitivity curve (Fig. 1) imply that masking is most effective at relatively *low* frequencies, you might assume that a low-pass filter would be good for the control path shown in Fig. 4. However, that turns out not to be the case. Figure 5 shows the frequency versus amplitude response of the DNR IC control path. The DNR system uses a *high-pass* filter with a -3 dB corner frequency of 6 kHz and -12 dB/octave roll-off slope. An optional notch at 19 kHz is for when the source material contains a stereo-FM pilot signal that might tend to increase minimum bandwidth above 800 Hz when the detector threshold is set at the noise floor.

The control-path frequency response is weighted in that manner because program material varies substantially in harmonic content, depending both on relative loudness and on the particular instruments being played. As an example, consider the case of a French horn. Most of the energy produced by that instrument is below 1 kHz. If a low-pass filter were used in the control path, it would respond to that energy and open up the filters to full bandwidth, unmasking noise in the 2-kHz and above region.

# DNR works because output is proportional to bandwidth, and because hearing one sound decreases our ability to hear another.

To avoid that, the system looks for high-frequency energy in the music source, and, not finding any higher harmonics, in the case of the French horn, the noise remains filtered out and bandwidth remains restricted. Multiple instruments or a solo instrument such as a violin, for example, may have significant high-frequency energy that will not only provide good noise masking but will require a wider system bandwidth. To summarize, then, the detection of high frequencies in the system's control path indicates that large levels of energy must be present in the critical masking-frequency range. This means that the audio bandwidth can be safely increased to prevent audible degradation of the music, since the noise will remain masked. To make up for the relatively fast decrease in spectral energy with increasing frequency, the control-path response is increased at a 12 dB/octave rate.

## Attack and Decay Times

If the detector of the DNR system were allowed to respond instantaneously to any input signal, ticks or noise bursts (of short duration but with rapid rise-times) would be able to open up the bandwidth of the system without simultaneous program masking. Also, different instruments have widely differing rise-time characteristics. With that in mind, the DNR system was designed with an attack time of 0.5 mS to

Fig. 4—Block diagram of the DNR system.

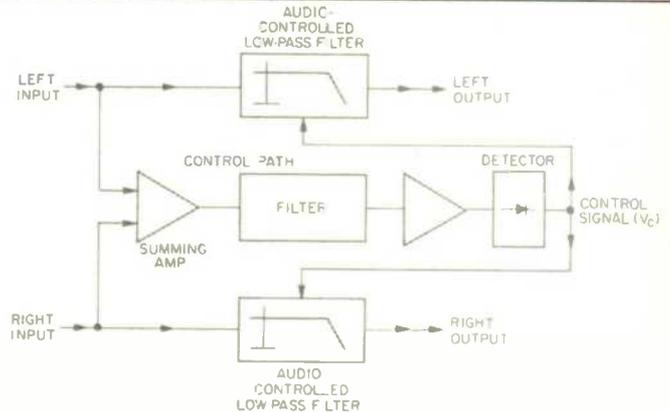
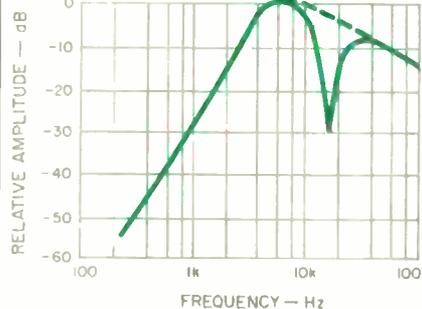


Fig. 5—Response curve for the DNR control path. Notch at 19 kHz is optional, to diminish response to FM pilot tone.



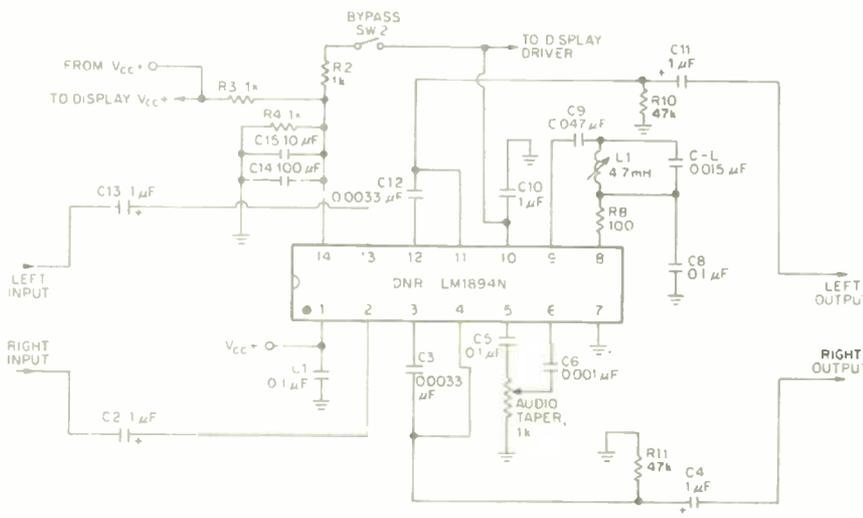
minimize potential loss of high-frequency transients. That does constitute a trade-off in that the system is susceptible to impulse-noise interference. Impulse noise, having fast rise- and decay times and quite a bit of high-frequency energy, must be eliminated using other techniques.

Once the detector has responded to a given musical transient, it must decay back to its inactive level when that transient is over. Once again, a compromise in parameters was required for the DNR system. Too slow a decay time would mean that system bandwidth would remain "wide open" for some period after the decay of the transient. A noise burst would be heard at the end of each musical transient since there would be nothing to mask it. If the decay was too rapid, on the other hand, a loss in apparent ambience would occur because harmonics occurring at the end of a transient would be suppressed. The DNR system decays to within 10% of final value in 50 mS. The ear's inability to recover sensitivity for 100 to 150 mS following a loud sound prevents the noise burst that is present at the end of each transient from being heard.

## Using the DNR System

The DNR system is designed to be placed before a system's tone and volume controls. This is because any adjustment of these controls would alter the noise floor seen by the DNR control path. A sensitivity-adjustment pot is provided, which may need to be adjusted for the noise floors of different sources (e.g., tape, FM or phono). This control should therefore be left readily accessible.

Fig. 6—Schematic of the DNR system, main section.



# A weighting curve adapts the control signal to the varying harmonic content of musical instruments and program material.

The system incorporates a display to assist in the proper setting of the sensitivity control. The display shows the instantaneous bandwidth of the two filters, *not* signal level (though signal level does affect it indirectly), and is logarithmic to best indicate the filters' audible effects. A bar-graph display is used instead of a meter because of the control signal's millisecond response time. The LM3915 display is recommended, as it requires only a few external parts and contains all the necessary circuitry for a 10-point, logarithmic display.

The left-hand LED corresponds to an 800-Hz bandwidth; the right-hand LED corresponds to a 30-kHz cutoff. The LEDs between these extremes each represent steps of approximately 1.5 times the frequency represented by the preceding step.

## Using the Filter

The DNR unit can now be connected in the tape monitor loop of a receiver or amplifier. The sensitivity control should

be turned down completely, and source material should be chosen that does not have musical content (the groove between cuts on a record, for instance).

Under these conditions, all but the first LED should be off. The sensitivity control is then advanced until the next LED just begins to flicker. This is an indication that the filter is barely opening on the noise floor and is capable of reaching full bandwidth on musical information above this level. Alternatively, the control may be advanced until there is a barely perceptible increase in the noise level and then backed off very slightly.

The bypass switch can be toggled between the bypass and active positions to compare the action of DNR with that of a full system response. The difference should be quite dramatic, giving a subjective improvement in S/N of 12 to 14 dB. The action of the filter is most apparent between record cuts, where it removes nearly all of the annoying hiss.

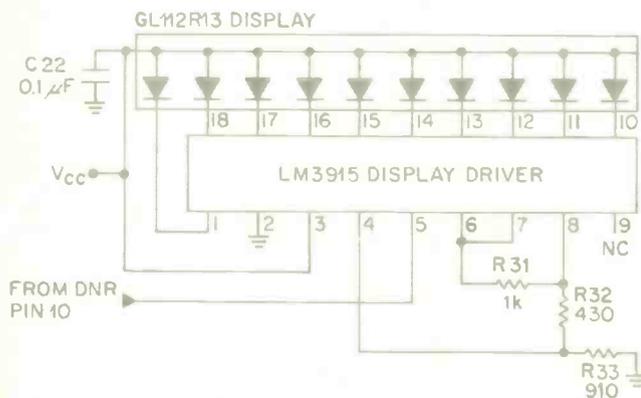


Fig. 7—Schematic of the display section.

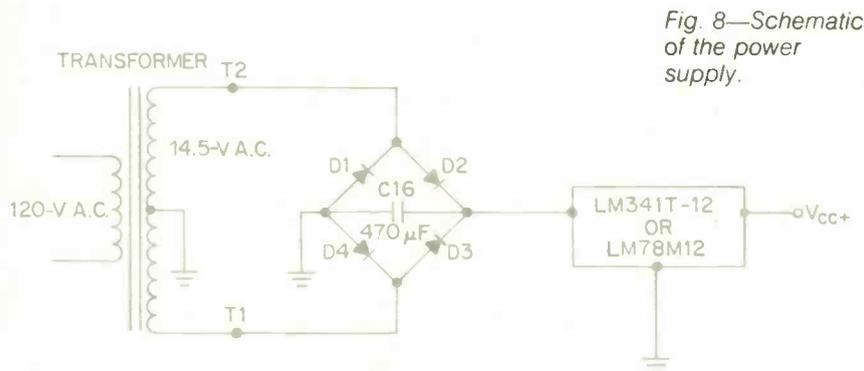


Fig. 8—Schematic of the power supply.

## Parts List

### Resistors

(All 5%, 1/4-watt, except R1.)

- R1—1-kilohm miniature pot, audio taper.
- R2 through R4, R31—1 kilohm.
- R8—100 ohms.
- R10, R11—47 kilohms.
- R32—430 ohms.
- R33—910 ohms.

### Capacitors

- C1, C5, C8, C22—0.1- $\mu$ F, 50-V Mylar.
- C2, C4, C10, C11, C13—1- $\mu$ F, 50-V electrolytic.
- C3, C12—0.0033  $\mu$ F, 50-V polystyrene, axial-lead.
- C6—0.001- $\mu$ F, 50-V Mylar.
- C9—0.047- $\mu$ F, 50-V Mylar.
- C14—100- $\mu$ F, 50-V electrolytic.
- C15—10- $\mu$ F, 16-V electrolytic.
- C16—470- $\mu$ F, 25-V electrolytic.
- C-L—0.015- $\mu$ F, 50-V Mylar.

### Semiconductors

- D1 through D4—1N4002 diodes.
- IC2—LM1894N DNR.
- IC3—LM341T-12 or LM78M12 regulator.
- IC4—LM3915N display driver.
- IC5—GL112-R13 12-element display.

### Miscellaneous

- SW1, SW2—SPST rocker switches.
- L1—4.7-mH adjustable inductor, Q=35 at 19 kHz (Toko CLN20-740HM).
- PH1, PH2—Dual phono jacks.
- Transformer—14.5-V, 250-mA, center-tapped (Triad F-112X).
- Fuse—1/4-amp, slo-blow.
- Fuse-holder, line cord, p.c. boards, control knob, and miscellaneous hardware.

The following are available from Advanced Audio Systems International, 4010 Moorpark Ave., Suite 105, San Jose, Cal. 95117. (California residents, add 4.5% tax.)

- Complete kit, including silk-screened enclosure (DNR-200X) . . . . . \$122.50
- Listed semiconductors and coil L1 (DNR-240X) . . . . . \$35.95
- Main and display p.c. boards (DNR-280X) . . . . . \$22.50

# The DNR system must precede the sound system's tone and volume controls, lest they alter the noise floor it senses.

You should be aware of a psycho-acoustic effect that is common to all noise-reduction systems. The addition of high-frequency noise (such as tape hiss) to a music signal will seem to increase the high-frequency content of the music. Thus, upon first auditioning DNR using noisy source material, the user will seem to hear a degradation of the music's high-frequency content. The system's actual effect on the high-frequency information can be observed by using a quiet source and switching the filter in and out.

It should be noted that the filter is designed for an average input level of 750 mV rms. Some tape decks are capable of much larger output levels at "0 VU," and they should be attenuated accordingly to prevent overloading the filter inputs.

## Building the DNR System

Construction is fairly simple, as the bulk of the circuitry is on two ICs, the

LM1894N DNR chip and the LM3915 display (Figs. 6 and 7), plus a power supply (Fig. 8).

The 19-kHz multiplex pilot tone present in all stereo FM broadcasts is attenuated by L1 and C-L. The presence of this pilot tone will limit the noise-reduction capability, since the noise filter will sense the level of the pilot tone rather than the level of the noise source.

The inductor provided with the kit of parts described in the Parts List is pre-tuned, and its adjustment should not be altered. If, however, you purchase coil L1 separately, then it must be tuned to within about  $\pm 20$  Hz of the 19-kHz pilot tone. The simplest way to obtain this reference frequency is to get it directly from the FM broadcaster. Tune your FM receiver and wait for a quiet interlude when there is no audio signal. Tune L1 for minimum noise-filter bandwidth as monitored on the front panel's LED display.

Video and TV sound can create similar problems due to the presence of strong line-scan components at 15.734 kHz. This can be accommodated by substituting a capacitor of 0.018 to 0.022  $\mu$ F for the 0.015- $\mu$ F value indicated for capacitor C-L, and readjusting L1. If both FM pilot and video line frequencies cause problems, it might be advisable to build two traps, with a selector switch. On the other hand, if neither FM nor video-sound signals are to be processed, then choke L1, capacitors C-L and C8, and resistor R8 (which forms a frequency roll-off with C8) may be eliminated.

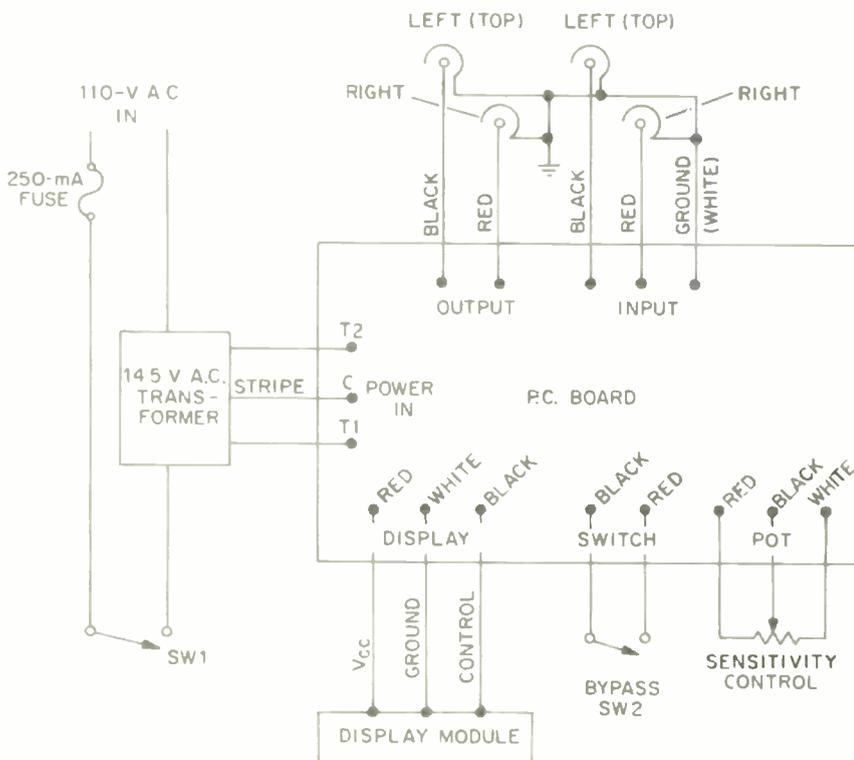
Printed circuit boards, silk-screened to show component placement and polarity, are available separately or as part of a complete parts kit. All components are mounted on these boards, except for the sensitivity control, switches, jacks, the power transformer and the fuse-holder. We recommend using IC sockets or Molex strips instead of soldering ICs in directly, to prevent possible damage to the ICs.

The component designations on the p.c. board and their explanation in the Parts List should provide all the information needed for successful board assembly. A schematic diagram (Fig. 6) is provided for technicians who feel more comfortable working from that, and for help in understanding and troubleshooting the circuit. The display and power-supply circuits are shown in Figs. 7 and 8.

Figure 9 shows how the boards and other components are wired together. Wire functions and colors are also silk-screened on the boards.

Nonetheless, mistakes are still possible. Our experience has shown that the most common assembly errors are as follows: ICs inserted backward, electrolytics installed with incorrect polarity, power diodes reversed, bad solder connections, no fuse in the fuse-holder, and failure to wire-connect one or more phono-jack grounds to a common ground on the p.c. board. But with a little care (or, failing that, a little after-the-fact trouble-shooting), you should have an addition to your system that makes a worthwhile, audible difference. Get out your old, pre-Dolby tapes and surface-noisy records, and prepare to listen to them—and enjoy them—once again.

Fig. 9—Assembly diagram, for use with p.c. board.



# Build A High-Performance Noise Reducer

JOHN H. ROBERTS

**T**aping from high-quality disc pressings routinely tests the dynamic range of even the highest-tech cassette decks, and CDs are even more of a challenge to tape adequately. All the new, top-line decks come with such powerful noise-reduction (NR) systems as dbx or Dolby C, which help recordists handle today's very dynamic program material. But for those whose decks have no noise reduction or only Dolby B NR, I've devised a low-cost, add-on companding noise-reduction system with which their decks can handle the hottest signals, just like the best new equipment.

The theory behind companding NR stems from the observation that tape hiss is effectively masked by loud music, and is only audible during quiet passages. Companding NR (like dbx and the two Dolby systems, which work on similar principles) is a two-part, encode/decode process. A compressor circuit in the record encoder reduces gain for signals above a cer-

tain level (the circuit's unity-gain threshold, or 0-dB level), and increases it for signals below that level. This brings loud passages down below the limits of the tape deck's headroom and lifts quiet passages above the deck's noise floor. A complementary circuit in the playback decoder expands the signal back to normal, boosting the loud passages and cutting back on the soft ones. In the process, it also cuts back noise (Fig. 1). Thus, companding not only reduces tape noise but increases headroom, for cleaner and louder musical peaks.

## The P-522 Noise Reducer

The Phoenix Model P-522 noise reducer, for which plans are given here, contains two simultaneous encode/decode channels (Figs. 2 and 3), allowing off-the-tape monitoring with natural dynamics when recording with three-head decks. Its operation is based on wide-band, 2:1 compression/expansion, and will deliver the same order of S/N improvement as the dbx systems (although no attempt has been made to make the two compatible).

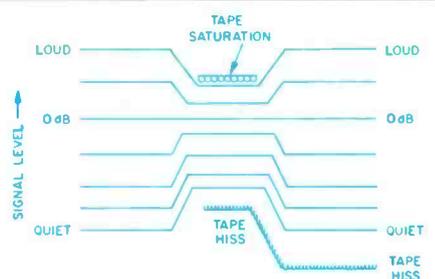
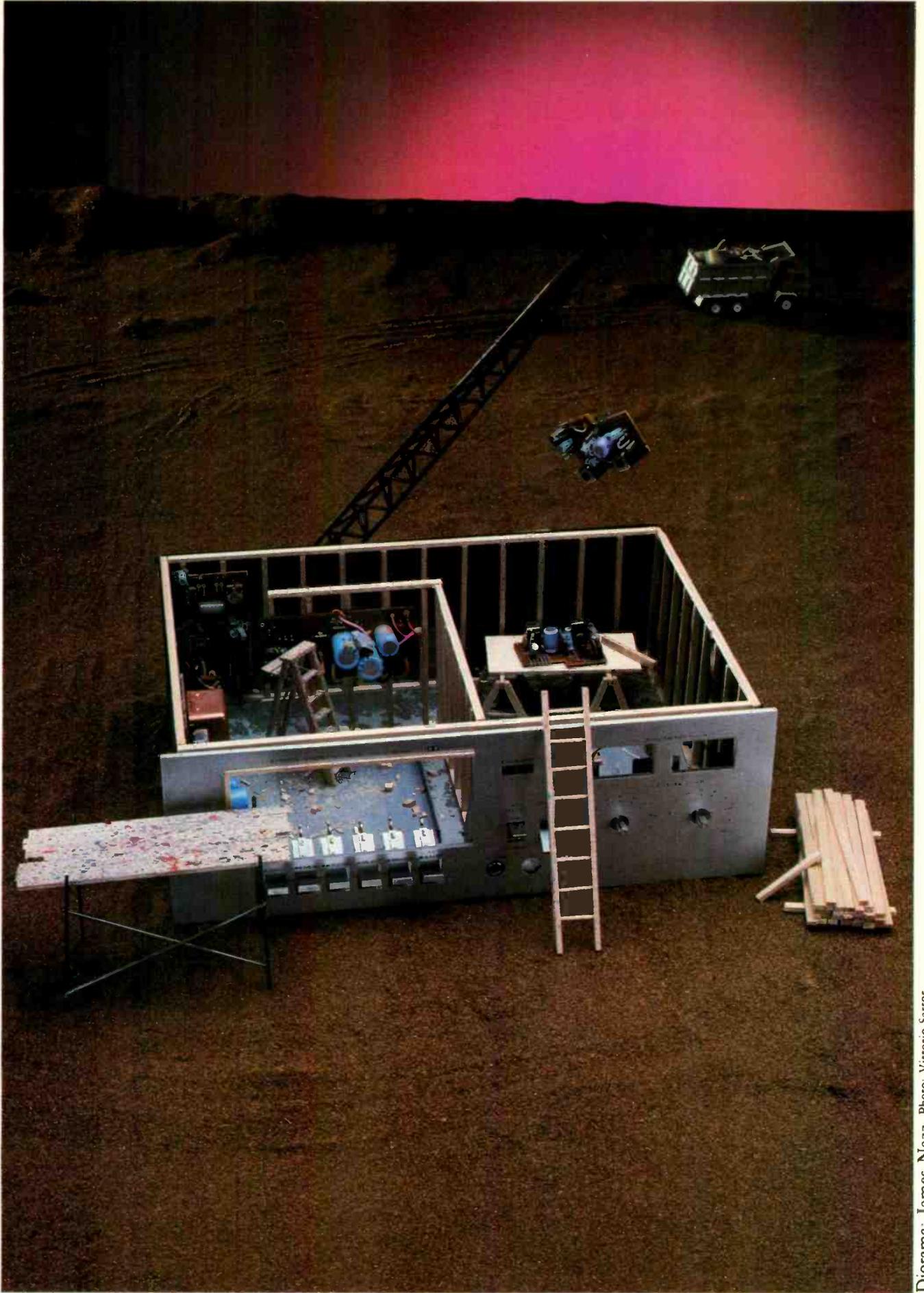


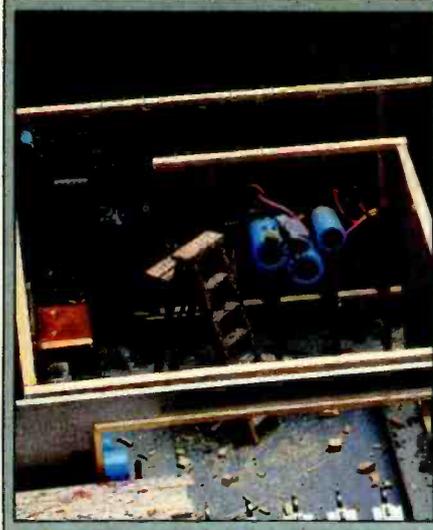
Fig. 1—How companding works.

Most companding NR systems rely on identical but inverse distortion in the playback expander to cancel out the third-harmonic distortion caused in the compressor by the audio signal modulating the gain-control voltage. The P-522 electronically cancels out this modulation at the compressor. Reducing this distortion at the source is advantageous, since imperfections in the tape record/playback process can affect the ability of conventional systems

*John H. Roberts is President of Phoenix Systems, Manchester, Conn.*



Diorama: James Nazz Photo: Vittorio Sartor



By building this low-cost, companding NR system, you'll get more dynamic range in your recordings.

to cancel out this distortion. However, crossing the P-522 with a conventional compander, by using one system to decode tapes made with the other, will yield higher distortion than will either system decoding its own tapes. Also, this new approach to modulation-distortion control uses different optimum attack/release time constants, so some dynamic mistracking could also occur.

For anything but noncritical applications, I do not suggest mixing different types of noise reduction. If you have an older-type NR (such as Dolby B) in your deck, just switch it out when using the new compander. Do not use them both at once, as you will get no further improvement in S/N, but you may overcompress the highs and produce a loss of frequency response.

I have, however, found that playback of P-522 tapes in the car with no decoding at all can be quite acceptable, becoming less acceptable as the car system's frequency response and dynamic range begin to approach those of a good home system.

The P-522 uses high-frequency pre- and de-emphasis to reduce the audibility of tape hiss when only low-frequency signals are present. A correction network at the input to the level sensing port prevents solo high-frequency signals from being overrecorded. In fact, the network intentionally overcorrects, so high-frequency signals when present alone will be recorded slightly cooler than low-frequency signals. This reduces tape saturation and frequency response problems commonly experienced with unprocessed cassette recordings. Dynamic tracking errors can occur if the frequency content at the input to the playback expander is much different than the output of the record compressor.

An adaptive high-pass filter in the compressor attenuates low-level, low-frequency signals caused by warped record and rumble, before they can get encoded. This is important because tape recorders generally have limited frequency response in the low bass and would not reproduce the warp signal, which has peak energy in the 5-Hz region. To further reduce this sensitivity to signals that the tape recorder can't reproduce, the input to the gain-control detector is rolled off below 38 Hz and above 20 kHz. (Note: As

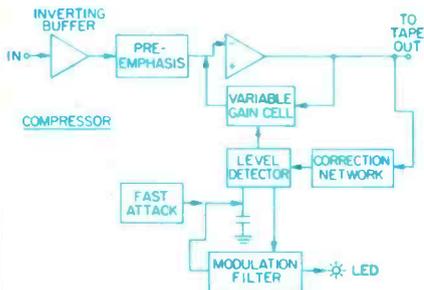


Fig. 2—Block diagram of the compressor section.

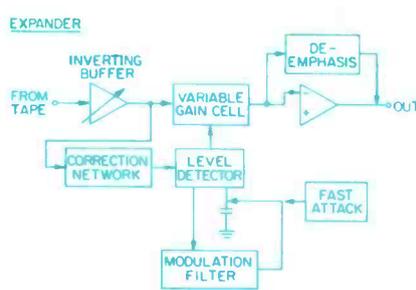


Fig. 3—Block diagram of the expander section.

