

Audio

JANUARY 1984 • \$1.75

TESTING PHONO
CARTRIDGE TRACKING

DOUG SAX & LINC MAYORGA:
WHAT'S WRONG WITH CDs?

SANSUI TRICORDER:
**PCM DIGITAL RECORDING
AT SLOW VCR SPEEDS**



TESTS IN THIS ISSUE:

YAMAHA M-70 BASIC AMP
EXTRA CLEAN

MONSTER CABLE ALPHA-1
**CARTRIDGE—FLAWLESS
REPRODUCTION**

**04/S OPEN-REEL
DECK**
EXCELLENT RESPONSE



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saddened by the
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ON

OFF

HIGH
FILTER

ON

OFF

LOUD

ON

OFF

MATRIX

ON

OFF

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DOLBY B-C NR

EQ

NORM

MONITOR

MIX

METAL

CLOSE GAP 3 HEAD SYSTEM

REC VOLUME

100

TAPE COUNTER

MEMORY

PLAY

OFF

STOP

MAX
10
9
8
7
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4
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MIN

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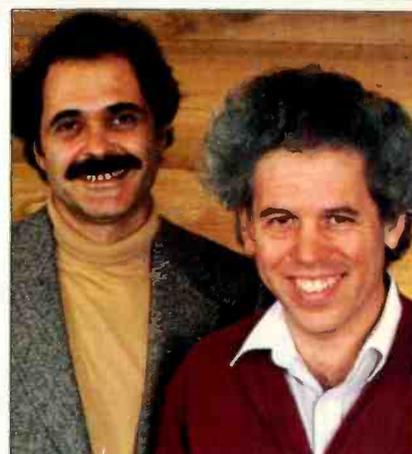
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JANUARY 1984

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See page 22.



See page 34.

A feast for the power hungry.

If you're hungry for a sound system with enough power to register on the Richter scale, here's some food for thought. Kenwood introduces the new BASIC series. Components so technologically advanced, they can be appreciated by serious audio enthusiasts, yet afforded by anyone.

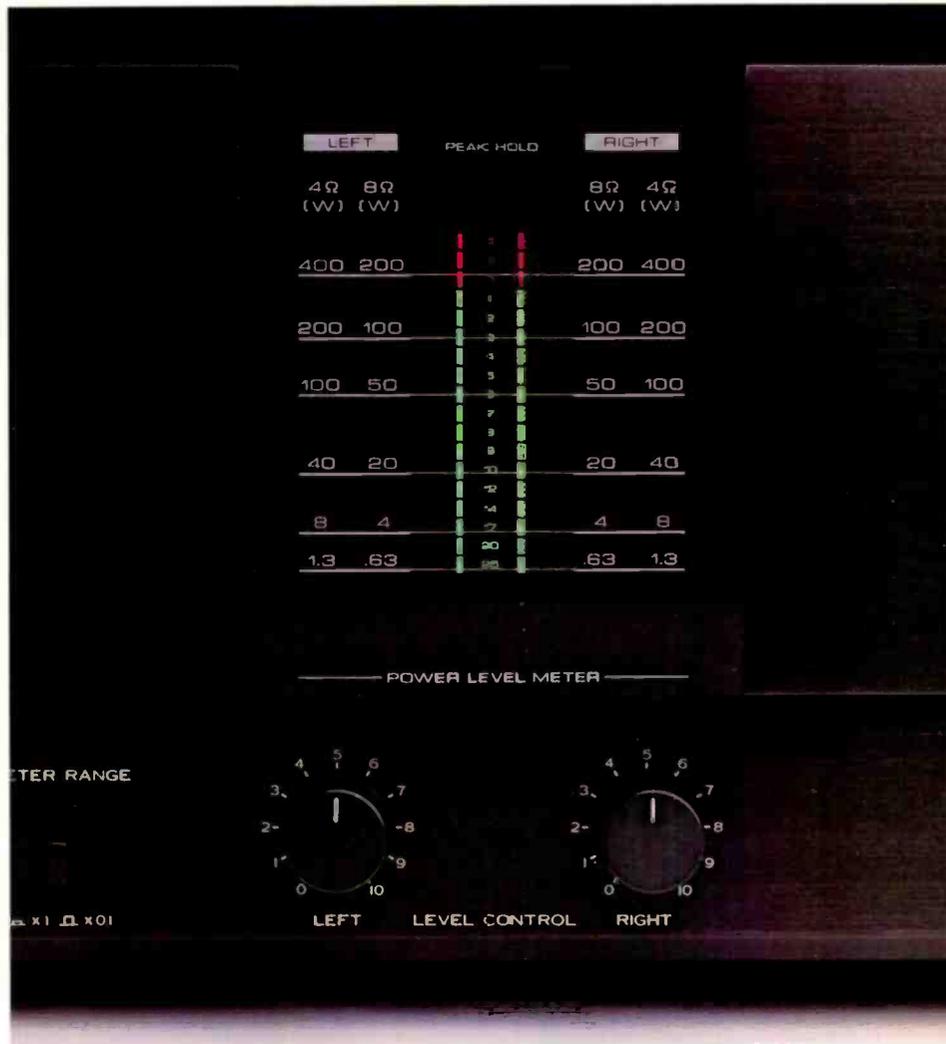
Consider. The BASIC M2 stereo power amplifier. At 220 watts per channel min RMS, both channels driven at 8 ohms from 20Hz to 20kHz with no more than 0.004% THD, it has power to spare. However, with Kenwood's unique Dynamic Linear Drive circuitry, you have the option to not use its vast power reserves, without interfering with tonal quality at low volume.

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As a stereo buff, it's important to have your amplifier combined with units that are not only compatible, but equally demanding of sound perfection. Take a look at the BASIC C1, a preamp engineered to match the high standards of the M2 exactly. With tremendous sensitivity to highs and lows, it delivers even the most dynamic source material clearly and smoothly.

Complete your BASIC system with the T1 tuner. At all times, in all conditions, its precision automatic electronic tuning brings in crystal clear reception.

Individually, the BASIC components offer performance,



refinements and engineering exceptional to the field of stereo electronics.

Together, they offer a sound experience that conventional systems haven't begun to approach.

If you're truly serious about your hunger for power, check into the new Kenwood BASIC series.

It will more than satisfy your appetite.



Kenwood's BASIC T1 stereo tuner and C1 preamp are also perfectly compatible with the M1 power amp pictured here.

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Peter Aczel *The Audio Critic* Winter 1982-83

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General Manager: Mary Anne Holley
Production Manager: Elaine S. Geiger
Asst. to the Publisher: Susan L. Newkirk

Marlene Jensen
Publisher

ADVERTISING

Advertising Director: Roman Beyer
(212) 719-6335
Eastern Ad Manager: Stephen W. Witthoft
(212) 719-6337
Western Ad Manager: William J. Curtis
Account Manager: Steve Moser
(213) 487-5880
Classified Ad Manager: Laura J. LoVecchio
(212) 719-6338

OPERATIONS

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Circulation Director: Norma Darragh
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That quality of thought has served as the foundation of all Harman Kardon audio products.

In 1958 Harman Kardon introduced the world's first stereo receiver.

In 1963 Harman Kardon introduced Ultrawideband Frequency Response and in 1970 Harman Kardon became the first company to use Dolby¹ in a cassette deck.

Today, Harman Kardon audio products continue to be so technologically advanced that "state-of-the-art" falls short of describing them. They have become "state-of-the-mind," the highest level at which the mind can create.

A distinct example of Harman Kardon's state-of-the-mind technology is the hk690i receiver, which leads their line of quality receivers and possesses their most important state-of-the-mind concept to date: High Instantaneous Current Capability.

Harman Kardon has consistently used High Instantaneous Current Capability (HCC) in all of their amplifier sections. HCC provides the instantaneous power that is vital to precisely drive and control nearly any loudspeaker system.

With its HCC of 45 amps, the hk690i will develop far more power under peak loads than its rated 60 Watts per channel² while

maintaining the low distortion and widebandwidth required for accurate sonic reproduction. This means that the hk690i gives you louder, clearer sound than any other 60 Watt² receiver.

The digital synthesized quartz-locked hk690i has an Ultrawideband Frequency Response of 0.2 Hz to 150kHz, as well as low negative feedback for extremely fast and accurate transient response. The result is the virtual elimination of TIM distortion.

The phono section of the hk690i has a unique dual RIAA equalization circuitry which maintains a constant low level of negative feedback throughout the audio frequency range. An exclusive sample-and-hold MFX decoder decreases high frequency switching noise while eliminating the need for much of the filtering normally required in FM processing.

Among performance features included are: Provisions for two tape decks (with tape copy capability), switchable bass and treble turnover frequencies, a Moving Coil head amplifier, and subsonic and high cut filters.

The hk690i provides the combination of pure power and sonic excellence that the true audiophile demands.

So, while other manufacturers continue to pile on unnecessary features and gimmicks, Harman Kardon continues to develop fundamentally advanced audio equipment.

1. Dolby is the registered trademark of Dolby Laboratories, Inc.

2. 60 Watts RMS per channel into 8 Ohms, 20Hz-20kHz with less than 0.6% THD.

harman/kardon

Our state-of-the-mind is tomorrow's state-of-the-art.

The Straight 'N Pivoted

Dear Editor:

I would like to make a few comments regarding the controversy between pivoted and straight-line tonearms. The articles that appeared in the June 1980 and June 1983 issues of *Audio* were some of the better ones that I have read. I concur with most of what was written, but I would like to comment regarding the lack of skating (lateral) forces in linear-tracking tonearms. One thing usually overlooked in linear-tracking turntables of the air-bearing type is the large tangential force that arises if the record hole is off center. The effective lateral mass of such a tonearm is the mass of the arm itself, and will be several times the effective mass of pivoted or servo-assisted tonearms. Such a large effective mass being accelerated laterally could result in a lateral force on the stylus that is much larger than the skating force of a conventional tonearm. It would appear that any advantage of an air-bearing radial over conventional radials and ordinary tonearms is negligible under real world conditions. It is interesting to note that the lateral mass and the effective vertical mass differ in this design. In physics we would say this produces a coupled oscillator whose frequency and amplitude are a function of time, and one has to wonder, what effect would this have on the system? It would seem that aside from the lack of a servo window, the air-bearing linear tonearm does not have any inherent advantages over the other design.

I also read with interest the letter-contribution by Graeme F. Dennes that appeared in "Signals & Noise" in the May 1983 issue. I have spent a considerable amount of time researching the literature regarding tonearms and, after constructing several, have concluded that differences due to overhang, length, and offset angle in a well-made and reasonably mounted tonearm are very small and will probably be of little significance compared to factors over which the user has no control. As an example, the skating force is a function of complex factors, such as groove material and modulation. Also, many records have offset centers, and this causes the cartridge to be continually accelerated. This, in turn, requires the stylus to supply a counter force that

will result in an unequal force on the groove walls. In regard to the selection of null radii (radii where the tracking error is zero), it has been said that one of these should be near the inner grooves since typically this is where the loudest passages are, but one's tolerance to distortion increases with increasing loudness, so maybe it doesn't matter very much.

Additional references are:

1. Olson, H. F., *Modern Sound Reproduction*, pg. 178. (This information is

the same as Ref. 5 cited by Dennes.)
2. Guy, P. J., *Disk Recording and Reproduction*, pg. 96. (The denominator has a mistake in it.)

3. Gicca, Francis A., "Tonearm Tracking in Stereo," *Electronics World*, Oct. 1959, pg. 70. (Largely concerned with the effect tracking error has on cross-talk ratio.)

George Shellenberger
Assoc. Prof., Natural Sciences
College of the Ozarks
Clarksville, Ark.

AUDIO ETC ??
Edward Tatnall Canby

(437 E. 11th Av., Eugene, OR 97401)

Dear AUDIO -

You are now observing my second letter on a genyooine Word Processor, a strictly pro model, the Osborne 1. The first letter was six lines long and took me two days. This one has taken about two weeks, what with accidental garblings, erasures and other dire mishaps. At this rate I figure I'll take about five years to do my first AUDIO copy, courtesy of the Osborne. It's all too zany. Like detaching pieces of words, which go scooting off on their own on the screen with me in hot pursuit; I never seem to catch up. Then, it is hard to understand that nothing here is always SOMETHING, that is, a space is a something and you have to treat it with respect becausew it won't go away yyyyyy, and dreadful things HAPPEN---

EEEEEEEEEE OOOOOOOOPS

WHA--??

HAY WIRE

It is always possible, if you are advanced enough in your thinking, to get track on the back. I mean back on the track, like this. Then all goes very welllllllllll, for awhile. Auntil smthng else goes wrong, which doesn't take very long, alas, what with my fingers.

blurp URP

hey!!!

ANYHOW, I'm taking advantage of the opportunity, until at least I have the basic concepts more or less under control and - maybe - can go on to a lot more, with my own machine???? Who knows - I might even get a whole AUDIO ETC column processed before too long.

I've been staying on here in Eugene (OR) beyond the end of the Bach Festival to gather some highly interesting info on the Hult Center, the latest in super-update concert halls, with THREE sound reinforcement systems including the fabulous 90-mike, 90-speaker AIRO, and ERES, as well as an update standard house system - this is the first all-purpose center designed from the start for electronic sound assistance. I've heard a dozen or so concerts of all sorts, with reinforcement to match, and yesterday I was up on the catwalks hundreds of feet above the floor (!!) to look at the mikes, each in a Helmholtz tube to resonate at a particular frequency... Will return to NYC July 11th and thence to Cornwall to finish writing something on all this heady stuff.

Yrs fr btr cmprts.

E.T.C.

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packages the DP-35F's performance in an elegant high gloss rosewood style veneer base for \$350 — each model in the new Denon DP-Series offers the maximum combination of performance, construction quality, convenience and styling.

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And you're just as selective in choosing your recording tape. TDK knows that. So we developed a line of high performance audio cassettes that meet your critical requirements.

We call it the TDK Professional Reference Series.

You're probably using TDK SA-X high bias cassettes now because of their superior performance characteristics. In addition, TDK has developed normal bias AD-X which uses TDK's famous Avilyn particle formulation and delivers a wider dynamic range with far less distortion than ever before. Plus, TDK's unique metal bias MA-R cassette which features high-energy performance in a one-of-a-kind unibody

die-cast metal frame.

The TDK Professional Reference Series...it'll sound impressive to your ears. So share the pleasure with your friends; they'll appreciate it.

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More on Tonearm Geometry

Dear Editor:

May I add another historical postscript to the comments on Tonearm Geometry by Graeme F. Dennes and B. V. Pisha found in the May 1983 "Signals & Noise" column?

My father [Percy Wilson] had published his solution to the geometrical problem in 1924. However, though the use of an offset to reduce the tracking error was soon universally adopted in Europe, straight arms persisted in record players manufactured in America for many years. The first American references I have found were published in 1937. I should be interested to hear of any earlier ones.

Glover [1], then Chief Engineer of Shure Brothers, reported the work of one of his staff, Ben Bauer, who devised a needle tilt arrangement in a replacement cartridge for mounting in existing straight arms. Bird and Chorpeneing [2] of Astatic describe the problem, and a crystal pickup with an offset to reduce the error. Olney [3] discussed both record wear and distortion resulting from excessive tracking error, though not the geometry required to reduce the latter.

Ben Bauer also deserves credit for drawing attention to the distortion criterion in his 1945 article. I myself recently followed the trail back from there to Baerwald's 1941 paper (which I had to send for) and thence to Lofgren's 1937 paper (which I found in the Penn State library). The latter is in German, which I don't read easily, but it is interesting to note that he gives references to both British and American papers, including the 1924 paper by my father.

In conclusion, I would like to mention that the 1929 Wilson and Webb book, long out of print and hard to find in the original, is now available in reproduced form from University Microfilms, catalog number AU00092.

Geoffrey L. Wilson
State College, Penn.

References

1. Glover, Ralph P., "A Record-Saving Pickup," *Electronics*, Vol. 10, No. 2, Feb. 1937, pg. 31.
2. Bird, J. R. and C. M. Chorpeneing, "The Offset-Head Crystal Pickup," *Radio Engineering*, Vol. 17, No. 3, March 1937, pg. 16.
3. Olney, B., "Phonograph Pickup

Tracking Error vs Distortion and Record Wear," *Electronics*, Vol. 10, No. 11, Nov. 1937, pg. 19.

Base to Computer

Dear Editor:

On pg. 37 of your November 1983 issue, Leonard Feldman says in "Computer-Aided Calculations" that base "e" logarithms are base 2.32059. This is wrong. Indeed, it would be inexcusable if most people did not already know that "e" is approximately 2.7182818.

Alex Lewin
North Haven, Conn.

Author's Note: I made a misstatement. The statement I meant to make was: "The log (to the base 'e') of 10 is 2.30259." To put it another way, on pg. 37, the parenthetical notation (2.30259) should have come at the end of the paragraph in which it appears—instead of in the middle. Thus: "... it is necessary to divide the log expression in these equations by the natural log of 10 (2.30259)."

Mr. Lewin is indeed correct, and everyone (including myself) does know that base "e" logs are to the base 2.7182818. However, rest assured that the misplaced parenthetical information in no way affects the actual computer program, which has been running successfully on my computer for many moons. So, no real harm done, except a pink-to-red coloration of my face. ...—*Leonard Feldman*

And More Kudos, dbx

Dear Editor:

In view of Frank Wolfe's appreciative comment on dbx (*Audio*, "Signals & Noise," February 1983), let me add this fillip.

I'm a stereo repairman by trade, and when my older dbx 118 developed an intermittent problem, I opened it up, rather than shipping it back to dbx, to see what the matter might be. While the problem itself was easily traced to a broken solder joint and quickly repaired, I took time to note what good quality parts and workmanship went into this device. I'd known before that dbx used walnut panels for their cabinets made by handicapped workers, a friendly gesture, but I'd no idea of the quality they put between those panels.

The insides of my dbx look and feel like the best pro equipment I have worked with, and on. Kudos!

Audio readers also might want to know that, as owner of dbx at the moment, BSR is able to offer dbx noise reduction in its cassette recorders, which cost surprisingly little and seem to work fine. This might be a good time to reevaluate BSR products and look seriously at what they're offering in the 1980s. I've taken a BSR cassette deck apart, and I can vouch for its quality innards. BSR changers have always been reliable low-fi performers, but now the company may be seeking serious higher aims. Based on their cassette deck, I think they may be on the right track. BSR, by the way, now incorporates both dbx and ADC under its brand name.

George Androvette
San Leandro, Cal.

Editor's Note: It's nice to know that you appreciate your dbx unit so much. Being a part of the audio world by trade, your comments may carry a little more weight than the average audiophile's would. —E.P.

Errata

● In the construction article, "Drive Your Walkman 'Round the Block" (July 1983, pg. 70), the LM2931T adjustable regulator was incorrectly listed as being available from various electronics mail-order houses. The only sources for this regulator are National Semiconductor Corp. distributors listed in local Yellow Pages directories.

● Figure 2 of M. J. Salvati's "Build a Center-Woofers Crossover" (August 1983) contains some errors. The pin numbers for the power-supply connections to the op-amps were accidentally omitted. The positive supply (+15 V) connects to pin 14 of each 4739; the negative supply (-15 V) connects to pin 7 of each. Also, pins 5 and 6 are reversed for each 4739. Pin assignments for the regulators (IC5 and IC6) were purposely omitted, as the pins of these ICs are not numbered in order. If you are unfamiliar with these ICs, consult a handbook or the pin diagram sometimes accompanying the IC. Also, both power-supply terminals were marked "-15 V"; the upper one should actually be the "+15 V" terminal.

Audio + Design Recording Interface

Even home recordists often use some pro equipment nowadays, and even pros often use home or similar semi-pro gear. The problem comes in interfacing home and pro equipment: Signal levels differ, and pro units use balanced-line inputs and outputs, where home units use unbalanced lines. The

Propak, from Audio + Design, is designed to match these two types of lines. The Propak II, shown here, can also correct for interchannel time differences which can occur when using direct digital outputs from EIAJ-standard PCM adaptors, such as the Sony PCM-F1. Prices: Propak I, \$240.00; Propak II, \$290.00. For literature, circle No. 100



Clarion Audia Car Stereo

At the top of Clarion's new, premium "Audia" line is the DTX-1000 tuner/tape deck. Its FM section has "Diversity Tuning," which switches constantly between two antennas, choosing whichever has the clearer signal. A defeatable circuit rolls off high frequencies on weak FM signals; pushbuttons select five preset FM and five AM

stations, and the AM section receives Traveler's Advisory stations (530 and 1610 kHz). The radio has scan tuning, and can be listened to while the tape is being fast-wound or the next track is being automatically cued. The tape section features Dolby B NR and an equalization switch. For acoustical control, there are bass and treble controls, plus a switchable 180-Hz notch



Superbrush Cleaner and Burnisher

The Eraser Company has adapted its technology to the cleaning and burnishing of electrical contacts and other surfaces. Twisting the tip of the Superbrush varies the brush length—longer for fine abrasive action, shorter for more aggressive cleaning. Price: \$2.98. For literature, circle No. 101

Heybrook Speaker Systems

The Heybrook HB-3 monitor speaker system employs a 10-inch, doped-cone woofer, a 4-inch midrange and a 3/4-inch tweeter. The internal crossover can be bypassed for multi-amplifier operation. Prices: \$989.00 per pair in walnut and teak; \$1,039.00 per pair in black. For literature, circle No. 103



filter to reduce common in-car resonances. There is provision for future add-on NR modules for dbx (available now) and DNR and Dolby C (to come). Specifications include FM sensitivity of 17 dBf for 50-dB quieting, FM S/N of 58 dB, and tape frequency response of 30 Hz to 18 kHz (± 1 dB from 30 Hz to 14 kHz). Price: \$625.00; dbx module, \$75.00. For literature, circle No. 102





Sumiko VTA Adjuster

The particular tonearm height that keeps vertical tracking angle correct for one cartridge may not properly match another. If you swap cartridges of dissimilar height, and your arm has a mounting post diameter of 16 mm or less, you can readjust arm height as needed, with Sumiko's VTA-U; for Grace G-707 and G-747 arms, use the VTA-7. Price: \$100.00 each.

For literature, circle No. 104

Mark Levinson Amp and Preamp

The Mark Levinson ML-11 power amp and ML-12 preamplifier are designed to work together, with the ML-11 powering the ML-12. The preamplifier has a universal phono stage for both MC and MM

cartridges, and internal cartridge loading sockets. The ML-11 is rated at 50 watts per channel with no more than 0.5% THD, or 140 watts when bridged for mono. Prices: ML-11 amp, \$1,750.00; ML-12 preamp, \$1,240.00.

For literature, circle No. 105



Pioneer CD Player

Pioneer has been making laser-disc players since before the Compact Disc—their LaserVision videodisc



players. Now, however, they'll have a CD player on the U.S. market, too. The P-D70 is a front-loading unit less than 4 inches high. To

find selections on a disc, any of the following modes can be used: "Index Search," which plays the first few seconds of each cut in forward or reverse order; "Track Search," which finds the start of each track; "Minute Search," which lets the listener enter the time code for the desired spot on the disc, and "Slow Scan," which plays music at an accelerated rate but at correct pitch. Price: \$750.00 to \$800.00. For literature, circle No. 108



Parasound Turntable

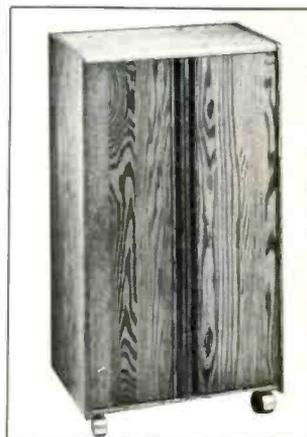
The LT_d900 is a direct-drive, linear-tracking automatic turntable accepting P-mount cartridges. Its features include microprocessor control; front-panel start, stop, cue and repeat

control, and a $\pm 3\%$ pitch control with illuminated strobe. Performance is specified as -70 dB rumble, 0.03% wow and flutter. Price: \$199.95.

For literature, circle No. 107

CWD Cabinet Doors

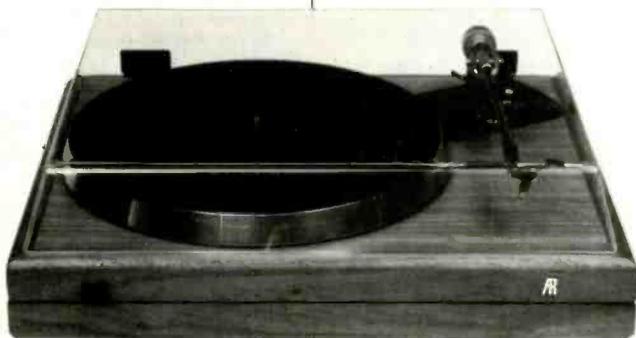
Wood doors with shaped handles are now available for the Woodmore hi-fi cabinets from Custom Woodwork & Design. The doors are available in solid oak and walnut to fit their 42-inch-high and lowboy style cabinets. Price: Starting at \$85.00 in oak. For literature, circle No. 106



Acoustic Research Turntable

The AR turntable is back, after a four-year absence. Like the original, the new version is belt-driven, with speed selection (33 $\frac{1}{3}$ and 45 rpm) made by manually shifting the belt on a pulley. Suspension is via a three-point cast T-bar sub-frame, a system which AR originally popularized. Wow and flutter is 0.03% or less,

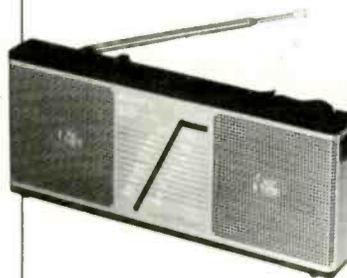
and rumble is -65 dB (DIN B). The table is available with a mounting plate for tonearms of the user's choice, or with a low-mass, straight-tube arm. The arm has an effective length of 9.33 inches (237 mm), oil-damped cueing, and an ADC-type headshell. Base finishes are walnut or oak veneers. Price: \$429.99 with arm, \$299.99 without. For literature, circle No. 109



Sony AM Stereo Portable Radio

The first portable AM stereo radio sold in this country is Sony's SRF-A100. The unit has two 3-inch speakers and a stereo headphone jack, and weighs 1 $\frac{1}{2}$ pounds. Using

a new Sony IC, the radio automatically decodes AM stereo broadcasts using the Harris, Magnavox and Motorola systems; a switch must be thrown to decode Kahn/Hazeltine-system broadcasts. Price: \$89.95. For literature, circle No. 111



Audio Pro Car Subwoofer

The B2-07 car subwoofer from Audio Pro uses the same "ACE-Bass" system as the company's home subwoofers to control driver

parameters electrically. The system has two 4 $\frac{1}{2}$ -inch drivers, working in push-pull, and powered by a 30-watt bridge amplifier. Performance spec-

ifications are: 105 dB SPL output in a car (95 dB in an anechoic chamber) and frequency response of 40 to 250 Hz, +0, -2 dB. The system includes an electronic crossover, adjustable between 50 and 250 Hz, to match the car's other speakers. The B2-07 measures 29 $\frac{1}{4}$ inches W x 5 $\frac{1}{4}$ inches H x 7 $\frac{3}{4}$ inches D. Price: \$595.00. For literature, circle No. 112



Audio-Technica Stylus Cleaner

The AT6016 TechniClean stylus maintenance system includes a stylus cleaning pad/applier with an inspection mirror on the back, a bottle of clearing solution which fits inside the handle, and a cover which locks over the stylus pad to keep it clean. Price: \$12.95.

For literature, circle No. 110

CSI Speaker

The MDM-TA2 Time-Align Nearfield Monitor, from Calibration Standard Instruments, has two unique switches: A "Position/Program" switch adjusts high-frequency response to compensate for the difference between near-field and distant (more than 4 feet) listening, and to simulate the high-frequency roll-offs between original and final stages of dubbing or mixing. A "Polarity" switch allows the absolute polarity of program material to be checked easily. The compact speakers have a rated frequency response of 60 Hz to 20 kHz, ± 3 dB, and a rated output of 108 dB SPL at 1 meter. The speakers are sold in pairs, matched within ± 0.5 dB. A "Protekt" circuit allows use of amplifiers up to 300 watts per channel. Price: \$990.00 per pair.

For literature, circle No. 113



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TAPE GUIDE

HERMAN BURSTEIN

Dubbing from CD to dbx

Q. I have a good cassette deck, and a dbx noise-reduction system. I would like to know if I can make successful tape copies of the new digital audio discs, with their dynamic range of more than 90 dB.—Richard Hermann, Astoria, N.Y.

A. The digital disc, better known as the CD or Compact Disc, has a dynamic range, or signal-to-noise ratio, of about 95 dB or better. A good cassette deck without noise reduction has a signal-to-noise ratio of about 55 dB. Inasmuch as dbx can improve S/N about 30 dB, the deck can achieve S/N of about 85 dB, which is very, very good. In other words, the tape deck should not be a seriously limiting factor in achieving a good copy. Noise elsewhere in your audio system—preamp, power amp, etc.—may be more significant. Further, the material on the CD may have S/N appreciably less than 95 dB, depending on its origin.

Accidental Magnetization

Q. Recently I purchased a head demagnetizer and began the process of using it on my cassette deck. After a few seconds my hand became tired, and my finger slipped momentarily from the on-off switch (spring-return type), turning the unit off and leaving the head with a much stronger magnetic field than the one I was originally trying to remove. Is it possible to remove this magnetic field short of having to replace the head—an expensive thing to do? Why didn't the manufacturer of the demagnetizer install a switch that would lock into place instead of going to the off position when my finger slipped from it?—Phillip Costello, San Diego, Cal.

A. Try repeated demagnetization of your heads. Hopefully, this will cause the magnetization to disappear gradually. If this doesn't work satisfactorily, try to borrow or rent from a local audio store the most powerful head demagnetizer that it carries, and go through the demagnetization procedure several times with care. It may be that you can't remove the magnetization completely. However, this can also happen with heads which have not been accidentally subjected to a magnetic surge.

Demagnetizers tend to heat up

quickly and thus have a duty cycle which is quite short but adequate—such as a minute or two or three. Hence, a spring-return switch is desirable to prevent overheating.

Noise-Reduction Systems

Q. I'm investing in a new cassette deck and am trying to decide between Dolby C and dbx noise reduction. If Dolby C is better than Dolby B, why do tape decks with Dolby C also provide Dolby B? Why don't they make an NR system that takes a normal signal, runs it through an encoder, and then through a decoder so that one doesn't have to buy encoded records or tapes?—Mark Townsley, Huntsville, Ala.

A. Decks provide Dolby B as well as C in order to permit proper (flat) playback of the millions of tapes recorded with Dolby B encoding, and to permit proper encoding of tapes intended to be played on the millions of other decks containing only Dolby B.

Noise-reduction devices such as dbx and Dolby are intended to reduce noise produced by the tape recording system, that is, tape hiss and hum and other noise produced by the tape deck. They operate by compressing the signal in recording and expanding it in playback; the expansion brings down the noise along with the audio signal. These NR devices cannot reduce noise already present in the audio signal. However, fairly successful reduction of noise already present in the signal can be achieved by means of dynamic NR units, sometimes called single-ended NR units.

In general, the greater the degree of noise reduction that a device provides, the greater the tendency to undesirable side effects such as volume changes and bursts of hiss. However, noise-reduction devices have achieved a stage of development which essentially overcomes these defects, as far as most listeners are concerned.

Dolby B provides about 8 to 10 dB of noise reduction, while Dolby C provides about 16 to 20 dB. In addition, Dolby C has a special encoding curve that provides increased protection against tape saturation in the upper end of the audio range. The dbx system affords 30 dB of NR. At low signal levels, distortion tends to be less with Dolby than with dbx; the reverse is true

at high signal levels. See the article on noise reduction by Howard A. Roberston in the April 1983 issue of *Audio* for a comparison of Dolby and dbx NR systems.

Accidental Underbiasing

Q. The other night I taped an organ concert, using chrome tape. However, I was dismayed later to find that my recorder had been left on normal bias setting. What can I do to correct this?—Harry Miller, Toledo, Ohio

A. After the fact there is nothing much you can do about having used the wrong bias setting. The chief result of underbiasing—which is what happened in your case—is to increase distortion and treble response. If the sound is too bright in playback, you can probably correct it fairly satisfactorily with tone controls or a graphic equalizer. If your recording took place at a moderate level, it is possible that the distortion is inoffensive enough to be acceptable. The only way to find out is by playing the tape. If distortion is excessive, nothing can be done.

Speed Problem

Q. Recently I purchased a cassette deck with three motors and a direct drive system, yet I have been greatly disappointed by its speed accuracy. When I record from an FM broadcast and then play back this tape, the speed on playback is slightly slower than the source sounded; this seems true from the beginning to the end of the tape. I am certain there is nothing wrong with any of my tapes. I must conclude that the playback speed of my deck is not 100% accurate. It sounds as if the music is being played at a slightly slower tempo. What could be the possible cause?—Jimmy Edwards, Greenville, N.C.