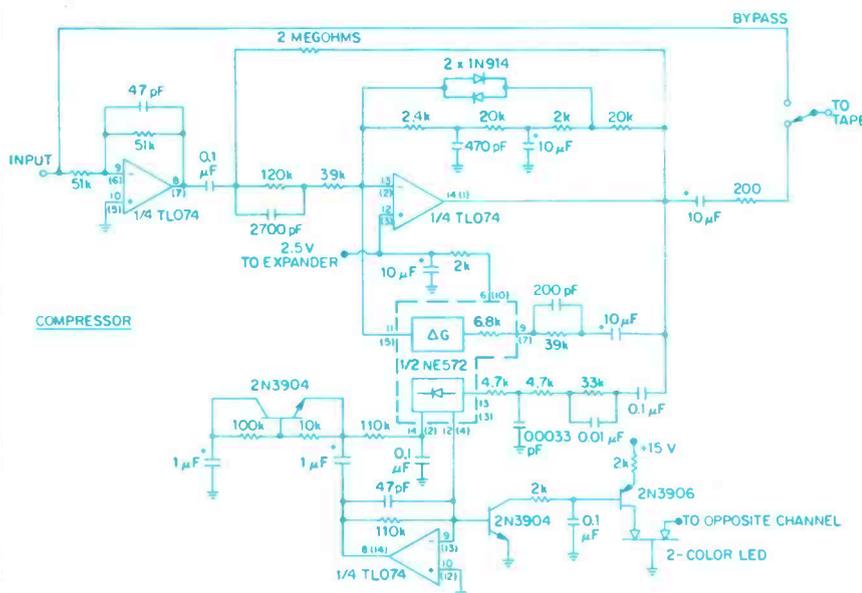


Fig. 4—Schematic diagram of the compressor section. Pin numbers shown on ICs here and in Figs. 5 and 6 are for left channel; numbers in parentheses are for right channel.

Power connections (not shown) are: +15 V to each NE572 pin 16 and TL074 pin 4, -15 V to each TL074 pin 11, and ground to each NE572 pin 8.

Dolby NR does not reduce noise at low frequencies, it will not be tricked by low-frequency response errors; however, it shows the same sensitivity to high-frequency errors as do all companding systems.)

### Using the P-522

The P-522 is designed to hook up between a control preamp and a tape deck. Its only front-panel controls are on/off and in/out (bypass) switches.

Without noise reduction, setting record level is a juggling act between distortion, high-frequency saturation, and tape hiss. As the noise reduction gives you more than 20 dB of hiss reduction, the optimum 0-dB record point moves down quite a bit below meter 0 dB. I have found -6 dB to be a good setting on a few two-head machines I've worked with, but it's better (and fairly easy) to find the best recording level settings for your tape and machine by ear.

To do this, use a familiar disc with a good, clean top end (cymbals, snare drum, etc.) and record at progressively higher levels until you notice a loss of sheen or edge. Back off your recording level until full sound quality returns. You then have your optimum 0-dB level. Interstation FM hiss can also be used as a test signal for these comparisons, but it may have a bit more high-frequency content than typical discs.

When making these listening tests, be sure you are playing back at similar loudness levels. Your ear is more sensitive to high frequencies at louder levels, so don't be tricked by simple volume mismatches. Also, with two-head decks be sure to listen to the playback from the tape because the deck's output during recording will not reveal tape saturation losses.

Once you've optimized your record level, you can calibrate the P-522's internal playback gain trim. With a three-head machine, which allows monitoring off the tape, you can make this adjustment while recording. With a two-head deck, you'll have to first record a track, then make the gain-trim adjustment while listening to playback. Adjust the gain trim so there is no loudness change between the original source material and the tape playback when you toggle the tape-monitor switch on your control preamp. As a

## PARTS LIST

### Resistors, 1/4-Watt, 5% Value, Ohms

Value, Ohms	Quantity
10	8
200	5
2k	6
2.4k	2
4.7k	8
10k	4
20k	6
33k	4
39k	10
51k	4
100k	4
110k	8
120k	4
2M	2

### Miscellaneous

DPDT push-push switch	1
4PDT push-push switch	1
Phono jacks	8
50-kilohm trim pot, 3/8-inch, square, single-turn	1
28-V center-tapped transformer	1
Line cord and miscellaneous hardware	

### Semiconductors

1N914 diode	6
1N4002 diode	4
2N3904 NPN transistor	6
2N3906 PNP transistor	2
Two-color LED	1
78L15, +15 V regulator	1
79L15, -15 V regulator	1
TL074CN op-amp	3
NE572 compander IC	2

### Capacitors

Value	Quantity
47 pF, 10%, ceramic disc	8
470 pF, 10%, ceramic disc	2
0.1 $\mu$ F, 20%, ceramic disc	9
0.02 $\mu$ F, 500 V, ceramic disc	1
200 pF, 5%, polystyrene	4
2700 pF, 5%, polystyrene	4
0.0033 $\mu$ F, 5%, polyester	4
0.01 $\mu$ F, 5%, polyester	4
0.1 $\mu$ F, 5%, Mylar	12
1 $\mu$ F, 25 V, aluminum electrolytic	8
10 $\mu$ F, 35 V, aluminum electrolytic	18
1000 $\mu$ F, 35 V, aluminum electrolytic	2

The following are available from Phoenix Systems, P. O. Box 628, Manchester, Conn. 06040. Prices in effect through April 15, 1985. (Connecticut residents must add 7.5% sales tax.)

Complete kit of parts with instructions, P-522-NR	\$79.00
Etched and drilled p.c. board, P-522-B	\$9.00
TL074 quad low-noise, high-speed op-amp (three required), P-TL074	@ \$2.50
NE572 dual compander IC (two required), P-NE572	@ \$4.50
28-V, c.t. transformer, P-10-T	\$6.50
Instruction set (including stat of p.c. board), P-522-INST	\$2.50

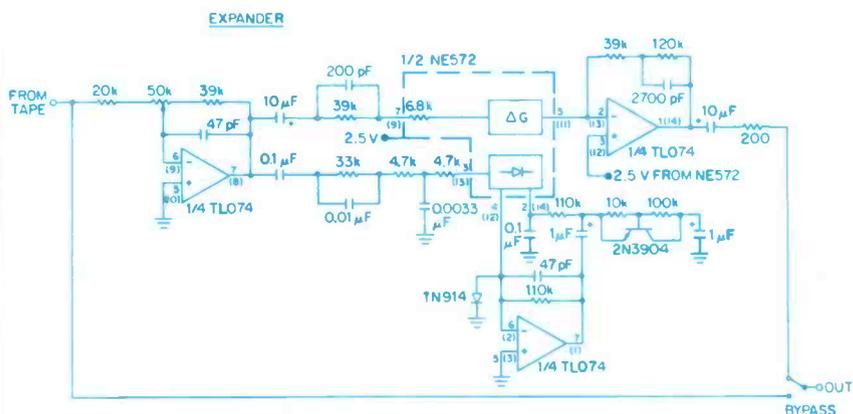


Fig. 5—Schematic diagram of the expander section.

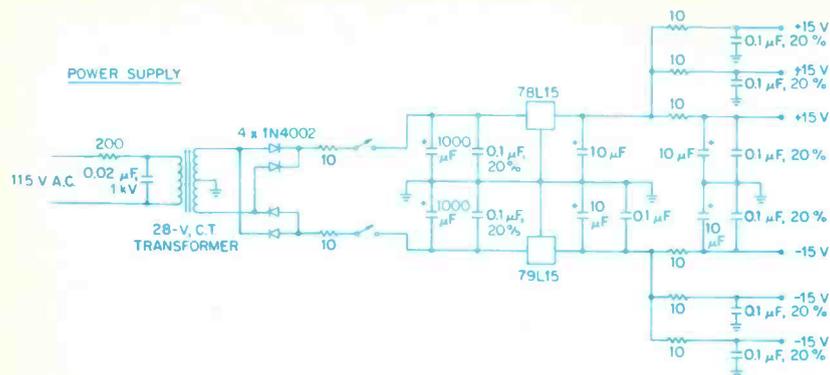


Fig. 6—Schematic diagram of the power supply. Note separate power feeds for each channel, to reduce crosstalk.

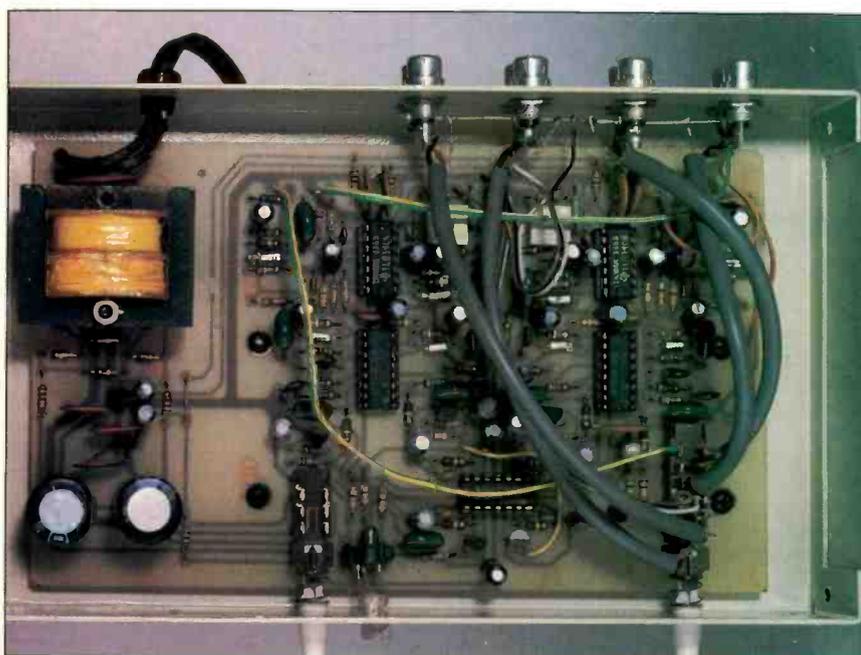
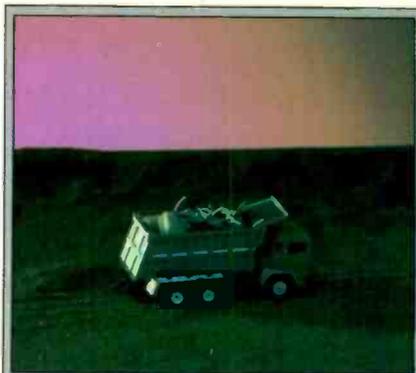


Fig. 7—Interior of P-522 noise-reduction unit, showing parts layout.



Fig. 8—Exterior of the completed unit.



This noise-reduction system takes away more than 20 dB of tape hiss and noise.

result of the new, reduced record level, some two-head decks may return a louder signal when monitoring record than during actual playback.

The P-522 has a transient-overload indicator, a two-color LED that flashes red when the right record-channel overloads and green when the left one does. It is normal for this LED to flash on momentary overloads, but it should not stay lit or flash more than a few times per second.

To record or play back tapes without companding, just switch the P-522 into bypass, and the tape deck will be connected to your control preamp. Although the P-522 uses a hard-wire bypass, the inputs to the compressor are always connected—so it may be a good idea to leave the unit powered up whenever signal is flowing in the tape-monitor circuit. Otherwise, if your preamp's tape outputs aren't buffered, the slight resulting change in impedance might introduce distortion in your main signal path. (The same is true of tape recorders, which should also be turned on whenever connected to unbuffered tape outs.)

#### Building the P-522

Schematic diagrams for the P-522's compressor, expander, and power-supply sections are shown in Figs. 4, 5 and 6, respectively. While I recommend use of the p.c. board I've made available (see Parts List), you should be able to realize acceptable performance with other construction techniques. Do try to follow the layout in the photo (Fig. 7) as closely as you can, especially the grounding scheme. Use care when substituting parts; wider-tolerance parts can affect frequency response and dynamic tracking errors. Substituting tighter-tolerance parts won't hurt anything but your pocket-book.



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thousand, substantial improvements can be made to your existing system.

Whether you choose to improve your current system, or start with a complete Linn/Naim system, your Linn dealer, because he fully understands that there is a hierarchy to the system, can see to it that each purchase does indeed bring you more enjoyable music, rather than simply more spectacular "hi-fi".

For additional information on Linn and Naim components and the hierarchy of a hi-fi system, contact your Linn/Naim dealer.

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ALDBURN ELECTRONICS, LTD., 50 ROLARK DRIVE, SCARBOROUGH, ONTARIO M1R 4G2

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See dealer listing on page 116.

## 1

## PIONEER CLD-900 COMPACT DISC/ LASERDISC PLAYER

### Manufacturer's Specifications

#### CD Player Section Only

**Frequency Response:** 5 Hz to 20 kHz,  $\pm 0.5$  dB.

**S/N Ratio:** 96 dB.

**Dynamic Range:** 96 dB.

**Channel Separation:** 94 dB.

**THD:** 0.003% at 1 kHz.

**Output Level:** 2.6 V at 0-dB level.

**Power Consumption:** 42 watts.

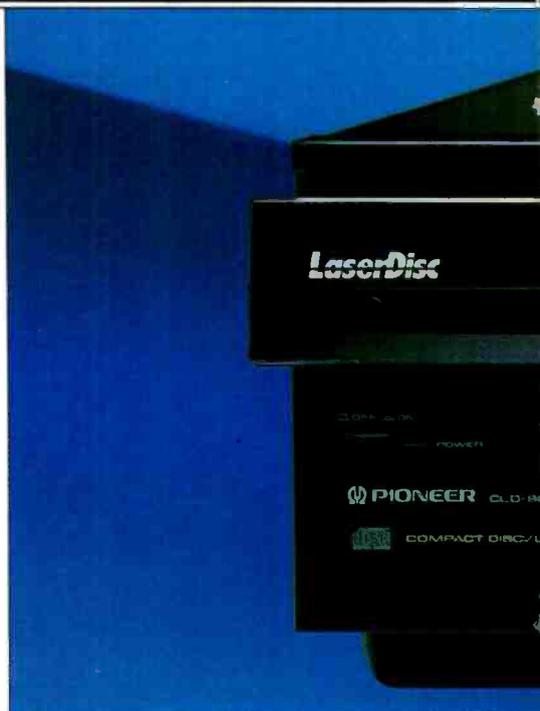
**Dimensions:** 16½ in. (42 cm) W × 6¾ in. (16.8 cm) H × 17-9/16 in. (44.7 cm) D.

**Weight:** 35 lbs., 3 oz. (16 kg).

**Price:** Approximately \$1,200.

**Company Address:** Pioneer Video, 200 West Grand Ave., Montvale, N.J. 07645.

For literature, circle No. 90



It was bound to happen sooner or later. Nearly two years ago, I was speaking to Bart Locanthi, a leading technical executive with Pioneer on the West Coast. Even then, he hinted that the presence of a common element—the laser pickup—in CD players and LaserVision videodisc players suggested that a player could be built to handle both types of program sources. At the recent Japan Audio Fair, held in Tokyo in the fall of 1984, Pioneer demonstrated the first such combination player. A month or so later, I was given a production prototype of the machine as it will be marketed in the United States early this year.

What Mr. Locanthi failed to tell me during our discussion was that it is possible to record the soundtracks on a LaserVision videodisc using the digital-audio CD format, and that such discs would become available when the combination player became a reality. Indeed, that is just what has happened. With this first combination CD/LV player I was given a videodisc which contains not only the AFM (audio frequency modulation) audio tracks which have been the standard all along (it is similar to the AFM technique used in Beta Hi-Fi and VHS Hi-Fi, and is therefore of excellent quality), but also contains CD audio, totally digital. Incorporating both kinds of audio is, of course, essential for compatibility, but on a player such as the new Pioneer CLD-900, the sound reproduction can be of the quality and dynamic range of CDs.

Pioneer has taken advantage of the more obvious similarities between videodisc and Compact Disc players, but they have gone beyond that. I was as impressed by the clever way in which they have assigned dual functions to the buttons on the supplied wireless remote-control unit as I was by the design of the actual player itself. The designers of this incredible instrument assumed (rightly, I believe) that

when playing a Compact Disc you would still have the video output of the unit connected to your TV set or video monitor. This being the case, they arranged for that video screen to display all the information sometimes found on CD players. Therefore, the front panel of the CLD-900 remains relatively uncluttered, considering the great number of operational modes it supports.

As for the LaserVision features, they are just about the same as those found in Pioneer's dedicated videodisc players, such as their Model LD-700. The same wireless remote

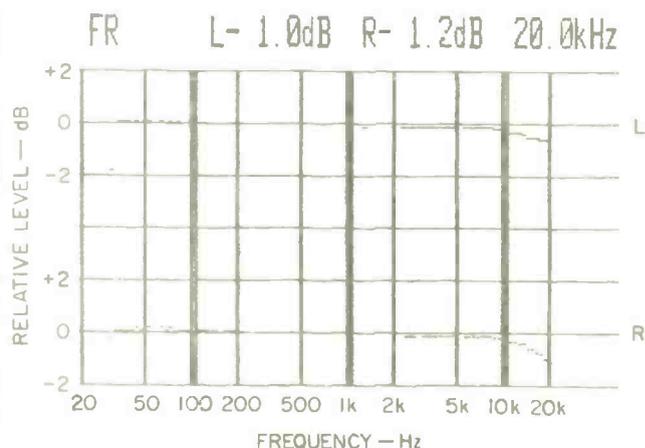


Fig. 1—Frequency response, left (top) and right channels, at 0-dB level.

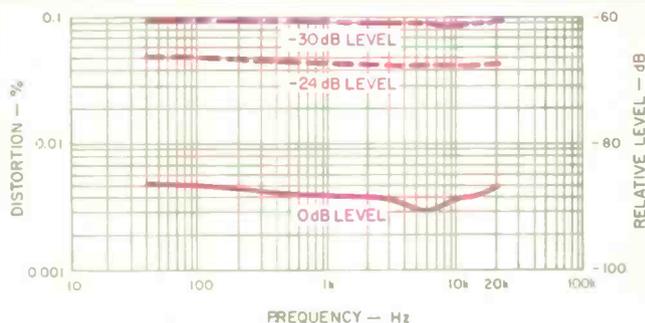


Photograph: Ross Elmi

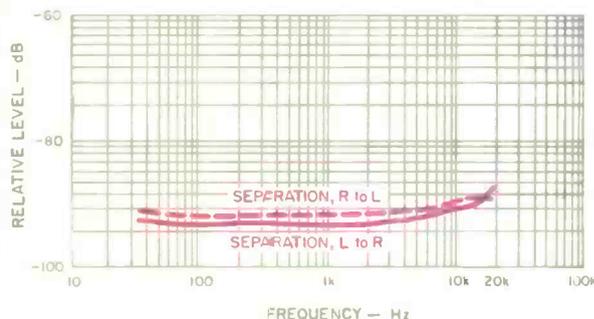
used when playing Compact Discs also controls such video special effects as freeze-frame, single-frame advance, slow motion, fast motion, and random access to individual frames by number. These effects, however, are available only with CAV (Constant Angular Velocity) discs, which play for 30 minutes per side, not with the more common, hour-per-side CLV (Constant Linear Velocity) discs. Like the LD-700, the CLD-900 is front-loading and handles either 12-inch or the newer 8-inch discs in CAV or CLV formats. Molded ridges inside the loading drawer help you to properly position both sizes of LaserVision discs as well as the 12-cm (4.7-inch) CDs before you push the drawer closed and begin play.

**Control Layout**

Most of the upper front panel is taken up by the disc loading drawer, which is opened by pressing the "Eject" button near the right edge of the panel or on the battery-operated, infrared remote control. Below the drawer, at the left, are a power on/off button and a stereo headphone jack. The TV video selector button is located near the center of the panel, next to the CX noise-reduction on/off switch. This form of dynamic noise-reduction circuitry, found on earlier LaserVision players, is used only when playing CX-encoded discs. The switch won't do anything if you play a future LaserVision disc with CD digital audio tracks, since no noise reduction would be needed with these already noise-free discs. Whether you are playing CDs or LV discs, a multi-function display lets you know what's happening: Numerals tell what CD track you're hearing or which LV "chapter" you are watching. Illuminated words tell you whether you are in the "Pause" or "Play" mode, whether soundtracks are digital or analog, whether you have selected one of the repeat-play features (and, if so, which one), and whether



**Fig. 2—THD vs. frequency at three signal levels.**



**Fig. 3—Separation vs. frequency.**

CD and LaserVision now have more than just lasers in common: LaserVision discs with CD-format audio tracks are coming soon.

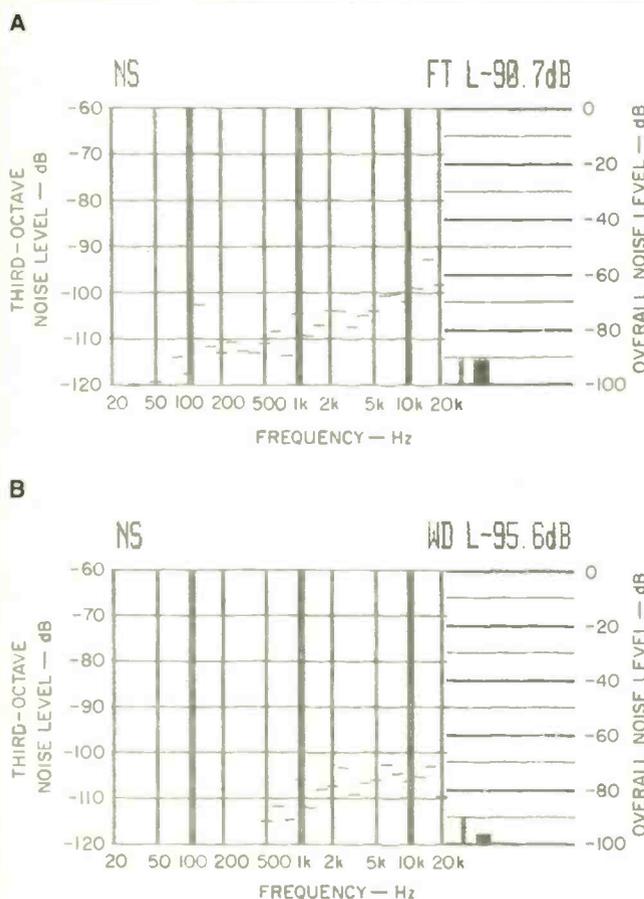


Fig. 4—S/N analysis, both unweighted (A) and A-weighted (B).

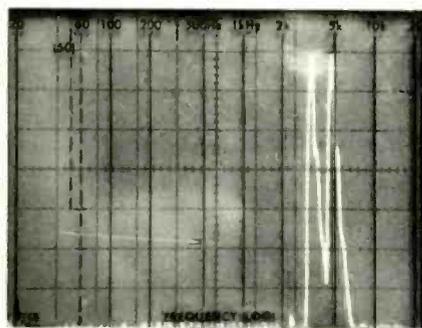


Fig. 5—IHF twin-tone IM test (14 and 15 kHz) showed 0.03% distortion—more than usual, but still minute.

audio is left-channel, right-channel or stereo. Additional small indicator lights tell the viewer whether the CX noise-reduction mode has been selected and whether or not an extended-play (CLV) videodisc is being viewed.

The more sophisticated special-effects and programming features available on the CLD-900 are accessible only via the hand-held remote control. It is this little module which lets you quickly access a specifically numbered "frame" on a videodisc (as many as 54,000 frames can fit on one side of a standard-play LV disc), choose one of several slow-motion or fast-motion viewing speeds, go into freeze-frame or frame-by-frame viewing, access a given chapter of an LV disc, quickly scan forward or backward to find the scene you want to watch, or turn on displays (superimposed on the picture you are watching) that show the chapter as well as the frame being viewed. When playing a CD (audio-only) disc, most of the touch buttons used for videodisc special effects and programming serve similar functions. You can access tracks or index points (if the latter are encoded on the disc you are playing). You can fast-scan the music (the music remains audible and does not change pitch while you scan), and of course, you can turn on the additional displays, visible on your video screen, that tell you the time into the track you are playing, the remaining time of the entire disc, and even the total time of the disc. Repeat-play, either from one point to another or for an entire track or disc, is possible both for LaserVision and Compact Discs.

#### Measurements

For the purpose of this report, I concentrated primarily on the CLD-900's audio performance as a CD player. I was unable to measure its audio performance with either the analog or digital soundtracks of LaserVision discs, as I was unable to obtain a suitable test disc.

As to the video performance, let me simply reiterate something that's been said by many others, many times: The LaserVision videodisc format gives you the very best picture presently available on a home video screen. Picture resolution surpasses what you can get with the best models of videocassette recorders, even at their fastest tape speeds. I would hope, personally, that now that the LaserVision's video virtues can be combined with the benefits and fidelity of Compact Discs, perhaps more people will come to recognize just how great the combination of crisp video pictures on a good TV monitor plus digitally recorded and reproduced stereo audio can be.

Having said that, let me go on to the CD player measurement results. Figure 1 shows the playback frequency response for the left and right channels. The vertical scale is 2 dB per division so as to highlight any small deviations from ruler-flat response. There were none to speak of, and, with the cursor of the graph set to read relative output at 20 kHz, the readings were only off by 1.0 and 1.2 dB for the left and right channels respectively.

Harmonic distortion at mid-frequencies, for maximum recorded level, measured 0.004%, remaining essentially at that low level over the entire audio spectrum. There was no evidence of any superaudible "beats" such as those I have found with so many other CD players. In fact, for a 20-kHz test tone, the single THD reading (which normally rises as a

This Is Nakamichi



OMS-1000  
Optical Memory System

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### OMS-7

Remote control, 24-command memory, and direct access to any track and index number—advanced features for our most sophisticated CD player.



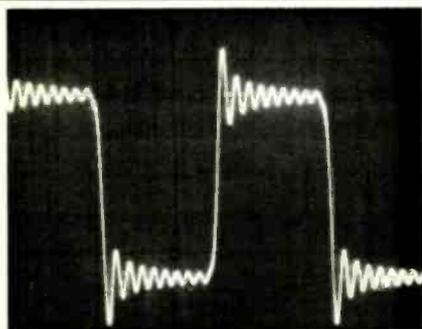
### OMS-5

OMS-7 sound thanks to 4X-Oversampled Digital Filters, Dual D/A Converters, and our exclusive Direct-Coupled Linear-Phase Analog Signal Processor.

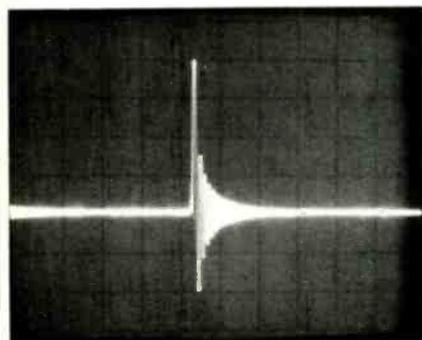
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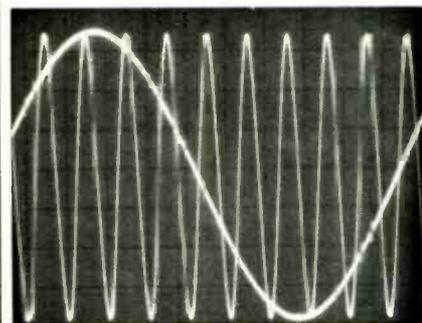
Since this dual-purpose player will normally be hooked to your TV set or video monitor, it displays CD information (such as elapsed time) on the screen.



**Fig. 6—**  
Square-wave  
reproduction,  
1 kHz.

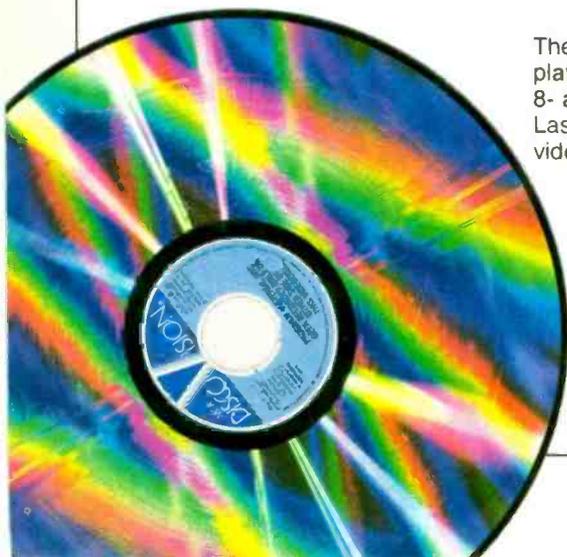


**Fig. 7—**  
Single-pulse test.



**Fig. 8—**  
Twin-tone phase-  
test signals  
(200 Hz and  
2 kHz) showed  
negligible  
phase shift in  
CD player  
section.

The CLD-900 plays CDs plus 8- and 12-inch LaserVision videodiscs.



result of non-harmonically related beats) remained a low 0.0045% at 0-dB (maximum) signal level. Figure 2 shows distortion versus frequency for maximum recorded level (0 dB) as well as for levels of -24 and -30 dB. As usual, the THD increases at lower output levels: At the -30 dB recorded level, THD for a 1-kHz signal measured 0.09%.

Output linearity was accurate to within 0.3 dB down to 80 dB below maximum recorded level. Stereo separation or crosstalk is shown in Fig. 3 and was extremely uniform over the entire range of test frequencies used. As with many other CD players, there was only a minimal decrease in separation at the frequency extremes. This suggests that the analog output stages of the player have been designed with good isolation between left and right channels.

Signal-to-noise ratio, measured without any weighting network, was 90.7 dB, increasing to an even higher 95.6 dB when an A-weighting network was introduced in the measurement path. An analysis of the noise content as a function of frequency distribution is shown in Figs. 4A and 4B.

The SMPTE-IM distortion was a low 0.004% at maximum recorded level, increasing to 0.012% at -20 dB recorded level. The CCIF (twin-tone) IM, using signals at 19 and 20 kHz, measured only 0.002% at the equivalent of maximum recorded level and 0.0028% at -10 dB.

I thought it more significant that I detected a small amount of IHF-IM distortion. At 0.03%, it was still minute, but on most CD players, IM is too low for my equipment even to measure. Figure 5 shows what happens when the player reproduces the IHF-IM test's twin tones. The two tall spikes represent the 14- and 15-kHz test tones, while the small spike just to their left is a spurious signal, 1 kHz lower. (The sweep here is linear, at 2 kHz per division.) The amplitude of this spike is approximately 70 dB lower than the composite of the two test tones, or 0.03%.

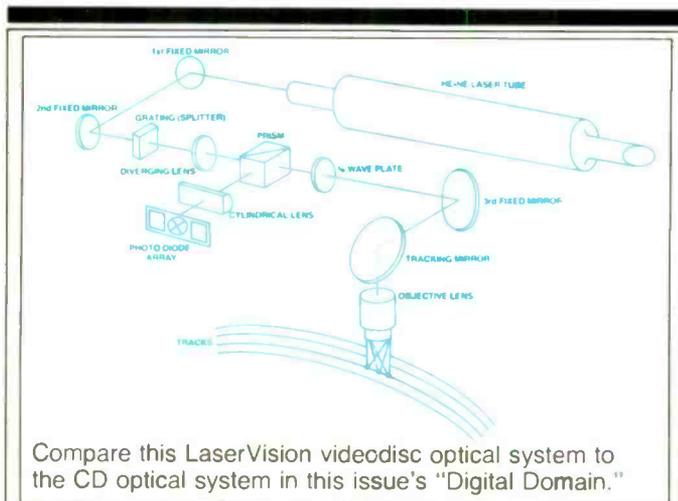
Square-wave reproduction of a 1-kHz, digitally generated square-wave signal (Fig. 6) was typical of that produced by CD players that use multi-pole, analog output filters, as was the reproduction of the unit pulse (Fig. 7). With a 200-Hz signal reproduced from the left channel and a 2-kHz signal coming from the right channel, there was little evidence of phase shift between the higher frequency and the lower one. Perfect phase relationship would be indicated by both sine waves in Fig. 8 crossing the zero axis in a positive-going direction at the same time—a condition which occurs near the right side of the 'scope photo of Fig. 8.

The CLD-900 was able to "read" through all of the built-in defects in my special Philips error-correction and tracking test disc. Specifically, it ignored 900-micron linear distances of missing information as well as 800-micron diameter simulated dust particles (actually black dots embedded beneath the surface of the test disc) and semi-opaque, simulated fingerprint smudges. This unit played the various musical tracks encoded beneath the defects without any muting and without skipping of any kind.

#### Use, Listening and Viewing Tests

Besides the usual assortment of favorite CDs that I use to evaluate the sonic performance of CD players, I listened to, and watched, the single LaserVision disc I had borrowed which contained digital (CD format) audio tracks and the

CX noise reduction is available for LaserVision discs encoded with it, but not for CDs or for digital-sound videodiscs, already noise-free.



AFM tracks normally found on LaserVision videodiscs. Unfortunately, the musical material on this videodisc did not provide sufficient opportunity to compare the two types of soundtracks, even though a switch on the front panel of the unit does let you select "Analog Only" sound. There were few silent passages in this particular disc, so I found it difficult to judge how much quieter the background was when I switched to the digital format.

Of course, when I played my regular CDs on the player, it performed handsomely, offering just about the same high quality of sound I have been getting from most CD players I've been measuring of late, as well as very fast access to a given point in a disc when I used the remote control for programming. As far as I could tell (I had only a Japanese owner's manual), there are no programming features on this machine. That is, you can't store a set of track or index playing instructions in any sort of memory. On the other hand, you can access a given point in a disc both by track and by index points (if the disc has been encoded with them). Audible scanning is also possible, as is scanning of videodiscs at a variety of fast- and slow-motion speeds.

I found the hand-held remote control easy to use. Color coding helps you push the right buttons for the right functions. Blue buttons are exclusively used for videodisc functions, while green buttons are used exclusively in CD operations. Buttons lacking either of these colors perform equivalent functions for both program sources.

As for the displays which are visible on your TV screen while you use the player for CD reproduction, you *don't* have to keep your TV set on for that display. Remember, the player itself tells you the track you're playing, and that's really the most important display you need when listening to a CD. Still, I found the video display to be a delightful addition, and I must confess I couldn't help gazing at it as I listened to my CDs. No doubt I would have grown tired of this feature in time, and so, probably, will you. But you're not likely to tire of the excellent video reproduction and, now, the excellent sound quality you can get from this combination player. It's been a long time since Bart Locanthi hinted that such a unit would someday be available, but the CLD-900 has been worth the long anticipation and the long wait.

Leonard Feldman

Revox B225

For those who waited.  
And those who wish they had.



All Compact Disc players are *not* created equal. This much, at least, has emerged from all the hype and hoopla.

Some CD players are built better than others. Some have more sophisticated programming features. Some are easier to use. And, yes, some *do* sound significantly better than others.

The new B225, from Revox of Switzerland, excels on all counts. For those who have postponed their purchase, patience has been rewarded. For those who didn't wait, the B225 is the logical upgrading route.

First, the B225 is designed for unexcelled CD reproduction. By using oversampling (176.4 kHz) in conjunction with digital filtering, the B225 guarantees optimum sound resolution and true phase response.

For your convenience, the B225 offers programming of nearly every conceivable combination of start, stop, pause, and loop functions, in any sequence, and using mixed combinations of track numbers and times. Cueing time is always less than 3 seconds, and a single infrared remote transmitter (optional) operates the B225 as well as all other components in the Revox 200 audio system.

Finally, the B225 is a product of refined Swiss design and meticulous craftsmanship. Behind its faceplate of functional elegance, you'll find the B225 is an audio component built in quiet defiance of planned obsolescence.

Without question, the definitive CD player has now arrived. For those who waited (and those who didn't), now is the time to see an authorized Revox dealer.

STUDER REVOX

1425 Elm Hill Pike, Nashville, TN 37210/(615) 254-5651

2

## TECHNICS SP-10MK3 TURNTABLE

### Manufacturer's Specifications

**Drive:** Direct.

**Motor:** Quartz phase-locked control, ultra-low speed, brushless, d.c.

**Platter:** Copper alloy and aluminum, diecast, 12.6-in. (32-cm) diameter; weight, 22 lbs. (10 kg); moment of inertia, 1.1 ton-cm (1,100 kg-cm).

**Speeds:** 33.3, 45, and 78.26 rpm.

**Pitch Control:** Quartz-locked,  $\pm 9.9\%$ , in 0.1% steps, at all three speeds.

**Starting Torque:** 1.2 foot-pounds (16 kg-cm).

**Startup Time:** 0.25 S to 33 $\frac{1}{3}$  rpm.

**Braking Time:** 0.3 S from 33 $\frac{1}{3}$  rpm.

**Speed Fluctuation Due to Load**

**Torque:** 0% within 0.72 foot-pounds (10 kg-cm).

**Speed Accuracy:**  $\pm 0.001\%$ .

**Wow & Flutter:** 0.015% wtd. rms (per JIS C5521),  $\pm 0.021\%$  wtd. peak (per DIN 45-507, IEC 98A weighted).

**Rumble:** -92 dB DIN B, -60 dB DIN A (both IEC 98A weighted).

**Dimensions:** Turntable, 14 $\frac{1}{2}$  in. (36.9 cm) W  $\times$  4-7/16 in. (11.3 cm) H  $\times$  14 $\frac{1}{2}$  in. (36.9 cm) D; power/control unit, 6 $\frac{1}{2}$  in. (16.6 cm) W  $\times$  3-

13/16 in. (9.6 cm) H  $\times$  16 $\frac{1}{4}$  in. (41 cm) D; optional SH-10B5 base, 22 in. (55.9 cm) W  $\times$  18 in. (45.7 cm) D  $\times$  6 $\frac{1}{4}$  in. (17.6 cm) H including dust cover.

**Weight:** Turntable, 40 lbs. (18 kg); power/control unit, 13.2 lbs. (6 kg); optional SH-10B5 base, 42 lbs. (19.1 kg).

**Prices:** Turntable and power/control unit, \$1,700; SH-10B5 base, \$800.

**Company Address:** One Panasonic Way, Secaucus, N.J. 07094.

For literature, circle No. 91

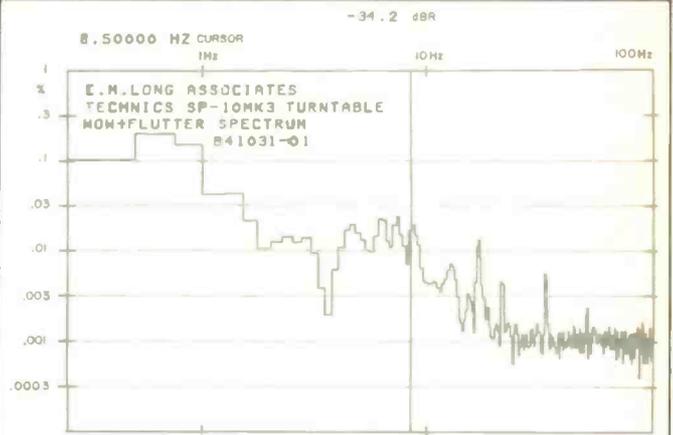


The SP-10MK3 is produced by Technics, a division of Matsushita Electric Industrial Co. Ltd., the Japanese company which also owns Panasonic and Quasar. Matsushita is a large, vertically integrated company, which means that it manufactures most of the parts used in the products it produces. Technics makes a full line, including receivers, amplifiers, loudspeakers and tape decks.

There has been a debate, over the years, as to the relative merits of direct-drive, belt-drive and quartz-controlled turntables. Technics makes all three types and therefore is in a unique position to make judgments about which is best. For the SP-10MK3, their top turntable, Technics has chosen to use quartz control and direct drive.

Direct drive allows very tight coupling between the motor and turntable platter, and therefore very precise control. To maintain precise motor speed, and thereby take advantage of such tight coupling, Technics uses quartz control. In this, a quartz crystal is used as a very stable control element in a high-frequency oscillator. The oscillator is then used as a reference to control the drive motor's very low rotational speed. (The exact control method can vary from one design to another.) The advantage of such an approach is in the ability to control the speed and to allow it to be changed in a very precise manner.

One very impressive thing about the SP-10MK3 is its weight. It is by far the heaviest turntable that I have ever tested, and I have had to lift some big ones! The immediate problem was to find a wide and stable platform upon which to place the SP-10MK3. Many of the turntables I have seen lately are so large and heavy as to cause the same problems as those "bookshelf" speakers not designed to fit on normal bookshelves. The Technics SP-10MK3 is much too heavy for any bookshelf I have ever seen. The weight of the SP-10MK3 turntable is 40 pounds, the control unit is 13 pounds and the mounting base is 42 pounds, for a total weight of 95 pounds! Technics obviously feels that the way



**Fig. 1—Wow and flutter spectrum. Note that the vertical percentage scale has been shifted from previous Long turntable reports so that 1% is the maximum level on this scale.**

to make a turntable immune to external vibrations is to make it massive. For past reports, I have placed the turntable under test on a special massive platform when I was measuring acoustical and mechanical isolation. With the SP-10MK3, I even made the listening tests with the turntable on this platform.

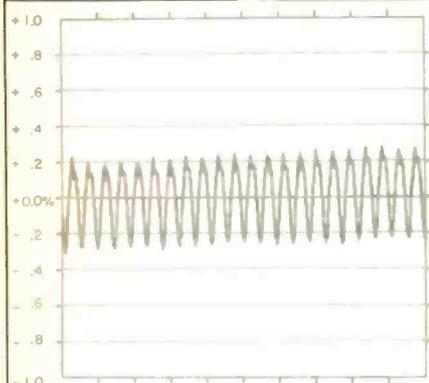
The electronic speed-control unit is also most interesting. There are eight control buttons plus the a.c. power switch and a large display window. Three of the buttons are for selecting the exact speeds; one is the speed lock, three more are for the plus and minus increments and a "clear" switch. The last control button is "Stop-Start." There is a rather large window on the left side of the control unit through which you can see the speed you have selected, and, if you decide to set the speed fast or slow to change pitch, you can see the percentage change in 0.1% increments as you increase or decrease the speed. If you have an interest in 78-rpm records, which I do, you will like the fact that the SP-10MK3 not only has the usual 33.3 and 45 but 78 rpm as well. The electronic speed adjustment will thus allow you to adjust the pitch of the sound to compensate for the old 78-rpm cutting lathes and tape recorders that did not always run at the correct speed.

The optional SH-10B5 turntable base includes a hinged dust cover of smoked gray plastic. The hinges can be adjusted so that the cover can be held open without raising it to its full height. Four feet are mounted on the bottom of the base, and these can be adjusted to level the turntable. The feet include heavy-duty springs which provide some isolation from external shocks. The black and silver styling of the SP-10MK3 is very clean and functional and gives the immediate impression that it is a very solid, professional turntable.

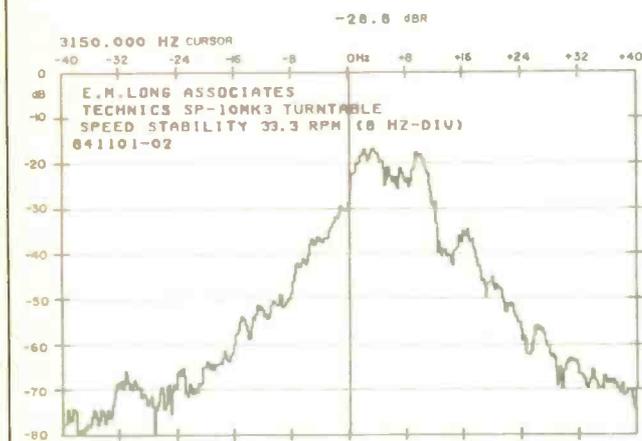
## MEASURED DATA

Parameter	Claimed	Measured	Comment
Speeds	33.3 and 45 rpm	+0.19%	Excellent
Speed Stability	±0.001%	±0.17%	Very Good
Wow, DIN Unwtd.		0.21%	Very Good
Wow, DIN Wtd.		0.08%	Excellent
Flutter, DIN Unwtd.		0.12%	Very Good
Flutter, DIN Wtd.		0.02%	Excellent
W & F, DIN Unwtd.		0.28%	Very Good
W & F, DIN Wtd.	0.021%	0.08%	Excellent
Long-Term Drift		0.40%	Good
Rumble, Unwtd.	-60 dB	-68 dB	Excellent
Rumble, Wtd.	-92 dB	-90 dB	Excellent
Suspension Resonance		5.3 Hz	Well Damped

The Technics SP-10MK3 uses quartz control and direct drive to achieve very tight coupling between the motor and platter.

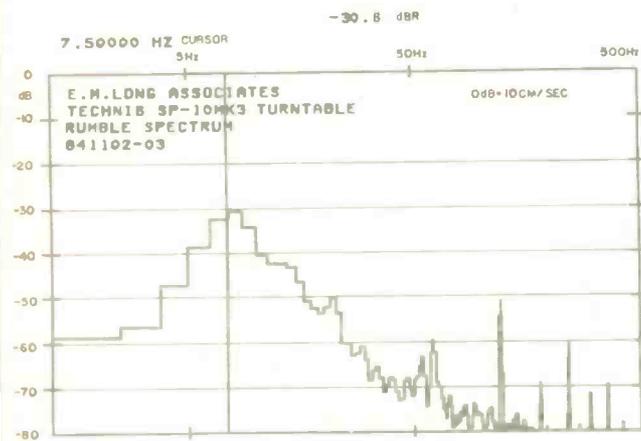


**Fig. 2—**Speed drift over a 41-S period. The 1.8-S cycle is 5.6 Hz and related to a single revolution at 33.3 rpm. Drift varies between +0.24% and -0.25%.



**Fig. 3—**Speed stability. The 0-Hz reference is to the 3,150-Hz tone on the

B & K 2010 test record. Note that speed tends to be fast.



**Fig. 4—**Rumble spectrum, with main output at the 7.5-Hz tonearm/cartridge resonance.

## Features

As mentioned before, the SP-10MK3 uses a direct-drive motor, which means that the motor drives the platter without going through any belts or gears. In the case of the SP-10MK3, the motor is part of the platter. The magnetic rotor is mounted on the underside of the platter and is driven by the electric current in the stator coils mounted on the base plate. The platter is made of copper alloy and weighs 22 pounds. Even though it must drive such a heavy turntable, the motor is capable of a starting torque of 16 kg per cm and a moment of inertia of 1.1 ton/sq. cm—quite remarkable. With such torque available, it is no surprise that Technics claims that the platter can reach stable speed within one quarter of a second. By looking at the strobe, I could see that the turntable locked in at 33.3 rpm within one-half turn of the platter. Since the platter makes one complete revolution in 0.56 S at this speed, it appears that the SP-10MK3 meets the specification.

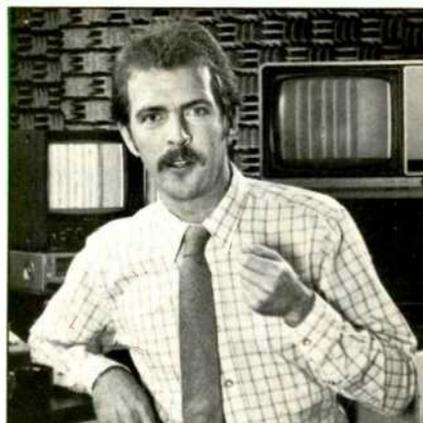
A technique called slip cueing is often used in radio stations to start records exactly. To do this, the record is held stationary while the turntable is rotated. At the desired moment, the record is released, and, since the turntable was already running, the start of the sound can be determined very accurately. The SP-10MK3 can do the same thing from a standing start. The stopping time of the turntable is also amazing, considering the mass of the platter, since it comes to a complete halt within 0.3 S after running at 33.3 rpm. The braking is both electrical and mechanical.

The speed can be locked to the standard speeds of 33.3, 45, and 78.26 rpm or it can be adjusted to  $\pm 9.9\%$  of each of these speeds in 0.1% increments. The increment is chosen by holding down either the "+" or "-" button on the control unit. Technics includes a chart which will allow you to determine the percentage of change in frequency or the change of pitch in percentage points. As an example, a change of speed from 33.3 rpm by +5.9% will cause a pitch change of a half-tone sharp, and a change of -5.6% will cause a pitch change of a half-tone flat. Adjusting the speed this way allows a recording to be set to the exact pitch originally intended and also allows one to play along in tune with the recording. A "clear" key allows the speed to be reset immediately to the exact rated speed. If you place the control unit next to the turntable, you will need a surface about 29 inches wide and 21 inches deep, and there should be a clearance of about 17 inches above the turntable to allow the cover to be opened.

Mounting a tonearm to the SP-10MK3 is facilitated by the fact that separate mounting platforms are provided with the SH-10B5 mounting base. One of the two that I received had a hole for mounting the Technics EPA-100MK2 tonearm; the other was blank. After the tonearm was fastened to the mounting platform, it was secured to the turntable base by four hex-head bolts. This allows different tonearms to be preset and then changed easily.

## Measurements and Listening Tests

As I mentioned earlier, all the measurements and listening tests were conducted with the Technics SP-10MK3 turntable mounted to the SH-10B5 base and with the combination placed on a very heavy and stable platform.



# Getting the most from compact discs.

Can your system really keep pace with digital audio?

by J. Robert O'Connell

Recording Engineer



As an audio enthusiast, you've probably read many articles on compact discs. Most have stressed the dynamic range available, and the consistent sound quality, play after play. Both of those topics are important. But what also must be considered, and is all too often ignored, is the impact of this new format on your present audio system.

## DYNAMIC RANGE: THE COMPACT DISC EDGE

**Peak Output.** The top two curves on the graph at right show the same piece of music played from a conventional LP and a compact disc. The peak output heard from a disc is substantially greater than that available from the LP, provided the rest of your system can reproduce it.

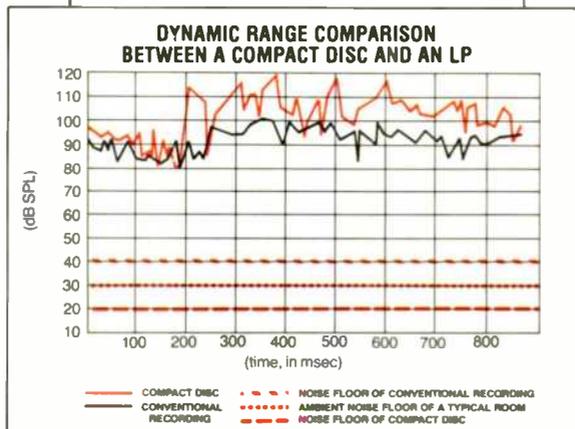
**Noise Floor.** As can be seen from the three lines at the bottom of the graph, the noise floor of the compact disc is below that of a common listening room, while a conventional LP is above it. This demonstrates that compact discs are so quiet that other factors (such as the room noise and the quality of the rest of your audio system) limit the softest sounds you can hear.

**Dynamic Range.** Since the compact disc exhibits both increased peak output and decreased noise floor, the dynamic range (difference between the softest and loudest sounds) is extended. But this extended range is only experienced if the rest of your audio system is physically capable of handling it.

## IMPACT ON YOUR AUDIO SYSTEM

Increased dynamic range and decreased noise floor places new demands on your audio system. Remember that each 3 dB of additional dynamic range requires *double* the amplifier power

speaker if the result will be "blown" tweeters rather than a more enjoyable experience. Finally, and perhaps most importantly, the speaker must be able to create the lifelike impact and flawless clarity captured by the disc.



At Bose®, we've invested 20 years developing Direct/Reflecting® speaker systems to deliver spacious, lifelike sound. We've also designed them to meet the demands of lifelike recordings, such as the compact disc. So, our 901® Series V system, for example, is rated for unlimited power handling. But the only way to evaluate our speakers, or anyone else's, is to listen to them. For help in properly evaluating speakers, we refer you to article #2 in this series, "Why didn't they sound like that in the showroom?" by John Carter, Chief Engineer.

to reproduce it. So, compared with conventional recordings, compact discs require higher amplifier power. But amplifier power is only one of the criteria which determines the quality of compact disc sound reproduction.

Extended dynamic range also places previously-unheard-of demands on your speakers. And, after all, speakers, more than any other component, determine the quality of sound you actually hear from a compact disc. The higher the speaker's sensitivity, for example, the less the necessary amplifier power to reproduce the peaks in source material captured by a disc. Further, to reproduce the incredible dynamic range available from compact discs, a speaker must also have high power handling capability. There's no sense feeding a higher level signal to a

For reprints of article #2, as well as more information on Bose products, please write: Bose Corporation, Dept. AU, 10 Speen Street, Framingham, MA 01701. ■

J. Robert O'Connell is manager of Bose Audio Visual Services.



The total weight here is 95 pounds! Technics feels this is the best way to make the table immune to external vibrations.

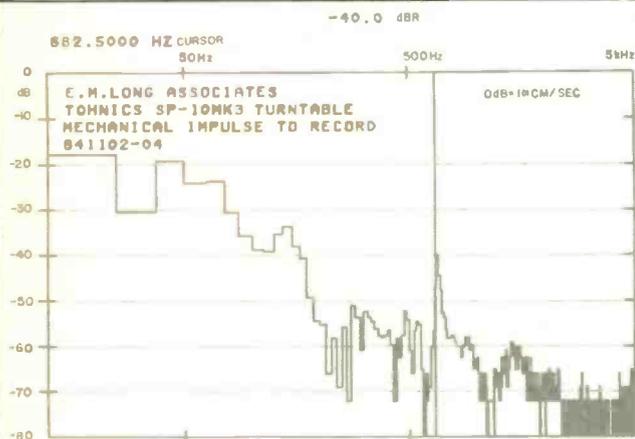


Fig. 5—Spectrum to 5 kHz due to a mechanical impulse applied to the edge of a stationary record with the stylus in a quiet groove. The cursor

is at 662.5 Hz, which is the main ringing frequency of the platter and where the output is -40.0 dB below 10 cm/S.