A. Although a deck may not have exact speed—many or most have inaccuracies on the order of about 0.5%, which is generally inaudible to all but the most acute ear—any inaccuracy in recording is compensated by the same inaccuracy in playback, assuming that recording and playback are on

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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Z-5000X

Z-7000X

Z-3000X

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Similarly, all models incorporate a high degree of automation, thanks to microprocessor

control. One-touch Simul Switching simultaneously turns on the power and one input—turntable, tape deck or AM, FM broadcast. The microprocessor also controls the Quartz-PLL digital synthesized tuning that presets 8 FM and 8 AM stations. The drift-free tuning, whether auto scan or manual, is so precise that in congested areas even the weakest station sounds as if it's just around the corner. There's also a programmable digital quartz timer/clock with three daily independent memory functions. You can awaken to FM; fall asleep to cassette music and arrive home to hear your favorite record.

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Z-7000X	100 w.	.005%
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Record Damage from Water

Q. I have an unusual problem. Roughly two years ago there was a slight flood in my basement apartment. My record collection, to say the least, was damaged. How do I remove the white residue left on my discs?—Benjamin L. Smith, Newark, N.J.

A. If the residue is not mold, I believe you can remove it with, of all things, water!! I know that your recordings already saw their share of that, but the water stayed on their surfaces for some time. Thus, the residue is probably material which was transferred onto the discs from the sleeves and jackets—aided by the wetness.

To apply the water, use it under high pressure, such as obtainable from a garden hose or kitchen sink sprayer. You will probably want to mask the label first, to prevent further staining.

When the discs have been thoroughly wetted, you must then wipe them vigorously and completely with a lint-free cloth. Even if there is some residual staining, I believe that the background noise created by the white material deposited on the surface of your discs will be reduced—hopefully to very low levels.

This procedure is designed to avoid the use of any soap compounds. Some detergents can cause more problems than they solve.

If mold is involved, you will need to investigate various fungicides, with the hope that you can find one which will not damage your recordings still more. To make this trial-and-error investigation, I believe you will have to try various fungicides on one or two recordings which are not of value to you. That way, if a disc is ruined by this research, you won't feel too bad.

I hope a reader with more experience with this sort of problem will write in to share his knowledge with us.

Impedance and Sensitivity Matching

Q. Is there any reason for matching the impedance and sensitivity of phono, tape and AUX inputs of a receiver to the outputs of components providing signals to those inputs?—Roger Ross, Peshastin, Wash.

A. No. Regarding sensitivity, if a device can supply more signal than is needed by a second device, there is

no need to lower the source's output. At one time, if a phonograph cartridge produced more output than was called for by the phono input, overload of the phono circuits was likely. This is no longer true.

It is sometimes a good idea to keep the output signal level from a preamplifier close to what is called for by a power amplifier, to maintain a good signal-to-noise ratio and allow easy volume adjustment. If the power amplifier has input level controls, there is no problem with a preamplifier having too much output.

Impedance matching is of little concern and, in fact, is not even desirable in most circumstances. With small-signal devices such as tape recorders, tuners and the like, the general rule is that the device being driven must have an impedance at least 10 times that of the device driving it. Even loudspeakers are not matched to the output impedance of the amplifier (but within limits, to prevent overloading of the output stages).

A moving-magnet phono cartridge usually should be loaded by a 47-kilohm resistance, not for impedance matching but for reasons having to do with the Q of the resonant circuit formed by the inductance in the cartridge and the capacitance of turntable wiring, interconnecting cables and phono input circuit capacitance.

Loudspeakers and Increased Dynamics

Q. How will the impending digital equipment, with its increased dynamic range and frequency response, affect my purchase of electrostatic loudspeakers? Specifically, will my new speakers be able to cope with the dynamic range of the new digital discs/sources?—Jim Spahr, Oradell, N.J.

A. Your electrostatic speakers (or any speakers, for that matter) can handle some maximum amount of input signal or power. This, in turn, permits that speaker to produce some given SPL (sound pressure level). If the dynamic range has been increased, two conditions can take place: We can keep the softest musical passages at their present values or we can lower them and keep the loudest sound levels at their present values. The choice is yours to make.

If the speakers you plan to purchase can produce sound at a level loud enough to be painful, you do not need a speaker capable of more. In this instance, you would keep your highest listening levels at or below those obtainable at the speakers' full output, and allow the softest passages to be heard at much reduced volume.

On the other hand, if the speakers you are considering are not capable of producing sufficiently loud sound, even when they are being driven by a sufficiently powerful amplifier, the softest passages might well, with greater dynamic range, virtually disappear. In that case, you should consider purchasing speakers capable of producing more sound volume.

Tuner to Monophonic Amplifier

Q. I plan to purchase a digital FM tuner, a preamplifier, a power amplifier, and a pair of loudspeakers. My budget will not allow me to buy all of these components at once, but I could purchase the tuner and enjoy it now. Would it be possible for me to connect the tuner to a mono amp with a Y-connector and a potentiometer between the two components? If so, what value should the potentiometer have? Should the potentiometer be wired after the Y-connector, or should there be a potentiometer for each channel before the connector?—Jeff Taylor, Johnson city, Tenn.

A. If your new tuner has provisions for monophonic operation (many of them do), simply switch the tuner to "mono" and connect one channel to the input of your monophonic amplifier. All will be fine unless your power amplifier does not have an input potentiometer and your tuner lacks an output pot. If that is the case, you will have to wire one between the output from the tuner and the input to the power amp.

Because many power amplifiers require a considerable amount of signal to drive them to maximum power output, you should be certain that the tuner can supply sufficient voltage to drive the amplifier to a reasonably high sound level. If it cannot do this, you

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

must find a way to introduce gain between the tuner and amplifier. This might take the form of a "power booster" sold by dealers specializing in musical instruments and accessories. These boosters have input potentiometers, so you need not provide your own.

If your new tuner has no manual stereo/mono switch, you will need to feed both its outputs to your amplifier. However, hooking them both together with an ordinary Y-connector can cause problems: Distortion, lack of bass and sometimes even damage to the tuner's output circuits. For that reason, it's best to wire each channel's "hot" (center) conductor through a 10-kilohm resistor, with the free ends of each resistor wired together and connected to the "hot" input terminal of the amplifier. Appropriate shielded cable and grounding practice must be followed.

If the power amplifier was inadequate with just the tuner connected, it

will be even less so with the resistors wired into the circuit. The booster is almost certain to be required.

These boosters are generally designed for battery operation. You may wish to use an appropriate power supply for the booster rather than use batteries.

If the booster is unnecessary, you will have to connect the "high" side of the potentiometer to the junction of the two 10-kilohm resistors, and the slider of the potentiometer to the "hot" input terminal of the amplifier, with the low end of the potentiometer grounded.

Turntable Hum

Q. My turntable hums—not much, but it is audible. I checked the ground by unhooking the ground wire, and the hum increased dramatically. The hum changes in pitch with changes in volume. The higher the volume control setting, the louder the hum. Is my grounding ineffective or is my turntable

defective?—Benjamin Blacque, San Francisco, Cal.

A. The fact that the pitch of the hum changes with volume suggests that this is not ordinary 60-Hz hum. Apparently, something is oscillating. The most likely cause of such oscillation is the proximity of the speaker leads to the phonograph input leads. There are other combinations of input/output leads which could possibly cause this, but this is at least a starting place.

Separate all input leads from all output leads and, while you're at it, from the a.c. power leads.

It is also possible that the oscillation is the result of problems within your preamplifier, the most likely of such possibilities being a defective decoupling capacitor. Such a conclusion is at least partially supported by the statement in your letter in which you say that the "hum" is not very dramatic.

There is yet another possibility, and this is that your "hum" really is hum!

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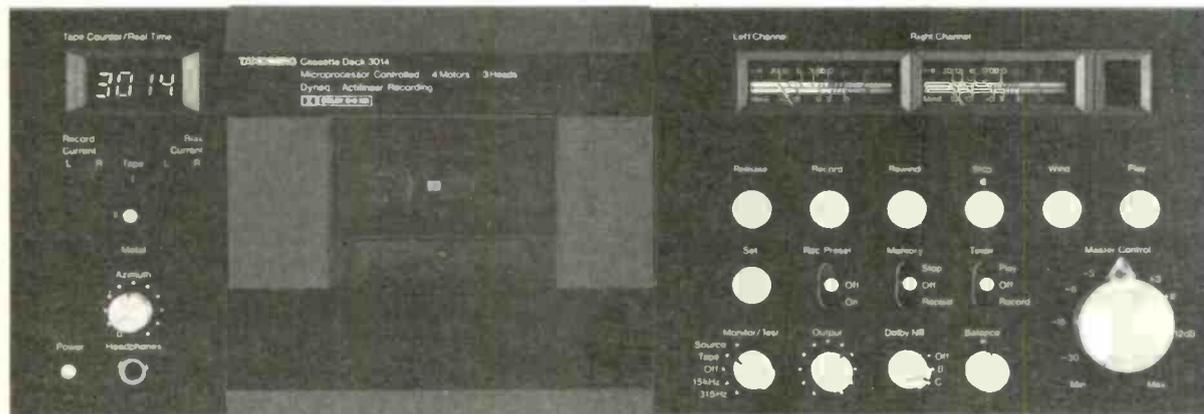
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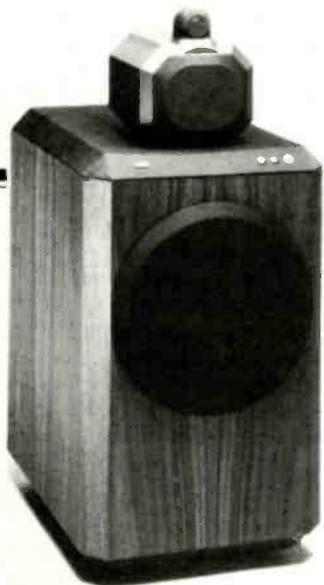
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TANDBERG

If a TV set with a hot chassis is connected to audio equipment, shocks and damage can occur.

You mention a change of pitch with changes of the setting of the volume control. If such changes are, in fact, changes of intensity rather than pitch, then you do have some hum. Whether or not this hum is significant is impossible to tell from my vantage point. I can say that if the hum is audible during the

softest passages of music to which you listen, then the hum in your system is too great. This hum may be the result of a cartridge with insufficient shielding or perhaps of a turntable located too near to a motor or heavy-duty power transformer, which results in hum being induced into the cartridge.



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Low-Pass Filter

Q. What is a low-pass filter?—William Kay, Yonkers, N. Y.

A. A low-pass filter is used to reduce background hiss from tapes or discs. It will also reduce record "scratch." This is done at the expense of the higher audio frequencies. Modern disc recordings are relatively quiet, so this filter might not be required. If you intend to play 78s, you will find this filter helpful. In most instances, you will not sacrifice much in terms of high-frequency response because highs were lacking on most 78s.

Amplified TV Signals

Q. A friend of mine has the amplified signal from his TV receiver patched into his Yamaha receiver. This signal is again amplified. What damage could occur?—Michael E. Chapman, Concord, N.C.

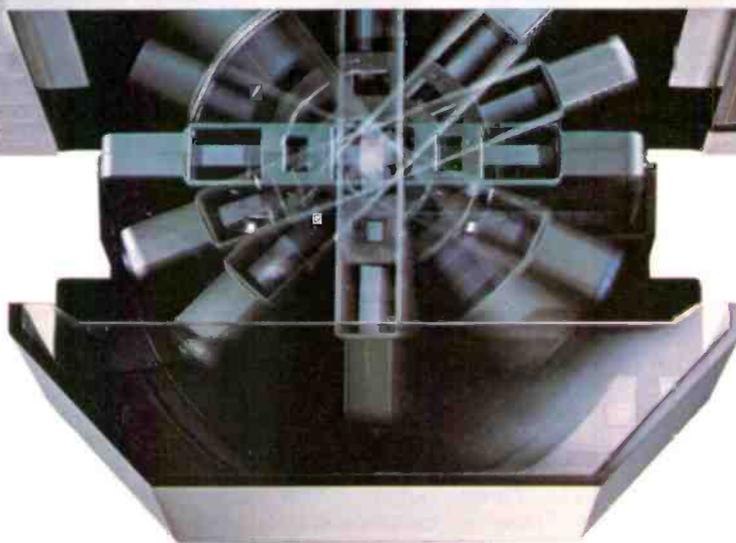
A. There probably is no harm in having a TV set connected to the input of a receiver. You say that the TV signal is amplified before it gets to the Yamaha receiver. By this I believe you mean that it is being extracted from the speaker terminals of the TV receiver. Although this is sometimes not the best way to obtain good sound quality, it is often the simplest way of extracting the sound. The resulting sound quality is likely to be better than the sound provided by the internal speaker of the TV set.

If the person has the necessary understanding of circuitry, he will know when to do this and when it should not be done. Your friend either understands the problems involved or was fortunate that the low side of the speaker line in the TV set was grounded.

None of this, however, relates to amplified sound. Rather, it relates to matters involving the output stage of the TV set and whether or not the low side of the speaker line is at true ground potential. Where this terminal is not truly grounded, damage to all equipment is possible with the connections you have described.

Even where grounding is not a problem, there is still the situation of the hot chassis. (I do not see one very often these days.) When it is present, using such a set connected to audio equipment can cause very dangerous shocks to the user and possible damage to the equipment. 

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Why sacrifice performance for convenience! If you've always wanted an auto-reverse deck but were too much of a perfectionist to settle for questionable response, Nakamichi has the answer—*UDAR—Unidirectional Auto Reverse*—a revolutionary development in the *true* sense of the word! Ordinary auto-reverse decks *change* direction at the end of the side causing tape to track along a different path and produce "bidirectional azimuth error." Since azimuth differs on the two sides, frequency response differs too. Compare this with UDAR. At the end of the side, UDAR disengages the cassette, flips it, reloads, and resumes operation in under 2 seconds! Tape plays in the *same* direction on Side A *and* on Side B so there's no "bidirectional azimuth error." UDAR *automates* the steps you perform on a conventional deck to give you auto-reverse convenience and *unidirectional* performance.

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RX-202



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ROM-ANTICS

A CD for Computers

Sony and Philips recently announced agreement on a basic Compact Disc format for computer data and program storage. Details of this CD-ROM (Read-Only Memory) format should be finalized by the time you read this.

The CD-ROM will hold about 550 megabytes of information, equivalent to about 12,000 letter-size documents. Personal-computer memory capacities range from about one-fiftieth to one-half megabyte; floppy disks hold anywhere from one-tenth to two megabytes, and hard-disk systems (at prices ranging from \$1,000 up—and up) hold five to 32 megabytes.

But computer users can store what they choose on these other media. As the ROM designation indicates, CD-ROM will be, like the audio CD, a playback-only medium. That will limit its utility for computer use to either very large libraries of long programs or very long data files that will rarely, if ever, be updated (encyclopedias or the 13-volume Oxford English Dictionary, perhaps).

However, if the format becomes established, it will probably prove very useful once home-recordable optical disc systems arrive—and they're being researched in labs all over the world.

Interestingly, the news of CD-ROM reached me just as I returned from a preview look at IBM's PCjr computer

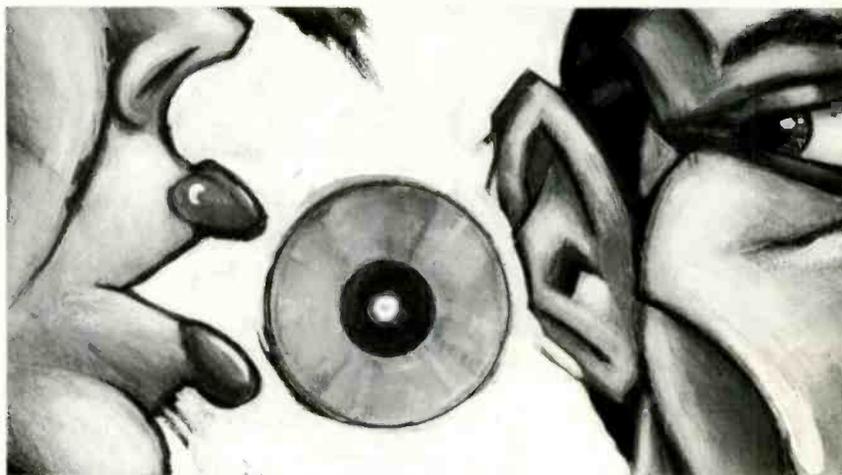


Illustration: Dave Shannon

(the fabled "Peanut"). The PCjr has an audio input hidden in its expansion buss—not to process audio signals, but to steer them, under program control, to the computer's direct audio output and the audio channel of its r.f. (TV-channel) output.

These two developments open up some possibilities for interactive audio, much like the interactive video systems now available for videodisc (though perhaps less useful). The Firesign Theater comedy group is reportedly preparing the first interactive CD, presumably adapted from their new videotape (which was originally to have been an interactive videodisc). Whether or not this uses the CD-ROM format, I don't know.

Having occasionally played

computer tapes by accident, I know how horrible the resultant garbage sounds. I hope that the directories of CD-ROM discs are encoded so as to tell an audio player not to play them, and that ordinary CDs will be encoded so as not to program computers into nervous breakdowns. Perhaps there might even be a dual directory structure, which would direct the CD player to read the audio-only tracks of a mixed CD/CD-ROM disc into a stereo system, while directing a computer to skip over them to read the ROM information. That way, one disc could carry both the computer instructions for an interactive program and the appropriate audio material.

Cassette Lifesaver

A friend's tape of her baby's first words just got snarled and broken. To fix it, I reached for my favorite cassette saver, the Scotch Editing and Repair Kit, No. ERK-130.

The kit looks like a square bar with a hexagonal end, something like a carpenter's crayon. But one side of the bar is a fairly good splicing block for cassette tape, and the hexagonal tip just fits into the hub of a cassette, for winding up the slack. Inside are pre-cut tabs of splicing tape and—the really clever touch—adhesive-tipped, flat polyester picks. The picks can be snaked through a cassette's tape path to pull out broken tape ends which have wound their way inside.

It's not quite as simple as it sounds: You usually have to tilt the cassette shell to make the tape end fall against the sticky end of the pick, and you may lose your tape once or twice before you can get it out.



But it does beat the alternative of taking apart the cassette, re-threading and repairing the tape, and either screwing the cassette together or, if the cassette was originally welded, transferring it to another cassette shell. The trouble with that approach is that you have to suspend breathing while the cassette shell is open, or your first breath will blow the wispy tape all over.

The Scotch kit sells for \$3.59—a bargain. But it's devilishly hard to find (I tried nearly a dozen stores), as 3M has done virtually nothing to promote it since its debut in the mid-'70s. So if you see one in a store, grab it fast—don't wait to hunt for it when you need it.

Illustration: Philip Anderson

JBL Automotive Loudspeakers.

When you understand how well they're put together, the argument for buying anything else simply falls apart.



A unique flat-wire voice coil (Patent applied for) helps JBL Automotive Loudspeakers achieve both high efficiency and high power capacity.



Each speaker features a die-cast aluminum frame to ensure complete freedom from warping or corrosion.



The loudspeaker's magnetic structure produces a symmetrical magnetic field around the voice coil gap of the low frequency driver. This design provides a dramatic reduction in distortion.

You're looking at the inner workings of a remarkable automotive product. It's manufactured to tolerances so precise that they actually rival those found in critical engine components. It incorporates some of today's most advanced metalworking and chemical engineering techniques. And its performance is unsurpassed.

The product is JBL's T545, 3-way automotive loudspeaker. Part of a full line of new JBL speakers designed with innovative features you can see as well as hear. Each model, for example, utilizes a rugged die-cast aluminum frame to ensure tight tolerances and complete freedom from warping and corrosion. The loudspeakers also feature large, long-excursion, flat-wire voice coils. This design uses the magnetic field in the voice coil gap more efficiently so the speakers need less power to operate.

And that's only part of the story. Through the use of large-diameter, high-temperature voice coil formers and the latest in high-temperature adhesive technology, power capacity has also been improved. Combined with the loudspeakers' high efficiency, this provides outstanding dynamic range and significantly higher maximum sound output.

Other features include a massive, barium ferrite magnetic structure, powerful high frequency and ultra-high frequency drivers, and bi-amplification capability on 6 x 9-inch models.

Of course, the best way to appreciate their advanced engineering is to audition them for yourself. So ask the audio specialists at your JBL dealer for a complete demonstration of JBL Automotive Loud-

speakers. Once you hear them, the argument for

buying anything else will simply fall apart.



First with the pros.

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KING: 17 mg. "tar", 1.3 mg. nicotine, 100's: 17 mg. "tar",
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You've got what it takes.
Salem Spirit

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Maestro Stokowski said Whyte's early stereo recordings were "the best sounding I ever made."



Bert Whyte

Audio Editors Cited

Associate Editor Bert Whyte holds the plaque given to famed conductor Leopold Stokowski in 1958 when he was made an Honorary Member of the Audio Engineering Society. The Stokowski estate decided that Whyte should have the plaque because of his association with Maestro Stokowski in making early stereo recordings. According to Jack Baumgarten, Curator of the Stokowski Archives, the Maestro said that these recordings were "the best sounding I ever made."

Born in Belfast, Northern Ireland, Whyte came to the United States at the age of 4. He began his professional audio career in 1949 as Director of Audio Sales for Concord Radio, was named Sales Coordinator

and Musical Director of Magnecord, and later became General Manager of Fine Sound and the Perspectasound Division of Loew's/MGM in New York. He was cofounder of Everest Records, where he served as Recording Director/Engineer and Director of Classical Artists and Repertoire and where he pioneered the use of 35-mm magnetic film for multi-track stereo recordings. He subsequently became Musical Director of RCA Victor Red Seal classical recordings.

In 1951 Whyte made the first modern classical stereo recordings with Stokowski, and the first big-band stereo recordings with the Benny Goodman, Woody Herman, and Stan Kenton Bands. After collaborating with Major Edwin Armstrong on special stereo recordings for the development of FM multiplex stereo sound, Whyte continued this work with stereo FM pioneer Murray G. Crosby. He is a member of the Audio Engineering Society and was elected a Fellow of that organization in 1977.

Senior Editor Richard C. Heyser has been awarded the Audio Engineering Society's Silver Medal for the development of time delay spectrometry (TDS) and its use in the study of loudspeaker and room acoustics. Since November 1973, Heyser has reviewed loudspeaker systems for this magazine using the TDS technique, on which he holds the patent; it is among nine which he holds in the audio and communications area.

Since 1956, Heyser has been associated with the Jet Propulsion Laboratory of the California Institute of Technology, Pasadena, where he is presently a Senior Research Scientist.

At JPL, his activities have included design of communications instrumentation for all major space programs there, beginning with the conceptual design of Explorer I, America's first satellite. His most recent projects have been with the improvement of underwater sound research and medical ultrasound imaging through the application of coherent-spread spectrum techniques.

Heyser is a member and Fellow of the Audio Engineering Society and of the Acoustical Society of America and a member of the IEEE and the Hollywood Sapphire Club. His biography appears in *Who's Who in the West*, *Who's Who in Technology*, and *Distinguished Americans of the West and Southwest*.

Richard C. Heyser



Sony and Philips Honored

The National Academy of Recording Arts and Sciences (the group that gives the Grammy awards) has given its President's Award of Merit to Philips and Sony, for their development of the Compact Disc system. The award ceremony took place October 10th, 1983, during the Audio Engineering Society's Convention.

This was the 10th such award

NARAS has given, and the first for a technical development. In a sense, though, the award was only half for the system's technical qualities. The other half was for "The cooperation between Philips and Sony in jointly developing a single standard for this new and vastly superior system." We say "Amen" to the cooperation half; it's all too rare to see firms this large cooperate so well so quickly.

Video on Radio

They're playing Beta Hi-Fi "Video 45s" over WDHA, an FM radio station in Dover, New Jersey. Crazy? Like a fox. The sound is better than from conventional records, the station can also use the Beta VCR as an audio production recorder with good fidelity and five hours of taping time per cassette, and though the audience can't see the video, the D.J. can, and tell the audience about it.

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Most multiplex-sound TV shows in Japan are musical—but there are odd exceptions, such as wrestling.

What's on Stereo TV?

Japan has had TV with multiplexed soundtracks for about two years now, but not that many broadcasts are using it. Of approximately 270 broadcast listings in the *Japan Times* on a recent Saturday, only 28 (10.4%) were in stereo, while another 17 (6.3%) were bilingual. (These numbers all include duplicate listings, where several stations carried the same shows.)

Most of the stereo broadcasts were music or variety, but there were interesting exceptions: "Quiz Derby," "All Japan Pro Wrestling," "Laughter Time," "Do Sports," several stations' morning sign-on shows, "Young Plaza" (a soap opera, perhaps?), something called "TV Graffiti," and even one station's weather show. The bilingual programs were mostly American movies and TV series, plus a few news and weather shows.

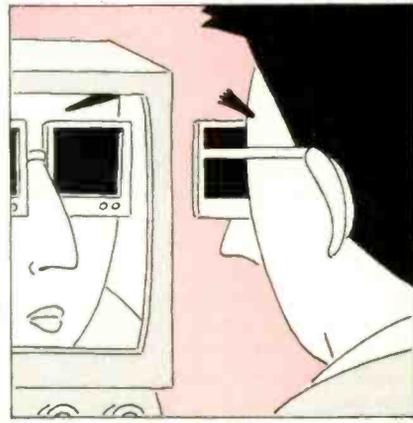


Illustration: Kurt A. Vargo

The Rhodium-Strip Mystery

A year or so ago, I addressed a class at a California university. In the Q & A session following, one student asked me if I'd heard of "the rhodium strip." It was, he said, a new recording medium. I tracked down his sources, and was able to discover that it is laser-etched, comes from a company called Precision Instruments, somewhere in Northern California, and that the strip itself is made by a DuPont subsidiary in Florida. My sources didn't even say if it is used for digital or analog recordings, or what its advantages might be. Anyone out there have further information?

Is a system's sound affected by the ways its components' a.c. cords are plugged in? Namiki thinks so—and has an answer.

Dynavector's Moving Coil



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You can now experience the superb musicality of Dynavector's moving coil cartridge at a reasonable price and without the additional expense of a step-up device.

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AcCESSories

At the Consumer Electronics Show, the major components get the major coverage, as indeed they should. But the minor items deserve some attention, too. The following caught my eye at last Summer's CES:

The dbx company offered a host of new products. There were noise-reduction systems for use with portable tape players (Model PPA-1, \$49) and for the car (the new CA-1, \$99, including Dolby B NR and sliding bass and treble controls). The old 20/20 automatic equalizer will soon be replaced by the 10/20. For complex systems, dbx now offers two Program-Route Selector switchboxes. The older, Model 200 (\$129) can hook together three tape decks, three sound processors and a noise-reduction unit, all to a single tape-monitor circuit on your amplifier. The new Model 400 (\$229) adds buffered tape outputs, LED indicators, and more complex facilities for processing signals as they're recorded.

QED has added a speaker protector, the Protech SP150 (\$115) to its extensive accessory line. The device protects against d.c., excessive high-frequency heating, excessive transients, and gradual voice-coil heating. When triggered, it does not cut off the signal, but reduces it by 40 dB then automatically resets when the emergency is over.

Russound now has a speaker selector box with gold connectors (\$90), a selector box for use with 4-



The dbx 400 Program-Route selector

ohm (and higher impedance) speakers (\$70), and a new speaker/headphone selector unit with volume control (\$50). They also offer remote volume controls for speakers (\$50) and for speaker/headphone use (\$70).

Do the polarities of your components' power plugs in the a.c. receptacles affect your sound? According to Namiki, they do; hence their DF-100 power direction finder (\$100, from Music & Sound Imports). Connect it to each component, try both ways of plugging that component in, and the device will show you which is correct. The premise sounds a bit farfetched, yet plausible; the device itself looks easy to operate.

Music & Sound is also importing "pigs"—small, rubber record-gripping devices which fit over turntable spindles like conventional clamps. But they weigh less than clamps and couple the record to the platter through a moderate damper, to isolate it somewhat from turntable resonances and vibrations. All for \$8.

AES Watch

We have warm feelings for the Audio Engineering Society; after all, it originally sprang from our loins, back about 1950, when this magazine was called *Audio Engineering*. But more important, its *Journal* carries quite a bit of interesting research. From time to time, I'll summarize some AES papers here; one follows.

Bent Arms and FM Distortion

According to Raymond Kilmanas of Monsanto, offset tonearms generate FM distortion comparable to tape-recorder wow and flutter. For the same ranges of stylus displacement,

he measured peak flutter of 1.33% to 3.99% on offset arms of the conventional 229-mm length and 0.96% to 2.88% on 305-mm arms, but only 0.03% to 0.27% on tangential-tracking arms. J. Rabinow, inventor of the Rabco arm, added a footnote to the effect that the side-to-side motion caused by eccentric records produces motion along the groove, causing additional frequency modulation. This effect is seen with linear-tracking arms but is greater with offset ones. ("Tonearm Geometry and Frequency-Modulation Distortion," *JAES*, Vol. 30, No. 9, Sept. 1982.)

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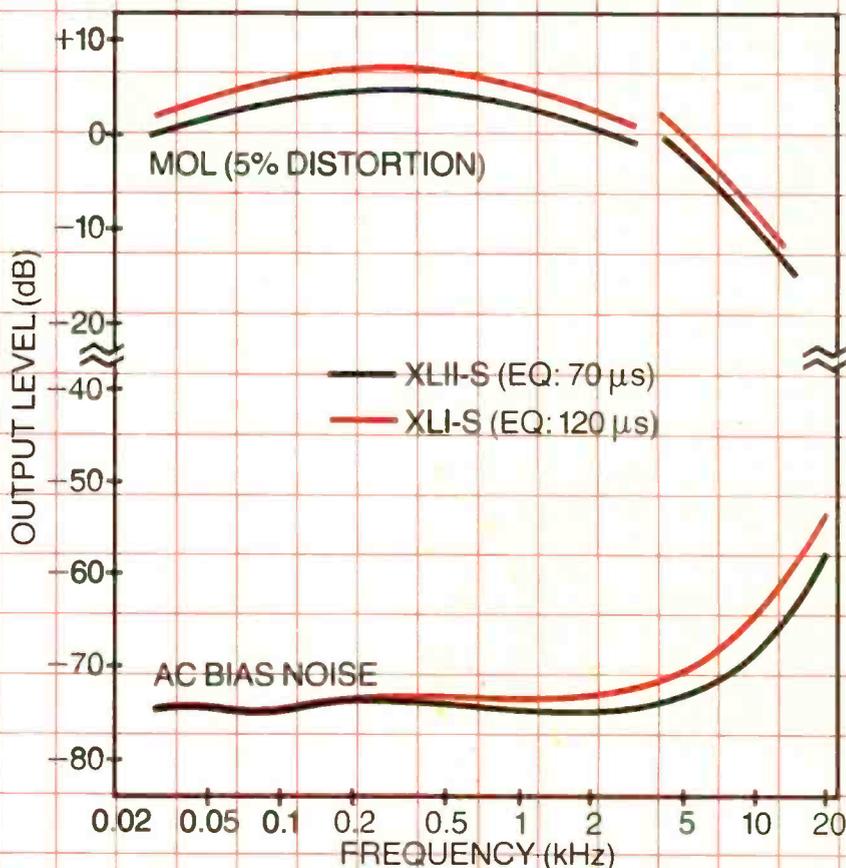
This increases maximum output level and reduces AC bias noise which in turn expands the dynamic range.

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NEEDLE TALK

Installation VI—new title: "My Lifetime in Audio & Music." On second thought, maybe the original title was better: "How I Fell into Audio." Either way, you'll find Chapter V in the May 1983 issue.

I left off on a curious note—the wooden phono stylus. Yes, it existed, and for many years. This was the stylus or needle that, in the mid '30s, was required by my university's music department for all who borrowed our 78-rpm records. They came in two types. One was naturally grown (and naturally variable), a sharp cactus thorn. The other was a triangular cut shaft of, I think, bamboo, sliced neatly off at the diagonal by a special hand tool. The apex of the resulting triangle at the end was a sharp point—for a few minutes, until it wore down. Then you sliced it off anew and again had a sharp point for several minutes. Excellent, we thought. Some fancier phonographs had a triangular shank expressly designed for these wooden styli, though the ordinary round needles would also fit.

I should explain for the young and unknowing that all styli were then called needles and were invariably removable. The norm was the old steel needle, out of acoustic days, also used in electric (electronic) phonographs. In the earlier acoustic machines, they came in a number of thicknesses ("loud needles" and "soft needles") for varying volume levels. These were fastened into the shank with a set screw on one side; you were supposed to use a new steel needle for each and every play (maximum four-plus minutes) but nobody ever did.