Fig. 6—Output vs. time of the impulse used to obtain the spectrum in Fig. 5. Total period is 0.205 S.

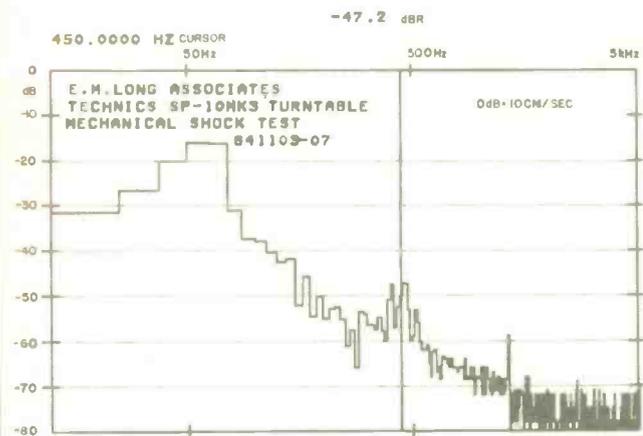
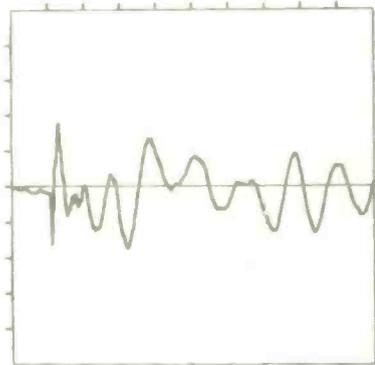


Fig. 7—Spectrum to 5 kHz due to mechanical shock applied to the massive platform upon which the

turntable and base rested during tests. Resistance to such shock was very good.

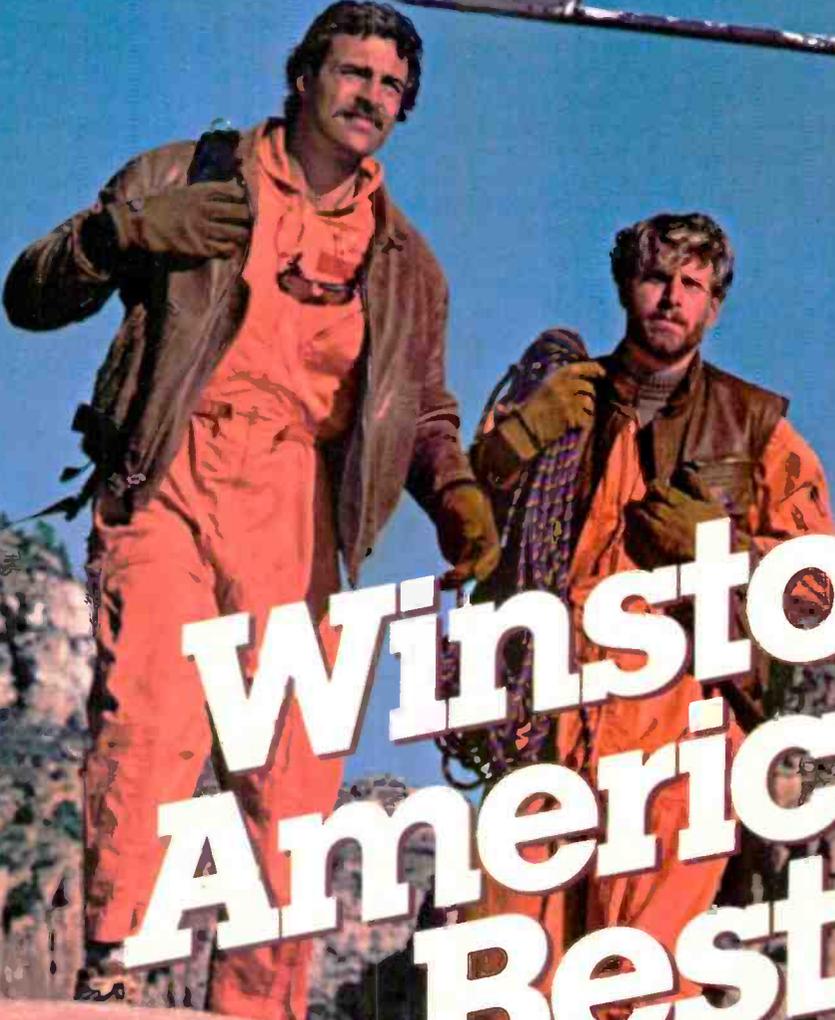
The wow and flutter was measured with a W&F meter and also by recording the component spectrum using the Nicolet 660-2D Fast Fourier Transform (FFT) Analyzer. Figure 1 shows the spectrum of the wow and flutter from the FFT. Most of the components are below 0.03%, and the cursor indicates -34.2 dB, which is 0.02%, at 8.5 Hz. The main component of the wow and flutter spectrum is at about 0.5 Hz. When the record groove is not perfectly centered, the stylus will read the signal at 0.56 Hz, which is the frequency of rotation at 33.3 rpm. This causes the wow modulation seen in Fig. 1, and the accuracy of centering the record has a definite effect upon the amount of wow. The "Measured Data" table shows that the unweighted wow and flutter is 0.28%, while the weighted wow and flutter is only 0.08%. Since the weighting has the effect of reducing the effect of wow and flutter below 20 Hz, this corroborates the data presented in Fig. 1.

The drift in speed over a 40-S period is shown in Fig. 2, a digital storage oscilloscope plot. There is an indication of a little "hunting" by the servo when the speed increases above +0.2%. This might be the reason for the components which appear at frequencies above 10 Hz in Fig. 1. Drift, displayed in Fig. 2, is minor and indicates that overall rotational speed is slightly fast. During the listening sessions, there were no comments regarding the sound that could be directly linked to lack of stability in tone when compared to the reference system. It is rather difficult, however, to be absolutely certain that a record is perfectly centered during listening tests, at least to the degree possible. I did try a separate experiment to check this. I offset the record slightly on one turntable while I carefully centered a duplicate on the other. When I did this, there was one comment from a panel member about a difference in clarity. I heard a difference also, but I discount my own conclusions to a great extent because I was aware of the test conditions. This might be a clue to explain a phenomenon reported by reputable persons that they have heard an effect upon clarity when the record is rotated to a different position relative to the platter.

Figure 3 shows the spectrum due to playing a recorded 3,150-Hz tone and indicates that the SP-10MK3 is running slightly fast in the 33.3 rpm quartz-locked mode. This is shown as +0.19% in "Measured Data." What this means is that a record which should be exactly 60 minutes when played at 33.3 rpm, will take 59 minutes and 53.2 seconds. This is excellent long-term stability and could be made almost perfect by setting the speed back two clicks to -0.2%. Precise control of speed is very important for timing broadcasts, but it is also handy when copying a record to tape because it can be used to avoid running out of tape at the end of a piece of music. The cyclical variation in speed, shown in Fig. 3, is not the best I have measured, but it is more a function of record eccentricity than of actual speed variations in the turntable itself. Still, the performance here is very good and translates to the  $\pm 0.17\%$  shown for speed stability in "Measured Data." The claimed spec of  $\pm 0.001\%$  may be a typographical error since it is easy to mix decimal points and percentages. I know, because I tend to fall into this trap myself!

The rumble spectrum is shown in Fig. 4. Most of the

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



# Winston America's Best.



Excellence.  
The best live up to it.

The Technics SP-10MK3 is certainly among the best turntables presently offered by anyone. It's a rugged, heavy-duty unit for daily use.

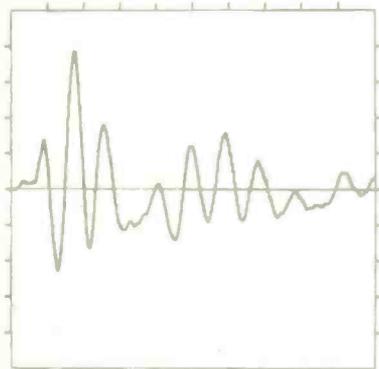


Fig. 8—  
Output vs. time  
of the impulse  
used to obtain  
the spectrum of  
Fig. 7. Total  
period is  
0.205 S.



Fig. 9—Spectrum to  
100 Hz due to a 100 dB  
SPL acoustic field at the  
record surface with the  
stylus in a quiet groove

near the middle of a  
stationary record. The  
acoustic isolation is  
excellent.

rumble is at the 7.5-Hz tonearm/cartridge resonance frequency. The unweighted and weighted rumble specs are shown in "Measured Data" as being  $-68$  and  $-90$  dB, respectively; Technics claims values of  $-60$  and  $-92$  dB. The rumble is so low that only the most sophisticated equipment and techniques will allow it to be measured with any accuracy, and it has to be rated excellent.

Figure 5 shows the averaged spectrum produced by a series of mechanical impulses. These impulses were applied to the edge of a stationary record while the stylus was resting in a quiet groove near the middle of the record. Figure 6 shows the output versus time caused by one of the mechanical impulses picked up by the stylus. Technics doesn't supply any type of record clamping device, so I didn't use one on the SP-10MK3 for these measurements. During the listening tests, no clamping device was used on either the SP-10MK3 or the reference turntable. The stock platter mat doesn't appear to be anything special, but it is effective in suppressing the ringing of the metal platter at 662.5 Hz. During the listening tests, comments were made about differences in tonal balance between the SP-10MK3 and the reference turntable. It was felt that these differences might be related to differences in the spectrum of the energy in the record. For example, the sound of acoustical guitar seemed a bit fuller from the SP-10MK3, which shows more energy in the range below 200 Hz than the reference turntable.

The isolation of the SP-10MK3 from external shock is indicated by the spectrum shown in Fig. 7. The cursor is at 450 Hz, and the energy rise at this frequency is down  $-47.2$  dB. The greatest amount of energy is concentrated below 100 Hz. The suspension resonance of the SH-10B5 is at 5.3 Hz and very damped, but the great mass of the system can be energized by external shock. Therefore, care was taken during the listening sessions to avoid any mechanical coupling between the loudspeakers and the turntables. Figure 8 shows the output versus time for the mechanical shock which produced the spectrum shown in Fig. 7.

Figure 9 shows the spectrum of the electrical output of the cartridge with the stylus resting in a quiet groove while an acoustical signal produces a level of 100 dB at the surface of the record. This signal is a very slow sweep from 20 to 100 Hz. The system's degree of isolation from this acoustical signal is excellent.

### Conclusions

The SP-10MK3 is offered by Technics as being the best turntable that they make; it is certainly among the best turntables presently offered by anyone. If you are in the market for a rugged, heavy-duty turntable which will hold up well in day-after-day use and has broadcast-type professional features, you should check it out. The overall sound quality is only slightly below that of a few top audiophile turntables, and the SP-10MK3 is as good as the best of them with regard to acoustical isolation. In order to achieve this performance, you will have to place the turntable and its base on a very solid platform. The precise control of speed and the ability to change tonearms easily are great features which should interest both musicians and audiophiles.

*Edward M. Long*

The separate control unit is used to select speeds and vary the pitch, with speed change shown in 0.1% increments.



3

## SIGNET TK10ML PHONO CARTRIDGE

### Manufacturer's Specifications

**Frequency Response:** 5 Hz to 35 kHz; 20 Hz to 15 kHz,  $\pm 0.5$  dB.

**Tracking Force:** 1.2 grams (1 to 1.5 grams).

**Channel Balance:** 0.5 dB.

**Channel Separation:** At 1 kHz, 35 dB; at 10 kHz, 26 dB.

**Output Voltage:** At 1 kHz and 5 cm per S, 2.2 mV.

**Stylus:** Nude-mounted, natural-diamond MicroLine.

**Cantilever:** Boron.

**Vertical Tracking Angle:** 20°.

**Resistance:** 240 ohms d.c.

**Inductance:** 85 mH.

**Impedance:** 550 ohms at 1 kHz.

**Recommended Load Impedance:** 47 kilohms.

**Recommended Load Capacitance:** 100 to 200 pF.

**Weight:** 7.5 grams.

**Replacement Stylus Assembly:** TKN10ML.

**Price:** \$380.

**Company Address:** 4701 Hudson Dr., Stow, Ohio 44224.

For literature, circle No. 92



When Signet introduced the TK10ML moving-magnet phono cartridge, it was the first in the United States to utilize the MicroLine diamond stylus. The design of this stylus is claimed to surpass all others in virtually every aspect of performance. The MicroLine has a scanning radius of only 2.5 microns, half that of other small, thin stylus tips. This permits the tip to trace modulations too finely cut for conventional styli. The length of this 2.5-micron ridge is 210 microns, compared to only 67.5 microns for elliptical tips and 143 microns for van den Hul tips. Signet calls the MicroLine's scanning radius and vertical contact dimension the narrowest and tallest "footprint" ever achieved by a cartridge manufacturer, and claims that its longer vertical contact line minimizes stylus pressure on the groove wall, even after taking the narrow scanning width into ac-

count. The end result, according to Signet, is wider frequency response, lower distortion, and less stylus and record wear.

Audiophiles with heavily played record collections should seriously consider the MicroLine stylus, because its extremely long footprint will contact parts of worn records' grooves which have never been played before. Thus, there should be a considerable reduction in surface noise and a cleaner sound—somewhat like that of a new record. However, to function properly, the stylus must be precisely aligned with the groove walls.

The stylus is made from a whole, natural octahedral diamond. It is grain-oriented and ground with a square shank to fit the laser-cut hole in the cantilever precisely, for perfect alignment and positioning.

The cantilever is made of boron,

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The Signet's extremely tall "footprint" can contact parts of record grooves in worn records never played before—making them sound like new.

among the most rigid and acoustically dead materials known. This rigidity eliminates spurious resonances, assuring smooth response within the audible range.

The Signet Twin-Flux generator system utilizes two completely discrete magnet/coil systems, one for each groove wall, each precisely aligned at a right angle to one of the walls. Each of these two samarium-cobalt magnets, along with its associated laminated ring core and toroidal coil, makes up an independent electrical generator that reproduces only the sound information on its own stereo channel. This results in very high stereo separation. The omega-shaped coils themselves are of 99.9% pure, oxygen-free copper, and are wound on a unitized core/pole piece made up of six wafer-thin metal laminations for the highest possible flux density. To eliminate crosstalk from one side to the other, a mu-metal shield is placed between the two coil assemblies.

The TK10ML is packaged in a plastic container. Besides the phono cartridge, the usual stylus brush, screwdriver and mounting hardware are included. The plastic container is boxed in a Styrofoam case which, in turn, is packaged in a reasonably good-looking display box.

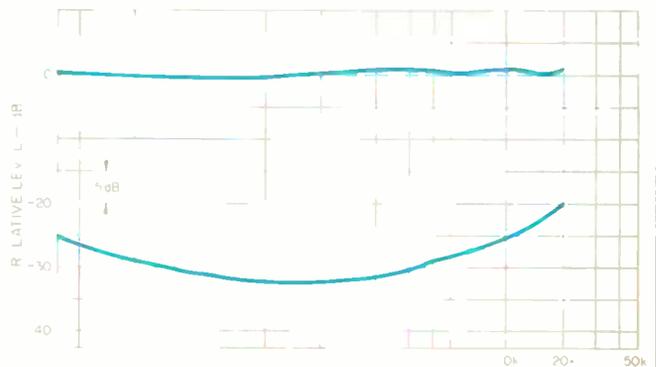
### Measurements

The Signet TK10ML moving-magnet phono cartridge was mounted in an EDS S-shaped tonearm, on an EDS 25F turntable. The TK10ML weighs 7.5 grams, and the headshell 6.9 grams, for a total weight of 14.4 grams. Each channel was terminated with 47 kilohms resistance and 180 pF capacitance. The Dennesen Geometric Soundtractor was used to orient the TK10ML in the headshell and tonearm.

All laboratory tests were conducted at an ambient temperature of 72° F (22.22° C) and a relative humidity of 55%, ±3%. The tracking force for all reported tests was set at 1.25 grams and the anti-skating force at 1.7 grams. As is my practice, measurements are made on both channels, but only the left is reported unless the two channels differ significantly, in which case both channels are reported for a given measurement.

The following test records were used

**Fig. 1—**Frequency response and separation (JVC TRS-1007 test record).



in making the reported measurements: Columbia STR-100, STR-112, and STR-170; Shure TTR-103, TTR-109, TTR-110, TTR-115, and TTR-117; Deutsches HiFi No. 2; DIN 45.549 and 45.542; JVC TRS-1005 and TRS-1007; B & K QR-2010, and Ortofon 0002 and 0003.

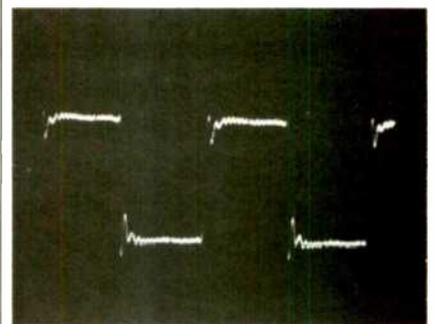
Frequency response, measured from 40 Hz to 20 kHz with the JVC TRS-1007, was among the flattest I've ever measured: +0.8, -0.25 dB (Fig. 1). Separation, using the same test disc, was 32 dB at 1 kHz, 26.5 dB at 10 kHz, 23 dB at 15 kHz, and 21.5 dB at 20 kHz. The frequency response from 30 to 50 kHz using the JVC TRS-1005 was -3 dB at 30 kHz, -5 dB at 45 kHz, and -7 dB at 50 kHz. The frequency response beyond 30 kHz was not remarkable. The 1-kHz square wave is quite flat, with no overshoot (Fig. 2).

The arm/cartridge low-frequency lateral resonance for either channel measured a surprisingly low 6.5 Hz at +7 dB. The vertical resonance was also 6.5 Hz. Given such a low arm/cartridge resonance, the measurement was repeated using a Technics EPA-A250 tonearm, with its anti-resonance device defeated. Again, the arm/cartridge resonance in both planes measured 6.5 Hz. Based on this, it seems that the TK10ML phono cartridge should be mounted in either a very light or a heavily damped tonearm.

Using the Dynamic Sound Devices DMA-1 dynamic mass analyzer, the arm/cartridge dynamic mass was measured at 16.5 grams, and the dynamic vertical compliance at  $35 \times 10^{-6}$  cm/dyne at the vertical resonant frequency of 6.5 Hz. The harmonic-distortion

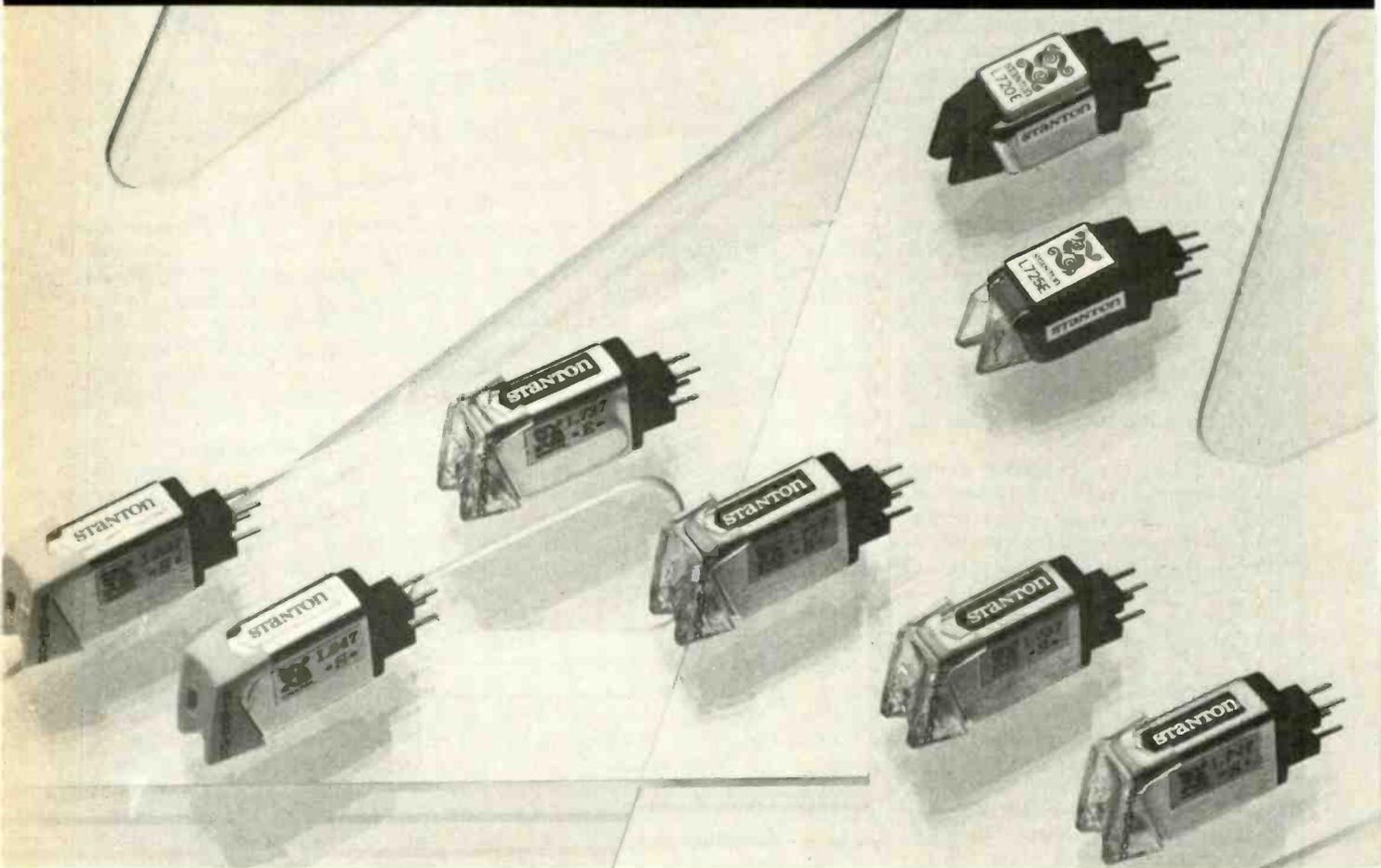
components of the 1-kHz, 3.54-cm/S rms, 45° velocity signal from the Columbia STR-100 test record were: 1.12% second harmonic, 0.5% third harmonic, with less than 0.2% higher order terms. The vertical stylus angle measured 22° at the tracking force of 1.25 grams.

Other measured data are: Wt., 7.5 g. Opt. tracking force, 1.25 g. Opt. anti-skating force, 1.7 g. Output, 0.51 mV/cm/S. IM distortion (200/4000 Hz, 4:1): Lateral (+9 dB), 0.6%; vertical (+6 dB), 2.2%. Crosstalk (using Shure TTR-109): Left, -24 dB; right, -27 dB. Channel balance, 1 dB. Trackability: High frequency (10.8 kHz, pulsed), 30 cm/S; mid-frequency (1 and 1.5 kHz, lateral cut), 31.5 cm/S; low frequency (400 Hz and 4 kHz, lateral cut), 24 cm/S. The Deutsches HiFi No. 2 300-Hz test band was tracked cleanly to 114 microns (0.0114 cm) lateral at 21.50 cm/S at +12 dB and to 55.4 microns (0.00554 cm) vertical at 10.32 cm/S at +5.86 dB. In repeating the test using



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

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After 40 hours of listening to every kind of music, I judged the Signet TK10ML one of the best and most natural-sounding MM cartridges available.



The tall, thin "footprint" of the Signet's MicroLine stylus scans fine details well.

the DIN 45.549 test record, the TK10ML tracked to 120 microns in the left channel and 100 microns in the right channel.

The Signet TK10ML encountered no difficulty in tracking all the test bands on the Shure Obstacle Course Era III and Era IV musical test records as well as level 6 of the Shure Era V trackability tests.

Since commercial analog records rarely have peak recorded velocities exceeding 15 cm/s, the Signet TK10ML would be able to track any audiophile records, such as those issued by Sonic Arts, Telarc, Sheffield, Reference Recordings, RCA Point 5 or Mobile Fidelity.

One cautionary note: The MicroLine stylus must be kept pristinely clean at all times; otherwise, the music will sound somewhat muddy. Undoubtedly this occurs because the stylus' extra-small scanning radius acts as a super scoop, penetrating deep into the record's groove and scraping dust and dirt particles from the groove's very bottom.

#### Use and Listening Tests

As usual, listening tests were performed both before and after laboratory tests. The following equipment was used: EDS 25F turntable and arm, Technics EPA-B500 tonearm assembly along with an A-250 S-shaped tonearm mounted on a Technics SP-10MKII

turntable, Audio-Technica AT666EX vacuum disc stabilizer, Amber Model 17FF preamplifier, two VSP Labs Trans-MOS 150 amplifiers (each used in the 300-watt mono mode), and a pair of B & W 801F loudspeakers. Speaker cable, interconnecting cables, and the wall foam for the live-end/dead-end (LEDE) listening room were from Discrete Technology.

Some of the super audiophile records I used to evaluate the Signet TK10ML were Gershwin: *Rhapsody in Blue*, *An American in Paris* (List, piano; Cincinnati Symphony, Kunzel, Telarc DG-10058), Saint-Saëns: *Symphony No. 3, "Organ"* (Zamkochian, organ; Boston Symphony, Munch, RCA Red Seal Point 5 ATL1-4039), *Adam Makowicz, Jazz Pianist* (Sheffield Lab 21), Vivaldi: *La Primavera, Opus 8, No. 1, etc.* (H. Ohyama and the Cremona Chamber Ensemble, Sonic Arts LS-8), Schubert: *Four Works for Violin and Piano* (Matoušek, violin; Adamec, piano; Denon OX-7141-ND), *Wild Bill Davison and Eddie Miller Play Hoagy Carmichael* (M & K RealTime Records—Digital Recording RT 306), and David Foster, *The Best of Me* (Mobile Fidelity MFSL 1-123).

At no time did I hear any coloration present except when the stylus of the TK10ML was dirty. Both applause definition and transient response were excellent. As expected, the TK10ML reproduced very high velocity cannon shots on the Telarc 1812 (matrix 2) with no apparent difficulty. The Bösendorfer piano, as well as the singing voices, were reproduced realistically. Both stereo imaging and depth were superior to the average phono cartridge. I found the bass sonically well-defined and tight.

Although the Signet TK10ML was put through the wringer, playing just about every type of music record commercially available, there was none it did not reproduce flawlessly.

After more than 40 hours of listening to the Signet TK10ML play practically everything, I judged it one of the best and most natural-sounding moving-magnet phono cartridges available today. Those enamored with the mystique of the vaunted moving-coil phono cartridges would undoubtedly find it ear-opening to audition this extraordinary phono cartridge. *B. V. Pisha*

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4

## HITACHI DA-600 COMPACT DISC PLAYER

### Manufacturer's Specifications

**Frequency Response:** 5 Hz to 20 kHz,  $\pm 0.5$  dB.

**S/N Ratio:** 95 dB.

**Dynamic Range:** 95 dB.

**Channel Separation:** 92 dB.

**THD:** 0.003% at 1 kHz.

**Output Level:** 2.5 V, variable.

**Number of Programmable Selections:** 15.

**Power Consumption:** 23 watts.

**Dimensions:** 17 $\frac{1}{8}$  in. (43.5 cm) W x 3 $\frac{1}{4}$  in. (8.3 cm) H x 10 $\frac{1}{8}$  in. (26.4 cm) D.

**Weight:** 13 lbs., 3 oz. (6 kg).

**Price:** \$700.

**Company Address:** 401 West Arteria Blvd., Compton, Cal. 90220.

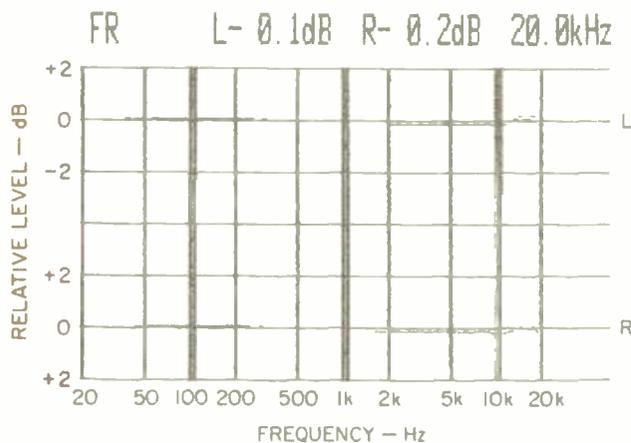
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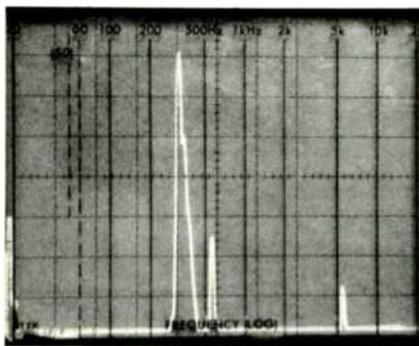
CD players have come a long way since I tested Hitachi's rather boxy-looking first model, the DA-1000, more than two years ago. I did not give it a rave review. In fact, I went through two samples before I got one that worked properly. How times have changed! This latest Hitachi CD player deserves high marks for performance and features, as well as for style. It allows you to program up to 15 selections in

any order, using a numeric keypad. There's an audible fast-search mode which helps you find the exact musical moment you want to hear. A repeat-playback feature lets you listen to a specific program over and over again, or you can repeat-play specific tracks. It's even possible to find specific points on a disc by keying in tracks as well as index numbers, if the particular disc has been encoded with such

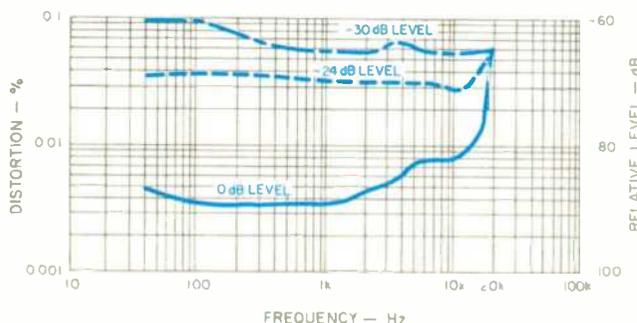
The DA-600 is amazingly versatile for a player with such simple controls, because its five keypads have double functions.



**Fig. 1—Frequency response, left (top) and right channels.**



**Fig. 2—Spectrum analysis of 20-kHz test signal (large spike) shows inaudible beat tone at 24.1 kHz, approximately 50 dB below the desired output. Horizontal scale: Linear, from 0 Hz to 50 kHz.**



**Fig. 3—THD vs. frequency at three output levels.**

index points. Perhaps best of all, a supplied wireless-remote control lets you handle all player operations except power on/off, drawer open/close, and output-level adjustment from the comfort of your listening location.

According to Hitachi, the low, slim look of the DA-600 was made possible in part by the firm's development of several LSIs which incorporate a great deal of circuitry into a few small chips. Hitachi also stresses that its CD players employ a three-beam laser-optics system for accurate tracking, though I'm not convinced that this approach offers any real advantages over the single-beam laser found in other, equally good players.

### Control Layout

Like most latter-day CD players, the DA-600 uses a front-loading, retracting drawer that holds the CD to be played. Below the drawer is the power on/off switch, and to its right is an open/close button. Further to the right is a fluorescent, multi-purpose display which indicates the track and index numbers being played, the time into the track (as well as the total recorded time of the disc just after it is loaded), and the selected mode. "Play," "Repeat," "Pause," "Open," and "Program" lights illuminate at appropriate times to tell you exactly what's happening. When a disc is first loaded, the display shows the total number of tracks on that disc. Below the display area are 10 small numeric keys used for manual track selection or for random-access programming. The "Memory" key for this programming and the "Repeat" key are positioned alongside the numeric keys.

The turntable's amazing versatility of operation is achieved using only five keypads. When used singly, these pads handle play, pause, stop, fast-forward, and fast-reverse functions. The fast-motion buttons, when pressed during play, advance the laser pickup rapidly, allowing you to reach a desired musical moment quickly. If the fast-forward or fast-reverse button is pressed while holding down the play button, the pickup quickly advances to the start of the next track or returns to the beginning of the current one. The stop button also serves a second function, clearing the program from memory. Doubling the functions of these control pads simplifies the look of this player, making it less intimidating than some others I've encountered that belong to the airplane-cockpit school of control-panel layout. Despite its clean simplicity, the DA-600 offers all of the operating features of those more complicated-looking models.

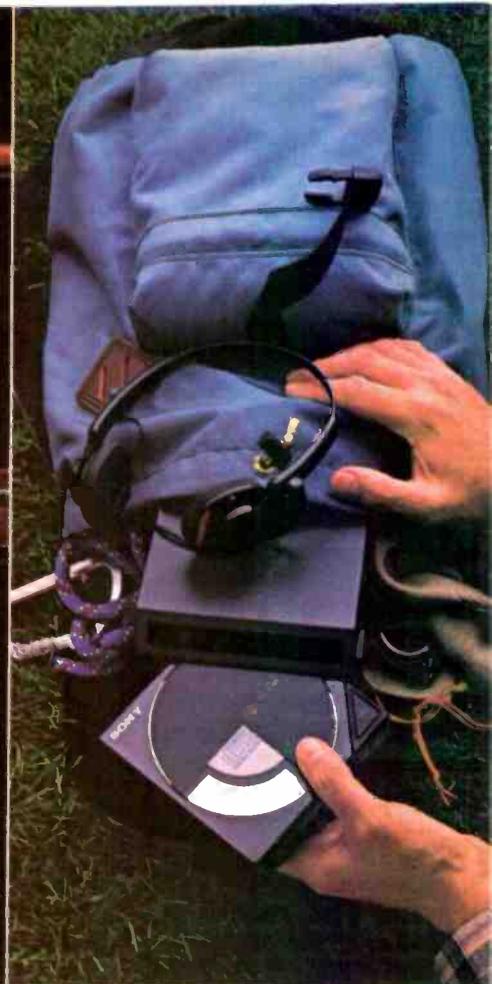
An output-level control and a stereo headphone jack are at the extreme right end of the front panel. The level control adjusts both line and headphone output levels.

The five major function buttons, the "Repeat" button, and the 10 numeric keys are all duplicated on the wireless remote control, permitting you to remotely program the tracks (and index numbers) you want.

Line outputs for connection to the left and right high-level inputs of a preamplifier, integrated amplifier, or stereo receiver are found on the rear panel.

### Measurements

Figure 1 shows the playback frequency response for the left and right channels of this CD player. The vertical scale is 2 dB per division, the better to highlight small deviations



# Sony revolutionizes the compact disc revolution.

If there are still a few among you who have any lingering doubts as to who the leader in digital audio really is, consider the following:

On October 1, 1982, Sony\* set the music industry on its ear with the creation of the world's first compact digital audio disc player.

Today, with over 30 companies joining the revolution, Sony is starting another. The Portable Compact Disc Player,\* and coming this winter, the Car Compact Disc Player.

Combine that with the fact that the CDP-111, shown above, represents another addition to the world's largest family of

home compact disc players, and one thing should become abundantly clear:

While other companies are claiming advanced circuits, Sony has taken a somewhat different course.

Advanced products.

**SONY.**  
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The DA-600's A-weighted signal-to-noise ratio was 104 dB, one of the best I've ever measured for a Compact Disc player.

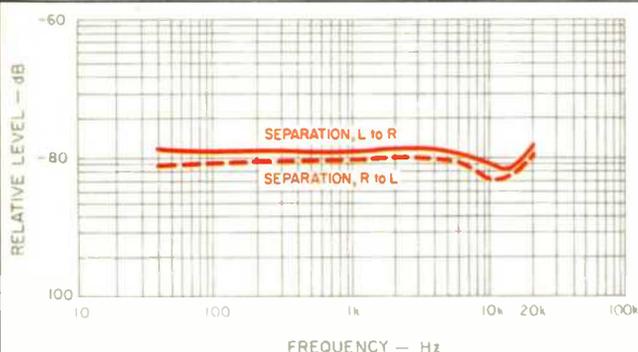


Fig. 4—Separation vs. frequency.

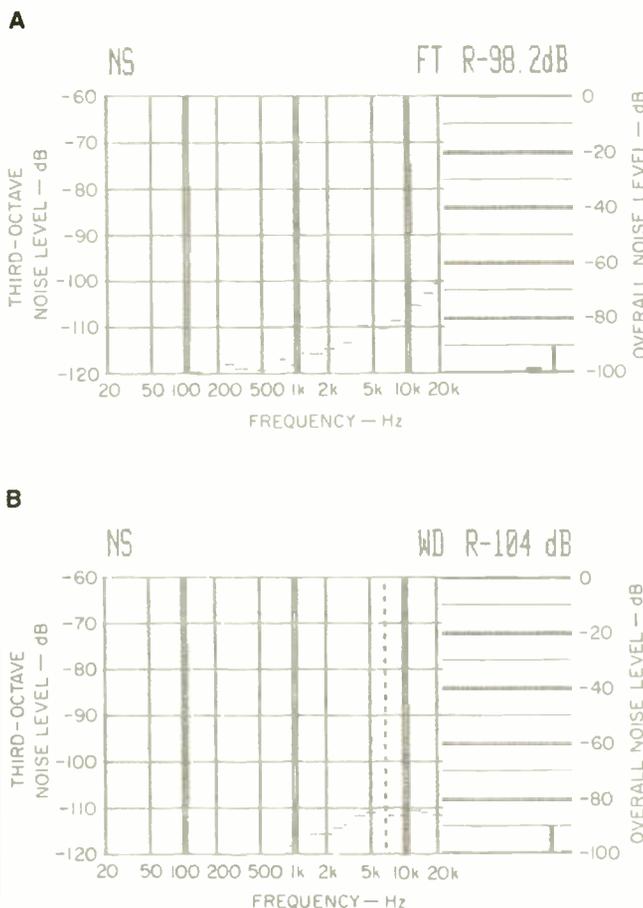


Fig. 5—S/N analysis, both unweighted (A) and A-weighted (B).

from ruler-flat response. There were none to speak of, and, with the cursor of the graph set to read relative output at 20 kHz, the readings were off by only 0.1 and 0.2 dB for the left and right channels!

Harmonic distortion at mid-frequencies, for maximum recorded level, measured 0.004%, rising to 0.008% at 10 kHz. Above that frequency, I ran into the usual apparent increase in THD, caused not by higher order harmonic components but by an out-of-band "beat" between the 44.1-kHz sampling frequency and the frequency read from the test disc. In Fig. 2, the tall spike represents a desired output at 20 kHz. In this spectrum-analyzer photo, the sweep is *linear* from 0 Hz to 50 kHz, in 5-kHz horizontal divisions. The 24.1-kHz spike caused by the beat phenomenon is roughly 50 dB below the desired output; you can also see a shorter spike just above 40 kHz in this 'scope photo. Neither of these spikes, of course, is audible, since they are beyond the highest frequency of human hearing.

Figure 3 plots distortion versus frequency for maximum recorded levels as well as for recorded levels of -24 and -30 dB. As usual for CD players, the THD increases at lower output levels. At the -30 dB recorded level, THD for a 1-kHz signal measured 0.06%.

Output linearity was accurate to within 0.1 dB down to 60 dB below maximum recorded level, and to within 0.4 dB down to 90 dB below maximum recorded level. Stereo separation, or crosstalk, shown in Fig. 4, was extremely uniform over the entire range of frequencies tested and did not decrease at the frequency extremes, as it does on so many other CD players. This suggests that the analog output stages of the player have been designed with good isolation between left and right output stages.

SMPTE-IM distortion was a low 0.01% at maximum recorded level, increasing to 0.03% at -20 dB recorded level. CCIR (twin-tone) IM, using signals at 19 and 20 kHz, measured only 0.002% at the equivalent of maximum recorded level and 0.0027% at -10 dB. The signal-to-noise ratio, measured without any weighting network, was an impressively high 98.2 dB, increasing to an even more impressive 104 dB when an A-weighting network was introduced in the measurement path. This is one of the best readings I have ever measured for a CD player. An analysis of the noise content as a function of frequency distribution is shown in Figs. 5A and 5B.

Square-wave reproduction of a 1-kHz, digitally generated square-wave signal was typical of that produced by CD players using multi-pole analog output filters (Fig. 6), as was the reproduction of the unit pulse (Fig. 7). With a 200-Hz signal reproduced from the left channel and a 2-kHz signal coming from the right channel, there was little evidence of phase shift of the higher frequency with respect to the lower one. Perfect phase relationship would be indicated by both sine waves in Fig. 8 crossing the zero axis in a positive-going direction at the same time—a condition that occurs near the right side of this 'scope photo.

Although the Hitachi DA-600 was able to track my special "error-laden" test disc to dropout lengths that exceed the minimum requirement called for in the CD standard (400 microns), it was not able to play through the widest portion (900 microns) of the test disc's opaque wedge, though it did

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Dual Capstar technologies found on Denon's DR-M33 and the DF-M44 Three-head Cassette Decks. Similarly, the outstanding audio performance of these decks can be attributed to Denon's electronics experience building the world's finest hi-fi components.

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The Hitachi DA-600 CD player and its less costly cousin, the DA-550, are up-to-date units that look as good as they sound.

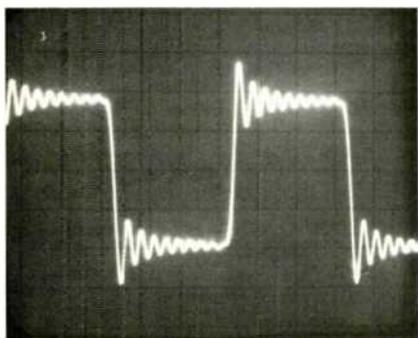


Fig. 6—Reproduction of 1-kHz square wave.

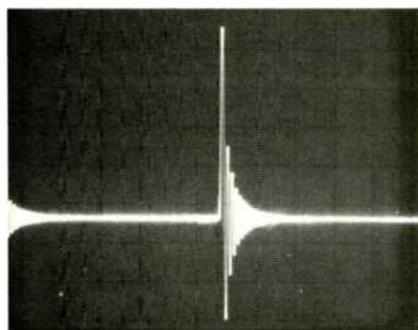


Fig. 7—Single-pulse test.

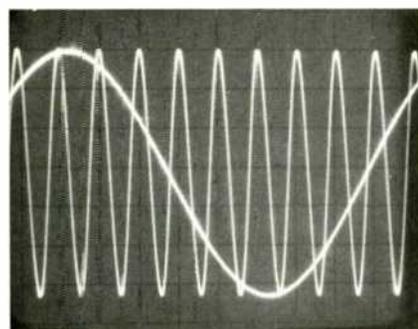


Fig. 8—Phase error check using tones of 200 Hz (left channel) and 2 kHz (right channel).

get past the 800-micron point. No trouble was encountered getting through the simulated dust spots (black dots on the test disc's surface), the largest of which is 800 microns in diameter. Nor did the simulated fingerprint present any problems for the DA-600's laser-optical pickup or servo-tracking system. Resistance to shock and mechanical vibration was better than average. In general, second- and third-generation CD players have been better in this respect than the first players, and the Hitachi DA-600 is no exception.

#### Use and Listening Tests

I'm getting to the point where I can usually distinguish between CD players that employ steep analog filters and those that use digital filtering (i.e., oversampling of one form or another plus gentle-sloping analog filters). The Hitachi DA-600 belongs to the former category; as such, it offers sound quality not unlike that delivered by players from Sony, Denon, Sanyo, Technics, Onkyo, and Pioneer. As I have stated on previous occasions, I cannot say with finality that CD players using multi-pole analog filters sound inferior or superior to players employing the alternate D/A configuration. I *can* say that I hear a difference between these alternate approaches. But more significant is the program source material. Its musical quality determines—to a far greater degree—how natural the reproduced sound seems, and even how appropriate the stereo separation and apparent depth of imaging seem.

I listened long and hard to the Hitachi DA-600, and, given no other frame of reference than my own memory for music performed live, I could not fault its ability to deliver lifelike sound from well-recorded CDs. Circuit-wise, I suspect that the only thing that distinguishes this machine from Hitachi's less-expensive DA-550 is the headphone output and level-control feature and the availability of the infrared remote-control unit. So, if these features have little importance to you, you may want to consider the lower-cost DA-550 and save yourself an additional \$100 or more. In either case, you'll be getting an up-to-date CD player that looks every bit as good as it sounds.

*Leonard Feldman*



The five keypads of the DA-600 perform dual functions, simplifying the player's appearance and enhancing its versatility.

# To Find Out Where Audio Is Going, You Should Know Where We've Been.



Over the last ten years, Onkyo has been responsible for many audio innovations that have since become industry standards.

Tuner technology, for example. Onkyo pioneered affordable Quartz digitally synthesized tuning in 1975, and followed it two years later with Quartz & Servo locked tuning. Last year, we developed our Automatic Precision Reception System, an on board microprocessor that automatically controls all critical tuner functions, and introduced the first receiver, our Integra TX-85, with dbx<sup>1</sup> and

Dynamic Bass Expander.

In cassette decks, Onkyo technology has always been at the forefront. We introduced the first cassette decks with bias adjustments (Accu-bias) to insure perfect recording with any tape formulation. Subsequently, we were first in the industry with high speed dubbing decks, real time counters, cassette receivers, and a deck with all noise reduction systems—Dolby B-C, HX Pro<sup>\*</sup>, dbx<sup>1</sup>.

Amplification has, in recent years, become another Onkyo hallmark. Our Super Servo, Linear Switching

and Delta Power Supply circuitries created the first amplifiers with wide dynamic range and low impedance drive capability. Soon to be introduced in 1985 is our new *Real Phase Amplifier Technology*, which utilizes *main and secondary power transformers to facilitate distortion-free handling of any speaker impedance load, even down to 2 ohms.*

Onkyo is proud to be celebrating ten years of sound achievements. Experience superb Onkyo performance for yourself by visiting your Onkyo dealer today.

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## CELESTION SL-600 SPEAKER

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Finding the proper perspective from which to evaluate the Celestion SL-600 loudspeaker makes this an exceptionally difficult review to write. On one hand, this is an excellent loudspeaker in many ways. On the other hand, I cannot totally decouple my review from the issue of value for money. The Celestion SL-600 is a small (15 x 8 x 10 inches) two-way system selling for \$1,380 a pair and requiring, almost absolutely, a heavy, rigid stand of the proper height. Celestion sells stands that match the SL-600 for an additional \$350 per pair, which adds up to \$1,730 for the system, while for \$120 per pair, one can obtain from Celestion wood stands that are decidedly less rigid and heavy. I have reservations about how well the \$350 stands match the speakers, as I'd prefer a stand whose speaker mounting plate precisely conformed to the speaker's size (this stand's edges protrude beyond the speaker) and whose height could be adjusted. However, Celestion intends to provide new stands, with properly sized mounting plates and, possibly, a lower price. And they feel that the stands' 18-inch height is precisely optimized for the speaker's vertical polar response.

In addition, I cannot in good conscience omit mentioning some of the other fine small monitors which achieve excellence at only a third the price of the Celestion. These include two that are directly competitive in terms of what the SL-600 does best, the SPICA TC-50 (\$450 per pair) and the Dayton Wright LCM-1 (\$499 per pair). Further, I should not ignore the fact that some of the best three-way systems I know of sell for less than, or close to, the final cost of the SL-600 including stands. Among these are the Thiel 03A and CS3, the Vandersteen 2C, the Phase Diametrics Fuselier 3.3, and the Magnepan MG-III.



I also can't ignore several real-world limitations inherent in any small monitor speaker. The potential advantage of a design like the SL-600's doesn't lie in its small size. If you select a small monitor, you're paying for coherence, imaging, a focused sound stage and uncolored sound from about 80 to 120 Hz. It will perform at its best only if put on a stand, placed at least 18 inches from a rear wall and 24 inches from a side wall, and so that no major pieces of furniture are between it and the listening position. I do not, therefore, believe a small monitor of this type saves space. A much larger three-way system will fit into any room where you can properly place this speaker.

A small monitor also cannot generate the bass power of a large speaker, and this is audible in the lower mid-range as well as the bass. The 1-meter, on-axis, measured bass response doesn't adequately indicate the true

bass power delivered to the ear. Design after design has shown that it takes a big woofer in a much larger cabinet to do this, regardless of woofer excursion, etc. This means that a small monitor always sounds slightly unbalanced. The much-praised LS-3/5A, for example, has a boost at about 120 Hz to make up for its lack of deep bass. It relies on illusion rather than accuracy.

In contrast, small monitors with flat frequency responses tend to sound bright and constricted. The Proac Tablette is a good example of a very small monitor speaker without enough bass power to be musical unless you add a subwoofer. The Tablette is "high fi," but I find it unacceptable as a stand-alone unit in terms of musical balance compared to any speaker with even adequate mid-bass. The old Spendor mini-monitor had better bass than the Tablette, but it made a fascinating contrast with the Rogers LS-3/5A. The flat

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**Something special about its timbre may suit your taste in a way no comparably priced speaker can, especially on voice and small musical groups.**

bass in the Sendor simply didn't have the impact to compete with the bass hump in the LS-3/5A. This may help explain why Sendor now licenses and produces the less "accurate" (or flat) LS-3/5A.

The SL-600 seems to use a variation of the LS-3/5A technique. It appears to have a rising bass characteristic, rather than a peak, down to the point where its bass response falls off. This provides a relatively flat apparent mid-bass and much better upper bass than most small monitors, and does so up to moderately loud listening levels, provided the SL-600 is driven by a "stiff," high-quality power amplifier. The SL-600s really should not be used with ordinary receivers or integrated amplifiers. Ideally, they need an amplifier on the order of the Krell or Threshold or, at least, the Belles Research, Hafler DH-220 or PS Audio IIC+. Even then, the SL-600 won't display the bass power, naturalness or the smooth bass-low midrange transitions of the best three-way systems in this same price bracket. You give up some important musical information to buy this speaker.

And yet, I have to say the SL-600s are worth considering, even with their high price and sonic compromises. Small monitors do offer some compensating advantages for what they give up. They provide a fairly close approximation of an apparent point source, and this can mean exceptional imaging and sound-stage stability. The SL-600s largely meet this test. They don't furnish the depth of some competing, high-priced, full-range speakers, but the sound stage is wide and generally well proportioned. The imaging is stable and has a good spread of instruments, rather than "dual mono." You can listen from a relatively wide range of listening positions, and the net effect is that the SL-600s provide a bigger and more natural sound stage than many much larger speakers which lack superior driver and phase alignment.

I also have to say that there is something special about the timbre of this speaker that may suit your taste in a way no other comparably priced speaker can. The SL-600s are as musical a speaker in reproducing male voice above the bass range, and female voice below upper soprano, as I have ever had the opportunity to re-

view. Guitar and flute, small wind and string groups, small jazz combos (those which do not rely heavily on a bass line for impact), and other music whose size and sound seems natural to a home-sized room can also take on a musicality that competes directly with the best loudspeakers in the price range.

I'm not entirely happy with this musicality. I've read through the technical literature on this speaker in some depth, and it is well written and generally convincing. Nevertheless, I seem to hear irregularities and a lack of data in the transition area from lower midrange to midrange that I don't hear in my Quad ESL 63s or in similarly priced competition like the Thiels or Vandersteens. I cannot object to the sound on most music, but I have the feeling that the SL-600s' magic is at least partly the result of euphonic coloration, rather than flat response.

The SL-600s do handle fast musical changes with exceptional naturalness, and without the apparent treble rise which characterizes many small speakers that seem fast and image well. Their upper midrange and lower highs seem closer to those of electrostatics than to those of dome or cone units. They are definitely the strongest aspect of the SL-600 and may ultimately justify its cost. They're easily the equal of the upper midrange and lower highs of loudspeakers costing twice as much.

Equally important, the SL-600s do not "etch" or emphasize the upper octaves, except perhaps the top octave. I prefer the more recessed top-octave response of my Quad ESL 63s, but this is a matter of taste. There's no question that the SL-600s add a touch of top-octave air and extension to a great deal of music—but the excitement, air, and transient detail come about without adding hardness or bringing you too close to the performance.

As for power response, bigger speakers produce bigger sound. Nevertheless, you can use high-power amplifiers and the SL-600s won't give up in distress. I threw the power of the Conrad-Johnson Premier Fives, the Futerman OTL-3s, and the Audio Research D160B at the SL-600s, and drove them to the maximum listening levels I consider natural. The bass was

a bit iffy, but the midrange and treble stayed fast and clean.

I did find the SL-600s to be speaker-cable and placement sensitive. You need a good, fast speaker cable, very tight connections (try the Monster Cable Xterminators instead of banana plugs), and careful attention to the rest of your system. I would recommend cables of the Powerline II, Livewire, Straightwire, Randall, and Discrete Technology caliber. Ordinary Monster Cables, or moderate quality speaker cables, don't seem to have the speed and upper-octave purity to get the best out of them.

As for placement, I ended up using a stand a friend had built, which had a sand-filled column, adjustable height, and heavy, adjustable baseplate. I found that height and speaker angle make a difference. The SL-600s seem to have a proper height for a proper listening position at which they lock in and really perform their best. They also merit "tweaking" in terms of altering angle of the speaker's face towards the listener, but this is not compulsory. You may well find that keeping soft furniture as far away from the sides of the SL-600s as possible, and minimizing coffee tables and other clutter between the speaker and the listener, will give you outstanding results. The SL-600s will provide a good, stable sound stage without this kind of purism, but if you want the best from a \$1,400+ pair of loudspeakers, you're going to have to pay close attention to your listening room.