Instead, as I can testify from abundant personal observation (not to say action), we retrieved used needles from cracks and crannies on our machines if we could pry them out; or failing that, we took them from those handy little round metal boxes with the hole on top that were built into many phonographs to take used needles. Just lift off the cap and there they were, waiting for further service. Stylus discipline, as you can see, was lax. One could call it almost fatalistic. The only time anybody I ever knew put a brand-new needle to work was when it was absolutely impossible to find an older one. Since steel needles had been marketed for a long time, this seldom



Illustration: Michael A. Donato

happened. Throw away a dangerous point like that! Better to keep it where it belonged, out of harm's way, and so we did.

The sound of a used needle? Well, fuzzy. Going on to worse. Especially at the beginning of a side and again at the vulnerable inner grooves. It was a sound not unlike the recent squallings of the "transistor" when pushed beyond capacity—the little ones, I mean. Unpleasant, but you got used to it. In time, that distortion was transferred to the record itself and so made semi-permanent, but by then you couldn't distinguish between the bad needle and the bad record, so why bother? More fatalism, or should I call it laziness? It was indeed a distorted sonic world much of the time. But never forget it was functional and useful. We could hear the music, even if it was too much trouble to change needles.

Yes, we were lazy, if imaginative. Aren't we still? Did I hear somebody mumbling about video remote-control units at \$\$\$? Now it's video laziness.

For many sophisticated souls in the 1930s, the muffled sound of a wooden stylus point was preferable to the metallic screech of the normal steel point, and they were probably right. The gourmets of the phonograph used them assiduously and boasted about

it. As for us at my university, the wooden stylus meant first of all safety—no-scratch, no-gouge. That's why we, and other early record-lending libraries, required their use.

Should I make a further aside to explain the needle point? Guess I'd better. There are many ways to cope with human failings, and the phono people had long since worked out an ingenious means to insure an optimum (relatively) needle point under these circumstances. Just provide a reasonably sharp end to your needle—no special radius configuration and all that jazz—and grind it down to size in the actual playing. Brilliant idea! All shellac discs, therefore, included an abrasive in the basic formulation which allowed the groove to shape the stylus unto itself, more or less. Do not be surprised, then, if your ancient shellac collectibles seem terribly worn for the first half-inch or so of play. That was the mechanical adjustment area, where groove and stylus came to mutual terms. Often, it was a battle.

Each time you put a used needle back in service that job had to be done again, with a vengeance, for it was impossible to align the usual needle in its socket; it just went in any old which way, including sidewise like a miniature bulldozer. Moreover, the grinding

All shellac discs included an abrasive in the basic formulation, allowing the groove to shape the stylus unto itself.

process worked well only so long as the cross-section of the needle tip was no wider than the groove itself. By the time a used needle had been in and out of service, on a number of occasions its point had widened with wear and there was shouldering; the needle leaned on the groove walls to each

side and began to add added echoes of preceding and approaching music to the general mishmash. Dreadful thought but only the sober truth.

I do not frankly think we do any better today, if in other areas. Have you listened lately to your neighbor's well-worn hi-fi system, bargain-style from

some department store outlet? Does he even notice the hideous (to you) sound? Do not feel superior when I recount these misdeeds of the past!

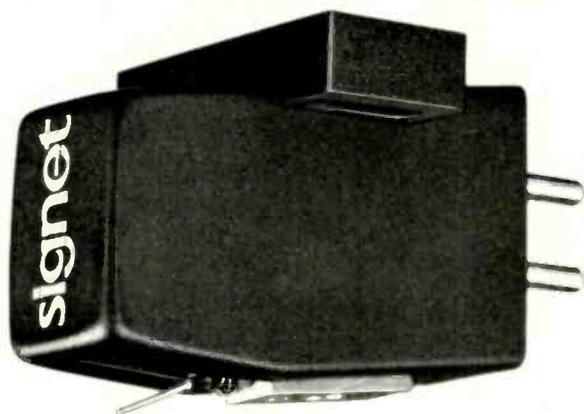
When I left the Great University and its record collection and moved to New York, I took up my second music appreciation job, not at a university for males but the very opposite, an finishing school for young ladies that had nominally become a two-year college. They wanted a music course suitably tempered to the "frivolous" female mind, upper-crust type. A touch of Culture but, please, nothing abstruse or too difficult. These ladies had more important things to think about, like clothes, money, marriage to the Right Boy. . . . Now I can smile indulgently, but in those days I was all set for battle and, by golly, it was going to be all-out. Via audio, too.

This was where by some miracle I ran straight into my second Carnegie Collection, with another of those monster state-of-the-art record players. It was like a gift of planes and tanks to a struggling third-world country—me. I was armed to the teeth with music. I fought the good fight there for four whole years and, I hate to have to say, I made more progress among those lovely young socialites, percentage-wise, than I have in 30 years of battling for music in the much larger world of audio buffs. (Dare you to print that, Editor!)

Which is to say, in different words, that I enjoyed it, every bit, both the music and the students, frivolous or no. One of them, for instance, was the president's sister, a wonderfully charming Irish colleen type, even if the musical portion of her brain was the size of the proverbial pea. We despaired of ever getting her through with a passing grade, but the other girls pitched in and helped and so she made it. She had to play the monster, the big Carnegie Phonograph! All of them did, records, needles and all.

Which gets me back to those needles. At the University, earlier, we had no students playing our equipment. I ran the Carnegie machine, I was its boss, and I *did* change the needle, every single play, like a dedicated monk. I also lowered the heavy pickup *carefully*. It never squawked or scraped. Indeed I was just too perfect

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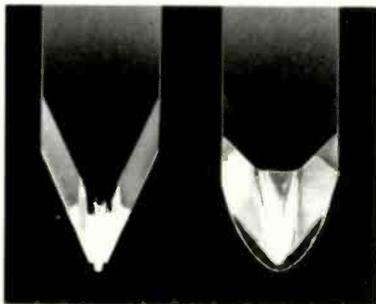
Even with repeated playings, the *MicroLine* stylus maintains its shape, without "spreading" like all other tips.

So grooves sound new, long after other styli are threatening irreparable damage to your record collection.

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In no time at all, we had piles of scimitar-like steel shards in active use on our records.

for words. But in New York the girls had direct access to everything and, indeed, played all their musical homework on the Carnegie machine, lacking for the most part any portables in their bedrooms. It was housed in the school library and therefore could never be played *loud*—the librarian saw to that. But that was all she did. She signed out the records and they did the rest. Mayhem!

No use trying to enforce a wooden needle rule. Those girls didn't know a cactus needle from a diamond brooch, and they would use either one if it made any noise at all. In case of need there were always safety pins, etc.

When I saw what was happening—those sweet, innocent girls, the agents of sheer destruction!—I knew something had to be done fast. But what? We started in with steel needles and fed them directly to the girls, for free, handfuls of them. No avail! How could they tell the new ones from the old? They didn't bother. In no time at all we had piles of scimitar-like steel shards in active use on our records—sometimes there were actually broken-off points, visibly so, though how they managed that I never could tell. Like everybody, they blamed the machine. Or the record. "Mr. Canby, that Hayden record you told us to play (i.e., Franz Josef Haydn) doesn't make any noise when I play it. And the needle sort of slides around. Do we *have* to know that one for the test?"

Then I had a bright idea, state-of-the-art. At that time, with war still holding off here, though it was at its worst in Europe, some bright-souled innovators were selling permanent needles. You guessed it: They had sapphire points and were ground to fit correctly, for an astronomical number of plays. Wow—was that for me, for us! Just put one of those in the machine and our problems would be solved. *E pluribus unum!* Out of the many, one. So I bought one. It cost a fortune, the school's money, equivalent perhaps to \$50 or so today, maybe more. I installed it, tightening the set screw so that it could not be released short of a pair of pliers or a wrench, and gave my instructions to the librarian. No more steel needles! The girls are not to touch the needle assembly; just play the records. And tell them to be *careful*—that's a *sap-*

phire point they are using. It'll play forever. No need ever to change. . . .

And so I went away, breathing sighs of relief. *That* problem solved, and so simply. True, true! Haven't we all converted to millions and millions of jewel points today, and long since? It was a brilliant forerunner, that experiment of mine, forecasting much that was to come, etc., etc., etc. . . .

When I returned a few days later, one of the girls said, "Mr. Canby, the phonograph is making a funny sort of noise—though I *did* play all the records you assigned for the test." (Just in case I thought she hadn't.) I went for a quick look. Yes indeed a funny noise. For days, the girls had been playing all their records with a jagged shank of metal that once held a sapphire. The jewel had lasted maybe a side or two before being knocked out. Nobody even noticed.

Well, this story ends gracefully. A new Swiss-made needle appeared, low in cost, called the Recoton. It used steel, not sapphire. Such ingenuity! This needle had a very hard, very thin steel point, rather, a thin steel wire shaped at the end, which was imbedded in a fatter upper metal shaft that went into the usual phono pickup. Sounds unlikely, but these needles played well and for much longer than the usual steel sort. With wear, they were thin enough to avoid most of the shouldering problem—no fat cone. You could play dozens of sides with them. If you were careful.

But their real virtue you will not imagine. Very hard steel is brittle! Under stress, these needles broke right off, cleanly, at their wasp waist. So neatly, so deliberately calculated, that what was left, the thick upper part, *would not play at all* but just skittered harmlessly over the surface. You *had* to put in a new needle. Moreover, if you dropped your heavy pickup, the point also broke, leaving just a small nick instead of a deep gouge, and the same for sidewise scrapes. Devilishly clever, obviously intentional.

So we converted to Recotons, and our problem was really solved. We used zillions but no damaged points ever got back into service—they broke first. Purposely delicate. I loved the idea and blessed Recoton once a minute for four whole years thereafter. **A**

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1947

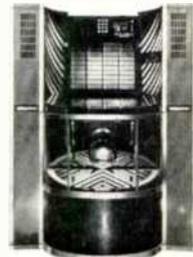
World's first magnetic cartridge was the Pickering S120. Acclaimed worldwide by radio D.J.'s, recording engineers and audiophiles alike, this monophonic pickup was easily plugged in with a simple slide-in motion, — great for "on-the-air" and entertainment security.



America's first magnetic cartridge — a plug-in

1954

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BERT WHYTE

DASH-ING THROUGH THE SHOW

It was autumn in New York again, and the 74th Convention of the Audio Engineering Society held forth October 8th through 12th. However, instead of being in the familiar, warm ambience of the Waldorf-Astoria, it was convened in the starkly commercial precincts of the New York Hilton.

Not many people were ecstatically happy about this change in venue, including yours truly; one complaint will serve to demonstrate our frustration. In the world of the New York Hilton, with its bottom-line-oriented efficiency, on the entire lobby floor and in the huge anterooms to the exhibit spaces on the second and third floors, there was not a single, solitary chair on which one could sit without encountering a cocktail waitress. Since informal "bull sessions" among AES members have always been a very important social function and a means to discuss and disseminate technical information, the lack of chairs torpedoed this activity. The only recourse was to the strategically placed bar/lounges, where if you didn't mind paying \$1.75 for a coke or \$2.00 for a cup of coffee, you could frolic with your peers.

Still, life does go on, and this was a very significant convention. Among other things, there was so much activity in the burgeoning world of digital audio that the convention ran to five days for the first time in its history. Saturday, October 8th had been designated "D" (digital) Day, and was wholly devoted to digital technology and workshops. All Saturday afternoon there was a hands-on digital workshop cochaired by my recording associate Frank Dickinson and Jonathan Howard. Frank demonstrated the use of the professional 2-track JVC digital recorder and the 32-track 3M digital recorder for digital recording and editing techniques. Jonathan demonstrated how the Sony PCM-F1, with the aid of several black boxes, could be made compatible with the professional Sony 1610 digital recorder and also synchronize with SMPTE time code and video interfaces. There was also an interesting day-long digital tutorial on Saturday which was very well received and gave a grounding in basic digital audio for those not yet familiar with this technology.

In my opinion, there were a number

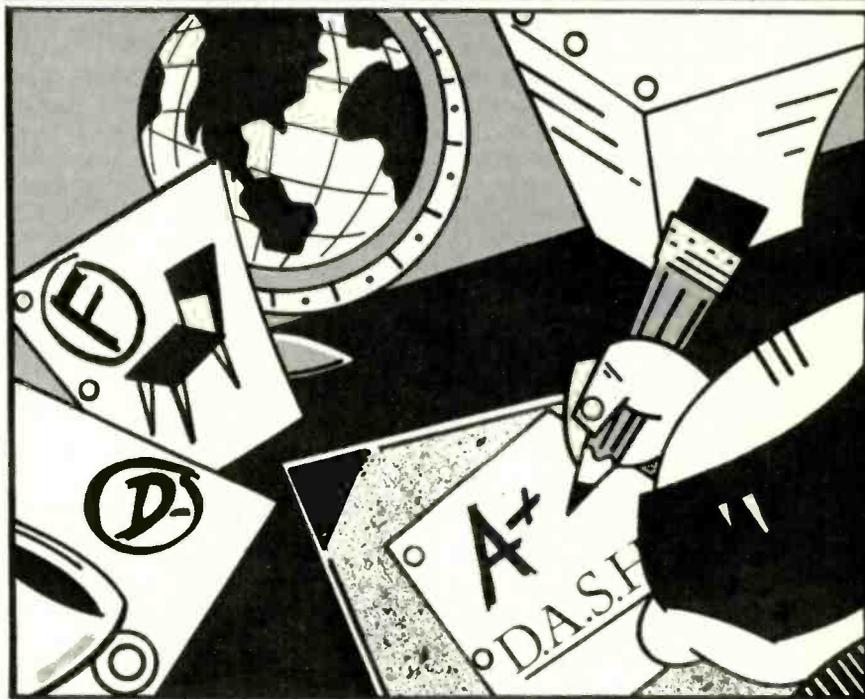


Illustration: Robert Scott

of papers presented which could be of landmark significance. Surely qualifying in this respect was "Signal Enhancement via Digital Signal Processing" by Dr. Roger Lagadec and D. Pelloni of Studer. Dr. Lagadec is a gifted young scientist, quite possibly the brightest star in the digital firmament. In fact, he deservedly was made a Fellow of the AES at the Convention Awards Banquet. The signal enhancement Dr. Lagadec has come up with is nothing less than the removal of noise from music program sources, plus the distinct possibility that, in time, such things as intermodulation distortion may be reduced. In Dr. Lagadec's own words:

"Signal enhancement describes attempts at approximating original musical signals from non-ideal recordings. In a novel processing method, a digitized audio signal is split into phase-linear, complementary narrow-band signals for individual processing prior to being re-merged to form the enhanced output signal.

"It is intuitively appealing to use digital audio techniques not only in the digital recording and processing of today's signals, but also in the archiving and possible restoration of yesterday's valuable musical heritage. The task is

almost a contradiction in terms: Possessing a recording of an unknown musical signal degraded by unknown noise components, one wants to preserve the music and suppress the noise, possibly in real-time, and with only a modicum of manual control. However, whatever in our brains differentiates between 'music' and 'noise' does not yet accept straightforward modeling. Some examples, however, indicate that musical signal enhancement should be achievable.

"Two different applications will be considered: One is to take decent recordings and improve the SNR by a perceptible amount, so as to make them better suited for new media such as the Compact Disc. The other is to take recordings of evident cultural value but objectionable technical quality and attempt to restore what occurred in front of the microphone. In the first application, noise components are small, and already far down the level scale, although still perceptible. In the other, they are large enough to interfere with the musical signals."

To accomplish this signal enhancement and noise reduction, Dr. Lagadec has designed a very special 512-band digital filter, far too complex to describe here. This multi-band filter

has been used in a broad range of processing and enhancement experiments. Dr. Lagadec describes some of his results:

"A large number of takes have been processed and stored digitally, ranging from high-quality analog masters where only very low noise components exist, to precious, but noisy early recordings, and to artificial signals, as used in assessing digital audio. Some results are humbling: Telling a computer to remove very much noise but to preserve a pianist's humming and breathing, while possibly removing some distortion effects—the whole of it on signals read from an LP—indicates enthusiasm, but does not lead to fully convincing results. Other results are extremely encouraging. Most results indicate that the approach is powerful, the parameters many, and that only professionals with musical expertise will know how to benefit from the system, and how to adjust the parameters properly."

Dr. Lagadec goes on to say that "An approach to signal enhancement based on efficient filter bank design has been presented. It is based on consequent refinements of the already powerful polyphase method, aimed at making it useful in digital audio applications. The result is a very high quality real-time, time-domain filter bank with linear phase, which can be implemented in hardware."

Brought down to practical aspects, Dr. Lagadec's multi-band enhancement/noise-reduction filter opens up fantastic potentials in many areas. Apparently, under optimum conditions the device could be used to remove the residual hiss from thousands of pre-Dolby tape masters (and, of course, from Dolby-encoded tapes as well). The late Bob Fine's famous Mercury Olympian Series recordings immediately come to mind. So do my own Everest three-channel half-inch tapes and 35-mm magnetic film masters. Think of the music treasures in the vaults of Decca, EMI, Philips, DGG, RCA, CBS, etc.! All this enhancement presumably without degradation of the music signals!

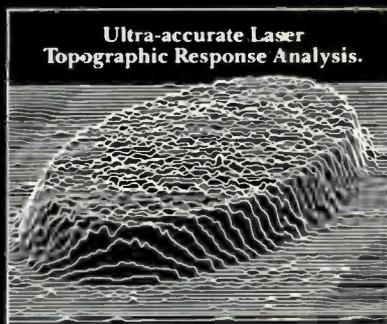
Dr. Lagadec was kind enough to demonstrate his filter system in his hotel suite. Even though it was a fairly primitive example of this new technol-

ogy, the results were nonetheless impressive. The reference a few paragraphs earlier to the "pianist humming" was an old 1955 Glenn Gould LP. The improvement between the unprocessed and processed sound was striking. Hiss certainly was reduced, but more than that there was a reduc-

tion in distortion. As Dr. Lagadec pointed out, there is still a long way to go, but I'm betting he will nurture the device and develop it to its full potential.

During the convention, a joint press conference was held by Sony, MCI, Matsushita and Studer so they could introduce us to something called

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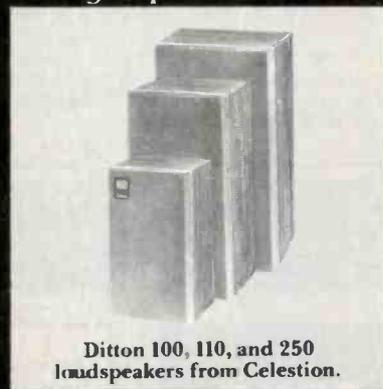
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DENON

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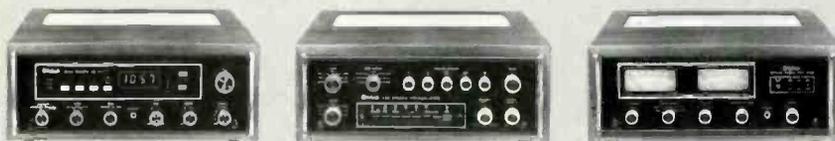
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"DASH." Is this a new soap powder? No, friends. DASH is the acronym for Digital Audio Stationary Head, a digital recording format jointly adopted by this group of companies.

Essentially, this is an attempt to set a standard for digital recording which will be internationally adopted by the audio industry. I believe that the idea and the goals are laudable. Full compatibility between the digital recorders of the various companies would mean easy international tape interchange. Digital copying could be direct, with no necessity of leaving the digital domain.

There are three versions of the DASH format, depending on fast, medium and slow tape speeds. However, encoders and decoders of all versions are identical. The number of tracks required to record one digital audio channel also varies. All three tape speeds operate at the 48-kHz sampling rate, which is also recommended as an international standard. The version of DASH for fast speed operates at 30 ips, requires one track per channel, and can accommodate 48 digital audio channels on half-inch tape. Medium-speed (15 ips) DASH requires two tracks per channel and can accommodate eight digital audio channels on quarter-inch tape, and 24 channels on half-inch tape. Finally, the slow-speed version, at 7½ ips, requires four tracks per digital audio channel, and accommodates two or four channels on quarter-inch tape.

Few would argue that the DASH format is not a good idea. In the best of all possible worlds, DASH would be adopted and we would all start digital recording, say, for example, on January 1, 1984. Unfortunately, there are thousands of reels and cassettes of digital recordings made in the last few years on Sony, Soundstream, JVC, 3M and Mitsubishi recorders. None of these machines are compatible with each other, nor can any of them make direct digital copies to DASH recorders, but must convert D-to-A and then back to A-to-D. This means, in essence, the present digital recorders must be maintained to service existing digital libraries. Is there a solution? Apparently none yet, and as long as this situation continues, it will certainly delay the adoption of DASH. A

BACK PORSCHE

**A Wreck in Clover**

"How can you cut up a lovely car like that?" Porsche lovers asked at Clover Industries' Winter 1983 CES display. Throwing away half of a \$30,000 car does seem a bit extreme, even to display speaker enclosures made for Porsches and such. But Clover had performed no such barbarism. The previous owner had, by colliding with a telephone pole. Clover bought the wreck for \$7,000, and lovingly refurbished the back half.

Car-Speaker Speculations

The speakers in the Delco-GM/Bose mobile sound system (Dec. '82) get good bass from enclosures and equalization systems custom-matched to a particular car, and good stereo balance from careful angling of the drivers. But what can be done if you already have a car, or want a car that's not available with this sound system?

One problem in getting good bass performance is that the woofer manufacturer knows only the probable range of enclosure volumes his driver must deal with. Tuning the driver to the enclosure on an ad hoc basis would be difficult—but how about doing the reverse?

A second driver, used as a passive radiator, could act as a port. It could be tuned by adding mass to built-in attachment points. Its damping could be adjusted if you left the voice-coil in

and connected a pot across its terminals. For extreme damping of particular frequencies, replace the pot with an amplifier having enough frequency-shaped, negative feedback to achieve negative gain at those frequencies.

So far, it's just an idea, and one which I lack facilities to try. If any of you attempt it, let me know how it works.

A Toronto reader, Clay Langhorne, sent in an equally untried suggestion for the stereo-balance problem. Putting the two stereo channels on opposite sides of the car makes it almost impossible to balance the sound so that both passenger and driver get good balance at the same time. But if one channel were placed on *both* sides, and the other channel in the middle, then a suitable balance should be possible. The only problem I could see is that the channels would be reversed for one passenger; some listeners are bothered by that.

Big-Trunk Blues

It may be heresy to say so, but different kinds of music do require different sound capabilities in the systems reproducing them. Not that a good system can't handle them all, if it's good enough (and if those sounds are properly recorded), but that a system which sounds good on one may not always work well for another.

This is most true in the bass. ADS tells me that their subwoofer, which is

designed to go down low and flat (a classical-music requirement) when working into an open trunk, is sometimes boxed into a small enclosure by dealers, who say it sounds much better for rock that way. It does, too—because it then has a big response hump at about 80 Hz.

At the moment, the bass in my car is right for neither rock nor classical: The woofer I'm now trying is designed for an enclosure volume of about 3 cubic feet while my trunk measures about 21 cubes, so it's underdamped, and loose-sounding. My trunk is not yet properly sealed to keep the front and rear waves of the woofer from mixing, so there's a definite bass roll-off. But it still sounds fine for country music—good thing one FM station here in New York broadcasts that.

EQ Before the Fact

In an ideal world, our car systems would be flat, and we'd only tweak the tone controls occasionally, to rebalance recordings whose engineers didn't share our tastes. In the real world, even custom systems like our project car (described in the Aug. and Sept. 1983 issues) are not completely flat, and the average installation is far from it. Hence, the omnipresent equalizers, used so often to iron out the grosser inadequacies of a mobile system's frequency response.

But the typical five-band mobile equalizer, with its sliders covering two octaves each, has too broad an effect; using one to even out the sound is like trying to sign a letter with a paintbrush. At the same time, even five bands are a lot to fiddle with while driving.

There is, however, an alternate route to equalizing your car stereo: Leave the stereo alone, and equalize the tapes as you make them. Your home equalizer probably has more and finer bands. But unless you have a spectrum analyzer you can take out to the car, this won't be easy. Expect a lot of trial and error, with a walk back from the car to the living room between each error and the trial following. First, cut back where your car's response peaks; boost out any dips later (and sparingly, to prevent tape overload). And be advised that you'll need to apply the inverse EQ when playing those tapes at home.

ROCK/POP RECORDINGS

MICHAEL TEARSON
JON & SALLY TIVEN

WINNING PARLEZ

No Parlez: Paul Young
Columbia BFC 38976.

Sound: A Performance: A+

The likelihood of a record featuring only two original songs, and with an emphasis on drum-machines and synthesizer, impressing this review team is pretty slim. However, Paul Young's American debut is one of the best records of 1983, hands down; its command of the synth-pop genre just destroys the competition. There is no need for anyone, except perhaps Marvin Gaye, Stevie Wonder or some other great, to even attempt applying this hit formula to their music. Paul Young has set such a high standard that to attempt any adoption will only invite comparison

and inevitable defeat. From the choice of tunes, to production/instrumentation, and The Voice, Young has given credibility to this style and, at the same time, has guaranteed its obsolescence.

Whether he is singing a country & western near-classic ("Love of The Common People"), or a Marvin Gaye semi-throwaway ("Wherever I Lay My Hat"), or a Joy Division relative unknown ("Love Will Tear Us Apart"), this 26-year-old can take any song and make it sound like an R&B classic. His vocal quality owes a bit to Paul Rodgers, but less than Robert Palmer's and Lou Gramm's do. Obviously, he's listened to every American soul single made since 1960. Young's phrasing is gut-wrenching, he knows just when to let his voice break, and he crosses all song-style demographic borders. He's the best white singer to emerge in 10 years, maybe more, male or female. He could sing "Anarchy in the U.K." to a Frank Sinatra audience and bring them to tears.

His own compositions aren't bad at all, but it's hard to tell how good they are, given his fierce delivery. The backing singers (Kim Lesley and Maz Roberts) add a nice touch, and bassist Pino Palladino soars above the arrangements with a style not heard on rock records since Andy Fraser. Rarely has an album oozed with such greatness, taste, style, and emotion. If this one doesn't sell like gangbusters, we should all be doomed to listen to elevator music for the rest of our lives. Paul Young is undeniably the best thing to happen to rock since The Pretenders, to R&B since Prince, and to country since Elvis Presley.

No Parlez

is a good gift for all your friends who like any kind of music—far-out enough for the progressives and straight-ahead enough for the middle-of-the-roads. *Jon & Sally Tiven*



Joe Jackson

Mike's Murder Soundtrack:

Joe Jackson

A&M SP-4931, \$8.98.

Sound: B- Performance: B-

Joe Jackson's soundtrack music for James Bridges' upcoming film, *Mike's Murder*, is a surprising yet natural turn from the wonderfully urbane *Night and Day*. Where that album's songs flowed one into another, the movie's songs stand more separately and with a harder edge, too. "Cosmopolitan" is jaunty in the "Stepping Out" mode, but "1-2-3-Go (This Town's a Fairground)," "Laundromat Monday" and "Memphis" (definitely *not* the Chuck Berry classic) are three nervous rockers, each filled with very visual imagery. The tender "Moonlight" closes the side.

Side two is something completely different for Jackson. It contains three instrumental pieces, headed by the 11-minute, Latin-rhythm workout, "Zemico," which carries its length very well indeed.

This album is not as invigorating as *Night and Day*, but it displays ongoing growth and vigor on Joe Jackson's part. He is a fascinating iconoclast of a writer and musician. *Michael Tearson*

Paul Young

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The Motels

Little Robbers: The Motels
Capitol ST-12288, \$8.98.

Sound: B+ Performance: B

Following the very successful *All Four One*, with the high-gloss/high-tech production of Val Garay, The Motels have clearly decided to further pursue what made their hit album a hit. Garay is not only back again as producer, he has become the group's manager as well.

Confidence glows in every aspect of *Little Robbers*. Martha Davis' songwriting is concise yet tuneful, strong yet nervy, with very healthy tensions built in. A fine example of this tension is Martha's flip-flopping from wistful to menaced and back again in "Suddenly Last Summer." The nervy pun named "Isle of You" could easily have been cheap or precious but is rendered so well that the song is a true highlight of the set. Elsewhere, a collaboration with Bernie Taupin, "Into the Heartland," is a Springsteen-Pontiac joyride that shows off a new-found narrative sense.

What it all means is that The Motels intend to firmly establish themselves as top-rank pop musicians with *Little Robbers*. The album explores terrain they first staked out on *All Four One* without really reaching any further. They have arrived at a formula and sound which they should be able to sustain very successfully for as long as Martha Davis' muse holds out. *Michael Tearson*

Bossa Nova Hotel: Michael Sembello
Warner Bros. 23920-1, \$8.98.

Sound: A- Performance: B+

If you haven't heard "Maniac," Michael Sembello's monster hit from the film *Flashdance*, you'd have to have been in Siberia for most of a year. That song appears on Sembello's *Bossa*

Nova Hotel. Do not dismiss "Maniac," or Sembello, as one-hit wonders. Michael Sembello is an extremely classy act who has learned worlds from masters of the forms of hit songs and production. The most notable must be Stevie Wonder, with whom Sembello worked, toured and co-wrote for years. Sembello absorbed many of Wonder's eclectic gifts for melody and phrasing.

Bossa Nova Hotel could easily turn into a hit factory. Even as I write, "Automatic Man" is starting to leapfrog up the charts. But nearly any song on the album, even the somewhat avant-gardish "Cowboy" with its chugging banjo part, has hit potential. Some of the credit must go to producer Phil Ramone who has brought his usual superb sound, detailing, and clear arrangements to bear.

It's been a long road from Philadelphia to *Flashdance* for Michael Sembello, but his payoff is going to be huge—an inevitable harvest of gold and platinum. And he is very likely to get only more amazing as his work develops. *Michael Tearson*

Michael Sembello



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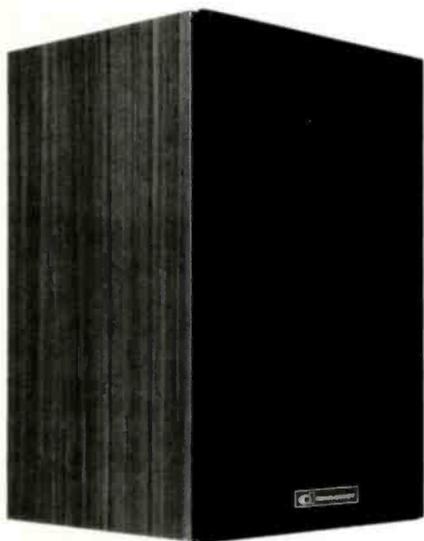
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Big Country

The Crossing: Big Country
Polydor 422-812, \$8.98.

Sound: A- Performance: B+

Rarely has a debut album by a virtually unknown group been met by such critical raves as has *The Crossing*. It's a rarity when one group can strike nerves with both the critics and the public, and this is the case. Big Country is selling lots of records, pleasing the aesthetes, and getting played on radio as if they're the New Beatles or something. Perhaps this has more to do with what they aren't—synthetic rock, English R&B, Springsteen rock, etc.—than what they are.

Produced by Steve Lillywhite, Big Country sounds sort of like U2 (produced by same) would sound if U2 could play a lot better, but without the charismatic lead singer. They are of Scottish descent and show it on their tartan sleeves, using cowboized, traditional Scottish melodies as the basis for their guitar lines. Of course, they're a bit derivative (who isn't) but they choose their role models well (Johnny Cash's "Ring of Fire" for one) and can actually write good songs on top of it all. "Fields of Fire," "In a Big Country," and "Chance" are among the best songs on any album that was released in 1983.

The group's main force is Stuart Adamson, who, in his previous group The Skids, was more a music-behind-the-voice than the singer/lead guitarist he is now. Although his vocal chops are somewhat limited, he makes the most of what he has. The other guitarist, Bruce Watson, plays staccato guitar lines that sometimes sound more like keyboards and add considerable

texture to the sound. Bassist Tony Butler (who guested on The Pretenders' last single) and Mark Brzezicki (a Pete Townshend sessionaire) hold the rhythm section together in a fashion similar to the original Pretenders style—distinctively British New Wave, but also owing to American R&B. They manage a sound that is vital, modern, and yet has a lot of heart—not easy in these mechanized times.

This will probably be the band that gets the shot at being the next huge English band (like The Pretenders did). Let's hope they don't blow it. They seem to have their heart in the right place, although they aren't phenomenal yet they could well be. Very good, these days, seems to be good enough.

Jon & Sally Tiven

Ark: The Animals
I.R.S. SP70037, \$8.98.

Sound: B Performance: B+

Ark is a reunion of the original Animals of "House of the Rising Sun" fame—Eric Burdon, Chas. Chandler, Alan Price, Hilton Valentine and John Steel. This is not their first reunion album. That one, done around 1976, was a dismal failure, badly recorded with

The Animals





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Mitch Ryder's new album stands on its own terms. It's a good rocking record that'll work well at parties.

atrocious material. By comparison, *Ark* is an unexpected triumph, a truly dandy album.