In short, the SL-600s are a fairly esoteric choice. At \$500 a pair, I could quickly recommend them, but at \$1,380 plus the cost of the stands, everything depends on whether you feel they have that special magic that suits your taste. If you favor voice or small musical groups, you may well feel the SL-600s are just what you want; oddly enough, you may also feel this way if you like rock. The SL-600s' bass may be slightly restricted, but this actually benefits that large amount of rock material where poor monitoring and recording drown everything with one-note bass. When I say this speaker merits careful listening, I am not reciting a cliché. At the price, its value depends on your ears, and not mine.

*Anthony H. Cordesman*

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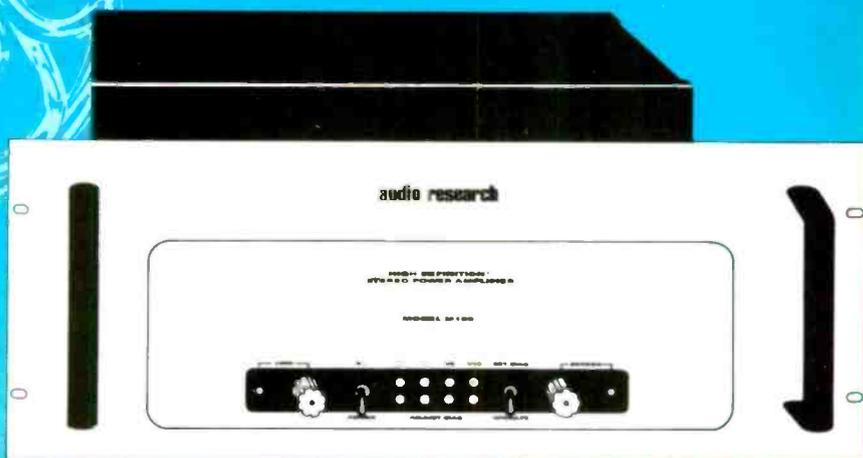
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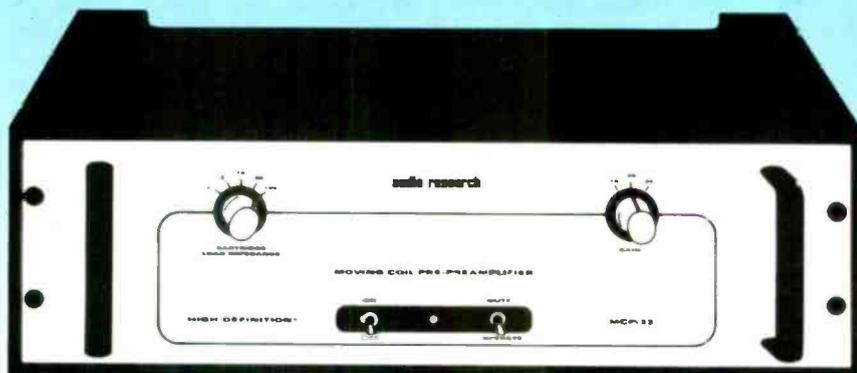
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## THE KING, FOR THE RECORD

Illustration: Rick Tulka



**Elvis—A Golden Celebration:** Elvis Presley  
**RCA CPM6-5172**, six-record set, \$49.98.

Sound: Variable Performance: A+

To mark Elvis' 50th birthday, RCA has assembled this boxed set of his performances. Given their track record, and the shoddy way in which RCA has treated Elvis over the years, no one had a right to expect the treasure trove they've released. It contains no fewer than 59 previously unreleased performances. What they are and their dates are the big story.

Side one is made up of outtakes from Elvis' monumental Sun Records sessions in 1954 and 1955. Sides two and three include all of his performances on six nationally televised Dorsey Brothers Stage Shows from early '56.

Side four contains the newly crowned king's TV appearances in the spring of '56 on the Milton Berle and Steve Allen shows.

Sides five through seven are recordings of live concerts at the 1956 Mississippi/Alabama Fair and Dairy Show in Elvis' home town, Tupelo, Mississippi. The voltage increases on sides eight and nine with his Ed Sullivan Show appearances from later '56 and early '57, just prior to his induction into the Army. Side 10 has five songs which

were home-recorded while he was stationed in Germany ('58 to '60). The most curious stuff of all appears on side 11 in the form of five demo recordings discovered in a shoebox in Graceland, the

Presley mansion in Memphis. The set closes on side 12 with a generous 26½ minutes of the jam sessions done as part of Elvis' 1968 comeback television special.

In short, this set features the real Elvis Presley: Young, hungry and happening, with the emphasis on live performance. There is a lot of song repetition, multiple performances of "Blue Suede Shoes," "Heartbreak Hotel," "Hound Dog," "Don't Be Cruel" and "Love Me Tender." However, in '56 to '57 these were the basis of the Presley explosion, the big hits. They would have to be played on TV for the exposure; it's what the fans wanted. Still, you can hear Presley grow up right before your ears and become the King.

Just consider the Dorsey Brothers performances, his first six shots at national exposure. On the first show his voice is high and pinched—from nerves, no doubt. But he is electric nonetheless, igniting squeals from the audience. The next week he is all there, in control and a *star*. By the time of the third week's show, Elvis is a sensation and the guys in the band are obviously fans. They join in on a killer-hot jam on the TV debut of "Heartbreak Hotel," featuring a blistering Tommy Dorsey trombone solo. Elvis just gets better as he gets more sure of himself. History before your ears.

When next he appears, on the Milton Berle Show, he does the meanest, dirtiest "Hound Dog" ever to grace the small screen. Presley slows it down, way low down, at the end. (Now wouldn't a video collection of all these network appearances be a swell development?)

Sound quality varies wildly as the source varies. The live shows in Tupelo have very poor sound, very rough and scratchy. Considering that the very existence of these tapes is something of a minor miracle, any sound at all is a plus. You do get to hear the man bantering with people who know him well. The '50s TV sound is a very pleasant surprise, clearer and more present than I expected. The '60s TV sound is surprisingly poor, though the side it's on runs 26+ minutes, it is muddier than it should be. The tapes made in Germany are rough but charming, as leisure tapes might be; the Graceland tapes are similar in nature.

As an interesting adjunct to the boxed set, RCA has some other Presley reissues: His first four albums—*Elvis Presley*, *Elvis*, *Elvis' Greatest Hits*, and *50,000,000 Elvis Fans Can't Be Wrong*—with their original, glorious mono sound digitally rerecorded from the original tapes and pressed on virgin vinyl. You don't need me to tell you how great those albums are.

Then there is *Rockers* (AFM1-5182) with 12 finger-popping, foot-stomping, rock 'n' roll gems from 1956 to 1957, all in glorious mono. My only complaint is that they must have thought "Heart-break Hotel" was too slow to include. They were wrong. It would have fit perfectly. Otherwise, it is an Elvis Presley album about which one can fairly say that if you are only going to own one Elvis Presley album it might as well be *Rockers*. And that says a whole lot.

Really, it is long past time for RCA to give royal treatment to Elvis Presley with proper reissues. All credit is due to Gregg Geller, who supervised the whole project and did it right.

*Michael Tearson*

**Big Bam Boom:** Hall and Oates  
RCA AJLI 5336, \$9.98.

Sound: A- Performance: B+

This record is impeccably recorded, well sung, and the songs are (on the whole) pretty good. They got Arthur ("New Edition") Baker in to add some of his dance savvy to the tracks, but allegedly he didn't last long in the studio with these two. The first cut is a clever revisit of a Motown-styled tune ("It's the Same Old Song"). Some of the stuff is pretty infectious, but there should be more rock, guts and soul here. But it's still pretty good for a pop record.

One would guess from the aural evidence in these grooves that the band itself is playing more of a subservient role in the studio; it also sounds like none of the musicians were in the studio at the same time. As Hall and Oates become more successful, their craft becomes less and less dependent upon the contributions of others. Personally, we miss the talents of the band (Mickey Currey on drums, T-Bone Wolk on bass, G. E. Smith on lead guitar, and Charlie DeChant on sax); there's not one tune that really

rocks. *Big Bam Boom* is not particularly different from their last record, except that everything is absolutely metronomic. As a dance/pop album it may have a bit of an edge on its predecessors, but the rock element is gone.

*Jon & Sally Tiven*

**Valotte:** Julian Lennon  
Atlantic 80184, \$8.98.

Sound: B Performance: B

Julian Lennon is the son of John Lennon and Cynthia Lennon, an inescapable fact which inevitably colors perception of his debut album, *Valotte*. Comparisons with father John are simply unavoidable. Even the cover photo maximizes familial resemblance. The record inside, tastefully produced by the very

classy Phil Ramone, is calculated to sound as much like a John Lennon record as possible. Indeed, the resemblances are eerie.

The pleasant surprise is that the project has turned out well. Julian's songs are often quite fine, most notably "Too Late for Goodbye." He doesn't always have great depth in his ideas, but the lad is still very young, and time has a way of deepening people. *Valotte* is a better start than anyone would have had reason to expect.

*Michael Tearson*

**Arena:** Duran Duran  
Capitol SWAV-12374, \$9.93.

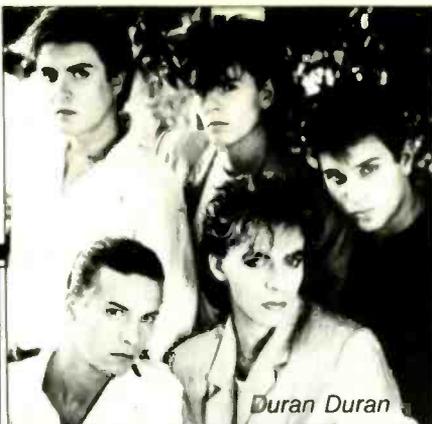
Sound: C+ Performance: C

*Arena* is a valentine from Duran Duran to their fans. It is a live album which includes their newest single, "The Wild Boys," that was co-pro-



*John Oates and Daryl Hall*

Clearly, the whole purpose of *Arena* is to mark time while Duran Duran tries to avoid becoming last year's sensation.



duced by Nile Rodgers with the band. Clearly, the whole purpose of *Arena* is to mark time while Duran Duran tries to avoid becoming last year's sensation. Many of my friends revile Duran Duran as bubble gum, yet I've always enjoyed their sunny music. This release won't change any minds in either direction.

*Michael Tearson*

**Go Insane:** Lindsey Buckingham  
**Elektra 60363-1, \$8.98.**

Sound: B Performance: B

As a member of Fleetwood Mac, Buckingham is responsible for the lion's share of songwriting, most of the production, a great deal of the singing, and much of the instrumentation. In other words, you'd be hard pressed to call him anything but the main creative force in the group, so you'd expect his solo albums to be similarly commercial fodder. Instead, he's delivered yet another quirky collection of tunes that are incredibly sweet and quite melodic, yet

defy convention. Although you've got to admire Lindsey for taking risks like this time and again, his melodic strengths are much more listenable when balanced against the creative rhythm section of Mick Fleetwood and John McVie (check out "Go Your Own Way" for a perfect example). The album is as top-heavy as it is bottom-light—all the instruments were played by Buckingham and the drums are all electronically generated.

Lindsey Buckingham claims to take most of his cues from Brian Wilson, but the difference is that Wilson spent most of his formative years as The Beach Boys' bass player. This allowed him to analyze how the bass and drums worked together to bring that extra element of accessibility into a song. This

album is laden with guitar overdubs and vocal layering, not to mention the sounds of the digital age, but the most basic element—the rhythm section—is neglected. This was also true on most of his first solo album, save for one outstanding cut, "Trouble" (on which Fleetwood played drums, if memory serves us right). This album is spacier, with the only obviously current influence being The Talking Heads, and the playing is beyond reproach, guitar-wise. But the songs all sound like they could have grown enormously within the context of a group arrangement, and Lindsey could have left a few more open spaces if there were a great drum and bass carrying the song.

But for some people, this is what the solo album is all about. They don't have to put up with an ornery rhythm section when they strike out on their own, and so they think they can do it all themselves. Lindsey, baby, they don't call it Fleetwood Mac for nothing.

*Jon & Sally Tiven*



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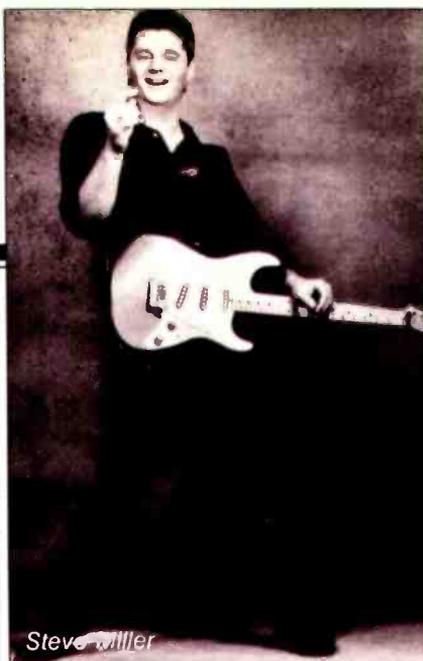
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**Italian X Rays:** Steve Miller Band  
Capitol SJ-12399, \$9.98.

Sound: B+ Performance: D

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Michael Tearson

**Santa Ana Winds:** Steve Goodman  
**Red Pajamas RPJ 003**, \$8.98. (Available from Red Pajamas Records, P.O. Box 233, Seal Beach, Cal. 90740.)

Sound: B Performance: A+

Last month, when I wrote that the late Steve Goodman had another record in the can waiting to join *Artistic Hair* and *Affordable Art*, little did I know how close to release *Santa Ana Winds*

actually was. Now that it is out, I can report that for his last record Steve Goodman made his best one. His songs are eloquent, by turns sad and funny and wise, sometimes all at the same time. I have no doubt that his tribute to the late Carl Martin of Martin, Bogan and Armstrong, "You Better Get It While You Can," placed as the album finale, sums up his own philosophy as well as it does Martin's. For Steve

Goodman was always a good-time performer who was tireless when it came to pleasing an audience.

From the wry ("Telephone Answering Tape" and "Hot Tub Refugee") to the tender ("The One That Got Away" and the lovely "I Just Keep Falling in Love"), Steve had a wonderful way with a song that could take a mundane cliché and turn it inside out into something fresh and new. Probably the best example of that touch on *Santa Ana Winds* is his arrangement of "The Big Rock Candy Mountain," the only song here he did not have a hand in writing. The verses are terse and tart, with guitar and harmonica switching to a deliriously dreamy, jazzy feel for the choruses behind Jim Rothermal's sweet sax part. An old chestnut lives anew.

So, too, does Steve Goodman with *Santa Ana Winds*. I miss Steve a lot. The album goes a long way toward filling the gap, but of course it can't. The best thing I can do is to let you know how fine it is. Michael Tearson

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Weight	24 lbs.	29 lbs.	48 lbs.	63 lbs.
Sensitivity	87dB at 1 meter with a 2.83 volt input	87dB at 1 meter with a 2.83 volt input and all controls at maximum	87dB at 1 meter with a 2.83 volt input and all controls at maximum	87dB at 1 meter with a 2.83 volt input and all controls at maximum
Finish	Genuine walnut veneer	Genuine wood veneer, walnut and oak standard. Scandinavian rosewood and black or white lacquer on oak finishes available on special order.	Genuine wood veneer, walnut and oak standard. Scandinavian rosewood and black or white lacquer on oak finishes available on special order.	Genuine wood veneer, walnut and oak standard. Scandinavian rosewood and black or white lacquer on oak finishes available on special order.
Inputs	Press connectors accepting "banana plugs" or bare wire up to 12 gauge	Press connectors accepting "banana plugs" or bare wire up to 12 gauge	Press connectors accepting "banana plugs" or bare wire up to 12 gauge	Press connectors accepting "banana plugs" or bare wire up to 12 gauge
Controls	None	2 — low and high frequency each with 3 positions	3 — low, high and perspective each with 3 positions	3 — low, high and perspective each with 3 positions
Power requirement on Music	20 watts minimum 90 watts maximum	30 watts minimum 120 watts maximum	35 watts minimum 200 watts maximum	50 watts minimum 500 watts maximum
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Price per Pair	Under \$595, depending on finish	Under \$995, depending on finish	Under \$1395, depending on finish	Under \$1895, depending on finish

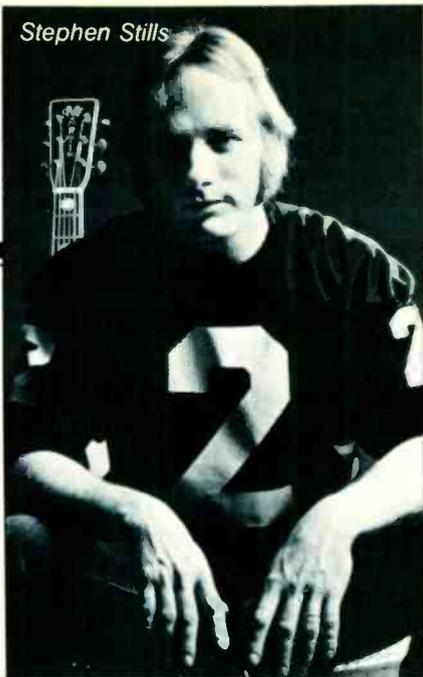
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Stephen Stills' album, *Right By You*, has lots of the Latin flavor that has been a trademark of his for some time.



**Right By You:** Stephen Stills  
**Atlantic 80177, \$8.98.**  
 Sound: B      Performance: C +

Divided into an upbeat side and a romantic, softer side, *Right By You* is a more or less standard, slightly better than average Stephen Stills album. The up side has lots of the Latin flavor that has been a Stills trademark ever since Buffalo Springfield. Some parts have real fire, notably "50/50" with its big horn sound, terrific percussion sound and a lead guitar part by Jimmy Page, one of three he contributes to the album. The percussion vitality is due in no small part to digital mixing. Energy is way up all through the side.

The second side, the softer one, I don't find quite as involving as the first, but "Grey to Green" has an intriguing melody line and an interesting lyric line about how a lady friend's eyes change color as she changes moods. This side is mostly covers, with a rather ordinary "Can't Let Go," a light stab at old-mate

Neil Young's "Only Love Can Break Your Heart" and a straightforward country run at The Carter Family chestnut, "No Hiding Place." Throughout the album Stills gets vocal support from Graham Nash and keyboardist Mike Finnegan.

Somehow I doubt that *Right By You* will be a major hit. It is a nice piece of work that just doesn't feel at all indispensable. *Michael Tearson*

**Cypress: Let's Active**  
**I.R.S. SP-70648, \$6.98.**  
 Sound: C      Performance: B -

Let's Active is a trio consisting of Mitch Easter, Faye Hunter, and Sara Romweber. Easter is also noted for his production of R.E.M.'s output to date. Let's Active actually fits into the same part of the ballpark as R.E.M., as they make rough-hewn, instinctive rock music out of songs which are simultaneously goofy and profound and have titles which are often only marginally related to the lyrics.

By "instinctive," I mean that the band doesn't seem to be interested in formula or emulation in their music. Instead, they appear to follow their own muse without a lot of thought about how they might fit into the marketplace. Clearly they are not about to put Culture Club or Prince out of work, but there is real charm to Let's Active. Adventurous ears should give a listen.

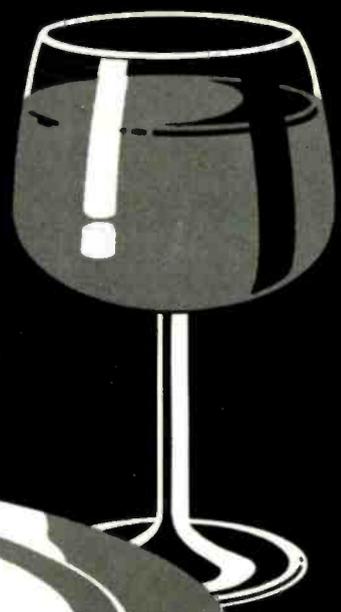
*Michael Tearson*

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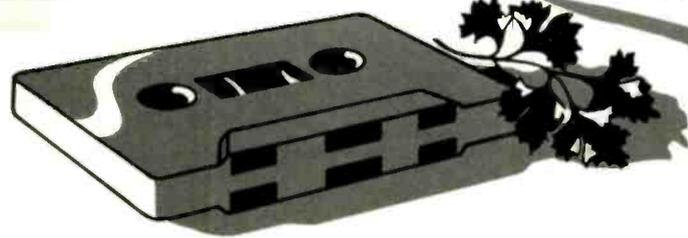


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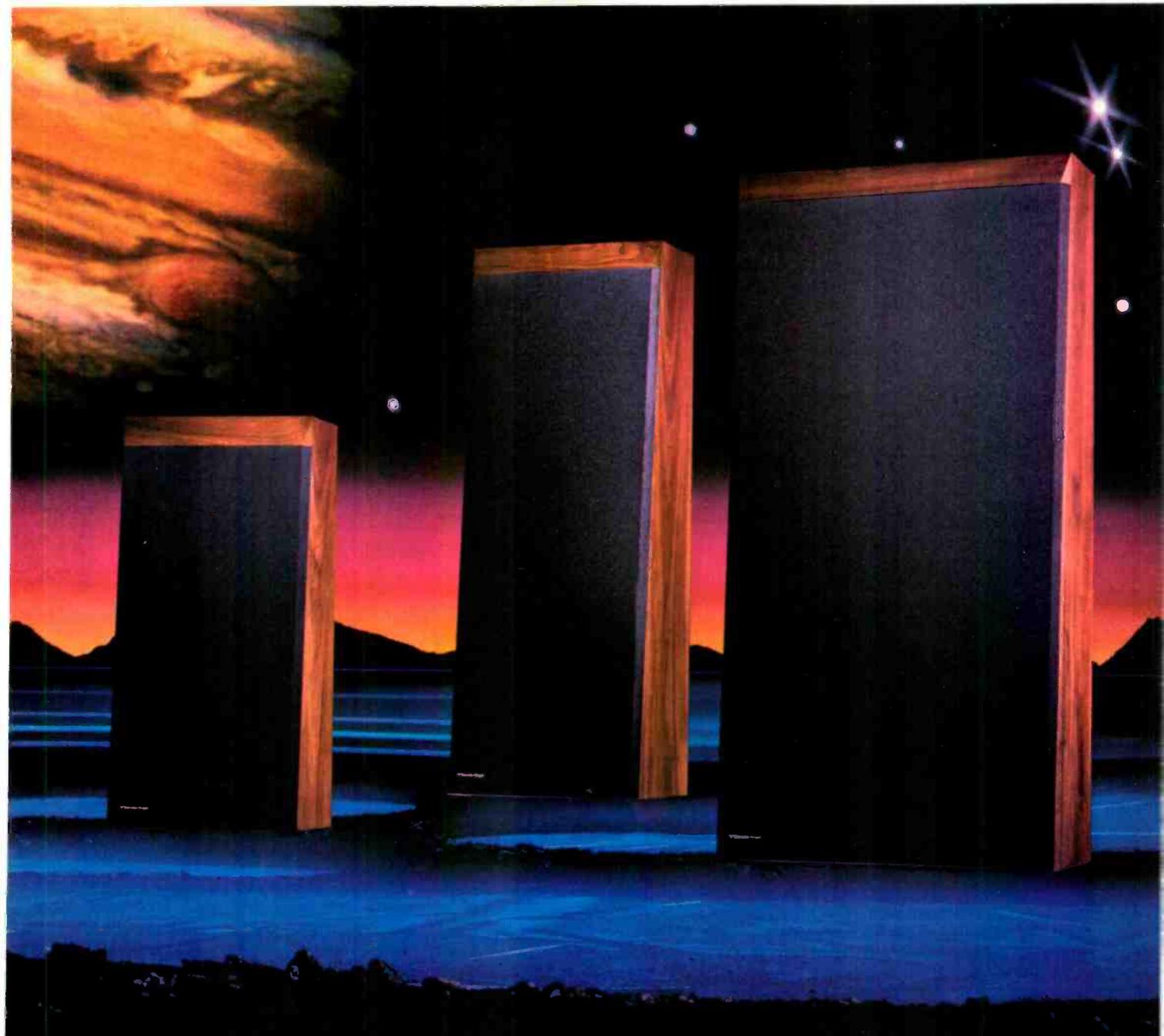


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EDWARD TATNALL CANBY

## OUT OF THE BACHS

**Peter Schickele: Bestiary, performed by Calliope; Quartet for clarinet, violin, cello and piano, performed by the Chamber Music NorthWest. Vanguard VSD 71278, \$8.98.**

I've been saying for years that Peter Schickele, under his loudly comic exterior, was a composer as pure as the driven snow. But the man has stayed in hiding behind the last of the Bachs (?), that preposterous creature who was dead long before he was born, a notable enough distinction to keep him alive through dozens of yearly Vanguard records. What P.D.Q. Bach has always needed was the music video-cassette for the visual horseplay which always goes with his music. Unfortunately, that new medium hasn't yet graduated from the high-money pop groups.

So, at last, P. Schickele, he of the roly-poly shape and large beard, is on his own! 'Bout time. The nicest thing about these two genuinely Schickelian works is that, minus P.D.Q., we find a new dignity and worth to the music, even though in one of them there is still the usual stage show. But you may easily ignore it (as described in the jacket notes) in favor of just listening, with the narrator's help in introducing various animals à la Ogden Nash and Camille Saint-Saëns in "Carnival of the Animals." Here, the words are less archly poetic, more casual, the music is, well, nicely modal and pseudo-medieval to suit the old instruments, superbly played and sung by the group called Calliope. The narrator, I can assure you, is the very ghost of P.D.Q. Bach himself, returned safely to his Maker. Perhaps at this point it should stay there.

The "Quartet" on side two is pure Schickele sound, no stage show, no story line. Set for a comfortably varied group of instruments (modern), it is gracefully written and again beautifully played, to complement Calliope on the first side. No great profundities here—only a series of episodes elaborated from a batch of loose ideas that had been hanging around for a good while looking for the right instruments. We move from a gentle neo-Brahms, minus weight, through lots and lots of casual counterpoint into a (gently) hysterical neoclassic jag, and end with a



Photo: © 1984 Peter Schaaf, Courtesy of Vanguard Records

wild (but gentle) neo-Near Eastern peasant dance à la Bela Bartók. But Schickele is no Bartók. So this music will fill your living room gracefully and easily. Or even your car. All hail P.D.Q. Non-Bach.

**Beethoven: Eroica Symphony, No. 3 in E Flat.** The Cleveland Orchestra, Christoph von Dohnányi. **Telarc DG 10090**, digital, \$12.98.

The telltale yellow and the code letters DG around the label denotes Telarc's now-international stance, though the recording remains the familiar Soundstream digital out of Cleveland's Severance Hall. (The jacket is from Canada.) The LP price is, of course, way down but remains a dollar higher than Deutsche Grammophon's digital LPs in the U.S.A.—i.e., Telarc is still Telarc. I would not argue with all this; the sound on LP remains excellent, and there is, indeed, a new gentleness, says my ear, that could have to do with direct metal LP cutting. It's cleaner, loud or soft.