The big difference is that the group has gathered and generated some excellent new songs, many of them co-written by Burdon. The Animals' thrust these days shows some obvious debts to Springsteen and Seger, which really amounts to them coming full circle. In addition, the band has a nice, floating swing to the rhythm section.

Best of all, even with Burdon's distinctive growling vocals, The Animals are not mired by looking backwards here. With thoroughly up-to-date music and arrangements, *Ark* is a very classy album. From chuggers like "Loose Change," "The Night" and "Being There" to the reggae-hued "Love for All Time" and the slow-burning "Prisoner of the Light" and "Melt Down," The Animals are on target.

Ark was one of 1983's very pleasant surprises. *Michael Tearson*

Never Kick a Sleeping Dog: Mitch Ryder
Riva 7503, \$8.98.

Sound: B- Performance: B

Mitch Ryder never really went away after his steaming Detroit Wheels hits of the '60s. It's just that we never noticed. Through the '70s and into the '80s, he actually released several albums, most of them in Europe, only available as imports.

Mitch Ryder



The new one is a nifty pop album. Produced and seemingly masterminded by John Cougar, *Never Kick a Sleeping Dog* is a completely current album, with no looking back.

Mitch Ryder is still a compelling rock 'n' roll singer who can ram a song home. "B.I.G.T.I.M.E." opens things with a banging rave-up. "When You Were Mine" is an early song by Prince that is really ingratiating here. Ryder duets with Marianne Faithful on "A Thrill's a Thrill," a most fascinating vocal mismatch. "Come Again" is a rollicking, rocking Cougar/Ryder original. "Cry to Me," the only oldie of the set, closes a terrific first side.

Despite three Ryder songs and one written by Cougar, the second side is less memorable. Not bad, mind you, but the best is bunched on side one.

It would have been easy and cynical to dismiss the whole project as a reclamation echoing Bruce Springsteen's two fine albums with Gary U.S. Bonds. But, like the Bonds albums, this Ryder album stands on its own terms. And that means a good rocking record that'll work well at parties.

It helps, too, that Mitch is still one whale of a singer. *Michael Tearson*

"... and a time to dance.":

Los Lobos
Slash/Warner Bros. 23963-1, \$6.98.

Sound: B+ Performance: A-

What a joy Los Lobos' mini album is. The band plays a tart slew of classic-style rock 'n' roll with a steeping of Tex-Mex *conjunto*. The album's seven songs swing wildly from end to end, with smooth vocals set against raucous party-style playing.

Material ranges from Ritchie Valens' "Come on Let's Go," through several band originals, to "Anselma" and "Ay Te Dejo en San Antonio," a swell pair of Spanish-language *conjunto* standards. Each and every piece is played with vim and spunk.

The Texas sounds of *guitarron*, accordion and *bajo sexto* mingle with electric guitars and bass. And, of course, drums. Steve Berlin of The Blasters adds sax; Berlin and T-Bone Burnett coproduced. They played it smart, keeping the sound clean, simple and lively. *Michael Tearson*

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BERT WHYTE, JOHN M. EARGLE,
C. VICTOR CAMPOS

BYZANTINE BUSINESS

Saint-Saëns: Symphony No. 3 "Organ." The Philadelphia Orchestra, Eugene Ormandy; Michael Murray, organ.

Telarc CD-80051.

Telarc's recording of the Saint-Saëns Third "Organ" Symphony stands in marked contrast to the DGG/von Karajan recording of this work which I reviewed in October. You may recall that DGG tried to make a composite recording, with the Berlin Philharmonic recorded in their hall, while the organ parts were recorded in Notre Dame in Paris. The ensuing mix just didn't work. The reason for attempting a composite recording of this exciting and dynamic music is that the proper, big pipe organs required for this work reside in great churches and cathedrals. These huge acoustic spaces are usually much too reverberant to successfully record the orchestral parts of this Saint-Saëns score.

Quite properly, Telarc wanted a recording venue in which the Saint-Saëns "Organ" Symphony could be recorded as a complete musical entity in accordance with the score. Having obtained the services of the great Philadelphia Orchestra and its venerable conductor Eugene Ormandy, Telarc felt that the Symphony could be successfully recorded in the St. Francis de Sales Church in Philadelphia. This church is modeled after the Hagia Sophia in Istanbul. With a central Byzantine dome, 90 feet above the floor, with four smaller domes flanking it.

While visually striking, domes are usually bad news acoustically. There is a tendency to vertical sound-focusing with problematic slapback, but this apparently was not so in this particular situation. However, recording in the St. Francis de Sales venue was still fraught with peril. The reverberation period of the church falls just short of making orchestral recording impractical. As it is, in orchestral tutti and fortissimos, and during the thunderous output of the full grand organ in the finale, the sheer volume of sound comes very near to overloading the room. On the other hand, smaller instrumental groupings of strings, woodwinds or brass can be ethereally lovely in the spacious acoustics of this church.

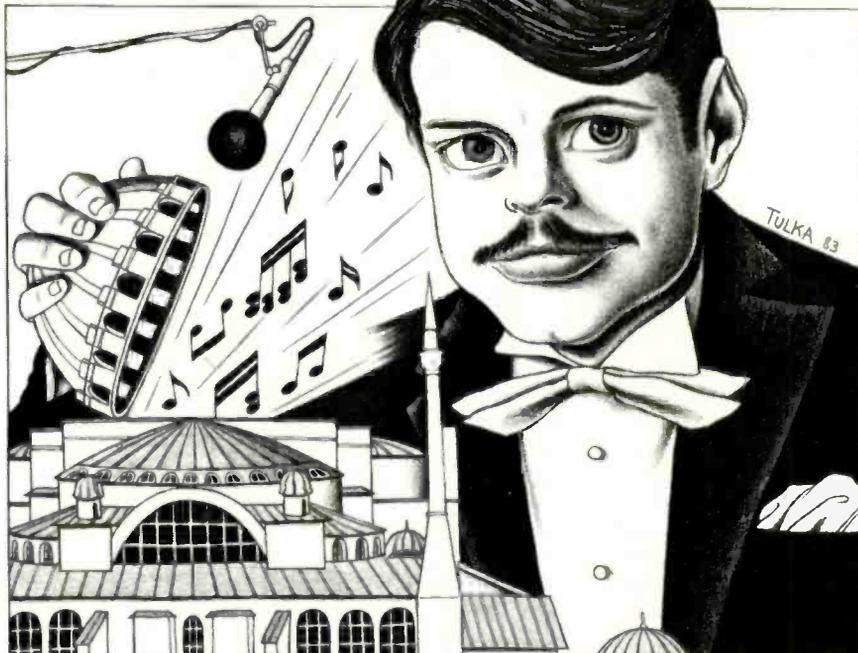


Illustration: Rick Tulka

The organ (a rebuilt and enlarged Haskell) combines the qualities of the great Aeolian-Skinner organs with the full-bodied French Cavallé-Coll organs. With four manuals, 93 stops and 112 ranks, it is an imposing instrument, with properly grandiose 32-foot pedal tones when desired. The hard interior of the church made for some extra brightness in the upper strings and brass, but the overall sound is very clean. The dynamic range in this recording is awesomely wide. The great sonic weight and sonority of the finale, with orchestra and organ in full cry, will tax even the most elaborate stereo systems to their limits.

Add to this sonic grandeur the excellent performance of Ormandy and the superb playing he elicits from his great Philadelphians, and you have an outstanding CD recording. *Bert Whyte*

Rimsky-Korsakov: Capriccio espagnol; Debussy: Iberia; Turina: Orgia. The Dallas Symphony Orchestra, Eduardo Mata.
Telarc CD-80055.

This certainly has to qualify as one of the best CDs on the market, both on technical and musical grounds.

Eduardo Mata is a fine conductor

who studied under my dear friend, the late Carlos Chavez (whom I recorded with the N.Y. Philharmonic in 1959). The Mexican-born Mata has done wonders for the Dallas Symphony Orchestra, and their playing in these works is eloquent testimony to their progress. Their unison string playing is excellent.

The music is given an excellent up-front, well-projected and well-balanced recording in the fine-sounding acoustics of Cliff Temple Baptist Church in Dallas. There are lovely French-horn

Eduardo Mata



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The recording approach to the Bartok concerto gave an excellent overall ambience, with sensible highlighting of individual sections.

sounds, very sonorous contrabassi, and smooth woodwinds firmly anchored in the phantom center channel. Brass has good projection and plenty of punch. There is the usual Telarc heavy bass drum—very clean and with no hangover.

Dynamic range on this CD is impres-

sively wide. If the "Capriccio" and "Iberia" are suggestive of Spanish influences, the Turina "Orgia" is the unadulterated real thing. All receive spritely, effective performances under Mata that, coupled with the stunning sound, make this CD among the very best currently available. *Bert Whyte*

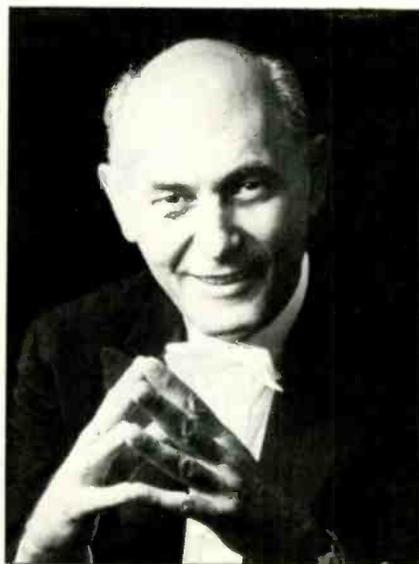
Bartok: Concerto for Orchestra; Dance Suite. The Chicago Symphony Orchestra, Solti.
Decca 400 052-2.

This recording clearly illustrates how digital recording's 90 dB of dynamic range can serve the music. This work begins quite softly, but most record listeners have probably never heard it without some degree of level boosting in the remixing process. There is a temptation, when you first put the disc on, to set the level where you think it should be, based on the last previous material. After a minute or so, the strings are screaming at you. At this point, you should stop and start over, this time keeping the opening section down in level where it belongs. This way, the music can be heard with all its dynamics in proportion. Let there be no doubt, however, that Solti and the Chicagoans reach some ear-rattling levels when heard in the normal concert hall environment.

Solti, of course, plays this music with about as much intensity and conviction imaginable, and the recording approach is typical Decca: An excellent overall ambience with sensible highlighting of individual sections. The bass drum in the "Dance Suite" is about as solid and deep as you are likely to hear.

John M. Eargle

Sir Georg Solti



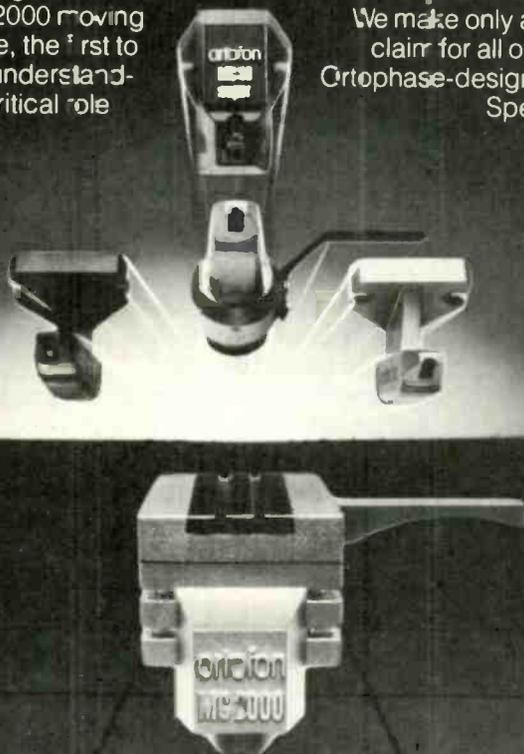
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Smetana Quartet

Beethoven: String Quartet No. 7 in F Major, "Rasoumovsky," Op. 59, No. 1. Smetana Quartet. Denon 38C37-7025, \$17.95.

It bears repeating that chamber music is transfigured by the digital disc. The intimacy of a string quartet, so apparent in a live performance, is lost with the imposition of distracting surface noises of a vinyl disc recording.

In this CD recording of the Beethoven String Quartet No. 7 by the Smetana Quartet, the sound of the music is very open and transparent, with even the most subtle nuances of performance and expression clearly revealed. The tonal qualities of the first and second violins, the viola, and the cello are very cleanly and accurately rendered. The recording has a fairly close-up perspective within a slightly reverberant field, which is as it should be. It is reasonable to record string quartets with just enough reverberation

to soften the contours of the music, but quite reprehensible, in my view, to overwhelm them with Mammoth Cave acoustics.

The Smetana Quartet does not quite have the polish and élan of some of the "big name" string quartets, but they have that intergroup rapport that is so vital, and their performance is thoroughly enjoyable. *Bert Whyte*

Mozart: String Quartet in B Flat Major "Hunting" and String Quartet in D Minor. Smetana Quartet. Denon C37-7003, \$19.95.

On this CD, the Smetana Quartet plays two of the more familiar Mozart quartets in a lovely recording, notable

for its clean yet well-defined string tone. The positioning of the instrumentalists is precise and stable, with the first violin on the left of the soundstage, then the second violin just left of center, the cello just right of center and the viola on the far right. Acoustics may be a shade too spacious for the intimacy of a string quartet. The highly burnished performances gleam with the innate musicianship of the artists. *Bert Whyte*

Holst: The Planets. L'Orchestre National de France, Lorin Maazel. CBS CD 37249.

Here is another example of a reasonably good performance much diminished by some poor sound.



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I have never heard the "Carnival" performed with as much attention to detail, and Previn's play on dynamics is a good part of this.

The opening "Mars" section is extremely coarse-sounding, with a grainy texture, further exacerbated by shrill-sounding strings. On this studio recording, detail is lacking to the point where everything becomes quite amorphous, and one can hear the artificial reverberation. The sound is better

in the quieter, more open sections. The dynamic expression in the "Uranus the Magician" section is quite impressive, too. The long diminuendo of the wordless female chorus in "Neptune," which is supposed to gradually fade into silence, was accomplished with a helping hand on the mixer controls.

Maazel elicits some fine playing from his French musicians in a better-than-average performance of this much-recorded work, but he is poorly served by the engineers. *Bert Whyte*

Saint-Saëns: Carnival of the Animals; Ravel: Ma Mère L'Oye. The Pittsburgh Symphony Orchestra, Andre Previn.
Philips 400 016-2.

This recording is miked simply, with quite natural perspectives. The layering of the orchestra from front to back is especially realistic, and the engineers have resisted any temptation to highlight the various solo instruments. In a piece such as the "Carnival," that takes some restraint.

I have never heard the "Carnival" performed with as much attention to musical detail, and Previn's play on dynamics is a good part of this. On the other hand, the Ravel, although very well performed, lacks the magic it has in the hands of, for example, Giulini. The piece is a unique blend of naiveté and sophistication (hardly a work for children), and Previn's approach seems to me to be a bit studied.

But, sonically, everything is glorious, and this CD is highly recommended. *John M. Eargle*

Sortileges de la Harpe Indienne. Ignacio Alderete, harp.
disques Pierre Verany PV782111. (Available through AudioSource, 1185 Chess Dr., Foster City, Cal. 94404.)

Apparently, like all Pierre Verany CDs I have heard thus far, the overall sound level is quite high and caution is indicated if playback is made at a volume setting used for lower-level CDs.

Miking is very close up, as witness the deeply sonorous bass viol played arco at the beginning of the disc. The Paraguayan Indian harp differs from the classical harp in that it is diatonic, with no pedal, and just a five-octave range. The biggest difference is in the inclusion of a resonance box which is excited by the vibrating harp strings and gives the instrument its distinctive tonal qualities. It can be considered much lighter and more brilliant in tone than the standard concert harp.



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While Ashkenazy takes care of the architecture of this work, the engineers have given us some of the loveliest sounds imaginable.

Accompanied by guitar and bass viol, the harp is in a highly reverberant field yet is very clean and well-defined. The harpist, Ignacio Alderete, is obviously a master of his instrument, as his flamboyant playing attests. All the music on this CD is of Latin-American origin, with "El Condor Pasa" the only work you may find familiar. *Bert Whyte*



Vladimir Ashkenazy

Sibelius: Symphony No. 4, Luonnotar, and Finlandia. The Philharmonic Orchestra, Ashkenazy; Elizabeth Soderstrom, soprano.
London Decca 400 056-2.

Of all the fine instrumentalists turned conductor in recent years, Ashkenazy gets my vote as the best. His recording of Tchaikovsky's *Manfred Symphony* a few years back made it obvious that he knew what the podium was all about. While Sibelius' Fourth has often been invested with beautiful sonorities, few conductors have really been able to make the piece sound cohesive. It can all too easily fall into episodes and end on a question mark. While Ashkenazy takes care of the architecture of the work, the engineers have given us some of the loveliest sounds imaginable. The melding of strings and brass, so important in the texture of the first movement, is stunningly done. All is in

balance, and nothing obtrudes. Colin Davis, with the Boston Symphony Orchestra, comes pretty close, but Ashkenazy wins.

The rarely heard "Luonnotar" probably deserves its obscurity. Some may feel that "Finlandia" ought to suffer a similar fate, but this version will make

everyone sit up and take note. It is a high-tension performance with brisk tempi. There is no time here for the usual milking of effects, and the work is all ice and steel.

Kenneth Wilkinson's engineering is as superb as it has ever been.

John M. Eargle

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Sonic Arts LS 23, digital, \$17.98.

Mozart: Violin Concerto No. 1 in B Flat, K. 207; Six German Dances, K. 571; Symphony No. 39 in E Flat, K. 543; Five Contradances, K. 609. The Mozart Festival Orchestra, George Cleve; Daniel Kobialka, violin.

Sonic Arts LS 24-25, digital, two-record set, \$20.98. (Sonic Arts, 665 Harrison St., San Francisco, Cal. 94107.)

The Concerto for Piano and Orchestra album is Mozart at his most expensive, in a handsome big box complete with foam padding inside and quantities of literature, both inside and out, to back the music. There is only one disc, and the first side runs all of 14:12, the second side a few minutes longer. But then one does not measure Mozart by the inch or the minute, and optimum technical quality of sound is thus guaranteed. This is also a "live in concert" recording, complete with audience sounds and rave applause at the end. It also is billed as "Direct-to-digital-direkt-to-disc." And it is a good, heartfelt, very musical performance, if somewhat untidy in spots in the orchestra's strings. No retakes,

remember, no editing. You get what was played at the concert, for ever and ever, amen.

If I may say so, then, this project invites every problem in the familiar repertory of ills which go with live recording. It is all very well to talk brightly about how an occasional mistake isn't really so bad, and the concert ambience, live, was so tremendously enthusiastic at the time, and so on and so forth. The vital question is—does all this come over to the *recorded music* listener, the exclusive audience for this record? This old pro of a half-century of listening in that fashion will have to say—maybe.

The performance assuredly does get through. Claude Frank is a superb Mozart player in the best European tradition, a master of good phrasing and careful dynamics and a profound musician who is modest before Mozart's genius. Rare! The smallest orchestra plays with dedication, and I don't mean in the computer sense. If I am right, there is even a most unexpected intruder hovering over Mr. Frank's shoulder during the first-movement cadenza—Beethoven! If this is not one of those astonishing (and wholly out-of-style) cadenzas that Beethoven wrote in his later years, then it is an even more astonishing imitation of the same, which I assure you is a thing quite

uncanny. One could buy the recording solely for these few moments and feel justified.

Let me be specific as to what I hear. The orchestra is recorded at a normal distance, more or less, in a somewhat dry acoustic (audience damping, we could call it); the piano, on the other hand, is recorded very close, seemingly only a few yards away, as though for a solo recital. The two do not blend. The orchestra, though it is loud enough, simply does not relate as the music demands to the sound of the soloist, who ought also to be out there on the platform. I could not adjust my ears to this to the point of forgetting it. And who is that voice, very close, humming bits of music out of tune? I fear it must be Mr. Frank himself, who seems to be another Glenn Gould! And since that sound is so very close, one simply cannot project the piano out where it belongs in space.

Audience? The somewhat lame solution to a never-absent sonic problem is to open the two sides of the disc with a longish stretch of audience noise. I found this offensive—on a record. It just does not project any real sense of our being *there*. Sorry, but so it hits me. And, much as I enjoyed the orchestra, I do *not* want to hear *again and again* such weaknesses as the unfortunate blooper in the strings just before the end of the work. Once is okay; *once* is all right! But is a recording for once?

Let's not forget that *no* record is ever a live concert. It is a different musical

Claude Frank



medium, for better or worse, depending. Best to go for the two-record set, also from Sonic Arts, of Mozart music.

Though the two-record set has much the same operating crew, including the Big Boss, Leo de Gar Kulka, as the Mozart Concerto for Piano and Orchestra, it provides better listening as live in concert recordings. It's a tricky art, easily thrown askew, this recording-with-audience.

In the violin concerto, here, the balance between solo instrument and orchestra is excellent, and the rapport between the two just about ideal. Whereas in the piano concerto, that instrument seems much too close and does not blend with the orchestra. How come? Live concerts are always hazardous, is all I can say. In the big E flat Symphony, the audibly larger ensemble of instruments is well managed, to give us a larger sound (though not actually any louder). And the little Dances are right out of a Viennese ballroom.

As in the piano concerto, the strings are not too strong and tend towards slight nervous quavers and mildly blurred fast passages, but their musicality is high and their enthusiasm easy to hear. No outright bloopers to make you cringe on every replay.

In particular, the audience sound is much better handled in the two-record set. There is first some opening applause—and we can thus set level, a musical essential; then we hear faint tuning sounds, a good touch, followed by the appropriate hush before the music begins. This is really constructive and useful. But we pay in one inevitable respect for these audience sounds. At the start of the Symphony's quiet second movement, there is just what we always expect—a rash of flu-like coughs, as loud as the music itself. All too live! This is one sound effect we can do without on our records. The coughs are unedited. Ah, the digital bogey! Can we ever again afford to edit a cough down to a gentle swish!



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Grieg's music goes badly with the modern, highly academic works of the other two composers on *The Saxophone Sinfonia*.

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One more odd significance. At the end of the violin concerto's middle movement, we reach the end of an LP. Surprisingly, we first hear continued audience sounds, then, to my astonishment, the first two notes, faintly, of the last movement. End of side. Now that is downright amateurish if we go by the analog standards of the last 30 years. Is this a product of digital production? Does basic digital editing have to be *that* clumsy?

Whatever I say, do buy this set if you enjoy Mozart. The violin concerto is full of verve and joy, if not ideally polished; the big symphony is majestic without being overblown à la Sir Thomas Beecham or Leopold Stokowski of a generation ago, and the informal little dances are perfect—even unto the last, the one I call the Cat's Miaow. It slithers and slides and leers wickedly. This time the audience helps, with some good chuckles and a lot of applause.

The Saxophone Sinfonia. Music of Grieg, Caravan, and Chandler. David Bilger, director.
Golden Crest CRSDG 4221, digital, \$9.98.

I had to try this one—not just a quartet or so of saxes but a whole band, 18 of them. Unusual—but I found the record less interesting than those which feature a small group of solo instruments. The sax doesn't blend very well when there are several on one part, as in this sort of band, and the overall sound tends to be crackly, metallic, with a lot of grunting and snorting, in spite of much virtuosity among these players.

This, too, is an overly professional-minded disc; everybody is involved in the special sax hierarchy, not only the players but the conductor (a sax man himself) and even the composers—except Grieg, who is the major musical force on the record. His music goes badly with the modern, highly academic works of the other two composers, present-day operators. When such a disc is sent out to general reviewers and for sale to the public at large, it should be understood that this larger audience is neutral, interested in many

The Schubert Octet in F is ideal in sound for the recorded medium—colorful, not too small, nor yet too big.

other kinds of music as well as saxophone. That's not the feeling I get here.

Thus, the main work, the Grieg Holberg Suite ("In Olden Style," Grieg's turn-of-the-century version of what we now call Baroque), is done in an all-sax arrangement, whereas the original was composed first for piano and then converted by the composer to its best-known form, for string orchestra. Both piano and strings can play rapid, smooth accompaniment figures with an easy background rhythm—but the saxes, though they get the fast notes, make them sound jagged and sputtery—too much articulation. So why bother—why should we bother? You can have the Holberg Suite played on the correct strings or piano in some 10 current LP recordings. That's what I mean.

As for the other music here, it is strictly pro, in that now-tired neoclassical style that seems to be required for music composed by "perfessers" in music schools. It was once fresh and new, from 1918 (when Stravinsky wrote "L'Histoire du Soldat" for seven snazzy, jazzy instruments) through the late 1930s and beyond the war. It is now played out—dry as dust for the most part. Why put this stuff along with the juicy, romantic music of Grieg? Well, it could work out, but it doesn't here.

Better to have gone to the live concert at Lincoln Center from which this LP is drawn. That might have been another story. A concert is a concert, a record is a record. And maybe they did them in a different order?

Schubert: Octet in F for Strings and Winds. Boston Symphony Chamber Players.

Nonesuch 79046, digital, \$11.98.

This unique Schubert piece, for five strings, including double bass, and three winds, is ideal in sound for the recorded medium—colorful, not too small, nor yet too big. It makes a gratifying effect in the living room. One of its early recordings was a minor hi-fi sensation in the early LP days on that prestigious label, Westminster—I remember my excitement when I discovered the album.

Well, times move on and maybe the music isn't a discovery any more. Too often played. Bit too familiar. That, I sense, is the feeling with which this very elegant Boston Symphony recording is made. These are some of the great orchestra's top players, but they are more than that: In Boston they get around town as respected citizens among the musical elite, as few members of other orchestras do in this country. I think that this, too, we can hear in their Schubert. It is faultless, of course, but it verges, just barely, on the complacent. Except when things really get dramatic (and they can rise to such occasions), the music is just too low in voltage. I was disappointed.

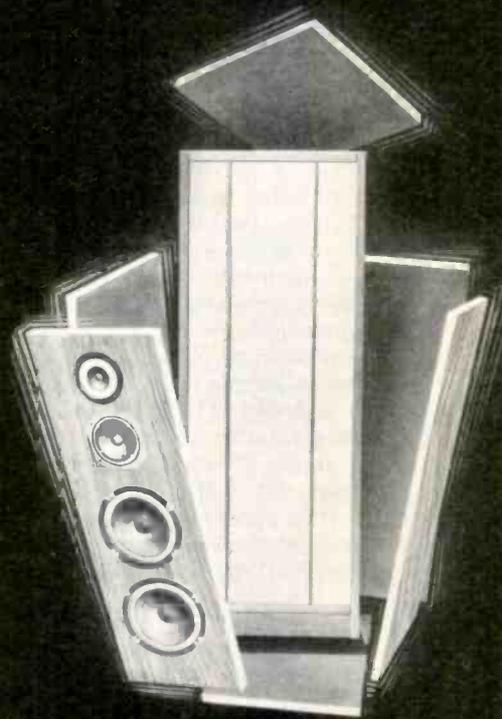
To be sure, Schubert based his music on the similar Beethoven Septet, a very popular work of that day and not one of Beethoven's heavy items at all. But Schubert cut far deeper. The performance must show it.

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McMillan's "Little Cosmic Dust" is instantly familiar, that sort of whooshing sea-sound we used to get from all of these prepared tapes.

Nancy Laird Chance: Exultation and Lament; James Luth: Pieces of Eight; Lee Hyla: Pre-Amnesia; Ann McMillan: A Little Cosmic Dust. Opus One 79, \$5.98.

Sound: B+ Recording: B Surfaces: B+

The principal work on this "contemporary" record is by Ann McMillan. Longtime friend of mine, she was chief Ampex operator in the early '50s for the now famed avant-garde electronic composer Edgard Varèse, who combined taped sounds and live music on a large scale in his final active years. McMillan was hooked—she went right on doing her own composing in a Varèse manner, also influenced by others such as Henry Cowell and his famed (1912) piano tone clusters. This piece is my first look-see at the result.

Well, interesting! Most electronics people are aware that electronic music has gone through two major stages very unlike each other. The first was the French-invented (during WWII) *musique concrète*, music made out of concrete sounds, as opposed to abstract music. It began even before tape, and for awhile, became a big thing. Then suddenly we had computers and synthesizers, and the older "tapesichord" music quickly gave way to the new squeaks and pops and tweets and blats, sirens, all the rest, not made out of any concrete original sounds but wholly synthesized.

So here is my friend Ann McMillan writing in 1981-82 an excellent work of *musique concrète*! She took piano tones and made a "collage" of them, and against this taped sound she puts a live piano, playing Henry Cowell clusters. It's very nice, but oddly old-fashioned. The sound is instantly familiar, that sort of whooshing sea-sound, minus percussion and mostly minus highs, which we used to get from all of these prepared tapes. Here, that sound goes well with the opposite sound of the live piano, bright and percussive. Old-fashioned but effective.

No slur on the other works intended, though they are shorter and all of them "live." One is for alto sax solo, another clarinet solo, a third for sax and tympani, all of these instruments rather beautifully recorded considering the intense and close-up sounds they make. I enjoyed the whole record.

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Dvořák's fairly prolific chamber music is definitely for chamber-music fans. Yes, the lovely melodies and fine harmonies we know in his familiar symphonies are here too, but in typically more complex form (like the more complex Beethoven string quartets, compared with the symphonies). This is right and proper and goes with the musical medium, which is for small spaces and does not ever use a conductor. On records, of course, all these nice distinctions have been blurred. Anything goes in the living room, be it



The New World String Quartet

large or small. Also in the four-door sedan or the sports car. But other aspects of this chamber music still obtain, to use the proper word.

Thus, you'll find these quartets (a) very stringy in the sound, as they should be at close range—which is a bit like saying you'll find a team of horses very horsey at a similar range; and (b) they are constantly busy, full of endless musical motion, much like the similar music of Mendelssohn. This business—busy-ness—can be wear-

ing on the unwary. You have to adjust to it, which isn't easy. Part of getting to know chamber music.

The quite young New World Quartet could, I think, integrate some of that busy-ness to a more subordinate level, shaping the larger musical elements for better communication. That might take them another 30 years or so—quartet playing is a rigorous art. But they are good, except for a somewhat weak first-violin sound. Engineering? I doubt it.

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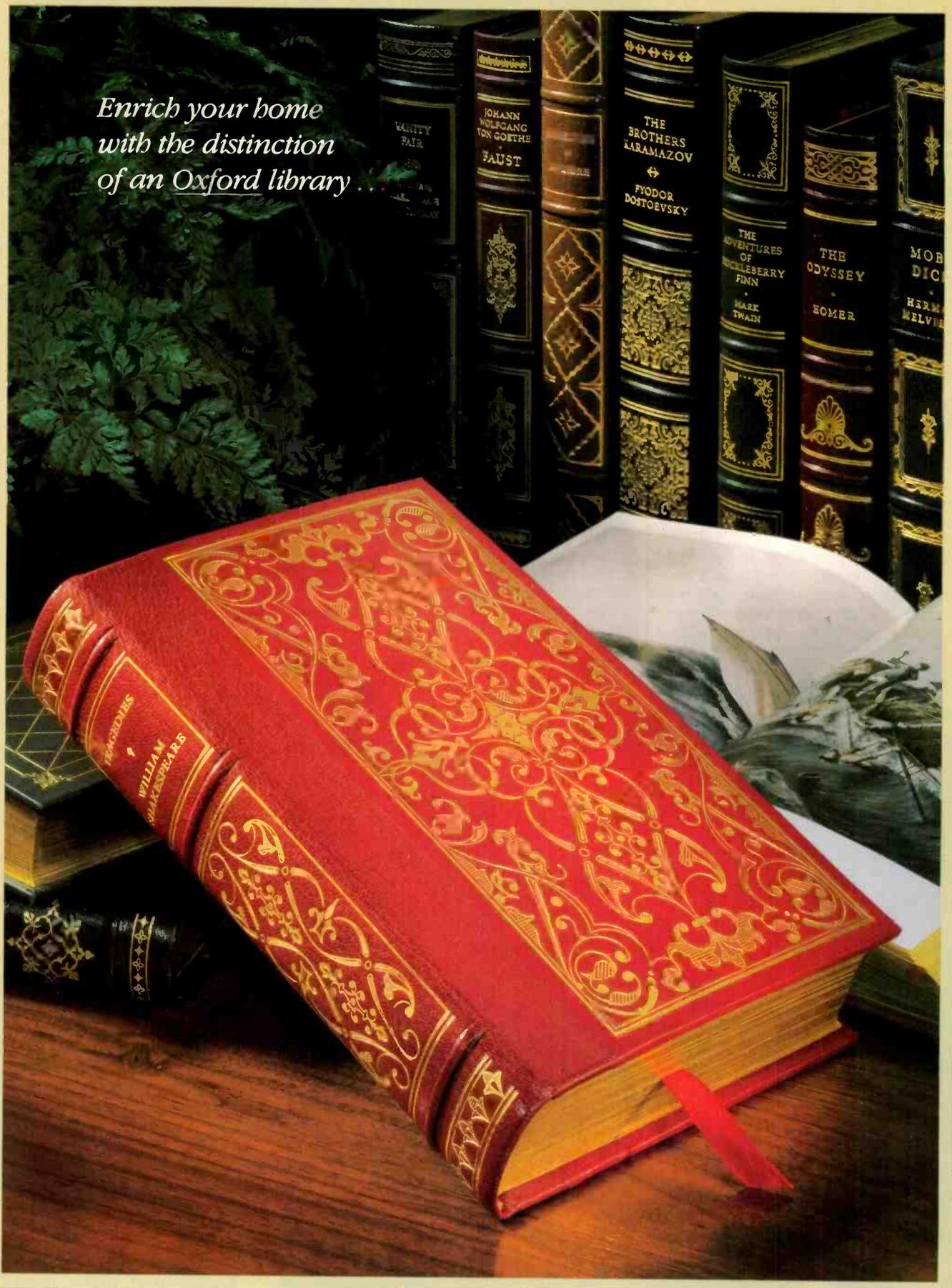
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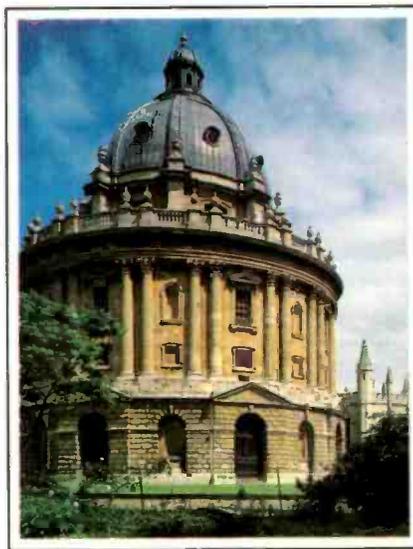
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DAVID LANDER

Sheffield Lab's DOUG SAX AND LINCOLN MAYORGA

On the Monday morning after Academy Awards week, the Polo Lounge of the Beverly Hills Hotel is a hive of dealmakers. Stepping out into a drizzle, I leave the film honchos hunched over their \$20 breakfasts and drive east on Sunset Boulevard, out of the manicured confines of Beverly Hills to a tawdry block in Hollywood where, amidst porno movie houses and used car lots, Doug Sax makes part of his living cutting master lacquers for other people's records.

Sax makes his own records, too, along with partner Lincoln Mayorga. While their Sheffield Lab label has adorned a mere 23 titles since their first release in 1970, the name and orchid logo which accompanies it are well known to audiophiles. Having admired Sheffield records for years, yet meeting Sax only briefly at a Consumer Electronics Show, I look forward to a working day with him and Mayorga.

When I arrive at The Mastering Lab, which has been Sax's financial mainstay for years just as studio musicianing has kept a continuous supply of provisions on Mayorga's table, the pair is tied up in session. Andrew Teton, Sheffield's marketing director, greets me in the waiting room. It's no Polo Lounge, but there's fresh coffee and Danish, Teton's affable manner and the promise of more good company to come. Outside, the rain stops, and the Southern California sky begins to turn from gray to blue.

The Sheffield Lab partners' friendship dates all the way back to junior high school. It seems Doug Sax, then a

budding trumpeter, needed an accompanist for a performance of "Tenderly." He was introduced to schoolmate Lincoln Mayorga, a pianist who, while protesting his bent was classical, sat down on a moment's notice and, without sheet music, produced precisely what was needed. After more than 30 years, Sax still seems awed by the feat.

The businesses which grew from their relationship are, Mayorga notes "a result of our frustration with the sound of phonograph records." He recalls hearing "some wonderful qualities on the old 78-rpm classical records we had in our libraries, some virtues which were not to be found on the modern LP."

One day in early 1959, Sax and Mayorga found themselves driving down Melrose Avenue, past the oldest of Hollywood's recording studios, Electrovox. On impulse the two went in and asked if they could cut a record. Mayorga was invited to take a seat at the studio Steinway, and a short demo was cut at 78 rpm. All of the equipment used dated back to the '30s.

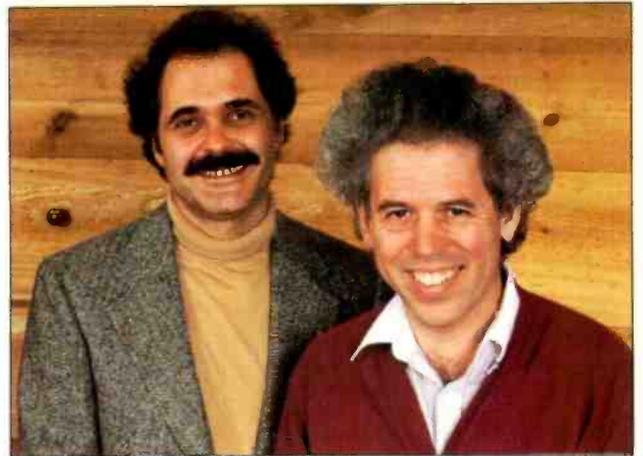
When they got the acetate home and played it, the pair found the absence of background noise so startling that Mayorga began "fiddling with wires to see if maybe I had not plugged in the amp or something." Then, the piano came in with such clarity that they feared the recording was cut at too high a level and would break up as the music became louder. That didn't happen. "We were in awe," recalls Sax. "Well, it sounded like a piano in the room," explains Mayorga.

Sax continued trumpeting in the U.S. Army while his brother, Sherwood, an electrical engineer, worked with Mayorga toward his goal of making a direct-to-disc piano recording. The results continued to prove unsatisfactory and, in 1965, Mayorga was on the verge of giving up. It seemed there were just too many problems between the master lacquer and the finished record, and the cutting rooms of the day were not up to handling them.

That was too bad, the musician-composer-arranger lamented one evening to the brothers Sax, since he knew of a number of producers who were unhappy with how their tapes were transferred to disc. This was the first time any of them had thought of their audiophile endeavor in business terms, relates Doug Sax, and it resulted in the three teaming up to form The Mastering Lab. The facility, which began operations in January 1968, today cuts masters for some 10% to 15% of the top commercial records.

The first Sheffield direct-to-disc, *Lincoln Mayorga and Distinguished Colleagues, Vol. 1*, was released in 1970. It was sold through audio sources, a precedent, with Mayorga's mother handling distribution from her Santa Barbara home. The Sheffield titles, many of which showcase Mayorga's musical talents, quickly became standard fare for hardware demonstrations at audio salons and shows, and an allegedly primitive recording process previously relegated to obsolescence by the tape recorder had been resurrected. But not without years of work, patience and concern on the part of Mayorga, Doug

Doug Sax (left) and Lincoln Mayorga are the proprietors of The Mastering Lab. Sax has some reservations about digital: "What I want to hear is somehow obscured. I don't have a good time, and that defeats the whole purpose. It doesn't have to do with accuracy or anything. Yet I can hear absolute virtues. Absolute virtues."



Photographs: Brad Fowler

"We have run digital tapes on many of our recordings, and we'll continue to do so."



"The biggest improvement, and the only broad-gauge improvement in audio, I feel, over something that was made 15 years ago, is the improvement of the modern phono cartridge. It's very interesting that the disc cutters we're using are essentially 15-year-old cutters."

find that the whole chain is inadequate, that the microphones are very inadequate, that the electronics are very inadequate, that the noise we've been living with from the electronics, the distortion we've been living with, is not suitable. So as a result you've got to improve every single piece of gear you have, and that's what goes on here. That's a never-ending quest that's far from finished.

Sax: We got into this thing, I think in retrospect, much more than I ever intended to, because as we started to make more records, I kept wondering why it didn't sound better, and I don't mean off the disc. I mean before any storage medium was involved. And it's led us to every step of the chain. These things hanging up there are all microphones. They're designed by my brother. They're literally, for what they do, state of the art. I took my brother out of retirement, and I said, "We need a microphone that has to have these noise specs. I want it to have this distortion. It has to feed a line with no transformers." I wanted a tube design because even the old tube microphones are the most revered in the industry—by all the recording engineers. We're probably making the only records in the world now that are all tube.

Well, am I oversimplifying by saying that what you do is take techniques of the past and refine them without looking at the newer technologies, be they solid state or whatever?

Sax: You are oversimplifying. All I'm doing is taking that which I know works, which my ear tells me works, and trying to make it better. If anything comes along of any technology that is audibly better, I'll jump on it.

Doug, you've said that hi-fi equipment hasn't improved over the years.

Sax: The biggest improvement, and the only broad-gauge improvement in audio, I feel, over something that was made 15 years ago, is the improvement of the modern phono cartridge. It's very interesting that the disc cutters we're using are essentially 15-year-old cutters.

Mayorga: But they're still modern devices. They're not old-fashioned.

Sax: Oh, no. They were never old-fashioned. They were very sophisticated pieces of equipment then and now.

Sax and his brother Sherwood, who designed the tube microphones and related tube equipment used in the Sheffield recording process.

After a morning at The Mastering Lab, Sax, Mayorga, Teton, and I lunch on lamb stew at Musso and Frank, a colorful barn of a place that claims to be Hollywood's oldest grille. From there we drive to Culver City, to the recording studio Sheffield constructed on an MGM lot just so they could record on the old soundstage where Busby Berkeley musicals were scored and Fred Astaire and Ginger Rogers re-danced the clacking of their flying feet into the soundtracks of now-legendary movies.

It's an ideal place for our interview, the control room with its tube electronics, the adjoining cutting room with its

bank of modified '50s lathes. Beyond a soundproof window, a TV remake of the Susan Hayward classic, *I Want to Live*, is being screened. Voiceless figures flicker, ghostlike on the screen, as two old friends talk about probing the past to bring a new luster to present-day recording.

Over the years in the audio business, we've watched what many or most of us assume is a steady progression in technology. At the same time, here's Sheffield with direct-to-disc records made with home-grown tube electronics. Is this not marching backward?

Mayorga: In a certain sense, but Doug can tell you in more detail about what goes on when you begin to refine. When you simplify and refine these techniques and listen critically, you

When you simplify and refine techniques, and listen critically, you find the whole chain is inadequate, including mikes and electronics.

You see, the interesting thing is that, when solid state came in, it virtually replaced all tube equipment overnight. And the logic progression would seem to indicate that it was better, but—and this is why I say audio doesn't have a logic progression—now you find that there are engineers who are paying two, three thousand dollars for prime old tube mikes, based on their function. These are the same mikes that were put away in some closet when solid state came in. The transistor, to this day, is having to prove itself against the best tube equipment. When the whole world went to solid state in the late '50s and early '60s, it was not on the merit of sonic value. It may have been on convenience, longevity, cost, power for size, but never on that it produced better audio.

The great tube versus solid-state debate seems to have been reincarnated in another form. Today listeners of the world appear to be dividing into two different camps, the pro-digital and anti-digital.

Mayorga: Well, that's good to see. I was afraid that they were all going to quickly jump into the new camp. [laughs] Incidentally, every time somebody asks me about Sheffield, "Oh yes," they say. "Sheffield. Oh yes, you guys do digital, don't you?" The first word! Or I'll say, "We do direct-to-disc," and the answer will be, "Oh yes. Digital."

Well, do you both feel digital sounds bad?

Sax: No. I have a stronger feeling about it than Lincoln.

What, specifically, is it about the sonic quality that you object to? Can you verbalize it?

Sax: I'd like to, because I ask myself the same question. I also ask myself, as a businessman, am I being prudent? I've worked with the various systems. We have run digital tapes on many of our recordings, and we'll continue to do so. If the whole world goes to a Compact Disc, I will be first generation live-to-digital. The different [digital] systems on different music have different proclivities. The commonality of all the systems—and there are some new systems coming out that are going to obviate this—is the fact that they lose low-level information in great quantities. The hall ambience, what's

left of the hall, is noticeably drier. That's one proclivity. How important is this? It turns out, to me it's very important. The second thing is that it tends on certain instruments to be harsh—all of the systems. Now we [at The Mastering Lab] make digital recordings from analog tapes for the record companies, and you get a chance to hear how certain music goes in and comes out of these things [digital processors], and it comes out really harsh. Brass in particular, which has asymmetrical half waves.

You've said digital recordings are like a mock version of wine synthesized in a laboratory. It may taste like Lafitte-Rothschild, but you don't have a good time when you drink it.

Sax: I don't have a good time with digital. What I want to hear is somehow obscured. I don't have a good time, and that defeats the whole purpose. It doesn't have to do with accuracy or anything. Yet I can hear absolute virtues. Absolute virtues.

Such as?

Sax: Very good low-end transient response, because that's where the phase shift of the existing systems is small. Phase shift on the high end is unprecedentedly large compared to analog tape recording.

Mayorga: Absence of background noise.

Sax: And a steadiness. The piano doesn't move around.

Many people like digital for its dynam-

ics. Yet others claim there's as much dynamic range to be had with analog recording.

Sax: There's actually more. On an analog tape or a disc, they give a signal-to-noise ratio as opposed to a dynamic range. In digital, for some reason or other, they decided to make signal-to-noise and dynamic range the same number. Basically, and there have been tests done in England by people with no axe to grind, you're accustomed on analog to hear music below the noise floor. In tests, there are people that hear music or tones 15 or even 20 dB below the noise floor. If you take what is now becoming in this town the industry standard, which is half-inch, 30-ips analog tape, it has a signal-to-noise ratio of about 76 dB. Now that doesn't sound very good compared to the 95 that is claimed for digital, but if you add the 20 dB below it that you can hear—it's not what you measure, it's what you can hear, and on digital, when you go to that last bottom digit, it turns off—you're now 96. And if you add the 18 or 15 that you can reliably get above it, albeit at a higher measured distortion than you would get on digital, you have another 10 to 15 dB, routinely, over anything claimed for digital—that you can hear. You know, I'm always talking about the circle. This great improvement to analog tape machines is only going back to the track width—almost the track width—and tape speed that came out in 1948

"How long before digital gets perfected? FM never got perfected. What makes us think digital's going to get perfected?"



The analog tape recorder of 30 years ago was in some ways arguably better than the analog tape recorder made today.



"All I'm doing is taking that which I know works, which my ear tells me works, and trying to make it better."

when Ampex put their first machine out. And by the way, the 23rd Ampex is in the other room. All they've done is gone back to the tape speed and the track width—almost. I say "almost" because it was quarter-inch full-track.

Mayorga: In '48. And the standard speed was 30 ips all the way until 1955 when the NAB decided to make a compromise and standardize it at 15 because it was more economical.

Sax: In the original Ampex manual it says 30 ips is here for music and 15 ips is included for speech. In the original manual. Now, the majority of tapes I get at The Mastering Lab and that other mastering facilities are getting, absolutely are half-inch 30 ips. And to my way of thinking, for what I want to hear, they have a wider dynamic range than any digital machine that is being used today. You'll find out what's wrong with the existing systems, which unfortunately are claimed to be perfect, when new ones come out.

It's interesting that once various manufacturers' DAD players began being compared, people stopped talking about perfection—at least for the current generation of machines. Analog had a long time to develop. How long will it take for digital to be perfected?

Mayorga: FM never got perfected. Television never got perfected. What makes us think digital's going to get perfected?

Well, do you think this particular storage medium, the Compact Disc, is a premature effort on the part of the audio industry?

Mayorga: What I see happening, what Doug has pointed out to me, is that history is repeating itself. A standard is being accepted, and it's a low standard, and we may well lock in, in 1983 here, to a standard that is not high enough for digital reproduction.

Is one of the two media, digital or analog, more perfectible than the other? If you were king, Doug, and you were able to say, "All right, everybody out there working on recording will work in the following mode and we will perfect it," which mode would you choose?

Sax: I've always been very, very relieved that I only speak as an individual and not a king. I think the marketplace will find its own solution with time, and I believe in that.

Mayorga: But you've dodged the question.

Sax: I wouldn't want the responsibility of picking it. I'm not anti-digital, I'm anti how far they've taken it. And I'm very leery. Once they lock into a standard, history has proven how difficult it is to obviate the standard. The argument that we've had 30 years to perfect analog tape recording, while digital is in its infancy, is an incorrect statement. The analog tape recorder, when it hit the streets, was in some ways arguably

better than the analog tape recorder made today. It worked instantly out of the box. You can hear a 30-year-old tape, some of these Capitol monos that I've heard, and your mouth falls open with what they were doing 30 years ago.

It seems to me there's a consistent strand, a thread that runs through your thinking. In comments of yours that I've read, in what's been said here today, I sense a longing for simplicity. Am I misreading something?

Sax: No. I wish I could put it in my life. Maybe I'm using simple techniques because everything else in this modern day is too busy and too complicated. One of the things that Lincoln and I both believe in greatly, when he arranges or we talk about the illusion of making a record—because it's all an illusion, it's just a piece of plastic—is the frustration in recording that less is always more. Three instruments totally satisfy your ears, and a hundred instruments can sound like four. It puts such strain on the whole medium. For sure, simplifying the electronics chain is not sonically worse. Three amps do not sound better than one, and 10 amps, guaranteed, won't sound as good as one or two. For music that acoustically balances in a room, I believe in a simple mike technique, yet it doesn't always make what is instantly obvious to the ear as an impressive record.

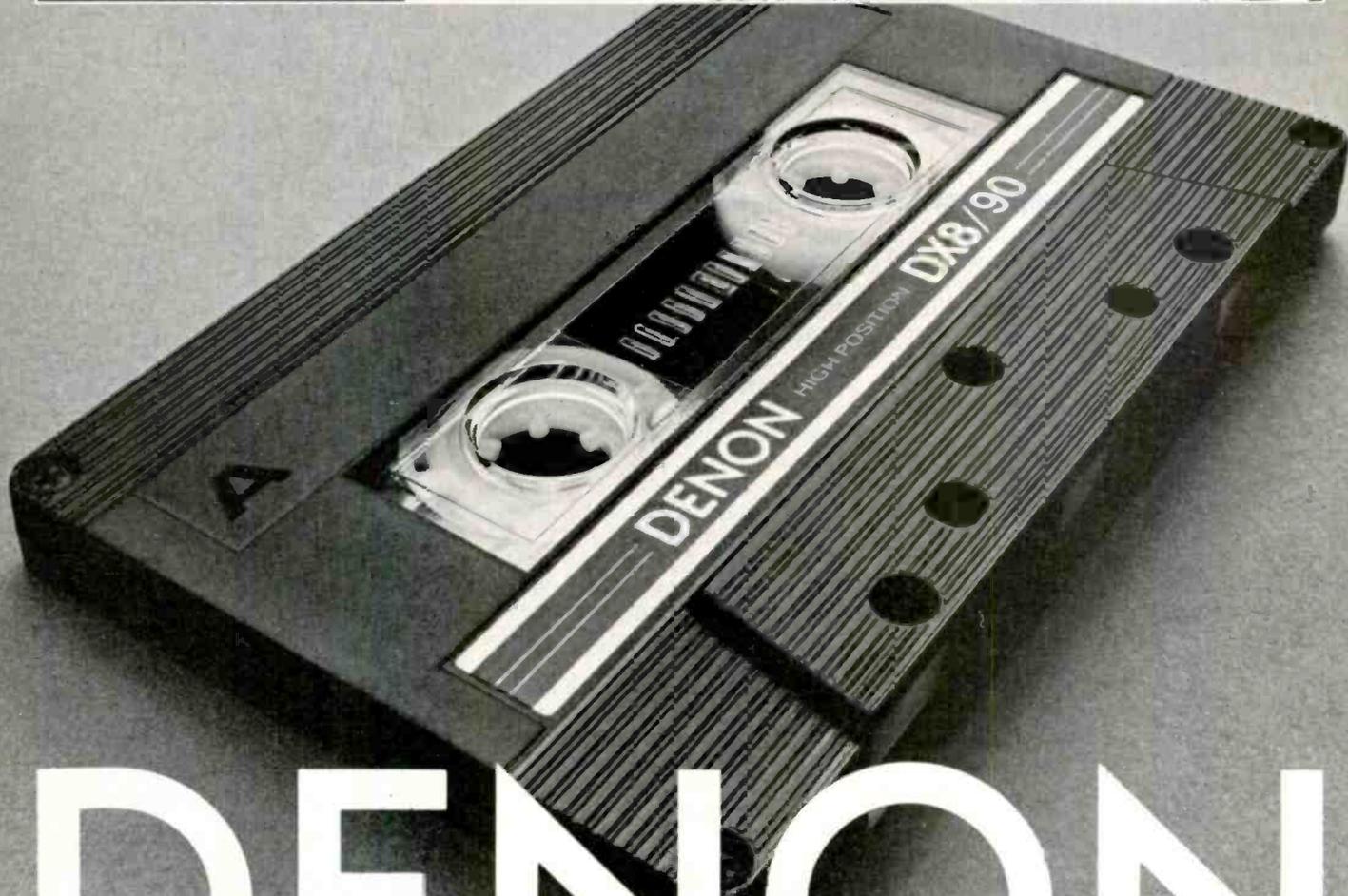
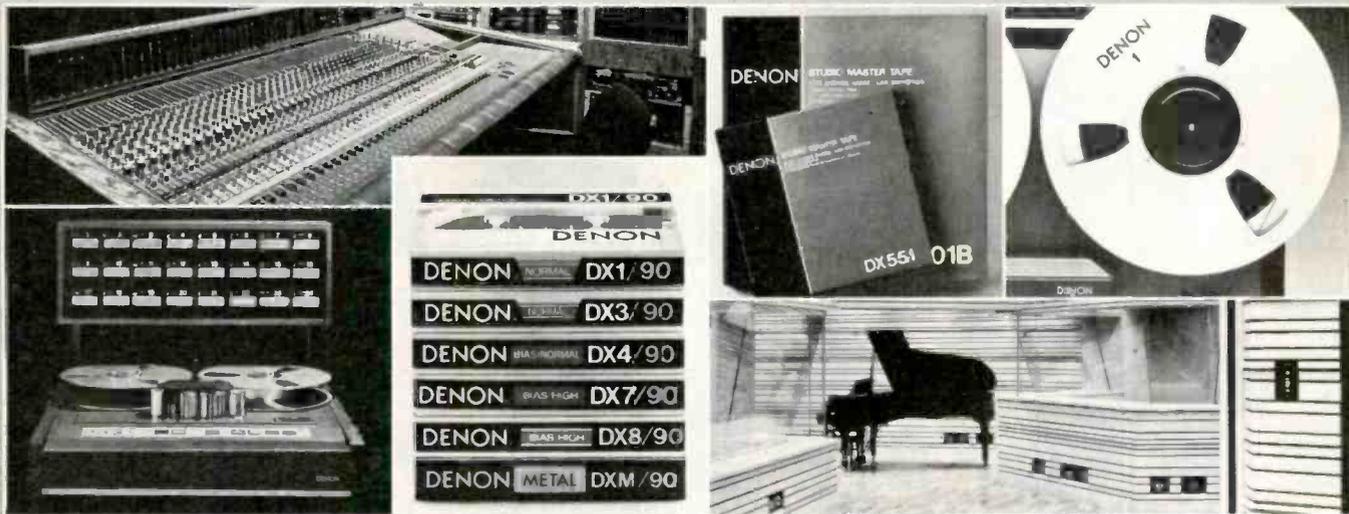
How do you feel as a musician, Lincoln? Is less more?

Mayorga: You certainly learn, when you arrange for recording, to make things as transparent as possible. Even some of the most experienced orchestrators and arrangers haven't quite learned that. They think, for example, if they have an organ doubling the cellos and the strings and all, that it will make it sound fuller. That would be so in a theater, where the organ would reinforce acoustically, but in a recording, where everything is a matter of balance and relativity, all that organ does usually is muck it up. Unless you need that color, unless you want that texture. But it's not about to help, usually. You strive for a transparency, and particularly when we do direct-disc things, I've always tried to lay out the arrangements in such a way that you zero in on colors and aren't distracted with a whole lot of thickness of texture. **A**

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BRINGING TRACKABILITY HOME

Robert Kita

To the casual observer of the audio scene, it may seem as if everything that could be done to improve the familiar phonograph, has been done. Each year brings product announcements that portray ever higher levels of audio performance. In particular, one of the most important elements of the stereo playback system, the phono cartridge, has undergone especially significant change in the last several years. Current cartridge models are so much improved they almost beg to be challenged.

The many product claims in evidence make one wonder if there couldn't be a way for an audiophile to prove, in simple terms, just which phono cartridges are really better. It should be easy to get the equipment. The comparison method should be straightforward to use and interpret.

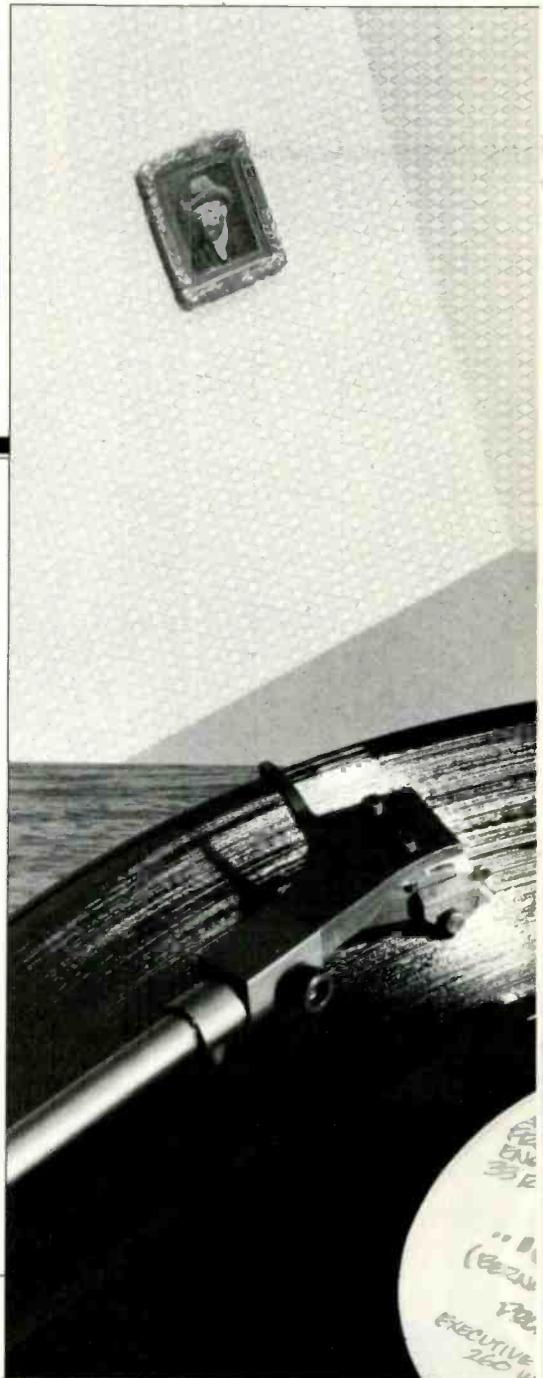
About two years ago, Shure introduced a new performance concept, the Total Trackability Index (TTI), specifically developed to address this issue. The TTI is a scale on which phono cartridge performance can be graded in a rational way. The audiophile need only have a phonograph record containing the tests and instructions (Shure TTR-117) and a good-quality stereo playback system to obtain the TTI number.

The TTI is based on two factors, the Trackability Factor (TF) and the Indentation Factor (IF). The TF is a measure of the dynamic properties of a phono cartridge or how well it reproduces complex audio signals. The IF accounts for the amount of tracking force used and the stylus tip contact geometry, both of which relate to record wear. When the two factors are multiplied, they yield ($TF \times IF = TTI$), a total trackability performance number. Phonograph cartridges with high TTI numbers most faithfully reproduce what is on the record, while at the same time producing minimal wear. The TTI for a particular phono cartridge can be compared directly with the TTI for any other. It should be pointed out that the trackability concept is not the only factor which describes phonograph cartridge performance. However, as Shure has been stating for many years, it is without question the single most significant factor.

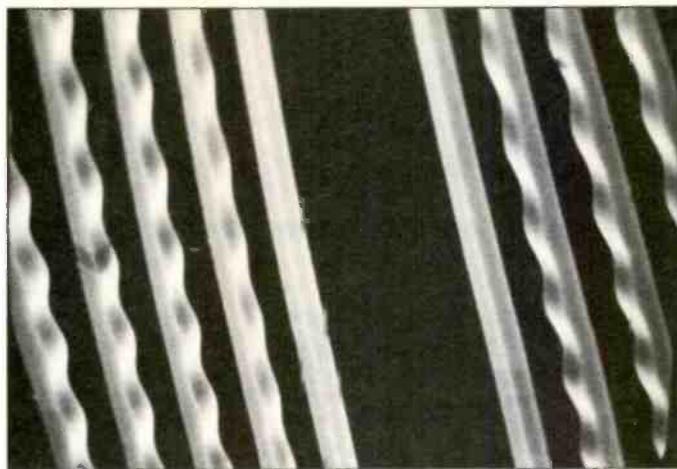
Trackability Factor

Let's look more closely at part of the TTI, the Tracking Factor (TF), and how it's obtained.

Robert Kita is Implementation Section Manager, Shure Brothers Incorporated, in Evanston, Ill.



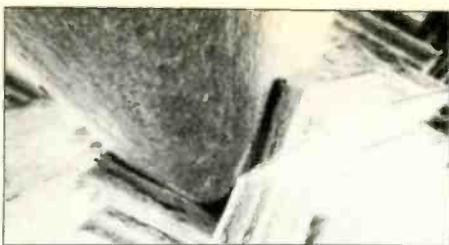
LITY



Photograph: Discwasher, Inc.



Photograph: James Wojcik



Scanning electron micrograph of a spherical stylus tip of 0.7-mil radius in an actual record groove.

Photograph: John L. Brown, Georgia Institute of Technology

In its most basic form, perfect trackability requires that the stylus tip never leave the record groove wall surface. It is a known fact that mistracking occurs when the tip lifts away from the groove wall. An equally unacceptable condition exists when the tip leaves the desired path along the groove wall surface and is pressed into the groove wall by excessive inertial forces. This action causes temporary or, more seriously, permanent groove deformation, which the listener perceives as subtle or even very noticeable distortion. Permanent groove deformation is observed as record wear or damage, resulting in an irreversible increase in surface noise and distortion.

It is important to note that if stylus trackability at a specific tracking force can be increased, there will be a corresponding reduction in audible distortion and wear effects. The factors that increase trackability also increase the useful life of the stylus tip. It is always true that higher trackability goes hand in hand with decreased dynamic force appearing at the stylus tip-groove interface.

To gain further understanding of these concepts, consider Fig. 1, which shows trackability requirements displayed in graphic form. The plotted curve relates frequency to the highest level a cartridge must accurately reproduce. In the figure, the portion of the audio spectrum from 100 Hz to 20 kHz is shown on the horizontal scale. The vertical scale represents peak recorded velocity or loudness, and extends from 1.0 cm/S, for a very quiet sound, up to 100 cm/S, an extremely loud recorded sound.

The full range of the audible spectrum must be included in any fair evaluation of a phono cartridge. After all, the variety of musical programs avail-

able today does utilize that spectrum more fully than ever before. The scattered pattern of circles is illustrative of the range of recorded signals to be found. Each circle represents a velocity and frequency value taken from an individual laboratory measurement of a commercial record. Measured signals from many records are shown in the graph, which represents the trackability challenge of modern phonograph records.

Early laboratory measurements of trackability were obtained by observing stylus behavior for calibrated signals. These were usually single tones and gave a trackability reading at one frequency in the audible spectrum. We have provided this specification data on our phonograph cartridges since the mid-'60s, and the data is very useful in comparing the performance of these cartridges. To be able to graphically portray the trackability performance of a cartridge across the audible spectrum requires the tabulation of readings taken at many velocities and frequencies. In the engineering lab, there is much value in obtaining a complete plot of this kind; it would not be practical for an audiophile to collect, plot, and interpret all of this data.

To allow the audiophile to deal with this problem, a more direct approach has been devised that produces accurate results suitable for comparisons. In this approach, the audio spectrum is divided into three segments, as shown in the lower part of Fig. 1.

The low-frequency region, below 1 kHz, contains recorded signals having large amplitudes, which call for large deflections of the stylus or high compliance. The mid-frequency region is populated with high signal velocities that necessitate a limited degree of stylus damping for good control.

Above 8 kHz are the high-frequency signals, which are small in amplitude but occur very rapidly. It is these tiny, energy-rich signals that impart intense accelerations to the stylus and give the effective mass of the stylus such great significance.

The trackability test signal has three parts, each one representing a segment of the full spectrum. Sine waves at 200 Hz, 2.1 kHz, and 17 kHz are used together to explore the low-, mid-, and high-frequency regions simultaneously. As the cartridge attempts to reproduce the composite signal, its three major characteristics—compliance, damping, and effective stylus mass properties—are simultaneously challenged.