This, like other releases, is also available on CD. Perhaps significantly, a

young friend of mine bought the CD, then went out and got the LP for comparison. I will say no more! There are times, still, when the LP shines, which is merely a reflection of the still-new CD technology compared to almost 40 years of LP development.

Music also still counts! Again, I had heard disparagements of this first batch of Dohnányi recordings with the Cleveland Orchestra. Terrible, did I hear one person say?

Okay—I've tried it and have my ideas. I can easily disagree with a lot that this conductor does, recording at a time when he was about to become the orchestra's new permanent director. But the performance is a very long way towards the good from "terrible." I found it stimulating and exciting, if only because it flies in the face of a thousand earlier versions which have formed the "Eroica" in my own mind over a half-century span. I had to "teach" this work as Music Appreciation in my early 20s—from recordings, of course. I know all the dogma that was passed onward by the Professors in charge of things, well before WW II, not to mention the older school of

# BRACE YOURSELF

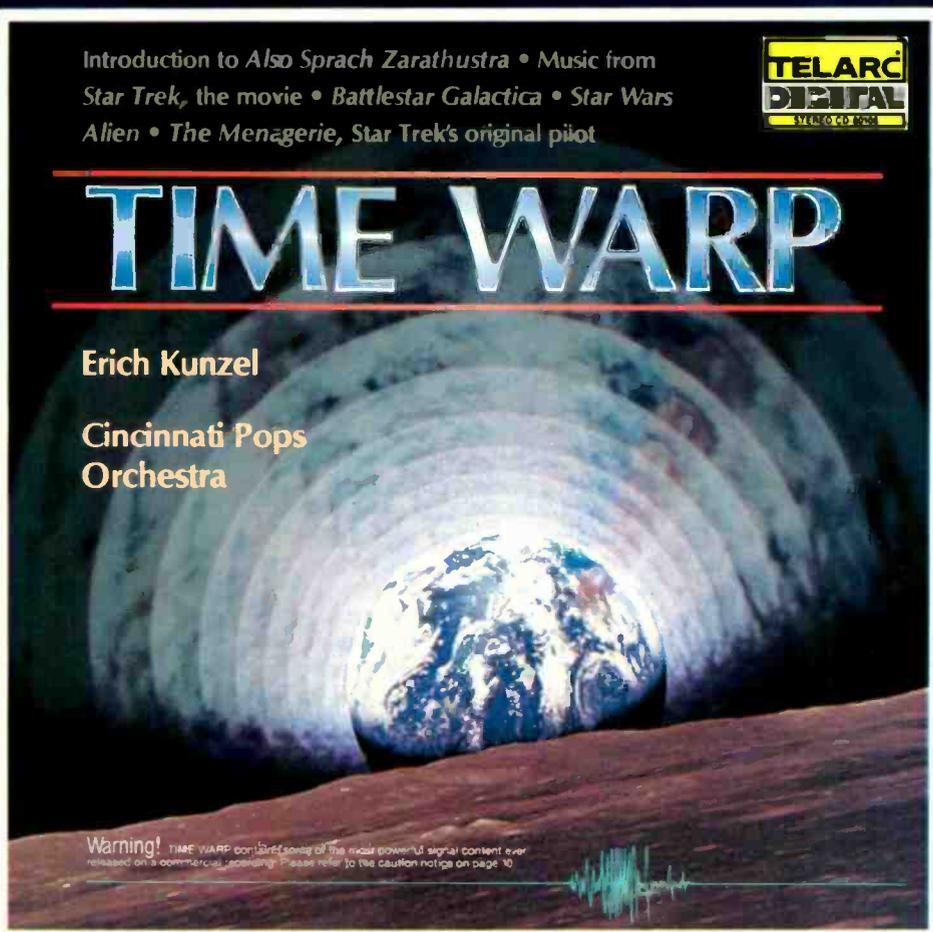
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For every missing traditional effect in this "Eroica," there are new ones that would make even Beethoven jump with surprise, deaf as he was.



Christoph von Dohnányi

heavyweight conductors, mostly with Russian, Dutch or German names. I remember the tempi—translate into record timing, 78 rpm and LP—which were *de rigueur*, that is, fashionable in those comparatively recent moments in this famous symphony's 180+ years of existence. Even the good program notes, jacket annotations for Telarc by Steven Ledbetter, reflect familiar thoughts on the "Eroica."

But not the performance! Where the old versions went massively slow, full of Significance, enlarging and emphasizing every musical effect in the undoubtedly revolutionary score of 1803, this one goes lightning fast, a disciplined, chrome-plated Viennese waltz of a sort never imagined in Vienna itself. The musically famous turning points of the work, that (we were always told, and believed) shook the very foundations of musical logic in Beethoven's Imperial Vienna of the classics, are here blithely traversed as though taken for granted and scarcely worth mentioning any more. I almost gasped at a number of these places—could it really have come to this?

But wait! Was the older and heavy-weight tradition, sealed on records straight out of the end of the 19th century, any closer to the "original" than Christoph von Dohnányi's reading? Not necessarily. There is no such thing

as a totally "authentic" rendition, not even of brand-new music today. The most persuasive versions of Stravinsky's music, for example, are largely not those conducted by Stravinsky himself (and preserved ceremoniously on records, largely by CBS); the best of Rachmaninoff is not necessarily in the Rachmaninoff recordings (equally zealous in the RCA preservation).

What I mean is that this "Eroica" is no ignorant, pedantic, coarsely conducted or coarsely played version. It is very full of life—you can hear that in the sparkling, impeccably accurate playing of this American orchestra, already famed for its precision under earlier conductors. It must have been a challenging occasion for most of the players, all but the incurably stodgy, if any. And, I have to add, for every missing traditional effect, there are a couple of new ones which might even make Beethoven jump with surprise, deaf as he already was in 1803. This is surely an updated "Eroica," speaking in 1985 terms, and I see nothing wrong with that. Therefore, I recommend the recording, whether LP, CD or cassette, if you will keep a more "traditional" version nearby, perhaps such as Bruno Walter's, still available on CBS's Odyssey label. Time does march on, if you can remember that famed Time/Life phrase.

**New Danish Orchestral Music. Aaquist Johansen: Sinfonia; M. Winkel Holm: Eurydice Hesitates, Cumulus; Nørholm: Fluctuations.**

**Paula 16, \$7.98.** (Available from Editions Orphée, P.O. Box 364, Prudential Center, Boston, Mass. 02199.)

Is this "new Danish orchestral music" for you? It could be. After all, a composer's aim is to produce interesting sounds out of whatever medium he may use, and the full-scale modern orchestra can do extraordinary things, once it is given the right instructions. Sounds that are unlike any orchestra's before our time, though the instruments are the same.

Thus, the opening "Sinfonia" by Aaquist Johansen, dating from 1976, begins with a blast of sonic dissonance that made my hair stand on end—nothing like it since Edgard Varèse. And so gorgeously recorded, a superbly produced LP, clean and clear, surprisingly wide in the dynamic range and with veritable A+ surfaces, so that every ping, boom and scratch is vibrantly real—the sheer dissonance of these sounds is what makes them sonically so interesting. Characteristically, it is not the big boom of the tympani that counts but the sharp edge to the drum sound, beautifully reproduced.

There is one potent influence in three of the four works here—electronic music. You will recognize it instantly—and yet there is no sound here that is not from a live instrument! Somehow, I think this accounts for the unusual appeal of the works as heard in our own recorded medium. I rather suspect I would like them less in a "live" performance; there is a certain inevitability as reproduced through a hi-fi system, and this is good. The old idea of "concert music reproduced in the living room" is indeed weakening; the new sounds we create today are midway between, often sonically more effective at home than in concert. Could we ask for more?

The one less dissonant work, "Eurydice Hesitates" by Mogens Winkel Holm, is also the most recent, 1977. It is actually the music for a ballet, performed by the Royal Danish, with choreography by the composer himself, a multimedia man, decidedly. These sounds, beginning somewhat harshly,

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Some traditions, musical or otherwise, manage to stay alive beyond almost any reasonable hope. And so it is with the Viennese waltz, thank you.

soon resolve into an increasingly gentle kind of neoclassic dialog, between a solo English horn, Eurydice, and a harpsichord, representing Orpheus, reminding strongly of the well-known "Goldberg Variations" theme of Bach and in a manner that recalls Stravinsky at his most gentle (he also did a ballet on Orpheus). I found this music lovely and very moving, a splendid contrast to the noisier sounds of the other works.

The final piece by Nørholm is for 39 stringed instruments (including mandolin, two harps, guitar and harpsichord), no one of which plays together with any other. An interesting texture of sound and, again, superbly suited for hi-fi reproduction.

I find to my surprise that these four recordings, all analog, were made at different places from 1969 to 1980. Therefore, the uniformity of sound is all the more remarkable. Since the liner notes are in Danish, you will understand why I have not given the performing details.

---

**The Real Thing.** Original cast recording with Jeremy Irons and Glenn Close. **Nonesuch 78027-1-P**, two-record set, \$17.98.

If you are a playgoer, if you have seen *The Real Thing* in person on the stage and want a detailed "memento," then this album is for you. Provided you don't mind some atrocious audio mayhem along the way.

Judge your own reaction by mine, which is probably different. I found two things very wrong here and, in fact, turned the thing off in disgust after around 10 minutes, as a result. No reflection at all on the original play by Tom Stoppard *in the theater!* Just the manner in which it has been transferred to the recorded medium, which seems to me to ignore a good half-century of useful experience in our ever-growing world of audio expertise.

First, these actors with the British accents do not act *for records*. As Jeremy Irons says, "We knew how to do it, we'd done it for the past 200 nights." Exactly. So they "played across the microphones to each other, swooping and swirling through the scenes." Precisely. But did they *play to you*, listening via those same mikes? Not that I

can see. Like all too many actors, they blithely ignored the little matter of mike technique and reproduction from records, which is *not* the theater. Frankly, I found this a bit insulting. A knowledgeable actor, one should think, would re-study the entire play for this radically different and close-up medium. Snappy repartee on a live stage becomes exaggerated pretension when it is only inches away in your loudspeaker.

Second, the production uses antediluvian musical "bridges," right out of the 1930s, which are made from bits of recorded classical music, reproduced anemically as through a 1930s radio. The music—good music, as important in its area as this play is in the theater—is simply sliced off crudely, not even mercifully faded out, as action resumes. Enough?

---

**Solid Gold Strauss: Greatest Waltzes and Polkas.** Vienna State Opera Orchestra, Anton Paulik. **Vanguard Everyman SRV 394 SD**, \$3.98.

Here is the nearest we can come to an "authentic" Strauss waltz (and polka) in recent times—including, of course, the authentic verve and dash of the original music in the 19th century. Where else does it exist but where it always has, in Vienna? Some traditions, you see, musical and otherwise, manage to stay alive beyond almost any reasonable hope. How can they do it—we say. They do. And so it is with the Viennese waltz. It lives in Vienna and, thank you, is very well indeed.

It is ever so clear, then, that these musicians not only know every nuance of the tradition but, also, that they have not tired of it. No—it's not electrifying playing, as perhaps it was on the first occasions, just about a century ago for the later waltzes. But there is no flagging, none of that "Do we have to play *this* old stuff again?" We hear it, alas, in almost every non-Viennese orchestra that gets a waltz assignment. Or else—worse—somebody thinks the stuff ought to be pepped up, modernized, rearranged maybe, say, with a bit of symphonic rock sound.

I don't know how recently this was recorded; Vanguard has been into this sort of thing for a long time. But I can say that the sound is plenty clean

enough, the ambience is big and suited to the enormous dance halls, palaces, where the music was first heard. And the pressing has no rumble, no pulsing, no obtrusive hiss. Ah, there goes the inimitable Hungarian cimbalom in "Tales of the Vienna Woods"—such gracious music it plays!

---

**Mozart: Wind Serenades in E Flat, K.375; C Minor, K.388.** Los Angeles Chamber Orchestra Winds. **Nonesuch 79073**, digital, \$11.98.

As recording "fi" has improved over the years, the sound of winds, especially close-up solo winds, has become more and more attractive for the home listener. Strings too, but there the situation is different. String tone is not radically different from one type of instrument to the next, but all have a strong pattern of highs that is highly sensitive to distortion. In the old 78-rpm reproduction, the strings were mercifully smooth simply because those highs were entirely missing. But clarinet, flute, and oboe sounded much alike. Their upper colorations are more radically different—and now can be beautifully reproduced, to give each its own musical personality.

All that as an introduction to these two wind works, featuring pairs of the above plus bassoons (very low oboes) and horns. The playing is the acme of technical perfection, though there are some overly mechanical rhythms here and there, accurate but not very expressive. The sound, for my ear, is just about perfection—not so much the "fi" as simply in the rightness and presence of each instrument, perfectly miked for musical communication. That would be again the team of Aubert and Nickrenz, who are doing splendid work these days. The sound I am speaking of comes through in any of the current media, LP, Compact Disc or cassette.

This job actually goes back to April of 1982, via a Sony PCM-1610 digital processor and mastering, for LP, by JVC. The progress from recording session to store shelves is often deliberate, as well as careful. Only the biggest would-be hits are rushed along, and these, often enough, show the signs of too much haste. Not this record. It was worth waiting for.

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## ROLLING STONES GATHERED

**The Rolling Stones Collection**  
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This lavishly packaged Mobile Fidelity Sound Lab Original Master Recording collection of 11 early Rolling Stones albums, cleaned up and remastered at half-speed, is obviously somebody's labor of love. At the suggested list price, it's also somebody's idea of how to make some bucks.

Almost all of the material was recorded between 1963 and 1969, although the original release dates for these LPs actually stretched from 1964 (*The Rolling Stones*) to 1971 (*Hot Rocks*). The 1969 cutoff date was chosen because of its significance and convenience; that year marked the departure and death of original Stone, Brian Jones, and it was the last year The Stones recorded for Decca/London before forming their own label under the aegis of Atlantic Records.

Physically, this package is simply gorgeous. Each disc is in a bright red jacket with the simple logo, The Rolling Stones, written across the front in jet-black script. Each disc is further protected by a cardboard insert and a rice-paper sleeve, and each fits into its individual slot in a sturdy, black presentation case bearing the same logo in bright red. Also included is a colorful booklet containing the original album, graphics and interviews with the engineers and producers involved with these recordings, plus Mobile Fidelity's Geo-Disc (which lists for approximately \$25) to assist in proper cartridge alignment.

So much for physical beauty. After first gazing upon this vision of vinyl loveliness, the audiophile and Stones fanatic alike soon will be asking if the contents of this attractive package justifies its hefty price. The Stones fan with a few coins to spare would do well to grab this beauty. Although not a complete set of early Rolling Stones LPs (missing are *Now!*, *December's Children [and Everybody's]*, *Got LIVE*, *If You Want It*, and *Flowers*, plus the five-song EP *Five By Five* and a couple of compilations), this is the most extensive collection from that period currently available.

It covers The Stones from the rough, raw, early blues-based rock days of



their first mono LP, *The Rolling Stones*, up to the more sophisticated, wider-ranging rock styles found on that glorious two-disc "greatest hits" compilation, *Hot Rocks*. The titles included in between are: *12 x 5*, *Out of Our Heads*, *Aftermath*, *Between the Buttons*, *Their Satanic Majesties Request*, *Beggars Banquet*, *Let It Bleed*, and *Get Yer Ya Ya's Out*. Listening to these albums in sequence is much like watching one of those speeded-up Walt Disney film sequences of a flower blooming. You can hear the growth before your ears as the boys go from bashing about ignorantly in the studio under the less-than-competent direction of producer/manager Andrew Loog Oldham, to working in conjunction with fine producers like Glyn Johns and Jimmy Miller, to producing their own complex, multi-layered cuts of the late '60s, culminating in the eclectic *Beggars Banquet*.

There is no shortage of great tunes here, from classics like "(I Can't Get No) Satisfaction," "Sympathy for the Devil," "Street Fighting Man" and "Jumping Jack Flash," to a slew of

lesser-known but potent Stones screamers and ballads alike. Further, these discs are clean and flawless, nicely pressed on Supervinyl, which makes their surfaces as quiet as a feather falling in a cotton factory. A true Rolling Stones addict tends to have copies that time and styli have treated mercilessly, leaving a legacy of scratches and worn groove walls. So for the sheer Stones fan, this one's a winner.

Some interesting questions arise for the true audiophile consumer, however. The half-speed mastering process certainly offers noticeable sound improvement. There is a new clarity to muddy passages, an audible extension of dynamic range resulting in sharper highs and fuller lows. Unfortunately, the original production on the earliest of these Stones discs was—dare I say it—lousy. I'm not talking merely poor, I'm talking terrible, the kind of stuff that will have an audiophile gritting his teeth in pain. The worst offender is the first album, *The Rolling Stones*. The distortion is appalling: Apparently the studios then used by The

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The selections in *Kiss the Sky* have been digitally remastered from the original tapes, with real gains in clarity and power.

Stones could not handle the raucous band's rip-roaring volume levels. And it seems as though their producer, Andrew Loog Oldham, couldn't handle the studio. In the booklet accompanying the set, Oldham confessed his ignorance of the recording process at the time, pointing instead to his and the band's youthful enthusiasm and willingness to learn on the job. Well, despite the poor recording, it is delightful to hear that wham-bam enthusiasm and fascinating to have this aural document of the early Stones.

The question remains, does the half-speed process serve the audiophile when it clarifies the flaws in a bad recording? Make no mistake, this technique cannot clean up this kind of distortion nor can it eliminate all of the hiss from the original tapes. And don't believe that hogwash about this kind of distorted sound being "authentic." If authentic sound is what you want, you'd be better off playing these distorted discs on a dinosaur '60s hi-fi set or, better yet, hearing them on a single-speaker radio of the same era.

None of the other discs are as badly recorded as *The Rolling Stones*, as The Stones improved rapidly in the studio. Besides some problems with spatial presencing and balances in *12 x 5* and *Out of Our Heads*, and an occasional spate of tape hiss here and there, the rest of the discs in this collection are much improved by the half-speed mastering process.

This is a guaranteed collector's item, printed in a limited edition of 25,000 numbered copies. Despite its flaws, it is a very special recording package. On a scale, weigh your love of The Stones against the shekels you can comfortably spare, and may the heavier pan win.

*Paulette Weiss*

#### **Knud Jörgensen Jazz Trio**

**Opus 3 #8401, \$18.** (Available from Scandinavian Sounds, P.O. Box 3656, San Clemente, Cal. 92672.)

Sound: A- Performance: A-

Opus 3, as the liner notes state, is a small, independent Swedish record company dedicated to recording timeless acoustical music such as classical, jazz and folk. The notes further state their intent to reproduce the

sounds of the instruments as naturally as possible, and, on this LP, they have done just that.

This is an excellent, well-recorded, and well-balanced program of standards played in a timeless, forward-looking style by Knud Jörgensen, a fine Danish pianist who has chosen to live in Sweden to pursue his love of jazz.

Mr. Jörgensen has a fine touch and clarity of expression with a direct way of stating what he intends to do, which is to make good, straight-ahead jazz. While I suppose one would call it modern, it is really very melodic and swinging and never far from the melody. Mr. Jörgensen and his sensitive accompanists, Johan Dielemans on drums and Sture Åkerberg on bass (both of whom make a solid contribution on their own) sound to me as if they had been working together, feeling one another, and reacting to each other's playing for a while. We, the listeners, are the beneficiaries.

This is an impressive debut record, and I very much like that Mr. Jörgensen keeps everything so well in balance. He likes the late Erroll Garner very much and there's nothing wrong with that, because he doesn't lean on that giant's style any more than absolutely necessary.

*Frank Driggs*

#### **Kiss the Sky: Jimi Hendrix Reprise 25119, \$8.98.**

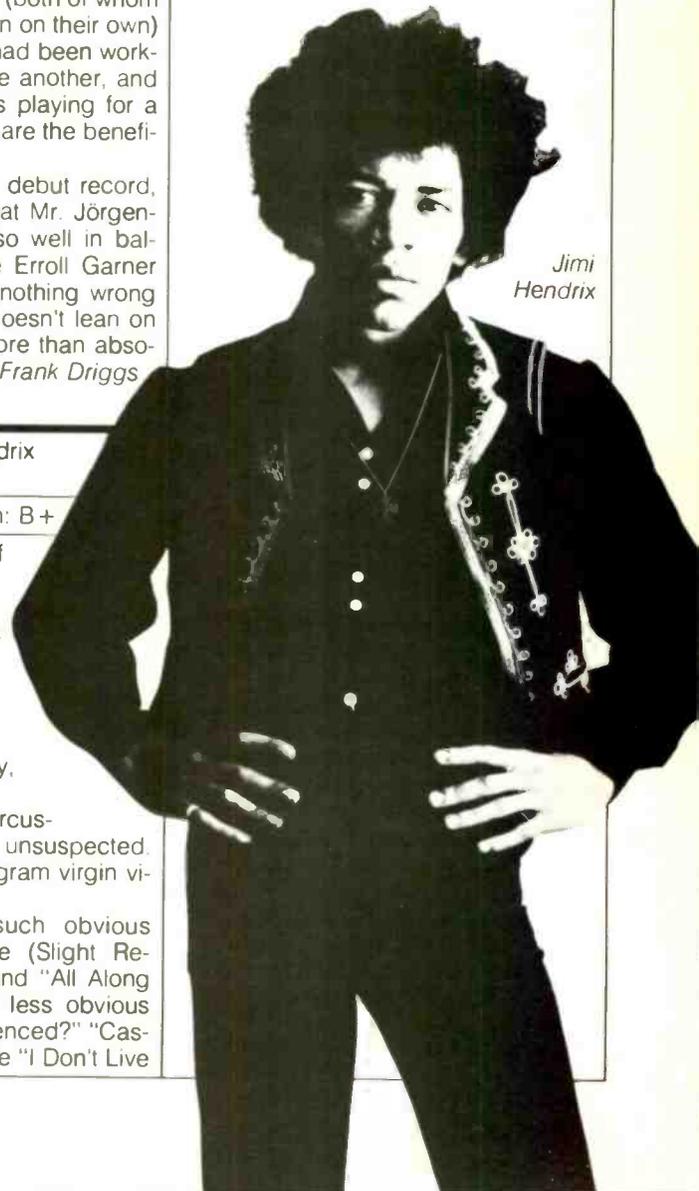
Sound: A- Presentation: B+

This newest reissue of Jimi Hendrix material is noteworthy in several respects. The selections have been digitally remastered from the original tapes, allowing real gains in clarity and power. Not unexpectedly, you can very clearly hear some incidental percussion previously nearly unsuspected. The pressing is on 150-gram virgin vinyl, and it is excellent.

Selections include such obvious ones as "Voodoo Chile (Slight Return)," "Purple Haze," and "All Along the Watchtower"; some less obvious cuts as "Are You Experienced?" "Castles Made of Sand," a live "I Don't Live

Today," and "Third Stone from the Sun," plus some that are at least partially new. These last include "Killing Floor," which opened Jimi's performance at the Monterey Pop Festival and has not been released before; "Stepping Stone" in its original mix, which also has not been on an album, and "Red House," listed as unedited for the inclusion of some studio patter. Data as to the when and where of recording has been included for each track, including educated guesses when exact information was not available.

All told, this new release serves best as an introduction to the genius of Jimi Hendrix for the previously uninitiated. The choice of material allows the re-



*Jimi Hendrix*

Placing Sinatra's voice so far front emphasizes his charisma, his command of phrasing and, alas, time's ravages to his voice.

mastering to be a factor while giving a feel for the full range of power and diversity in his work, from the rave-ups and psychedelia to the lyrical, mystical moments. Hendrix completists will want this anyway, but they will be very pleased when they do get it.

*Michael Tearson*

**L.A. Is My Lady:** Frank Sinatra with Quincy Jones and Orchestra  
**Qwest 25145**, digital, \$9.98.

Sound: B                      Performance: C

Frank Sinatra has achieved such standing as an institution that any new release of his is a major event. Here he has teamed with that consummate pro, Quincy Jones, for a swinging soiree of tunes recorded on both coasts. The all-star orchestras feature players and soloists with top pedigrees, people like George Benson, Lionel Hampton, Bob James, Ray Brown, Joe Newman and

Randy and Michael Brecker, among many others.

Still, it is Sinatra's album. For better or worse, Quincy has placed the man's voice all the way out in front of the orchestra. "For better" means the man's charisma, which is inescapable, and his phrasing, which is commanding. "For worse" means the raggedy quality of his instrument itself, which simply cannot escape time's ravages.

As for performance, the orchestras used here play splendidly throughout, behind splendid arrangements. They are recorded beautifully with digital technology.

Sinatra is Sinatra, and his self-conscious swagger is at the fore most of the time. This is the saving grace of the title song which, otherwise, is pretty repulsive. He is most at ease on songs like "It's All Right with Me," "Stormy Weather" and "After You've Gone," all songs he has lived with for many years, ones he doesn't have to push so

hard on. Other times he can sound downright pugnacious and arrogant, as when he is taking great liberties with "Mack the Knife" and "Until the Real Thing Comes Along." On "The Best of Everything," a new 1984 number, Sinatra sounds like he hasn't really come to grips with the song, as if he should have done a few more takes or just left it and come back to it later.

By anyone's standards, Frank Sinatra is one of the all-time greats, but *L.A. Is My Lady* just isn't anywhere near his best work. Time's toll being too great could be one big reason. His own cockiness is another problem, as it repeatedly threatens to overwhelm the songs. Could be he feels the need to constantly remind people just how unbelievably hip it is to be Frank Sinatra.

This is one that will get played a couple of times before it finds its home on the shelf, nestled between other earlier and better Sinatra albums.

*Michael Tearson*

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## OUT OF THE MOUTHS OF BABES

Illustration: Rick Tulka



**Children's Songs:** Chick Corea  
ECM 25005-2.

The first gentle but firm piano notes of Chick Corea's *Children's Songs* emerge crisp and clear against the clean silence of this sweet ECM Compact Disc. With the clarity of the bold, oversized letters on the white pages of a child's first reader, note after note possesses a vivid presence, whether standing alone or bouncing along in a tumble of headlong melody.

I cannot praise the sound quality of this original digital recording too highly; Corea's acoustic piano is so *alive* on this CD. Firmly situated in the phantom center channel, the piano is a palpable aural presence which seems to radiate music in all directions. There is a slight echo on extended notes which I find appealing; it heightens the sense of a rooted location for the instrument. I suspect this echo is a product of the West German studio—Tonstudio Bauer in Ludwigsburg—where *Children's Songs* was recorded, and also a production choice of Manfred Eicher, who, ably assisted here by engineer Martin Wieland, is responsible for some of the

most exquisite recorded sound of the past decade.