An important decision that was made concerns the recorded velocity or loudness at which the composite trackability signal is presented. The Tracking Factor should imply a degree of trackability excellence with respect to a reference level of some kind. To establish this reference, a trackability curve for an ideal high-performance cartridge was drawn on a graph of known high-level recorded signals (Fig. 1). All the circles, or measured signals from records, are encompassed by this curve. The curve was based on the trackability the ideal cartridge should have at each frequency to faithfully reproduce all of these signals. This curve is called the envelope of measured signals. The envelope represents the maximum trackability limits of the ideal phono cartridge if it were measured just one frequency at a time.

To best reproduce the measured signals within the curve, the trackability designed into the ideal cartridge should have the same proportions (at low, mid, and high frequencies as the envelope indicates.) Therefore, the three-part trackability test signal has its recorded velocity components balanced to agree with the contour of that envelope. The combined velocity level of the three parts must equal that of any one single-frequency signal on the ideal trackability curve. This means that the recorded velocity levels of the three individual parts is about 10 dB below, or one-third the level of, each equivalent point on the ideal curve, as shown in Fig. 2.

TABLE I

Signal Level (dB)	0	-1	-2	-3	-5	-6
Trackability Factor	100	89	79	71	56	50
Level Number	6	5	4	3	2	1

Table I—Trackability Factor (TF) as a function of signal level; dB values are relative to reference level shown, and numbers in bottom line refer to bands on Shure TTR-117 test record. The 0-dB reference level for the composite signal is made up of 200 Hz at 3.3 cm/S plus 2.1 kHz at 21 cm/S plus 17 kHz at 20 cm/S, all peak recorded velocities.

Low-frequency signals call for high compliance, mid frequencies for stylus damping, and high frequencies for low tip mass.

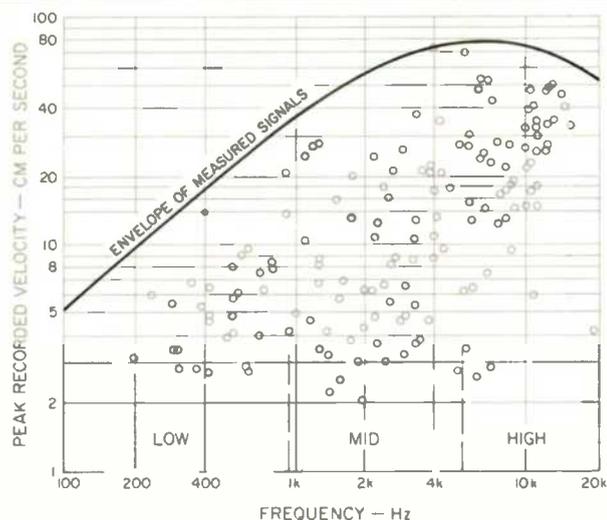


Fig. 1—Measured signal levels from actual recordings (small circles); the envelope encompassing these measurements shows the maximum individual-frequency tracking requirements for an ideal cartridge.

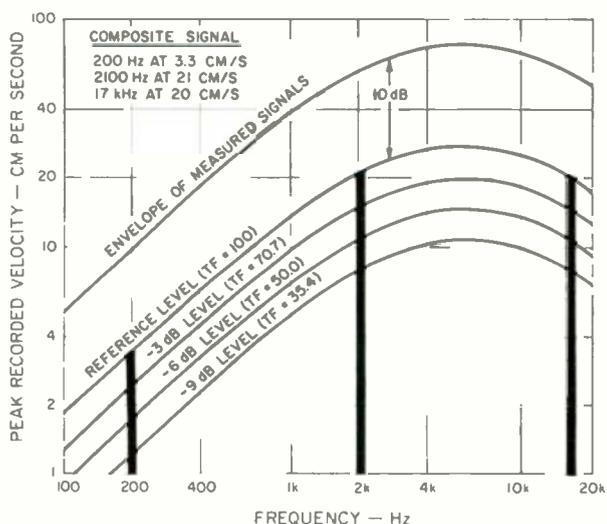


Fig. 2—Recorded levels of the trackability test's low-, mid- and high-frequency signals (reference curve) are 10 dB lower than the measured-signal envelope, so the combined level will equal that of single frequencies on the envelope curve.

In practice, only a phono cartridge having high overall trackability plus the correct balance between low-, mid-, and high-frequency trackabilities will faithfully reproduce this test signal. For example, a very compliant phono cartridge will not score very well unless the effective stylus mass is sufficiently low to reproduce the 17-kHz signal without breakup. Conversely, a cartridge having a low stylus mass and corresponding high-frequency trackability may not score well if its compliance is not adequate to reproduce the 200-Hz component. Cartridges having a balance of trackability well suited to reproduce the signals under this

curve, and do so at a low tracking force, will achieve a high TF.

The trackability test signals, available as part of the TTR-117 test record, are recorded at six modulation levels. The highest level is the reference level just described (see Fig. 2). Faithful reproduction of this level results in a TF of 100. Tracking a signal level of -1 dB, 11% lower in velocity, corresponds to a TF of 89. Trackability signals at -1, -2, -3, -5, and -7 dB below reference are also provided. These trackability test bands, which are sequenced in order of increasing velocity, are played by the cartridge under test. The highest level test band that is

reproduced without distortion is used to determine the cartridge's TF from Table I.

Indentation Factor

The second factor in the TTI equation is the Indentation Factor (IF). While the TF relates to trackability, an additional factor is needed which will quantify distortion due to mild but permanent groove wall deformation.

To understand this relationship, a computer-aided mathematical analysis was conducted to examine the tip-groove interface. The degree of indentation of the stylus tip into the vinyl-record groove wall was calculated for many combinations of tip geometry and tracking force. An important premise was that the depth of indentation of the tip into the soft vinyl surface is the dominant factor in permanent deformation.

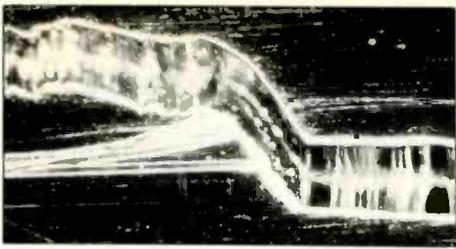
The Indentation Factors calculated in the study were tabulated with respect to tracking force and stylus geometry. From Table II, it can be seen that the IF is a very strong function of tracking force, more so than it is a function of tip geometry. From this relationship, one can appreciate the value of a cartridge that requires only 1 gram for its recommended setting, as compared to another that requires 2 grams or more. A record played with a spherical, 0.0006-inch radius stylus tip will take 100 plays at 1 gram to exhibit as much degradation as it will after only 63 plays with a 2-gram tracking force, assuming no mistracking occurs. While the primary use of the IF is related to record life, it is also a guide to estimating relative diamond-stylus tip life.

TTI Examples

In the final step, the two factors, TF and IF, are then multiplied to yield the TTI. For example, a cartridge with a hyperelliptical stylus tip shape, measuring 0.0002 inch \times 0.0015 inch, has an IF of 1.03 for a tracking force of 1 gram (Table II). If it were to satisfactorily reproduce level 5 of the TTI test signal, it would be given a TF of 89 (Table III):

$$TTI = TF \times IF = 89 \times 1.03 = 91.7.$$

Let's now look at a few numbers for typical cartridges. A moving-coil cartridge with a recommended tracking



A real-world challenge: The cannon shot on Telarc's 1812 Overture.

TABLE II

Tip Geometry	Tracking Force					
	7.5 mN 0.75 Gram	10 mN 1 Gram	12.5 mN 1.25 Grams	15 mN 1.5 Grams	20 mN 2 Grams	25 mN 2.5 Grams
Spherical 15 μ (0.0006")	1.21	1.00†	0.85	0.76	0.63	0.54
Spherical 18 μ (0.0007")	1.28	1.06	0.91	0.81	0.67	0.58
Biradial (Elliptical) 5 μ × 18 μ (0.0002" × 0.0007")	1.07	0.88	0.76	0.67	0.55	0.48
Biradial (Elliptical) 7.5 μ × 18 μ (0.0003" × 0.0007")	1.10	0.91	0.78	0.69	0.57	0.49
Biradial (Elliptical) 10 μ × 18 μ (0.0004" × 0.0007")	1.17	0.97	0.84	0.74	0.61	0.53
Hyperelliptical (HE) 5 μ × 38 μ (0.0002" × 0.0015")	1.25	1.03	0.89	0.79	0.65	0.56
Hyperelliptical (HEJ) 7.5 μ × 38 μ (0.0003" × 0.0015")	1.31	1.08	0.93	0.83	0.68	0.59
7.5 μ × 75 μ (0.0003" × 0.003")	1.52	1.26	1.08	0.96	0.79	0.68
3.8 μ × 75 μ (0.00015" × 0.003")	1.42	1.17	1.01	0.89	0.74	0.63
3.8 μ × 100 μ (0.00015" × 0.004")	1.52	1.26	1.08	0.96	0.79	0.68
2.5 μ × 100 μ (0.0001" × 0.004")	1.46	1.21	1.04	0.92	0.76	0.65
5 μ × 50 μ (0.0002" × 0.002")	1.33	1.10	0.95	0.84	0.69	0.60

†Reference—15 μ spherical at 10 mN.

Table II—Indentation Factor (IF) as a function of tracking force and stylus geometry.

TABLE III

Cartridge	IF	TF	TTI
V15 II	0.91	45	41
V15 III	0.91	71	64.6
V15 III HE	1.03	71	73.1
V15 IV	1.03	79	81.4
V15 V	1.03	89	91.7

Table III—Total Trackability Index (TTI) is the product of IF and TF. Values shown here are for five models of Shure V15 cartridges.

force of 2 grams, and having a long-contact area stylus tip measuring 0.0003 inch × 0.003 inch, has an IF of 0.79. It was able to play level 3 and achieve a TF of 71. This combination results in a TTI of 56, but the cartridge was penalized to some extent because of excess stylus damping, which limits the mid-frequency trackability and necessitates the 2-gram rating.

Another type, an electrostatic cartridge

rated at 1 gram, has a 0.0003 inch × 0.0007 inch elliptical stylus tip and an IF of 0.91. It tracked only level 2 at 1 gram and yielded a TF of 56. The TTI for this example is just 51, primarily because of its lack of adequate trackability. The stylus effective mass is high, which causes high-frequency distortion at a low test level.

In Table III, TTI values are shown for several models of Shure V15 cartridges. In each successive model, a significant increase in TTI was achieved. The improvements in trackability and optimization of tip geometry each contributed to the changes.

An important fact to be recognized is that the TTI number is determined with the audiophile's home playback system. The test is conducted under the same conditions normally used to play records. A special measurement setup is not needed. This *in situ* evaluation will portray performance results individually for each unique combination of equipment.

Summary

Using the TTI, the audiophile can compare, on a rational scale, any good-quality phono cartridge, be it a moving-magnet, a moving-coil or an electrostatic type, with any other. This scale combines an evaluation of a cartridge's dynamic properties, stylus tip geometry, and rated tracking force. The TTI signal is a real challenge and will produce revealing results. **A**

(Editor's Note: Shure's TTR-117 test record is available for \$15.00, including postage and handling, directly from Shure Bros., 222 Hartrey Ave., Evanston, Ill. 60204, or some Shure dealers.)

References

1. Kogen, James, "Trackability," *Audio*, Nov. 1966.
2. Kogen, James, Bernhard Jakobs, and Frank Karlov, "Trackability—1973," *Audio*, Aug. 1973.
3. Masticola, Scott, "Record Wear," *Stereo Review*, July 1976.



C37-7001 BEETHOVEN SYMPHONY NO. 5 in C Minor, Op. 67
Otmar SUITNER conducting
STAATSKAPELLE BERLIN



38C37-7026 HANDEL TRIO SONATAS
Heinz HÖLLIGER, oboe



C37-7003 MOZART STRING QUARTET
NO. 17 in B Flat Major, KV 458 "HUNTING"
NO. 15 in D Minor, KV 421
SMETANA QUARTET



C37-7004 DIE GROSSE SILBERMANNORGEL
DES DOMES ZU FRIEBERG
J.S. BACH
Hans OTTO, organ



38C37-7011 BEETHOVEN SYMPHONY NO. 3
"EREOICA" in E Flat Major, Op. 55
Otmar SUITNER conducting
STAATSKAPELLE BERLIN



38C37-7013 ANTONIO VIVALDI: THE FOUR SEASONS
Gunars LARSENS violin
Rudolf BAUMGARTNER: direction
FESTIVAL STRINGS LUCERNE

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38C37-7032 BEETHOVEN NO. 7 in A Major, Op. 92
Otmar SUITNER conducting
STAATSKAPELLE BERLIN



38C37-7033 BEETHOVEN STRING QUARTET NO. 8
in E Minor, Op. 59, NO. 2
RASOUMOVSKY NO. 2
SMETANA QUARTET

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power without distortion.

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1

SANSUI PC-X1 PCM DIGITAL PROCESSOR

Manufacturer's Specifications

Frequency Response: 5 Hz to 20 kHz, +0, -0.5 dB.

THD: Less than 0.007% at 1 kHz.

Dynamic Range: More than 86 dB.

Input Sensitivity: Line in, 90 mV; mike in, 0.45 mV; video in, 1 V p-p.

Maximum Allowable Input (1 kHz, for 0.02% THD): Line in, 500 mV; mike in, 2.5 mV.

Quantized Bits: 14-bit linear quantization.

Sampling Frequency: 44,056 kHz.

Code Format: EIAJ standard format.

Power Consumption: Using d.c. supply, 16 watts.

Power Consumption: Using AC-X1 d.c. power supply accessory, 35 watts.

Dimensions: 10½ in. (26.6 cm) W × 2⅞ in. (7.3 cm) H × 11-5/16 in. (28.7 cm) D.

Weight: 5.5 lbs. (2.5 kg).

Price: \$1,000.00.

Company Address: 1250 Valley Brook Ave., Lyndhurst, N.J. 07071.

For literature, circle No. 90



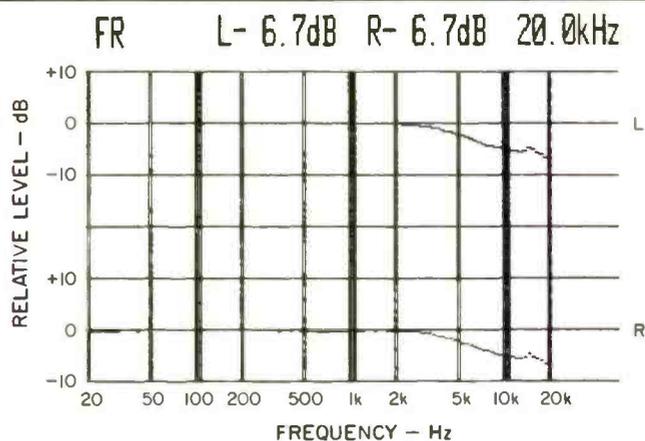
Photograph: Vittorio Sartor

The thing that makes Sansui's PC-X1 different from other EIAJ-format PCM processors that are designed to work with videocassette recorders is its TriCode circuitry, which gives it the remarkable ability to "read" deteriorated PCM signals that other such processors might well fail to read. From a practical point of view, what this means is that you can record digital audio at the slowest available VCR tape speeds and still get error-free, mute-free playback with the same level of performance as you would get at faster tape speeds. If you own a VHS VCR, that means you can record up to eight hours of high-quality digital audio on a single T-160 videocassette. When you stop to think of it, that's an incredible bargain compared with any other high-quality recording medium, and with Sansui's PC-X1 selling for

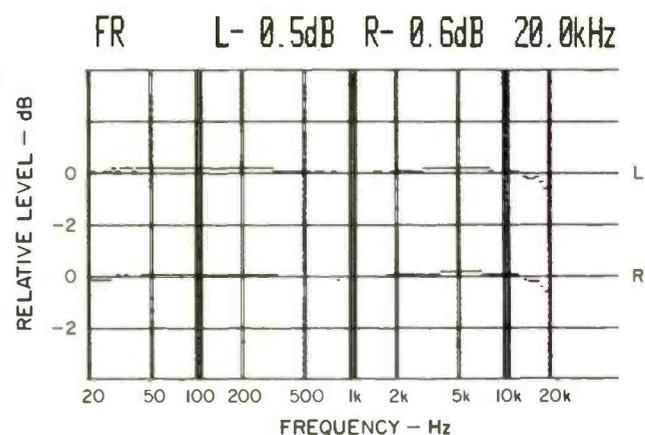
\$1,000.00, the price/performance ratio of such a recording system becomes even more attractive.

The PC-X1 can be used with any one of three different power sources, household a.c., internally housed battery pack, or automobile battery. The battery pack (Model LCS-2012V or VW-VB10) is not included in the purchase price of the PC-X1, but the a.c. power supply is packaged with the unit. A fully charged battery will allow about 90 minutes of continuous recording or about one hour of continuous playback.

A pair of useful checking functions is included in this well-designed PCM processor. You can check and adjust VCR tracking using the metering system on the PC-X1, and another check function allows you to check battery charge



A



B

Fig. 1—Record-replay frequency response of Sansul PC-X1 processor and VCR combination. Note that in (A), overload caused high-end roll-off.

status at a glance. During playback, an automatic muting function prevents the generation of noise bursts in the event of dropouts or other tape impairments. A "Rec Mute" switch allows you to cut out unwanted portions of sound during recording and to create silent intervals between selections. Additional features of this unit will be apparent from the description of the front panel, which follows.

Control Layout

A power on/off switch, headphone jack, and headphone level control are positioned at the extreme left of the front panel. A "Record/Play" rocker switch and a momentary "Rec Mute" pushbutton switch are just to their right, while still further to the right is a vertical row of four slide switches.

The first of these, labelled "Copy," allows you to perform dropout-compensated digital tape-to-tape copying with no deterioration of sound quality. A "Meter" mode switch selects meter function, either "Level" or "Track/Batt," which transforms the left-channel meter into a tape-tracking indicator and the right-channel meter into a battery-status indicator. A "Muting" switch, normally set to the "Auto" mode to prevent noise caused by dropouts or other tape faults, can be turned "Off," in which case more noise will be heard, but playback will continue without mute interruptions. The fourth switch in this group, an "Input" selector, chooses "Line" or "Mic" signal inputs to the processor.

A two-channel meter display at the center of the panel has an interesting calibration scheme which might well

The thing that makes Sansui's PC-X1 different from other PCM processors is its ability to handle signals others fail to read.

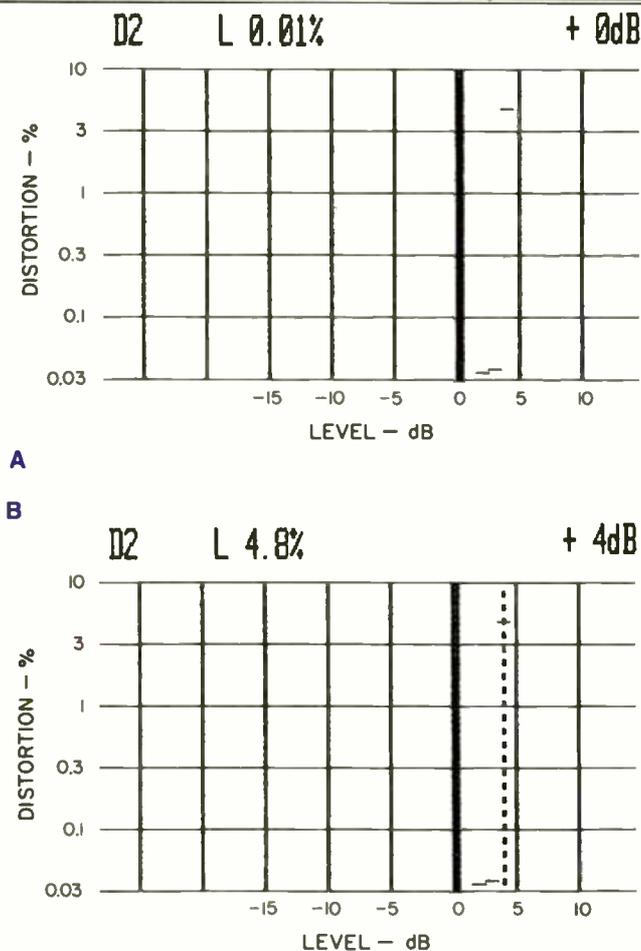


Fig. 2—Second-order harmonic distortion vs. record level for the PC-X1 and VCR. Distortion was negligible at maximum record level shown in (A), but increased rapidly to 4.8% when overload levels of +4 dB were recorded, as shown in (B).

serve as a model for all digital recording equipment designed for nonprofessional use. Since "0 dB," in the case of digital recording, has no real standardized value, Sansui has elected to calibrate "0 dB" at a point some 15 dB below the maximum allowable record level of the system. The LED metering system is therefore calibrated from -30 dB to +15 dB, with the "0 dB" mark occurring just past the halfway mark on the calibrated scale. Users are instructed to set levels so that average readings are at "0 dB" while peak levels are kept at or just below the +15 dB mark. If levels exceed that maximum allowable +15 dB mark, a red "Over" display lights up. "Record," "Play," "Muting," "No Copy," and "Charge" indicator lights below the meter dis-

play illuminate when appropriate. The "No Copy" light will come on when playing back a tape that contains a tape-copy prohibition code, to indicate that a digital copy cannot be made.

Dual concentrically mounted left- and right-channel record level controls are located to the right of the display area, and individual left- and right-channel microphone input jacks are at the extreme right edge of the front panel. A battery-insertion door flap, battery eject button, and a 12-V d.c. input terminal are all located at the rear of the left side panel of the PC-X1. The right side panel contains all remaining jacks, switches, and controls.

These include a low-cut filter on/off switch for cutting out low frequency or infrasonic noise when using a microphone, a microphone input attenuator (which offers 20 dB of attenuation in its "on" position), left- and right-channel line input and output jacks, video-in and -out jacks (for connection of the associated VCR), a "Copy Out" jack, which delivers a digital (PCM) signal for copying from one tape to another, and a small rotary control labelled "Read Level." This control, normally set at its detented midpoint, can be rotated if the tracking adjustment referred to earlier cannot be fully accomplished using the VCR's tracking control. Two additional jacks, identified as "Monitor TV" and "Video Tuner," plus a "TV/Processor" slide switch allow you to use both your component TV set (if you own one) and your digital processor/recording system without having to change system connections. In addition, the arrangement allows you to "watch" the digital pattern on a TV screen if you derive pleasure from such "bit gazing" (see Fig. 5).

Measurements

Having been involved in the testing and evaluation of many CD players for just over a year, I have become accustomed to truly incredible dynamic range and signal-to-noise figures, and to the negligibly low distortion figures associated with a 16-bit linear quantization system. The standard EIAJ system for PCM recording on videotape employs a sampling rate not far removed from that used in the CD system (44.056 kHz as opposed to 44.1 kHz) but is, however, a 14-bit system. As such, its best possible dynamic range, signal-to-noise and harmonic distortion performance cannot match the best theoretical figures obtainable with CD players. Still, the results I did get using the Sansui PC-X1 are impressive and certainly far superior to what you might expect from a top-quality home or even professional reel-to-reel analog tape deck.

One problem of measurement (but not inherent in the processor itself) became apparent when I tried to plot frequency response at maximum record level—the +15 dB designation on the meter scales. Since the unit has built-in non-defeatable pre-emphasis (during recording) and de-emphasis (during playback), high frequencies overloaded the system during the automatic sweep of my Sound Technology 1500A, and the overload light flashed its warning for a good part of the sweep. Results of this incorrect plot are shown, as a matter of interest, in Fig. 1A. Note that in this plot, the vertical scale is 10 dB per division, and overload causes a roll-off to begin above 2 kHz, where pre-emphasis pushes levels beyond the maximum allowable record level.

My tests suggest that there is no reason to use anything but the slowest speed available on the VCR coupled with the PC-X1.

Though due to a completely different set of phenomena, the resulting curves, shown more as a matter of academic interest than as an indication of performance, resemble those obtained at "0 dB level" on a cassette recorder when tape saturation limits high-frequency output.

Once I backed off the level to allow for pre-emphasis, response settled in nicely, as shown in Fig. 1B. Here, it was flat over nearly the entire audio spectrum, exhibiting a roll-off of only 0.5 dB at 20 kHz for the left channel and 0.6 dB at 20 kHz for the right channel during playback. Note that Fig. 1B was plotted using a more sensitive vertical calibration, 2 dB per division.

Distortion, at levels up to and including an indicated +15 dB, measured 0.006% at 1 kHz, 0.01% at 10 kHz, and 0.007% at 20 Hz. To illustrate the effects of over-recording, I plotted second-order and third-order distortion using the Sound Technology 1500A tape tester, much as I would for an analog tape deck or tape test. Bear in mind that the lowest distortion that this instrument can read is 0.01%, and the readings listed above were made using another, more sensitive distortion analyzer. The point I am trying to illustrate in Figs. 2 and 3 is how rapidly overload distortion occurs with any PCM system once you exceed maximum record levels.

In Fig. 2 I have plotted second-order distortion versus record level. The double vertical line represents +15 dB level (maximum allowable) on the PC-X1 metering system, and the test frequency was 1 kHz. With the cursor set to this reference level, identified as "0 dB" by the test instrument, in Fig. 2A, the distortion reading was as low as the instrument can give, 0.01%. The "blips" that appear in the display to the right of the double vertical line show the rapidly rising distortion as record levels are increased above the allowable maximum. In Fig. 2B, with the dotted line cursor now set to +4 dB (in reality, 4 dB above the +15 dB point on the processor's meters), second-order distortion has already risen to a whopping 4.8%. The two lower "blips" visible near the bottom of the graph, just to the right of the reference double vertical line, suggest that up to 3 dB of over-recording will be tolerated fairly well by the system. These represent readings just a bit above 0.03%.

The same sort of plot is represented in Figs. 3A and 3B, except that this time the instrument measured third-order harmonic distortion. In Fig. 3A an over-record level of just 1 dB (above the maximum +15 dB on the meters) produced a third-order distortion reading of 0.05%, while increasing the level by just another dB (to +2 dB above maximum allowable) resulted in a rapid jump of third-order distortion, up to an unusable 3.5%!

Signal-to-noise ratio, referenced to maximum allowable record level, measured 80 dB, unweighted, and 83 dB using an A-weighting network. If you add in a couple of dB for allowable overload, the dynamic range of the system comes within a dB or so of the 86 dB claimed by Sansui, hardly worth quibbling about when you are talking about performance quality of this kind.

For those interested in knowing just what is actually recorded onto the videocassette when a PCM processor is used, I photographed the face of my oscilloscope when it was connected to the "Copy Out" jack, while turning on a

maximum-amplitude 1 kHz at the input to the processor (Fig. 4A) and when no signal was applied to the processor (Fig. 4B). In effect, what you are seeing is a bit more than one complete video "frame" (1/30th of a second's worth of data). In Fig. 4A, the data area is filled in with "ones" (full amplitude pulses), while in Fig. 4B we see that the data area is at lowest amplitude, which, of course, represents absence of signal, or a frame full of "zeros." As a further item of academic interest, I connected the "Copy Out" terminal to my own video monitor during playback of a recorded musical passage. Using the "Pause" button on my VCR, I was able to create a "freeze frame" picture of an "instant" of music, which is shown in Fig. 5. I, for one, am getting to the point where, by gazing at the video screen during playback of a PCM-recorded music program, I can almost distinguish between loud and soft passages, as well as between low-

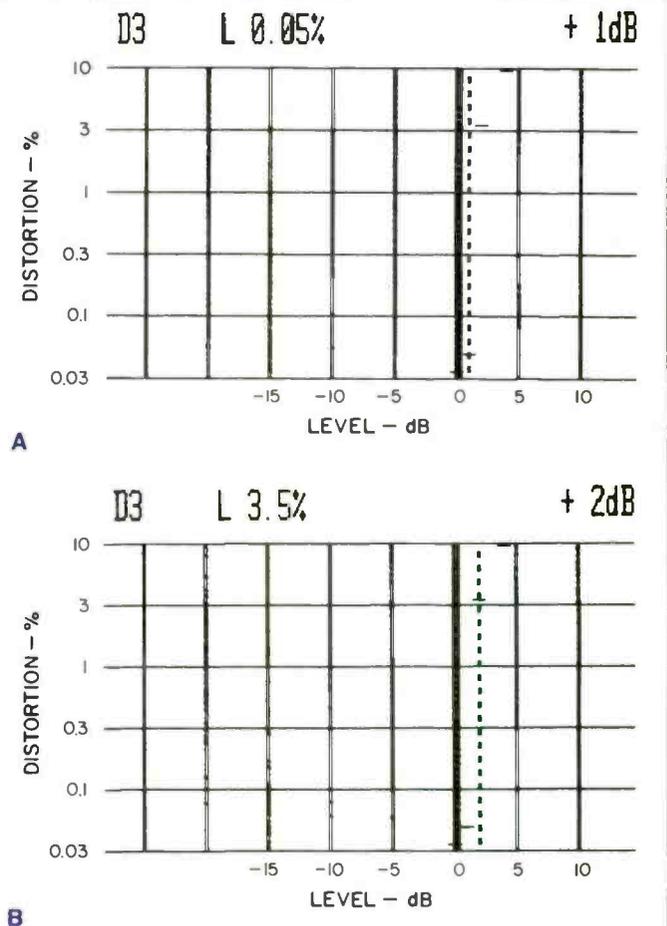


Fig. 3—Same as Fig. 2 except third-order harmonic distortion was measured. At +1 dB, HD₃ was only 0.05% in (A), but it has increased to 3.5% at +2 dB in (B).

Sansui's PC-X1 is a real winner, and I can't blame them for keeping the secrets of its circuitry completely to themselves.

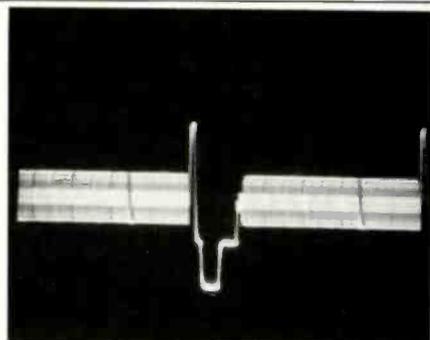


Fig. 4—Scope photos of one "frame" of PCM-encoded digital audio data. A maximum-amplitude 1-kHz signal is shown in (A), while a no-signal condition is shown in (B).

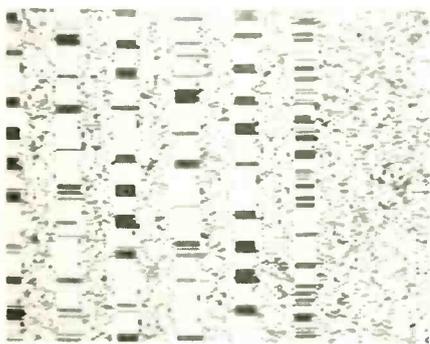
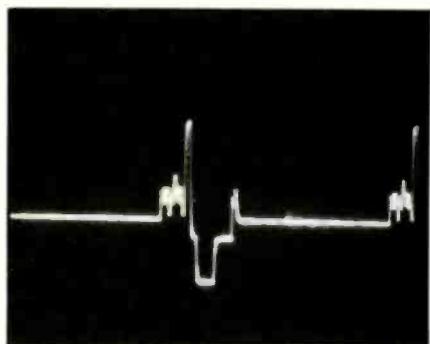


Fig. 5—An "instant" of PCM-encoded music program, as displayed on a video monitor.

and high-frequency tones. I expect it will be some time, however, before I can "read" the patterns as one would read a musical score. . . .

Use and Listening Tests

Since I usually have several Beta and VHS video recorders on hand in my lab, in addition to my own portable and table-top VCRs, I was able to connect the Sansui PC-X1 to several video recorders. I can state that it worked equally well with all of them, regardless of format. The real test, however, was when I ran the PC-X1 with my somewhat antiquated (two-year-old) VHS table-top recorder operated at its slowest (EP) speed, using a T-160 tape. I could detect no difference in performance or sound quality playing back that slow-speed tape, when compared with the sound quality I heard when the same selections were played back after having been recorded on a late-model Beta VCR operating at its fastest Beta II speed. Indeed, my tests suggest that there is no reason to use anything but the slowest available

VCR tape speed (Beta II or EP, depending upon your VCR format) for all PCM recording work, unless your tape is of such poor quality or your tape heads are so dirty or damaged that even the Sansui PC-X1 TriCode PCM system cannot read it without muting.

You are probably wondering what material I used for my listening tests. I can remember when I checked out my first PCM processor for *Audio* a couple of years ago. At that time I jokingly pleaded for some live musicians to come and play in my lab. (Incidentally, I got several sincere offers from local music groups to oblige.) Since then, I've amassed my own collection of source material that's "good enough" to use in evaluating a product such as this one. The source material is, of course, in the form of Compact Discs, some of which are musically superb and as close to "live" music as I've ever heard. Since they utilize a 16-bit system, that also puts them a step ahead (in theory) of what can be accomplished with a 14-bit quantization scheme such as that used in the Sansui PC-X1 processor/VCR combination.

With levels properly adjusted, it was virtually impossible to tell the difference between the CD playback and the PCM-recorded playback of the same material. When I turned up the volume to very loud levels (louder than I would normally employ for serious listening), I was able to detect a bit of residual noise floor in the case of the PCM/tape playback, but it was at a level that I would hardly call intrusive under any reasonable listening conditions.

I am somewhat puzzled by the fact that products such as Sansui's PC-X1 are not selling to serious recordists in greater numbers. I am told that sales of this and other PCM processors are, in the main, being made to small studios, radio stations and other professionals or semi-professionals, but that very few are going to serious audiophiles. It seems to me that with the kind of performance results I heard and measured using the Sansui PC-X1, anyone seeking a superb recording system would jump at a chance to own a true PCM digital recording system such as this one. And particularly so now that prices for such a device are so much lower than they were just a year or two ago. Perhaps it is the inability to edit that stops many prospective buyers, or perhaps it is the knowledge that there are few sources of programming (other than live music or Compact Discs) that are worth transcribing onto such a high-quality recording medium. And as for CDs, the old justification for transcribing mint-condition records onto tape really doesn't apply, since CDs, with proper care, retain their own mint condition indefinitely.

Be that as it may, the Sansui PC-X1 is a superb PCM encoder/decoder that has been intelligently designed for ease of use and that works well even under the most trying conditions that might trip up other PCM processors I have tested in the past. It is reasonably priced, attractively packaged, and superbly engineered. I have tried to learn more about just what TriCode PCM circuitry involves and how it differs from other PCM processor circuitry, but so far Sansui seems intent upon keeping that information to themselves. While my curiosity remains unsatisfied, I can't really blame the people at Sansui. They have a real winner of a product here, and probably want to keep its secrets for as long as they can.

Leonard Feldman

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The CD491 incorporates a dual capstan transport with twin flywheels to insure perfect movement of the tape across its 3 high performance heads. The dual capstan serves to isolate the tape from the cassette shell while the dynamically balanced flywheels help generate a

consistently accurate tape speed. Together they enable the CD491 to reduce wow-and-flutter to an inaudible .025%. The only "wow" you'll ever hear is the reaction of people listening to your Harman Kardon cassette deck.

The CD491 incorporates Dolby[®] HX Pro¹ for extended frequency response, plus Dolby B and C¹ for maximum noise reduction. Three precision heads offer improved performance and the convenience of monitoring while recording. Included is a Sendust head to withstand high record levels without overload and a ferrite playback head for extended high frequency response.

The combined benefits of the CD491's performance features allow for the accurate recording of more dynamic audio signals than previously possible. In fact, the large signal response (frequency response at 0V_u) of the CD491 is a virtually unrivaled 20Hz-20kHz \pm 3dB. This is especially significant as more demanding forms of software, such as digital audio, become available.

So, while other manufacturers continue to pile on unnecessary features and gimmicks, Harman Kardon continues to develop only fundamentally advanced audio equipment.

(1) Dolby is the registered trademark of Dolby Laboratories, Inc.
(2) In 1982, Harman Kardon challenged individuals to bring in their cassette decks to a local HK dealer. All units were cleaned and demagnetized in order to insure fair test results. The Harman Kardon unit was factory packed.

harman/kardon

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2

ASC AS-6004/S OPEN-REEL RECORDER

Manufacturer's Specifications

Frequency Response: 20 Hz to 22 kHz at 3¾ ips, to 25 kHz at 7½ ips, and to 28 kHz at 15 ips.

Signal/Noise Ratio: 64 dB.

10-kHz Dynamic Range: 53, 63 and 70 dB at 3¾, 7½ and 15 ips, respectively.

Input Sensitivity: Mike, 0.2 mV; line, 22 mV; DIN, 0.04 mV; mixer, 100 mV.

Output Level: Line, 1 V; DIN, 650 mV; headphone, 1.6 V; mixer, 100 mV.

Flutter: ±0.1%, ±0.05% and ±0.04% weighted peak at 3¾, 7½ and 15 ips, respectively.

Wind Time: 160 seconds for 3,600-foot tape.

Dimensions: 16.9 in. (430 mm) W x 15.6 in. (395 mm) H x 6.1 in. (155 mm) D.

Weight: 44.1 lbs. (20 kg).

Price: \$1,795.00.

Company Address: Hammond Industries, 8000 Madison Pike, Madison, Ala. 35758.

For literature, circle No. 91



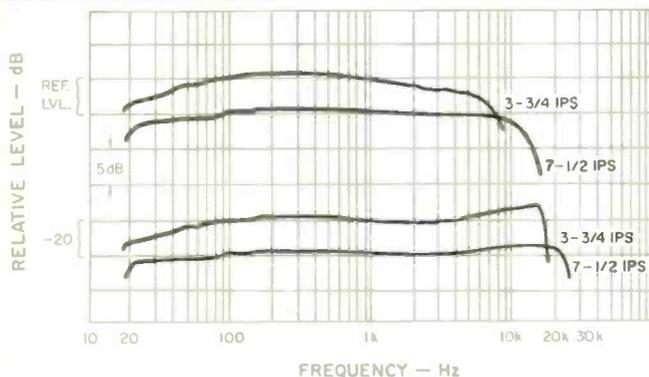


Fig. 1—Frequency responses at reference level (400 nWb/m at 400 Hz) and at -20 dB, at both 3¾ and 7½ ips, using Maxell XL I tape.

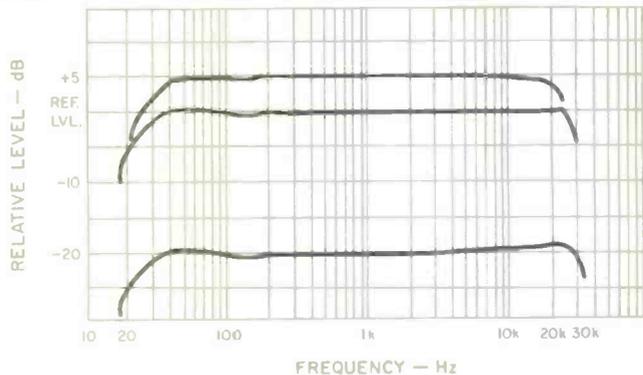


Fig. 2—Frequency responses at 15 ips, measured at reference level, at +5 and -20 dB, using Maxell XL I tape.

The ASC Model AS-6004/S is a well-performing tape recorder recently introduced in the United States by Hammond Industries. The manufacturer is the German firm of Audio System Componenten; they use the initials "ASC" for their products, and so shall the text that follows. After a period of testing only cassette decks, I was glad to dig into the versatile AS-6004/S. This deck provides *three* speeds: 3¾, 7½, and 15 inches per second. Many recorders offer 3¾ and 7½ or 7½ and 15 ips, sometimes charging more for the higher speed unit. The ASC unit has the expected three heads, with space to mount a fourth. The deck received for evaluation was a four-track, two-channel unit, and a half-track stereo head could have been mounted in the fourth position, enabling playback of that format. (There is a half-track-recording version which can accept an auxiliary quarter-track playback head.) The headblock assemblies are of plug-in design, which makes fast format changes easy.

The transport system includes a d.c. capstan motor and two outside-rotor reel motors. The tape speed can be changed at any time, even while in play or record mode. There is tape-end sensing for automatic drive-shutoff, both from an optical sensor at the supply end of the headblock (useful with transparent leader) and from a position switch on the take-up tension arm. Just to the left of the arm roller is the rubber-tired drive idler for the five-digit, red-LED counter which reads in meters and decimeters. The first digit reads to "1" only, but that is sufficient even for the longest tapes on 10½-inch reels. A tilt-down section just below the straight-line tape path provides access for cleaning and demagnetization. A "Cue" knob to the left of the counter locks into a soft detent when its lever is pushed to the left. The reels can then be moved manually, while the tape remains in contact with the playback head. If the deck is put in a wind mode, "Cue" will automatically reduce the level and roll off the highs, and winding will continue only while the button is held in. If "Play" or "Record" is resumed, "Cue" immediately snaps back to its off position. In addition to the

normal transport-control buttons, there is a "Repetition" key which gives rewind when held in, and then switches to play mode when released. In general, the logic allows making changes from any mode to any other, but fast-wind modes are locked out when recording in order to prevent inadvertent mistakes.

Two sets of dual-concentric level pots for both microphone and line inputs provide complete mixing of these sources, and there is a master level pot as well. The peak-responding level meters and the headphone level pot are above, and the headphone and microphone level pots are to the left. A red record-mode indicator is just below the scale of each meter. The headphone level pot does *not* affect the line output, and the "Tape [line] Output" pot (on the top panel, near the output jacks) does not affect the headphone level. This is a desirable configuration, but it is all too rarely found.

Four lever-action switches select monitor mode (source or tape with either DIN or NAB equalization), effects mode (echo/off/sound-on-sound), record track (upper/stereo/lower) and tape speed (9.5/19/38 cm/S or 3¾/7½/15 ips). Power is controlled by a large, yellow pushbutton. The white designations on the black panel were easy to read, whatever the lighting.

While headphone and microphone jacks are on the front of the deck, all other connections are made to a jack strip recessed into its top panel. (When the deck is operated horizontally, this becomes the rear panel, which is also convenient.) There are phono-jack pairs for line in and tape (line) out, a level control for the output jack, a DIN "Radio" jack, and four other, more unusual connectors. The multi-pin "Remote Control" jack can accept wired or infrared remote controllers, a variable speed control, or both the vari-speed and a remote, with an optional "Y" connector. Also on the panel are two jacks, labelled "Projector" and "Dia," which the manual does not explain. The manufacturer reports that the first is for "double-system" Super-8 film sound (in which

"Cue" allows audible location of points on the tape in fast wind or with manual reel movement for fine editing.

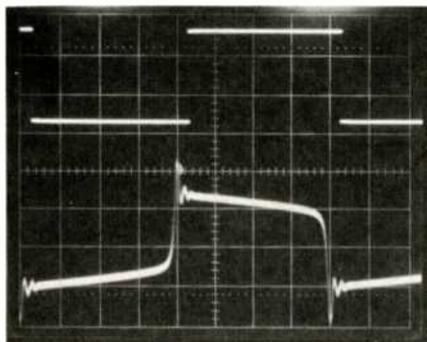


Fig. 3—Record/playback of 634-Hz square-wave signal at 15 ips. Horizontal scale: 0.2 mS/div.

the sound is on a separate tape rather than on the film), while the second is for synchronizing slide-show soundtracks. These are apparently for European projectors, and the "Dia" feature, at least, requires an "impulse head modification" at extra cost.

The last jack is labelled "Mixer," and has a dummy plug in it. The dummy plug contains jumpers to feed through the signals of the two channels. This break-in point is after the master gain control and before the meters and the record amplifier. With the plug removed, it is possible to insert external signal processing such as noise reduction or to mix in additional sources, if desired. This is an unusual feature, and it could facilitate some tasks that are done less satisfactorily with other decks. There is also a screw-type fuse-holder on this panel.

For ventilation, the back panel is perforated over its entire surface, while the front panel has slots near its upper edge. This allows convection cooling with the deck positioned vertically or horizontally. Removing the back panel allows interior inspection. The soldering was excellent, in general, with just a few spots of flux where there had been hand soldering. The high-quality parts on the p.c. boards were identified, and the layout and workmanship were good. A large transformer was at the top, a good placement which restricts its heat and field to less-critical areas. The good-sized, outside-rotor reel motors were noted, but it was not possible to get a good look at the capstan system with the limited disassembly performed. A carrying handle was provided—more open-reel decks should have carrying handles, particularly those that might need to be moved for remote recording.

Measurements

The playback responses were checked with Ampex and MRL test tapes. With very few exceptions, all of the points were within ± 1.8 dB, including some fringing corrections needed at the lower frequencies because of using full-track tapes. The measured frequencies of the played-back tones indicated that the three play speeds were 0.1% to 0.3% slow, which is plenty close. A 200 nWb/m flux level at 500 Hz gave a meter indication of about "-9." Record/playback

tests at 500 Hz showed that the reference level of 400 nWb/m was obtained with a meter reading of "-2.5." Meter zero was very close to 500 nWb/m, which is a very high flux level; consider the fact that some recorders have meter zero at 185 nWb/m, almost 9 dB lower in flux level. Many of these recorders have average-responding meters, while the AS-6004/S's are peak responding, so the difference is actually quite logical.

The record/playback responses were checked at 20 dB below 400 nWb/m, and the responses at 7½ and 15 ips were excellent for all the tapes tried: BASF LH, Maxell UD and XL I, and TDK LX and GX. At 3¾ ips, the BASF LH response was the flattest, but the distortion was higher. Maxell XL I was selected as the best tape for this unit, considering all factors.

Swept-frequency responses were made at reference level and 20 dB below that for all three speeds, and also at +5 dB at 15 ips. The plots are presented in Figs. 1 and 2, and the 3-dB-down points are listed in Table I. The results are very good, and the highest speed provides obvious benefits in flatness, higher recording levels, and extended high-end responses. In general, the results meet the specifications, although they appear to be shy at the low end at 15 ips and at the high end at 3¾ ips. The tests were, however, run at levels 4 dB higher than specification, so the discrepancies (which are judged to be minor) would be even less at the specified 20 dB below 250 nWb/m.

Table II lists various measured record/playback characteristics. All of them are very good, although careful head adjustment would reduce the A/B phase error. (My playback test tapes indicated just enough head misalignment to account for this.) Note that the jitter and phase error are more or less inversely proportional to tape speed.

In recording, fairly little bias appeared in the output from the tape monitor jack. Figure 3 shows the input and record/playback waveforms of a 634-Hz square wave at 15 ips. (This was actually quite good at all three speeds.) Note the short oscillation at the leading edges of the waves; this oscillation occurs on many decks at the resonant frequency of the record EQ circuit.

With a reference level of 400 nWb/m (meter "-2.5"), distortion levels were measured, for all three tape speeds, from -10 dB to the points where $HDL_3 = 3\%$ for a 400-Hz test signal. The distortion limits, listed with the other data in Table III, are very close for the three speeds, but 15 ips does evidence the lowest distortion at zero and below. There was consistent HDL_2 of 0.08%, which other checks showed to be in the electronics. This was the limiting distortion below -4 dB, although 0.08% would be low enough for most everyone. There also was some HDL_5 which was always 7 dB below HDL_3 at 15 ips and about 15 dB below at the other speeds. Essentially, its level was not significant until zero was reached. Table IV lists the signal-to-noise ratios with both IEC A and CCIR/ARM weightings, with figures for both reference level and the 3% distortion limit. All of the figures are excellent, and these are obtained without any noise reduction.

The level of HDL_3 was measured at 10 dB below reference level from 30 Hz to 6 kHz at 3¾ and 7½ ips. In general, the results at 7½ ips are better at the low end, and

Output clipping occurred just above meter maximum—no limitation, as that's just above the 3% distortion limit, and the meters are peak-reading.

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

Tape Type	Tape Speed, ips	+5 dB		Ref. Lvl.		−20 dB	
		Hz	kHz	Hz	kHz	Hz	kHz
Maxell XL I	3¾			23	6.0	20	17.0
Maxell XL I	7½			20	12.0	19	24.7
Maxell XL I	15	29	23.3	24	28.5	23	30.3

Table III—400-Hz HDL₃ (%) vs. record level (0 dB = 400 nWb/m).

Tape Type	Tape Speed, ips	Record Level					HDL ₃ = 3%
		−10	−8	−4	0	+4	
Maxell XL I	3¾	0.05	0.07	0.19	0.63	2.5	+4.4 dB
Maxell XL I	7½	0.04	0.07	0.21	0.79	2.5	+4.5 dB
Maxell XL I	15	0.05	0.05	−0.08	0.71	2.8	+4.2 dB

Table V—HDL₃ (%) vs. frequency at 10 dB below reference level.

Tape Type	Tape Speed, ips	Frequency (Hz)							
		30	50	100	400	1k	2k	4k	6k
Maxell XL I	3¾	0.30	0.20	0.12	0.05	0.03	0.10	0.42	0.71
Maxell XL I	7½	0.18	0.16	0.06	0.04	0.09	0.14	0.45	0.75

3¾ ips is a bit better at the high end, which seems a little surprising. Because of high-frequency bandwidth limitations at lower speeds, the signal/noise ratios did not indicate an advantage for the higher ones, nor do those tests show up the headroom limitations of the lower speed. The manufacturer's specifications include figures for the 10-kHz dynamic ranges at each speed, and they state that at 7½ it is 10 dB better than at 3¾, and that at 15 ips it is 7 dB better than at 7½. My 0-dB swept responses for the two lower speeds, and my +5 dB response at 15 ips at 10 kHz, show the same relative differences between speeds as the manufacturer's specifications do. As we shall see, the meters are designed to make the user aware of these changes in saturation level with change of speed.

Table VI presents a number of input and output characteristics measured at 1 kHz. The reference meter reading was zero, and it should be noted that the manufacturer's specifications are referenced to a level of 250 nWb/m, which is 6 dB (half the voltage) below zero. With this in mind, I point out that the line input was more sensitive and the microphone input less sensitive than specified. The mixer in/out level measured 200 mV, which would be a good match for most external devices. The headphone output impedance of 200 ohms seemed a bit high, but its output was 930 mV with the test-standard 50-ohm load. The maximum level was excruciatingly high for all of the headphones tried, but it could be lowered to any desired volume with the pot. Output clipping

Table II—Miscellaneous record/playback characteristics.

Tape Speed, ips	Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase	
				Error	Jitter
15	70 dB	60 dB	−67 dB	−15°	10°
3¾				−50°	30°

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

Tape Type	Tape Speed, ips	IEC A Wtd. (dBA)		CCIR/ARM (dB)	
		Ref. Lvl.	HD = 3%	Ref. Lvl.	HD = 3%
Maxell XL I	3¾	64.2	68.2	62.0	66.0
Maxell XL I	7½	60.6	64.9	61.7	65.8
Maxell XL I	15	62.7	66.7	60.3	64.3

Table VI—Input and output characteristics at 1 kHz.

Input	Level		Imp., Kilohms	Output	Level		Imp., Ohms	Clip (Re: Meter 0)
	Sens.	Overload			Open Ckt.	Loaded		
Line	22 mV	7.0 V	190	Line	2.5 V	2.4 V	447	+4.8 dB
Mike	0.58 mV	170 mV	1.7	Hdphn.	3.6 V	930 mV	200	

occurred right about the meter maximum of "+4" at +4.8 dB re: meter zero. This is not the limitation it appears at first because (1) the 3% distortion limit is just below this, and (2) peak-responding meters need little clipping headroom.

The dual-concentric microphone and line input pots actually tracked fairly well when the knobs were held together (there is no friction coupling). The master level pot tracked within 1 dB, from maximum down close to −80 dB; this is superb and much the best I've ever measured. While setting levels for distortion checks, it was found best to make certain that the master pot was always set higher than the channel pot sections, to minimize the possibility of internal overload. The tape/line output pot on the top (or back) panel tracked within 1 dB from maximum down to about −35 dB, fairly good. The headphone pot sections tracked within 1 dB for about 40 dB, quite acceptable for the purpose. The output polarity was reversed from the input, both in source and tape monitor. Playback polarity was also reversed, according to the Lipshitz polarity test tape.

The response times of the meters were exactly in agreement with IEC Standard 268-10 on peak program meters, better than any others tested to date. A meter indication of "−20" was reached at −15.4 dB, but all other points were much closer—most of them within 0.2 dB. The frequency response of the meters reflects the fact that they are fed the record-equalized signal, leading to a slight rise at the low end and a high-end boost dependent upon tape speed. At

The ASC-6004 is a versatile, well-performing recorder, and its price is quite reasonable for all that's included.

15 ips, the boost was 1.5 dB at 10 kHz and 4.6 dB at 20 kHz. At 7½ ips, the boosts were 7.5 dB at 10 kHz and 24.4 dB at 20 kHz, and at 3¾ ips the boosts were 11.4 at 10 kHz and about 36 dB at 20 kHz. This metering approach ensures that the recordist is shown how levels must be set to minimize distortion and saturation losses whatever the tape speed and whatever the music content.

The flutter was very low at all three tape speeds, and for all positions on a reel. Weighted-peak figures were ±0.035%, ±0.028% and ±0.019% for 3¾, 7½, and 15 ips respectively. There were no changes in tape speed with changes in line voltage from 110 to 130 V. Over a period of time there was a total spread in play speed of about ±0.02%. A few fast-wind tests showed that the tape speed was close to constant for most of the reel, indicative of constant tension. The winding time for a 10½-inch reel with 3,600 feet of tape was 110 seconds, considerably shorter than the specified 160 seconds. Changing directions of wind took less than a second, while going from winding to play required about 2 seconds. At 15 ips with the deck horizontal, there was a take-up oscillation when 7-inch reels were used. This did not occur with the deck vertical, nor did it occur at other speeds under any conditions. A slight touch of the hand corrected the problem, but I suspect that a slight adjustment would have eliminated it.

Use and Listening Tests

The bilingual owner's manual has most of the basic information, but there is much needed detail that is missing. The ASC deck has a number of features and its own particular characteristics that the manual should fully discuss—using the "Mixer" connection, meter/flux levels, setting levels, etc. A service manual is provided, with helpful schematics and layouts, but its English text is clumsy in spots. Hammond

Industries stated that there will be improvements made in these manuals. A rear-panel illustration is also needed, to ensure that the user understands the functions of all the jacks and what accessories mate to them.

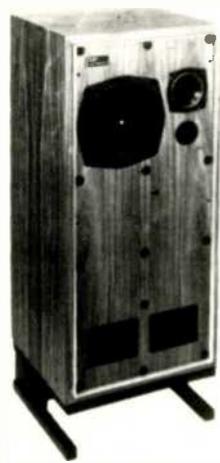
Tape threading across the headblock assembly is straight-line, although a little care was needed to avoid letting any slack get caught. Looping the tape over the tension arm and counter rollers was quite easy, better than on many open-reel decks. Tilting the headblock dust cover down gave fairly good access to the heads for editing, and good access for head cleaning and other maintenance tasks. Equalization and bias adjustments were inside the deck, hence not readily accessible for touch-up adjustments before important recording sessions or for changing tape types.

All of the controls and switches were completely reliable, with no failure of any kind. The only difficulty was the slow, oscillating take-up with 7-inch reels at 15 ips when the deck was horizontal. The counter evidenced no slippage, and it was possible to return to exact points after fast winding the tape back and forth.

"Record" caused a slight clunk in tape noise, but there was no stop sound detected. The metering was excellent with all types of music and under a wide range of lighting conditions. Switching to a lower speed resulted in an immediate indication that a lower level was needed to prevent distortion.

Listening to the playback proved the excellence and importance of the AS-6004/S metering scheme. It was most enjoyable to listen to the smooth, open sound with 15 ips, but the lower speeds had much to commend them as well. This ASC deck is a very versatile and well-performing recorder, and its price is quite reasonable for all that is included.

Howard A. Roberson



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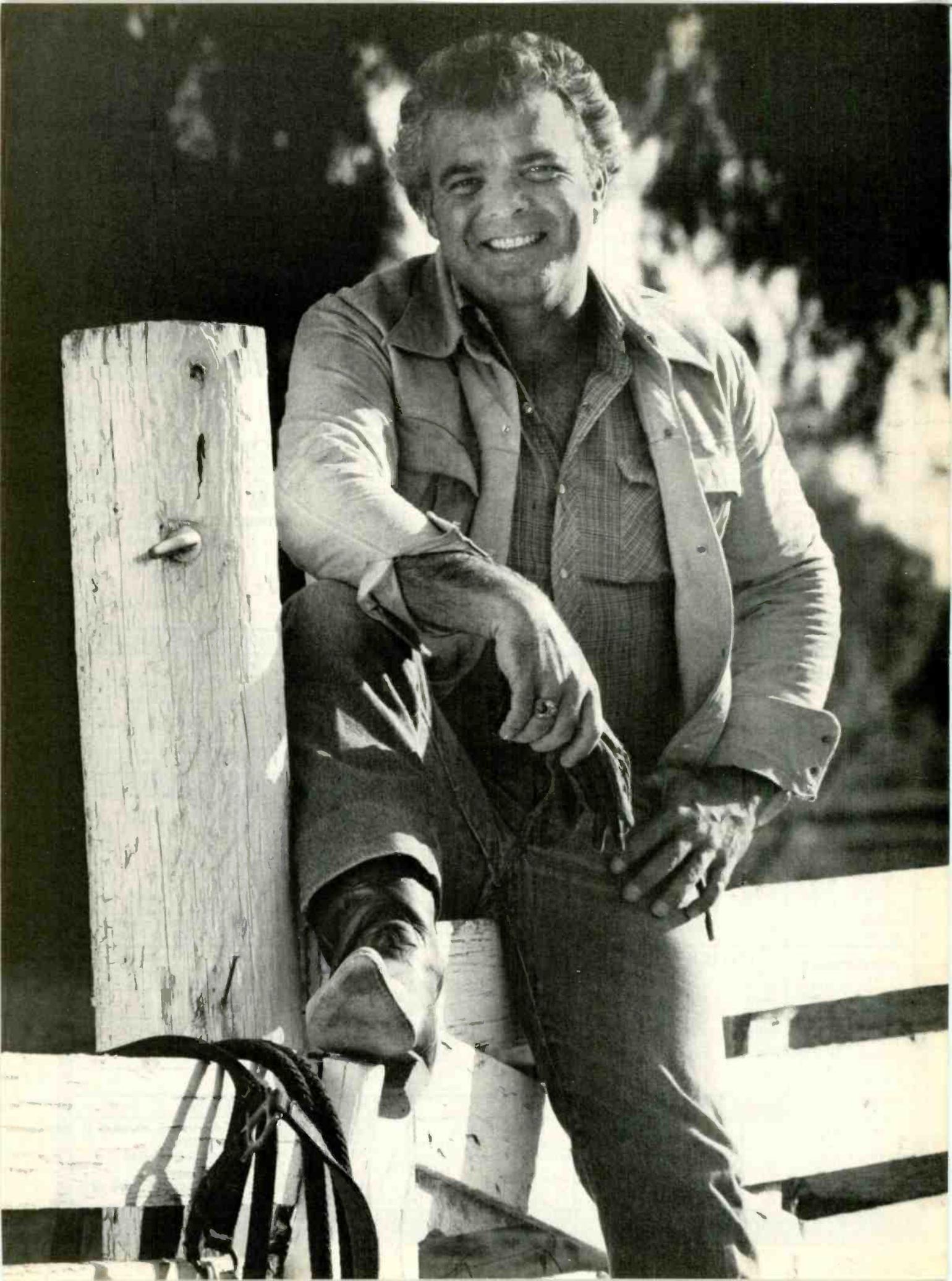
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3

YAMAHA M-70 POWER AMPLIFIER

Manufacturer's Specifications

Power Output: 200 watts per channel, 8-ohm loads, 20 Hz to 20 kHz.

Rated THD: 0.002%.

Clipping Power, 4 Ohms: 250 watts per channel.

IM Distortion, at Half Rated Power: 0.002%.

Damping Factor, 8 Ohms, 1 kHz: 200.

Frequency Response: D.c. to 100 kHz, +0, -0.5 dB.

Input Sensitivity, for Half Rated Power: 1.41 volts.

S/N, re: Rated Power Output: 124 dB.

Slew Rate: 200 V/μS.

Power Consumption: 600 watts, 1,200 VA.

Dimensions: 17 1/8 in. (43.5 cm) W × 5 1/4 in. (13.3 cm) H × 15 in. (38 cm) D.

Weight: 30.1 lbs. (13.7 kg).

Price: \$950.00.

Company Address: 6600 Orange-thorpe Ave., Buena Park, Cal. 90620.

For literature, circle No. 92



The Far Eastern penchant for naming special circuits with descriptive slogans, initials and acronyms reaches its pinnacle with the Yamaha M-70, which is actually a perfectly good amplifier that meets virtually all of its specifications and delivers in excess of 200 watts per channel into 8-ohm speaker loads. Just consider the following: The Yamaha M-70 is a "Natural Sound" stereo power amplifier. It uses "ZDR" (Zero Distortion Rule), not to mention a High-Efficiency Yamaha "X" Power Supply and an "X" Amplifier Circuitry. All this and it amplifies audio signals, too! Joking aside, I promise to decode all of these phrases shortly; first let's take a look at the physical layout of the amplifier itself.

A square power on/off pushbutton and a "Protection" indicator light are located at the left end of the front panel of the M-70. The indicator glows for a few seconds after turn-on (during which time speakers are muted) or whenever else the protection circuitry mutes the amplifier. The center portion of the panel is occupied by a pair of logarithmically compressed bar-graph meters, calibrated from 0.02 to 300 watts. "Meter Off," "Peak Hold" and "Range" buttons are located to the left of the meters. When the "Range" switch is depressed, it multiplies the sensitivity of the metering system by a factor of 10 (a reading of 20 watts then means 200 watts, for example). When this range multiplication is selected, an indicator located between the two bar graphs lights up to denote the fact.

The right section of the panel is given over to speaker-selection and input-level controls. Here, Yamaha has come up with a simple but much appreciated innovation. The switches which select speakers "A" or "B" simultaneously select separate pairs of left and right input-level controls. If you have one pair of speakers in one room and a different pair, with very different efficiency, in a second room, you can adjust the level controls so that volume levels will be the same when you switch from the first pair of speakers to the second pair. (Only one pair of speakers can be selected at one time, however.) A third pushbutton switch allows you to temporarily turn off the signal being fed to either speaker pair, since the "A" and "B" switches are interlocked (one or the other must always be depressed).

The rear panel of the M-70 is equipped with a pair of input terminals, a chassis ground terminal, an unswitched convenience a.c. receptacle, and two sets of stereo speaker-cable connection terminals. These connectors are extremely easy to use, requiring only that the stripped end of a speaker wire be inserted in a small hole at the front of each connector, following which the connector housing is simply rotated one-half turn to lock the speaker wire firmly in place.

Circuit Highlights

And now, for a translation of all those circuit acronyms and abbreviations. Let's take ZDR first. It consists of a distortion detector and summing circuit (see Fig. 1). A bridge detector and comparison amplifier monitor input voltage, output voltage, and output current of the final stage and detect any harmonic distortion, changes in output, or impending instabilities. The bridge elements are pure resistances, and the circuit is designed so that variations in load impedance have no effect upon the detector. The distortion detector compares the power stage's output waveform with

the stage's input waveform, generating a distortion waveform that is 180° out of phase with the distortion in the output signal. This signal is fed back to the input of the power stage in the correct proportion to cancel virtually all distortion. Even undesired signals generated by the back EMF of the speakers are dealt with by the ZDR circuit, according to Yamaha.

The difference between this and negative feedback is that only the distortion products are returned to the input. In theory, at least, ZDR can be used to totally eliminate distortion (hence the name); with regular feedback, the only way to eliminate distortion completely would be to feed back enough of the amplifier's output to totally eliminate all gain, as well. ZDR should also eliminate the instability problems which high feedback can cause.

The X power supply and X power amplifier turn out to be a single system, not unlike several other two-level power-supply arrangements which have been appearing from various amplifier manufacturers in recent years. Elements of the X power system are reminiscent of the Carver Magnetic Field amplifier, and, in fact, part of the circuitry used in the Yamaha M-70 is licensed from Carver Corp. The X power supply provides two d.c. power lines to the X amplifier stages—low power and high power. Circuitry in the X power amplifier stage then selects the appropriate supply line, according to the input-signal requirements. During amplification of average-power music signals, only the low-power line is utilized, reducing heat dissipation and increasing efficiency. When high-level music peaks come along, the amplifier switches to the high-power line.

The Linear Transfer Complementary SEPP circuit in Fig. 1 is the power output stage. The "SEPP" stands for "single-ended push-pull," a design much favored by Japanese manufacturers. This sounds like a contradiction in terms, but actually denotes a push-pull circuit which looks single-ended to the d.c. power supply, so that its mid-voltage point is 0 volts. This prevents d.c. from reaching the speakers, without the use of blocking capacitors.

Another circuit found in the Yamaha M-70 is called Linear-Transfer Bias Circuitry (not shown in Fig. 1). It biases the bipolar transistors so that their operating points are slightly staggered, converting their total transfer characteristics to an ideal "square" characteristic in the low-current region. Overall effect is to reduce crossover distortion to negligible or unmeasurable levels.