The intriguing music so lovingly preserved is certainly not kid stuff, despite the misleading title. Here are 19 deceptively simple bits of mood and melody, with the longest running just over 2½ minutes, and the shortest a mere 38 seconds. Except for an extended "Addendum" incorporating violin and cello, these are all solo acoustic piano pieces. There are actually 20 solo pieces if you go by Corea's original notation, although ECM has put two solos together and notes the CD as having 19 solo pieces. Corea maintains the illusion of simplicity with repetitive, rhythmic, left-hand figures, but what he does with his dexterous right hand—that's another story. Some pieces meander through snatches of lovely melody like a butterfly lightly exploring a meadow. Others scurry intensely in all directions like an ant on an undefined mission. Floating or scurrying, thoughtful, querulous, ominous, prancing—so many moods are created expertly in swift mini-chapters. The 5-minute-plus "Addendum" adds violin and cello to Corea's piano in an excit-

ing interplay which shows off this CD's marvelous dynamic range and further enhances its wonderful sense of aural space.

*Children's Songs* is one CD in an 11-title 1984 release from ECM. The whole package is splendid, and this lovely volume will delight the child in you and leave your adult sensibility satisfied, to boot.

Paulette Weiss

**You and Me Both:** Yazoo  
Mute Records VG 651.

Yazoo's second album, *You and Me Both*, is soulful, doleful, bright and bouncy. It's a bittersweet universe painted by the sparkling synthesizers of Vince Clark, which conjure up pinpoints of light and vast surfaces of lifeless planets, and by the equally evocative vocals of Alison (Alf) Moyet, which ground the songs in an earthy blues style. Like the real universe, there's lots of empty space between these twinkling stars and solid planets. The velvety silence of the Compact Disc defines the music and lyrics without the lunar dust that clouds the surface of most standard analog LPs.

The imaging on this disc is divine, creating the illusion that each musical texture comes from a different source instead of being cooked up in the same oscillating circuit. Besides being well placed, each synthetic voice is different, ranging from fragile chimes to powerful aural explosions, yet they never devolve into cheap sound effects created for their own sake. The all-too-humanly flexible voice of Moyet adds depth and poignancy to the mellifluous melodies and sad lyrics of lost love.

Yazoo (known as Yaz here in the U.S.), creates moods ranging from the outer-space solitude of "Mr. Blue" to the delightfully imbecilic "Happy People," who "believe in having fun and smiling all the time" (Vince sings on this one). Recurring undercurrents tell of valiant struggles against death, war, and depersonalization. In "Softly Over," the spasmodic percussion echoes lyrics about a collapsing relationship. And still, a cheerful playfulness in the music and an assertive strength in the singing challenge the sorrowful mood.

It's compelling stuff that works on

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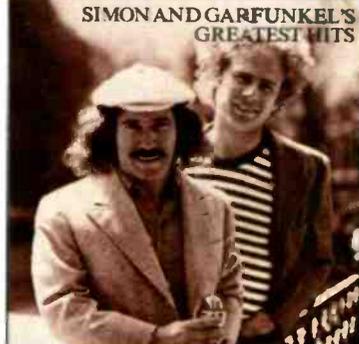


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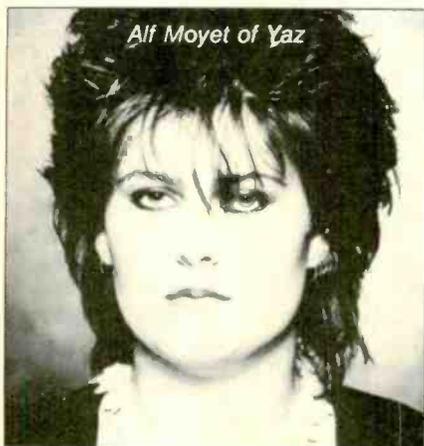
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Organ pipes photographed at Casadesus Recital Hall  
State University of New York at Binghamton, N.Y.

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The imaging on Yazoo's CD is divine, creating the illusion that each musical texture comes from a different source.

many levels, rewarding close and repeated listenings with discoveries of low-level comments from the keyboards behind the primary riff or the rough-edged, seductive intonation in Moyet's voice. It's an album of many moods, irresistibly danceable when played loud and comfortably soothing when played softly. And it isn't marred by the same pointless noodling and pretentious gibberish that infested two tracks on Yazoo's first album, *Upstairs at Eric's*.



This album, which, sadly, is the final collaboration of Clark and Moyet, has a consistency that gives the repeat button on your CD player a reason for existence: You can nod off to the pretty songs or keep the neighbors awake all night with your nonstop aerobic dancing. A few of the riffs get caught in a rut, but what the heck. The 11-song disc lasts for only 40 minutes and 28 seconds, but you can set it to repeat for as long as you like. And I like.

Paulette Weiss

**The Many Moods of Christmas:** Atlanta Symphony Orchestra and Chorus, Robert Shaw.  
**Telarc CD-80087.**

Over the years, countless Christmas programs have been recorded. They have ranged from fairly straightforward presentations to the employment of all sorts of musical gimmicks in an attempt to create a big seller. Most of these albums are ephemeral, though a rare few have become Christmas standards. Telarc's CD contribution is *The Many Moods of Christmas*, and it cer-

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Peter Aczel *The Audio Critic* Winter 1982-83

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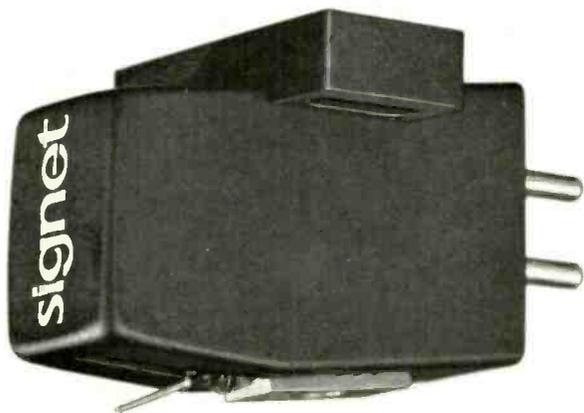
Robert Shaw re-creates a program he recorded back in 1965. Telarc once again gives us a CD with good sound and very clean definition.

tainly must be regarded as a true audiophile-quality Christmas album.

*The Many Moods* . . . title rang a bell for me, and, sure enough, this is a remake of the same program Robert Shaw recorded for RCA Victor about 1965. (I was Music Director for RCA Victor classical records at that time.)

The CD uses the same wonderful Robert Russell Bennett arrangements as on the original RCA recording. He has taken a group of traditional Christmas carols and scored them for large chorus and orchestra. Mr. Bennett has embellished the lovely old melodies with brilliant orchestrations, combining

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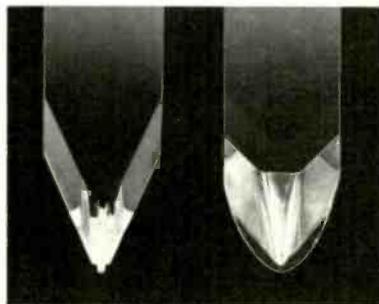


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Robert Shaw



tender lyricism with great, brazen fanfares and the exultant outpourings of a full chorus and an orchestra, each of tremendous sonority.

All the familiar carols are here—"Silent Night," "O Come, All Ye Faithful," "Joy to the World," etc. In "What Child Is This?" a lute is softly played against a background of lovely hushed strings, all to the old tune of "Greensleeves."

Dynamic range on this CD is awesome. On "Bring a Torch, Jeanette, Isabella" (I sang the solo refrain of this work when I was a 12-year-old choir-boy), the piece begins at a fairly low level, and by the time the finale is reached, the sonic output is very loud indeed! The general level of orchestral performance is very high, and, as usual, Robert Shaw's handling of choral balances is impeccable.

This is typical Jack Renner sound—very clean, good definition in the large acoustic perspective of Atlanta Symphony Hall, and with fine choral/orchestral balance. *The Many Moods* . . . is an outstanding recording and a joyous assemblage of Christmas music.

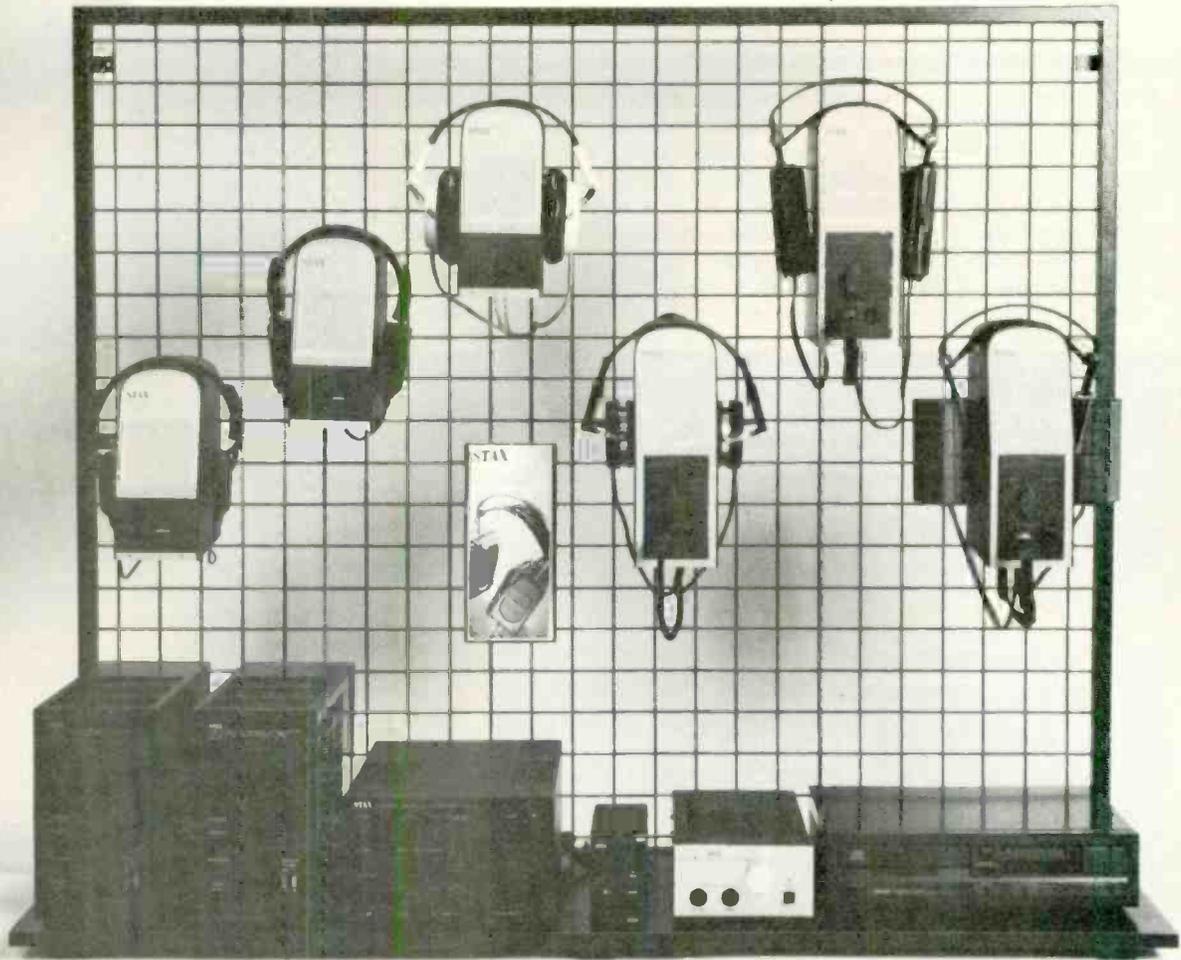
*Bert Whyte*

**Shostakovich: Cello Concerto No. 1;**  
**Kabalevsky: Cello Concerto No. 1.**  
The Philadelphia Orchestra, Eugene Ormandy; Yo-Yo Ma, cello.  
**CBS Masterworks MK37840.**

For lovers of cello concertos, this CD is a must. The Shostakovich "Cello Concerto No. 1" is a difficult work, combining march-like rhythmic elements with angular dissonances and dance-like motifs from Russian folk music in the first movement, an expressive and lyrical second movement, an intricate cadenza that Yo-Yo Ma tosses

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Yo-Yo Ma brilliantly displays his virtuosity throughout the cello pieces. The CD provides generally good balances and nice, clean sound.



off with great panache, and a finale of great intensity and excitement. The Kabalevsky "Cello Concerto No. 1" is a much more lyrical and expressive piece, with a lovely and ingratiating largo second movement.

Throughout both works, Yo-Yo Ma brilliantly displays his virtuosity and

ever more strongly reminds me of Pablo Casals. I had the pleasure of recording Casals doing the Dvořák "Cello Concerto" at the Casals Festival in Puerto Rico. I remember him at his master classes, exhorting his students to "play from the heart." "You must play cantabile, you must make your

instrument sing," he would say. Yo-Yo Ma has certainly adopted this philosophy, a great complement to his technical armamentarium.

Eugene Ormandy, conductor emeritus of the great Philadelphia Orchestra, is getting on in years, but his accomplishment here is splendid. Ormandy was a personal friend of Shostakovich and premiered several of his works in this country.

As for sound, this was recorded by CBS engineer Bud Graham and his cohorts on the Soundstream digital recorder. Harkening back to the old days of CBS recordings of the Philadelphia Orchestra, they used the Scottish Rite Cathedral. Bud provides a moderately close-up sound, affording good orchestral definition in the warm and spacious acoustics of the Cathedral. Yo-Yo Ma's cello is in the phantom center channel, just slightly forward of the orchestra, and never sounds too prominent. Generally good balances and nice, clean sound—except, alas, when massed high strings begin to play at higher amplitudes. Then, they get overbright and somewhat shrill. Nonetheless, this is a most worthwhile recording. *Bert Whyte*

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Bert Whyte, **AUDIO**, September 1984



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**Fresh Aire: Mannheim Steamroller American Gramophone AGCD-355.** (Available from American Gramophone, 9130 Mormon Bridge Rd., Omaha, Nebr. 68152.)

For the last half-decade or so, the productions of American Gramophone have been audiophile favorites, renowned for their quality of production and technical excellence. This company's still-small catalog is finding its way onto CD, and how welcome it is. This album is the first of the "Fresh Aire" set, which presently numbers five, and over the coming months we expect to see them all on CD.

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B&W goes one step beyond. B&W has totally redesigned the magnet circuits and motor system by producing nickel-cobalt centre pole magnets. B&W has produced ZMF speakers, giving virtually a Zero Magnetic Field. This revolutionary new approach actually enhances the performance of the loudspeaker system beyond anything achievable with simple screening; B&W ZMF speakers can be placed immediately adjacent to the television monitor without creating any adverse effect.

Behind the successful development of these video acoustic monitors lies B&W's world leadership in loudspeaker technology and design. B&W's Model 801 has been selected by famous recording companies, orchestras and conductors worldwide as their classical music monitor. For both the professional recording artists and the critical music lover, B&W has dedicated itself to the pursuit of perfection in the recreation of live sound.

More than a contribution to viewing pleasure, B&W ZMF loudspeakers provide all that has been missing from the complete audio video experience. LISTEN AND YOU'LL SEE!



## B&W

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Joe Beck's music is interesting and well scored. It ranges from a sort of introspective collage of guitar to lusty romps with the sextet in full cry.



"Fresh Aire" is the brainchild of composer-arranger Chip Davis, whose ability to meld modern and baroque musical styles is unique. Old and new instruments blend beautifully in a tasteful classical/rock setting. Highly recommended. *John M. Eargle*

**Friends: Joe Beck**  
**DMP CD-446.** (Available from Digital Music Products, Rockefeller Center Station, P.O. Box 2317, New York, N.Y. 10185.)

Tom Jung continues to expand his Digital Music Products catalog with mostly small-scale stuff—but, without question, some of the best-sounding CDs on the market.

On his latest, *Friends*, he has recorded the redoubtable Joe Beck with his electric guitar, along with some stellar sidemen making up a really free-swinging sextet. All but one number in this generous 58:55 program was composed by Joe Beck. It is interest-

ing, well-scored music and ranges from a sort of introspective collage of guitar, with bells and percussion exhibiting much energy in the upper harmonics, to lusty romps with the sextet in full cry. The group frequently sounds like Weather Report.

As usual, Tom Jung has provided superb sound, recorded close-up with moderate reverb. It is pristine clean, highly detailed, beautifully balanced. Another winning effort! *Bert Whyte*

**Buxtehude Organ Works, Volumes 1 and 2.** Wolfgang Rubsam, organ. **Bellaphon 690-01-007 and 690-01-017.**

Bellaphon is a small German label whose CDs are now being distributed here. Their classical catalog seems to be largely baroque offerings, but there is a significant jazz segment as well.

These CDs are the first of the complete set of Buxtehude's organ works,

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Dolby B & C noise reduction controls placed logically inside cassette drawer. **8**

A sonic knockout which makes full use of the CD medium, Jeffrey Osborne's *Don't Stop* delivers fine, fine music.

and the decision to issue them all on CD is a bold one. Rubsam has chosen different instruments for the two discs, and both are in quite reverberant environments, upwards of 5 seconds. A good bit of musical detail could be lost under such circumstances, but Rubsam has paced the music in such a way that the structure comes through clearly. His performances tend to be a little mannered, at least in my opinion, and some of the drive of the preludes and fugues is sacrificed to a too flexible and pliant rhythmic line. However, this approach is well suited to the choral preludes, which make up a large portion of both programs.

Acoustics aside, the recorded sound is clean and realistic, if a bit distant. *John M. Eargle*

**Don't Stop:** Jeffrey Osborne  
A&M CD 5017 DIDX 85.

*Don't Stop* punches its way out of clean silence with a fistful of musical

muscle, and it's a CD knockout. True to its title, Jeffrey Osborne's high-energy 1984 recording never stops delivering fine, fine music. With the exception of a couple of sweet, soul-tinged ballads such as "Let Me Know," the rabbit-punch rhythms of these cuts sweep them along at a swift clip. There's a wonderful staccato quality to these arrangements; percussion, synthesizers, bass, drums, and guitars jab cleanly into aural space, held together by Osborne's rich, commanding vocals at center ring. This staccato quality really shows off the capabilities of A&M's CD. The sound is crisp and pristine, each note wonderfully defined, whether it's deep in the mix like the faintest of chimes in the far right channel of "The Power," or way up front, like the lovely ringing guitar work by Michael Sembello on the opening title cut.

Here I must make note of a major error in A&M's otherwise superior liner booklet, which is one of the rare CD inserts to contain complete lyrics and

credits for the folks involved in this hot project. The credits for the title cut and the one that follows it, "Let Me Know," apparently have been reversed. The giveaway lies in the string credits: Hard as I listened, I could discern no strings attached to "Don't Stop," contrary to the credit line. Producer George Duke's own acoustic piano solo is a no-show on "Don't Stop" as well. However, both strings and piano appear on "Let Me Know."

Although this album has an R&B sensibility and a slam-bang energy associated with heavyweight dance music, it offers much, much more, and it is patently unfair to categorize it so narrowly. Osborne takes a lightning stab at funk-rock in "Hot Coals," knocks the ladies off their feet with the sensual, string-sweetened balladry of "Let Me Know," and presents a cast of pop champs—Pat Benatar, James Ingram, and Kenny Loggins among them—in a rocking yet voluptuous "Live for Today." His lyrics are pop/literate, and



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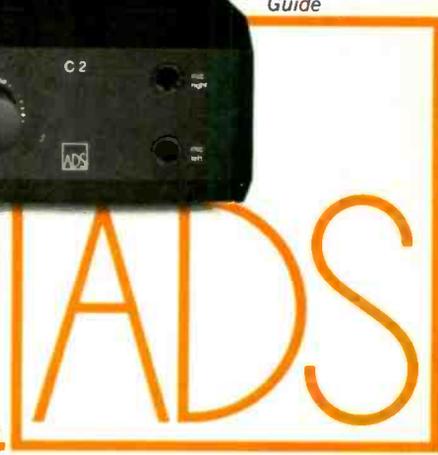
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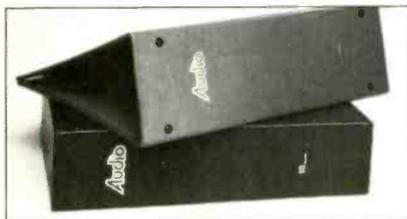


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With an orchestra pared down to the size of those originally used, conductor Gerard Schwarz gives a fast-paced reading of Beethoven's "Pastorale."

his vocal and instrumental command are unquestionable.

Producer Duke deserves a trophy for his efforts, as does chief engineer Tommy Vicari and the large team of assistant engineers who turned out this championship recording. Spatial presentation is spectacular. Osborne's voice is center ring, where it belongs, surrounded by an instrumental arena of real aural depth and breadth. A high point is the ear-opening sense of movement created by a synthesizer in "The Power." The synth, sounding like a giant slowly inhaling, sweeps from right to phantom center to left channel as the cut ends. In fact, *all* the cut endings are impressive and a splendid showcase for the CD's extended dynamic range.

This CD is, both musically and technically, a real winner. *Paulette Weiss*

**Beethoven: Symphony No. 6, "Pastorale."** Y Chamber Symphony, Gerard Schwarz.  
Delos D/CD 3017.

Here is an unusual Beethoven Sixth Symphony, "Pastorale," in that the performing orchestra is scaled down in size to the forces employed during Beethoven's time.

The Y Chamber Symphony of New York is conducted by its founder, Gerard Schwarz. Mr. Schwarz has turned his orchestra into a fine-sounding ensemble, much admired by the tough New York critics.

The Soundstream digital recording was engineered by my good friend Marc Aubort, which usually guarantees sound of exemplary quality. The work was recorded in Masonic Temple in New York, a spacious but not overly reverberant hall with a nice ambience and one where Marc has recorded many times. Using his basic tube-type omni Schoeps mikes, Marc achieves a very open and cohesive sound field, with good orchestral definition.

My only quibble is a bit of over-brightness in the high strings. Schwarz's performance is somewhat fast-paced, but his "Storm" is tumultuous and very exciting, with the Soundstream's unbridled dynamic range affording a most full and sonorous sound in spite of the reduced size of the orchestra.

*Bert Whyte*

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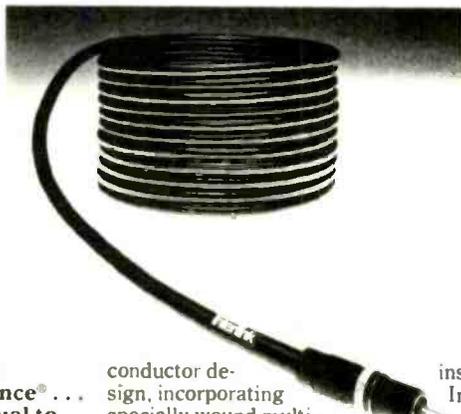
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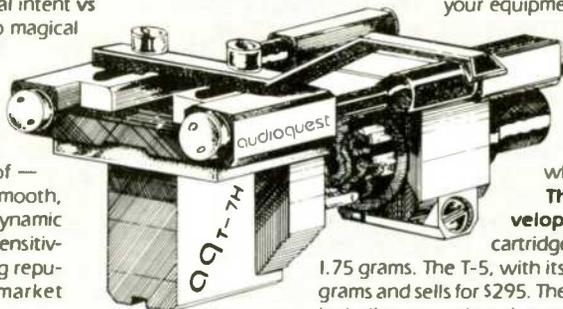
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### INTEGRA - 1 MkII

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Power Handling Capacity	100 Watts RMS
Frequency Response	45-25000 Hz
Woofer Type	6" Dia. 3" Aluminum voice coil
Tweeter Type	Soft dome, Aluminum voice coil
Ferrofluid Cooling/Damping	Yes
Impedance	4 ohms
Sensitivity 1W/1M	91 db
Magnetic Structure Weight	2.3 lbs./1.05 Kgs
Dimensions	160mm/6 1/4" Dia. 67mm/2 1/4" Depth
Mounting Depth	53mm/2 1/8"
Net Weight	2.85 lbs./1.3 Kgs
Front Grill	Integral metal grill

### INTEGRA - 2 MkII

Integrated 2-way 8" / Dome Tweeter (Adapted for bi-amp)

Power Handling Capacity	120 Watts RMS
Frequency Response	35-25000 Hz
Woofer Type	8" Dia. 3" Aluminum voice coil
Tweeter Type	Soft dome, Aluminum voice coil
Ferrofluid Cooling/Damping	Yes
Impedance	4 ohms
Sensitivity 1W/1M	92 db
Magnetic Structure Weight	2.3 lbs./1.05 Kgs
Dimensions	220mm/8 1/4" Dia. 75mm/3" Depth
Mounting Depth	57mm/2 1/4"
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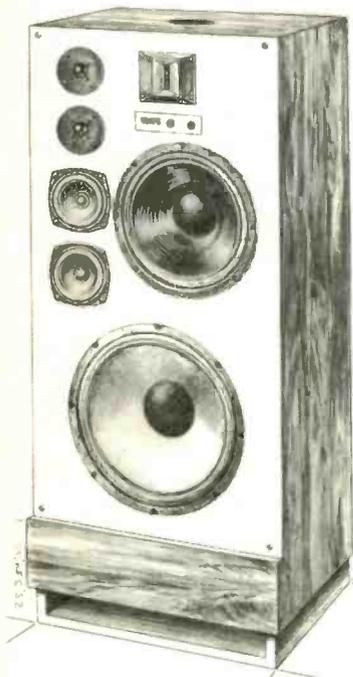
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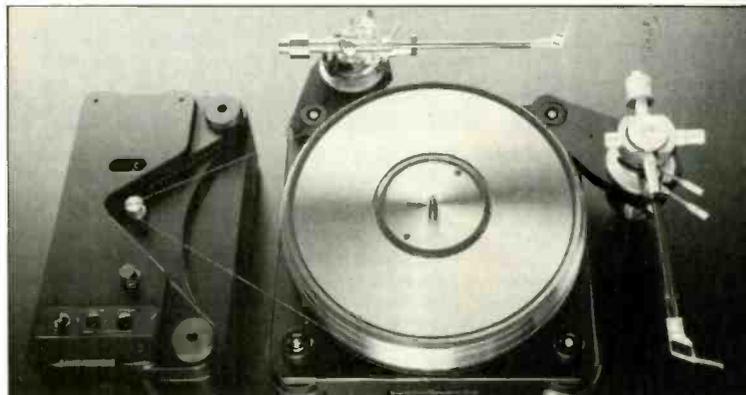
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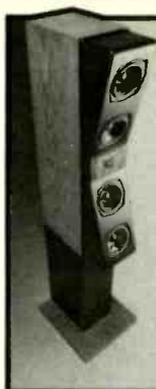
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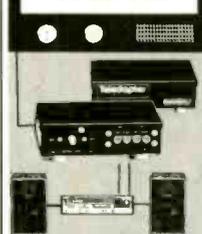
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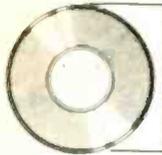
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