Measurements

The extremely low rated distortion quoted for the Yamaha M-70 made it almost impossible for me to verify the quoted figures, since my test signal source contains approximately 0.002% harmonic distortion to begin with. Furthermore, trying to measure distortion levels of 0.002% or lower with reference to power output levels of 1 watt or less (as required by the FTC) invariably involves one in measuring the residual noise floor rather than pure distortion. This is true even if spectrum analysis is used, since even when restricting bandwidth of measurement, some noise is still present in the reading. After all, 0.002% corresponds to -94 dB! Nevertheless, I can confirm that at a power output level of 200 watts per channel, both channels operating, using 8-

Transient response of the M-70 was excellent, and bass reproduction very good, with no muddiness or overhang.

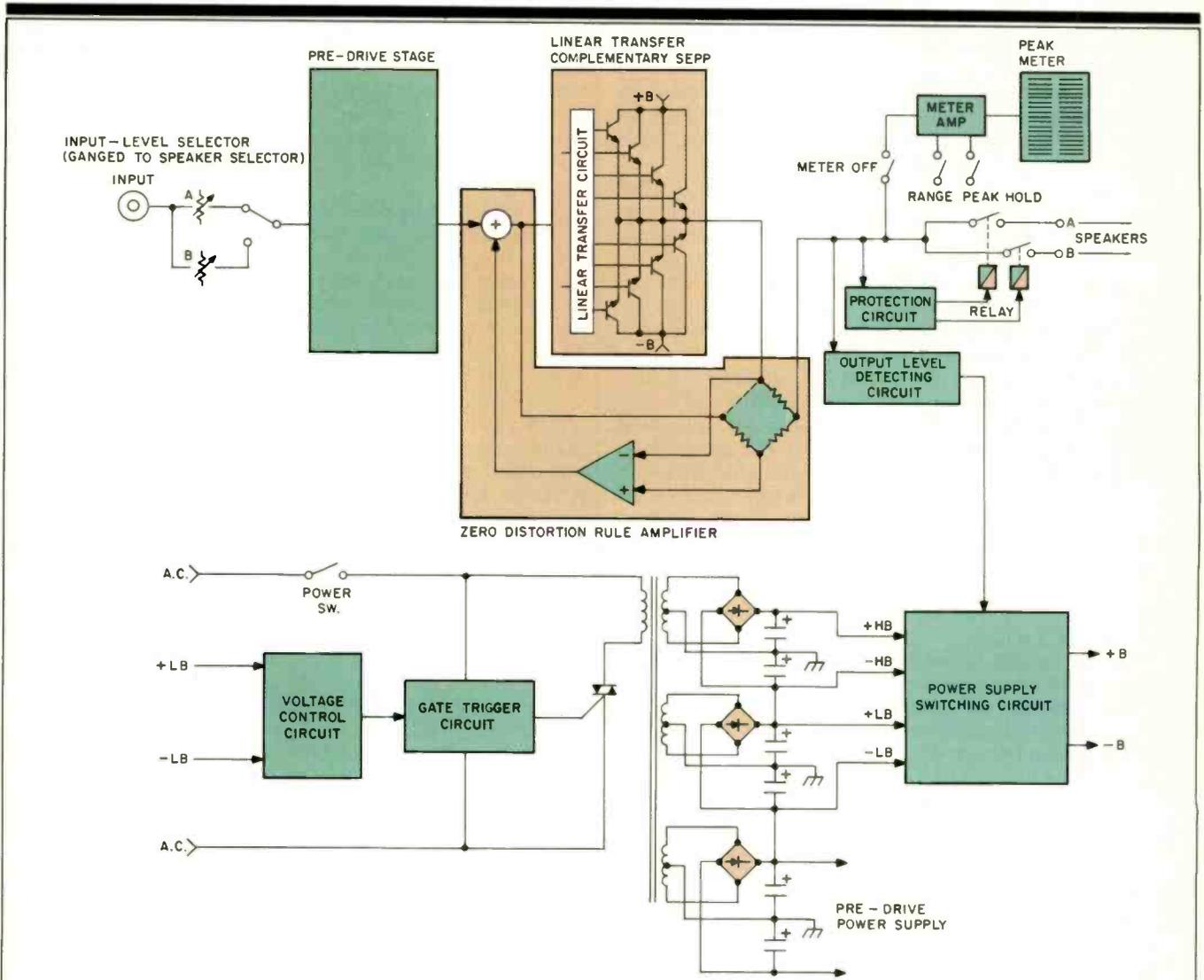


Fig. 1—Partial block diagram of the M-70.

ohm loads, I measured 0.0024% THD for a 1-kHz test signal, 0.0015% for a 20-Hz test signal, and 0.0023% for a 20-kHz input signal. SMPTE IM at rated output measured an insignificant 0.0033%, while at the half-power point quoted in the manufacturer's specifications, SMPTE IM was, indeed, exactly 0.002% as claimed. Damping factor came close to the 200 figure claimed by Yamaha; my slightly lower reading of 175 might be due to either the slight series resistance of the short connecting cables between the amplifier's output terminals and the test instruments, or the fact that I measure damping factor relative to a 50-Hz signal (in accordance with EIA Amplifier Measurement Standards) whereas Yamaha quoted damping factor relative to a mid-frequency signal of 1 kHz.

Frequency response extended from below 4 Hz to 115

kHz for a -1 dB roll-off and up to 215 kHz for a -3 dB roll-off. CCIF-IM distortion, using twin-tone input signals set 1 kHz apart and measuring any 1-kHz signal component at the output, was a minute 0.0035%. IHF-IM distortion, using the same twin-tone input signals, was below the limits of the test instrumentation, or less than 0.03%. Input sensitivity for 1-watt output was 100 mV, while S/N (relative to 1-watt output, with 0.5-V input) measured 92 dB, A-weighted.

It was not possible to measure dynamic headroom using the standard tone-burst test signal normally used for that test. The tone-burst signal caused the protection circuit of the amplifier to operate when the clipping level was approached. This is not in and of itself a bad thing, since it suggests that the protection circuitry of the M-70 is extremely reliable and is not likely to allow any damaging types of

I must repeat that I liked the amp's tight sound, but it may have nothing to do with ZDR, X power supply, or X amplifier design.

outputs to pass through the final stages of the amplifier; it simply prevented me from measuring dynamic headroom. It is interesting to note that in their published specifications, Yamaha lists a series of harmonic distortion numbers for a variety of frequencies from 20 Hz to 100 kHz. In all these listings, however, power output is at *half* rated power rather than at full rated power. The same holds true for IM distortion. It would appear that Yamaha, too, avoids running the amplifier at full rated power for extended periods of time. From a practical point of view, half-power is, after all, just 3 dB below full power and I can understand their wanting to brag about the fact that at the half-power level, THD at 1 kHz is an incredibly low 0.0005%, while even at 20 kHz, THD for this output is only 0.001%!

Use and Listening Tests

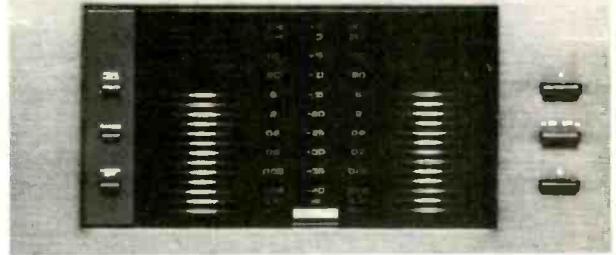
I have to say that the Yamaha M-70 is an extremely clean-sounding amplifier, though I would be hard-pressed to state that it is any cleaner sounding than a host of other amplifiers of approximately the same power ratings I have tested in recent months. The M-70 supplied enough power to drive my relatively low-efficiency reference speakers to adequate sound levels, even when I played some of my more dynamically recorded Compact Discs. Transient response was excellent and bass reproduction was very good, with no evidence of muddiness or overhang. The low internal impedance of this amplifier seemed to work ideally with my reference speakers and at least two other sets of high-quality loudspeaker systems that I hooked up to it.

Altogether, though, I get the feeling that the Yamaha M-70 is too close to being "overprotected" by its admittedly efficient protection circuitry. This circuitry almost seems to work too quickly, not allowing for even momentary peak clipping—a condition which is likely to occur more often than not, now that CDs, with their awesome peaks, are with us to stay. Whether this is a characteristic of dual-level-supply designs in general (I noticed the same quality some

years ago when I first tested the Carver M400), or whether it's just peculiar to this unit or model amplifier, I really can't say. I suppose it really doesn't matter, since the muting that does occur when the amp is severely overdriven seems to cause it no permanent damage, and its sound is quickly restored once the overload is removed. Even with medium-efficiency speakers, overdriving of this amplifier is most unlikely, no matter what types of discs or source material you use, so I suppose my concern is more academic than practical.

Getting back to the sound quality of the amplifier (which is, and should be, the first and most important consideration), I must repeat that I liked its tight overall sound. I'm fairly well convinced that this sound quality has little or nothing to do with ZDR, X power supply or X amplifier design, but if it makes the Yamaha folks (and their customers) happy to believe that these are the circuits that are responsible for the good dynamic sound qualities of the M-70, who am I to argue!

Leonard Feldman



Twenty red LED bars per channel show peak power, from 0.02 to 300 watts—plenty, as the protection circuits limit headroom above the rated 200 watts.

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4

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Manufacturer's Specifications

Frequency Response: 10 Hz to 50 kHz; 20 Hz to 20 kHz, ± 1 dB.

Vertical Tracking Force: 1.75 grams (17.5 mN).

Channel Separation: Greater than 25 dB at 1 kHz.

Channel Balance: 0.2 dB.

Stylus Rake Angle: 0° , $\pm 2.0^\circ$, with proper VTA set at 19° to 20° .

Stylus: Line-contact, nude diamond, 0.1-mm square shank.

Tip Dimensions: 6×35 microns.

Cantilever: Hollow amorphous boron tube, 0.4 mm diameter \times 6 mm long; inner diameter, 0.3 mm.

Compliance: 15×10^{-6} cm/dyne at 11 Hz, 70° F.

Output: 0.3 mV at 5 cm/S at 1 kHz.

Internal Impedance: 4 ohms.

Recommended Load Impedance: 40 to 100 ohms; optimum, 80 ohms.

Weight: 6.5 grams.

Price: \$475.00.

Company Address: 101 Townsend St., San Francisco, Cal. 94107.

For literature, circle No. 93



Despite the spectre of the laser-beam phono pickup looming over the analog phono cartridge, new models continue to be designed, developed, and introduced in the audio marketplace. A recent entry, the Alpha-1 moving-coil phono cartridge, comes from Monster Cable, known primarily for their high-quality cable and connector accessories.

The Alpha-1 utilizes an ultra-rigid, hollow-tube cantilever made from boron, which is extremely hard and light. To reduce the cantilever resonance as well as equivalent moving mass, this cartridge incorporates a paralleled dual-

damped system on the rigid boron cantilever. The stylus is made from a 0.1-mm square-shank diamond, with a special line-contact configuration, that has been brought to a fine mirror polish and nude-mounted on the boron cantilever.

Magnetic circuits, including those in moving-coil phono cartridges, develop Foucault (eddy) currents on their surfaces. The unique new "magnetic feedback control" circuit in the Alpha-1 eliminates these unwanted currents, which are said to blur transients and cause both phase and intermodulation distortion.

The Alpha-1 comes mounted in a sturdy, round, machined aluminum canister located within the two halves of a styrofoam box that also contains a small screwdriver, screws, nuts, a small packet of Stylast stylus-treatment fluid by LAST, and a small, dense stylus-cleaning brush. The styrofoam container is enclosed in a nice-looking display box.

Measurements

Due to the minute size of the moving coils, the signal output is very low and a step-up device is needed to raise the output voltage to a level that can be used with the usual preamplifier phono input stage. Accordingly, most of the reported measurements of the Monster Cable Alpha-1 were made using my measuring amplifier and, where necessary, the Audio Interface CST-80H, a 40-ohm, step-up transformer. All musical evaluation was done with this transformer (see my review of it in *Audio*, December 1982), which proved to be an excellent, passive-matching device for the Alpha-1.

The Alpha-1 was mounted in a Technics headshell and used with the Technics EPA-A250 (S-shaped) interchangeable tonearm unit attached to the Technics EPA-500 tonearm base mounted on a Technics SP-10 Mk II turntable. The Alpha-1 was oriented in the headshell and tonearm with the Dennesen Geometric Soundtracktor.

Laboratory tests were conducted at an ambient temperature of 72° F (22.22° C) and a relative humidity of 66%, $\pm 3\%$. The tracking force for all reported tests was set at 1.75 grams, with an anti-skating force of 2.1 grams. The load resistance at the phono input was 47 kilohms, and the load capacitance was 300 pF. As is my practice, measurements were made on both channels, but only the left channel is reported unless there is a significant difference between the two channels, in which case both channels are reported for a given measurement.

The following test records were used in making the reported measurements: Columbia STR-100 and STR-112; Shure TTR-103, TTR-109, TTR-110, TTR-115, and TTR-117; Deutsches HiFi No. 2; Nippon Columbia Audio Technical Record (PCM) XL-7004; B & K QR-2010, and Ortofon 0002.

Frequency response, using the Columbia STR-100 test record (Fig. 1), was -0.5 , $+6.25$ dB from 40 Hz to 20 kHz. Response is ± 0 dB from 40 Hz to 5 kHz, ± 0.5 dB to 8 kHz, and from ± 0.5 to $+6.25$ dB between 8 kHz to 20 kHz. Separation was 22.5 dB at 1 kHz, 27 dB at 8 kHz, 24.5 dB at 10 kHz, 19.5 dB at 15 kHz, and 16 dB at 20 kHz. The data indicate that the Alpha-1 has an excellent frequency response and a very good high-frequency separation. The rise in the frequency response from about 8 to 20 kHz is typical of most moving-coil phono cartridges. The 1-kHz square-wave response (Fig. 2), using the Columbia STR-112 test record, is consistent with that seen for most moving-coil phono cartridges, where there is a large overshoot (equal in amplitude to that of the square-wave itself), followed by a low-level ringing that decays rapidly. This ringing is probably due to a relatively undamped stylus resonance that takes place at about 35 kHz, in addition to some ultrasonic cutter ringing present on the test record. To measure the arm-cartridge low-frequency resonance, it was

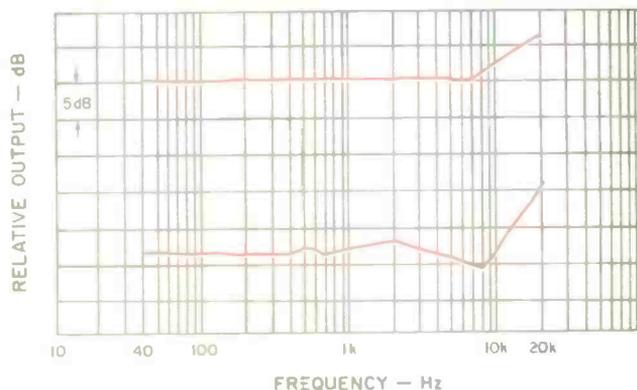


Fig. 1—Frequency response (upper curve) and separation.

necessary to disable the arm's anti-resonance unit. The arm-cartridge low-frequency lateral resonance point for the left channel was 7 Hz with a 4-dB rise, while for the right channel it was also 7 Hz but with a 5-dB rise. Vertical resonance was at 8 Hz. Neither the lateral nor the vertical low-frequency resonance was measurable when this tonearm's anti-resonance device was used.

Using the Dynamic Sound Devices DMA-1 Dynamic Mass Analyzer, the arm-cartridge dynamic mass was measured as 20 grams, and the dynamic vertical compliance as 20×10^{-6} cm/dyne at the vertical resonant frequency of 8 Hz. The harmonic distortion components of the 1-kHz, 3.54 cm/S rms 45° velocity signal from the Columbia STR-100 test record are: 1.78% second harmonic and 0.5% third harmonic, with less than 0.25% higher order terms. The vertical stylus angle measured 25.5° using the CBS Model 3002 Vertical Tracking Angle Meter.

Other measured data are: Wt., 6.5 g. Opt. tracking force, 1.75 g. Opt. anti-skating force, 2.1 g. Output, 0.12 mV/cm/S. IM distortion (200/4000 Hz, 4-to-1): Lateral (+9 dB), 0.72%; vertical (+6 dB), 3.4%. Crosstalk (using Shure TTR-109): Left, -17 dB; right, -22 dB. Channel balance, 0.5 dB. Trackability: High-freq. (10.8-kHz, pulsed), 30 cm/S; mid-freq. (1000 and 1500 Hz, lat. cut), 31.5 cm/S; low-freq. (400 and 4000 Hz, lat. cut), 24 cm/S; Deutsches HiFi No. 2, 300-Hz test band was tracked cleanly to 86 microns (0.0086 cm) lateral at 16.20 cm/S at $+9.66$ dB and to 55.4 microns (0.00554 cm) vertical at 10.32 cm/S at $+5.86$ dB.

The Alpha-1 cleanly played all the test bands on both the Shure Obstacle Course Era III and Era IV musical test records, and all six levels of the Shure Obstacle Course Era V test record also were tracked without mishap. This is a remarkable feat inasmuch as it is a rare cartridge, indeed, that is able to track all the peak recorded velocities on these records, some of which exceed 50 cm/S (the peak recorded velocities of commercial analog records averages about 15 cm/S). Of course, as was expected, the Alpha-1 was able to

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The Alpha-1 played all six levels of the Shure Era V Obstacle Course record without mishap, a remarkable feat.

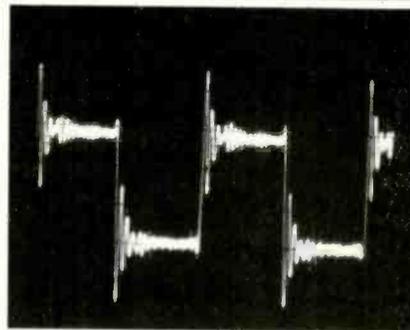


Fig. 2—Response to a 1-kHz square wave.

track, without difficulty, all the high-velocity cannon fire present on the Tchaikovsky 1812 (Telarc DG-10041) in a truly awesome manner.

Use and Listening Tests

As usual, I performed many hours of listening tests, both before and after measurement. Equipment used in the listening evaluation of the Alpha-1 included the aforementioned Technics arm and turntable, the Audio-Technica AT666EX vacuum disc stabilizer, a Crown IC-150 preamplifier, two VSP Labs Trans-MOS 150 amplifiers, each used in the 300-watt mono mode, and a pair of Pentagram P-10 full-range loudspeakers connected to the two VSP amplifiers with 4PR Kimber Kable in parallel with the Live Wire speaker cable, as recommended by the speaker manufacturer.

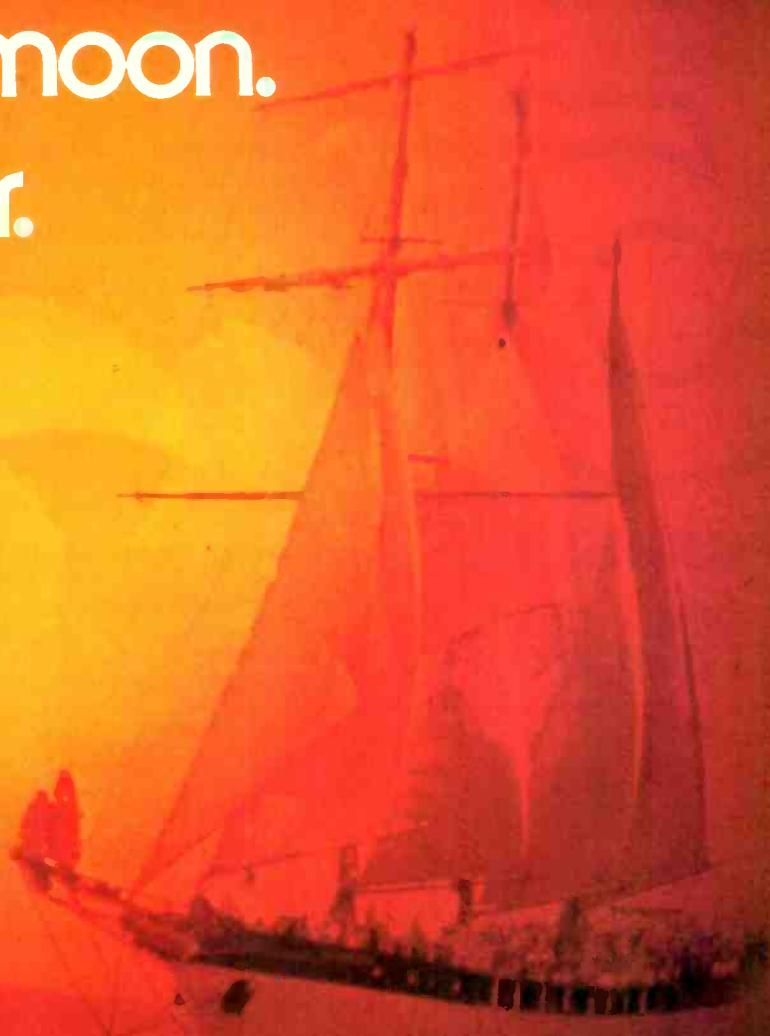
Some of the other exceptionally good records I used to audition the Alpha-1 were *Wheels & Pipes* (Warren Lubich, organist, Sonic Arts LS-28), Elgar's *Falstaff: Symphonic Study* (London Philharmonic, Boult, Mobile Fidelity MFSL 2-501), *Listen* (L.A. Jazz Choir, Mobile Fidelity MFSL 1-096), and *Frederick Fennell, The Cleveland Symphonic Winds* (Telarc DG-10050).

The Alpha-1 moving-coil phono cartridge was able to accurately and cleanly reproduce Fritz Reiner and the Chicago Symphony Orchestra's superb, remastered, and now near-legendary Strauss: *Also Sprach Zarathustra* (RCA Red Seal Point Five Series ATL1-4286). Transient response, tracking ability, and transparency of sound were excellent. While listening to various recordings, I noted that the Alpha-1 had unquestionably good sonic clarity and stereo imaging with no detectable coloration, especially when reproducing the high recorded velocities present on most audiophile recordings. Bass was sonically well defined and tight. Although there is a gradual rise in frequency at the high end, which is typical for moving-coil cartridges, I did not feel that the Alpha-1 produced overly bright sound.

All in all, I am impressed with the Alpha-1, especially with its ability to flawlessly reproduce any recorded sound. The Alpha-1 moving-coil phono cartridge by Monster Cable is truly deserving of serious consideration by audiophiles as well as all music lovers.

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5

PIONEER F-90 TUNER

Manufacturer's Specifications FM Tuner Section

Usable Sensitivity: Mono, 10.8 dBf

Fifty-dB Quieting Sensitivity: Mono, 16.2 dBf; stereo, 37.7 dBf.

S/N: Mono, 93 dB at 80 dBf; stereo, 86 dB at 80 dBf.

THD at 80 dBf: Wide—mono, 0.0095% at 100 Hz and 1 kHz; 0.01% at 10 kHz; stereo, 0.02% at 100 Hz and 1 kHz; 0.07% at 10 kHz; narrow—mono, 0.09% at 1 kHz; stereo, 0.5% at 1 kHz.

Frequency Response: 20 Hz to 15 kHz, +0.2 dB, -0.8 dB.

Stereo Separation: Wide—65 dB at 1 kHz, 50 dB, 20 Hz to 10 kHz; narrow—40 dB, 20 Hz to 10 kHz.

Capture Ratio: 0.8 dB (wide).

Selectivity: 85 dB (narrow).

Muting Threshold: 25.2 dBf.

Audio Output Level: 650 mV at 100% modulation.

AM Tuner Section

Sensitivity: 150 μ V/meter.

S/N: 50 dB.

Audio Output Level: 150 mV at 30% modulation.

General Specifications

Power Requirements: 120 V a.c., 60 Hz, 14 watts.

Dimensions: 16-9/16 in. (42 cm) W x 2 $\frac{3}{8}$ in. (6.1 cm) H x 12 $\frac{1}{2}$ in. (31.7 cm) D.

Weight: 9 lbs., 15 oz. (4.5 kg).

Price: \$300.00.

Company Address: P.O. Box 1720, Long Beach, Cal. 90801.

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The most outstanding feature of this new AM/FM tuner from Pioneer is its Digital Direct Decoder, a unique system which decodes stereo directly from FM i.f. signals instead of having to decode the composite signal appearing at the output of the FM ratio detector or discriminator. The new circuit is said to improve overall sound quality of FM reception, particularly in the areas of stereo separation, distortion and signal-to-noise ratio.

Other features of the F-90 include "Auto Search," an electronic tuning circuit that searches for stations automatically, and preset selection for eight FM and eight AM stations. Narrow- or wide-band i.f. is selectable at the touch of

a front panel button, too, so that listeners in differing r.f. environments (with many stations crowded together on the dial or with few stations widely separated in frequency) can select the optimum setting for best, interference-free reception. There's even a record-level check signal built into this tuner, which delivers a mid-frequency signal corresponding to about 50% modulation (of an FM signal) to help you set up tape recorder levels before beginning to record from FM.

Control Layout

A power on/off switch, its associated indicator light, and AM and FM band touch-button selectors are all located at

the left end of this tuner's slim front panel. A multi-function display area just to the right of these pushbuttons shows tuned-to frequency (kHz for AM, MHz for FM), optimum tuning, reception of a stereo signal, and activation of the nearby "Memory" switch to store favorite AM or FM station frequencies. An up and down tuning switch, to the right of the display, is used for manual tuning; depressing the right half of the button moves frequencies upward, while touching the left half of the switch lowers frequencies. This tuning switch is also used for "Auto Search," touching it initiates the search action, which stops only when an acceptable signal has been tuned in.

The "Memory" switch comes next. It is followed by "Rec Level Check," "Manual Search/Mute-Off" and "FM IF-Band" switches, each with its own indicator light, and followed in turn by eight numbered "Station Call" buttons. By depressing any of these buttons, as many as eight AM and eight FM stations which have been previously stored can be recalled. The "Manual Search/Mute-Off" switch is rather unusual in its operation. Though used primarily to choose between manual tuning and "Auto Search," it also turns interstation muting on and off. When FM muting is off (that's the same as when the switch is in the manual position), only mono transmissions can be received.

The rear panel of the F-90 is equipped with the usual AM and FM external antenna terminals. A true loop antenna (as opposed to the usual ferrite loopstick) is provided for AM reception. FM input connections include both a 75-ohm coaxial F-type connector and a 300-ohm twin lead. A slide switch determines AM channel spacing for the frequency-synthesized tuning system (10-kHz spacing is used in the U.S., 9 kHz in other parts of the world). In addition to the usual left- and right-channel outputs, the tuner has an AM stereo output jack intended for connection to future AM stereo adaptors, if such products ever become available.

Digital Direct Decoder Circuit

In conventional FM tuners, the incoming radio frequency signal (at a frequency between 88.0 and 108 MHz) is converted to a 10.7-MHz intermediate frequency signal which is amplified and then demodulated by one of several available types of FM detectors. The composite signal recovered is then applied to a multiplex decoder circuit. This MPX decoder circuit usually re-creates a 38-kHz subcarrier by means of a phase-lock loop circuit. The composite stereo signal is then decoded by switching to produce separate left and right signals. In this conventional approach, it can be shown mathematically that certain undesired components appear in the decoded outputs. These cause a type of "beat" or interference generally referred to as "birdie" noise.

Most manufacturers attempt to counteract this problem by introducing filters between the output of the FM detector and the input to the stereo decoder circuitry. Such filters, however, introduce amplitude response irregularities as well as finite time delays. These filter imperfections, in turn, cause decreased separation at high frequencies. While it can be argued that separation need not be very great for frequencies above 8 or 10 kHz, distortion also rises rather rapidly when high-frequency audio is present in the trans-

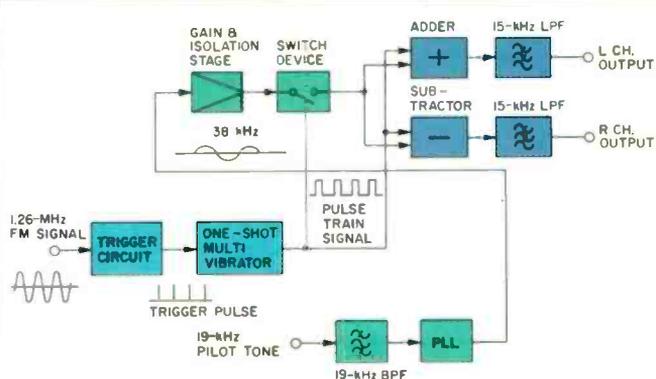


Fig. 1—Block diagram of Digital Direct Decoder.

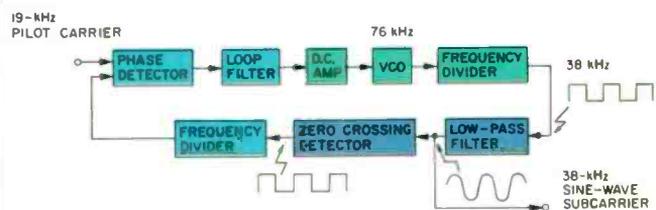


Fig. 2—Block diagram of phase-lock loop circuit used in the Digital Direct Decoder.

mitted signals. Often, this distortion is in the form of lower frequency, audible "beats" or "birdies" rather than the more tolerable, pure harmonic distortion. Filters, in other words, can reintroduce the problem they're designed to prevent.

A block diagram of the direct stereo decoder is shown in Fig. 1. The 10.7-MHz i.f. signal is first converted to 1.26 MHz. A trigger circuit detects the zero-crossing point of the FM signal and generates a trigger pulse each time the axis-crossing takes place. The trigger pulse, in turn, is used to fire a one-shot multi-vibrator which generates a constant-width pulse train. So far, the description sounds a bit like that of a pulse-count detector (used by Kenwood and others in some of their FM products), but it is at this point that the major difference between pulse-count detectors and Pioneer's new Digital Direct Decoder occurs. In a conventional pulse-count detector, audio signals would now be reproduced by integrating the pulse train. In Pioneer's circuit, the pulse train is not directly integrated to form audio signals. It is first used as a control signal for a switch which "chops" a 38-kHz subcarrier sine wave, switching it on and off in sync with the pulses (which are variably spaced, as a function of the audio modulation in the original i.f. signal). This process effectively modulates the subcarrier with the audio information carried by the pulse train.

In most tuners, distortion in stereo rises steeply at high frequencies. In the F-90, it stayed extremely low, 0.08% at 10 kHz.

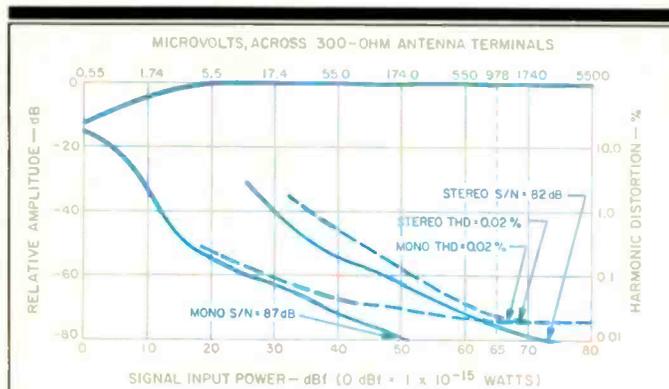


Fig. 3—Mono and stereo FM quieting and distortion characteristics, wide-band i.f. mode.

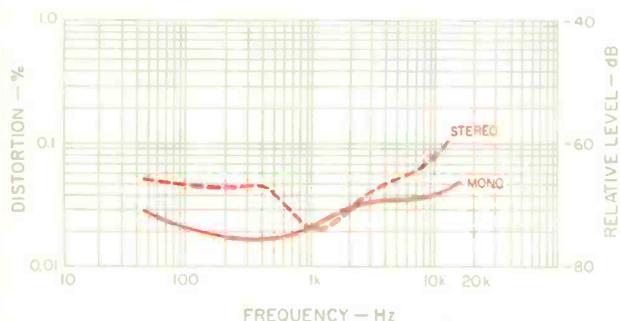


Fig. 4—Harmonic distortion vs. frequency, wide-band mode.

Adding this chop-modulated subcarrier and the original pulse train produces a left-channel signal; subtracting them produces a right-channel one. Because these signals were formed by combining squared-off pulse and sine-wave signals, they contain many undesired high harmonics, which are then filtered off by 15-kHz low-pass filters.

In examining the frequency spectrum generated by the pulse train and all the other signal components, composite signals are found in the low-frequency region; spurious signals exist at around 100 kHz, with the rest of the spectrum centered around 1.26 MHz and its harmonics. Because the pulse train is multiplied by the sinusoidal 38-kHz subcarrier, the spectrum around 1.26 MHz, with its harmonics and spurious signals, does not affect the audio signals, and beat noise is not generated. As a result, no amplitude- or phase-altering filters need be inserted in the signal paths, and the measured separation remains extremely high even at the upper frequencies.

Since a sinusoidal subcarrier needs to be used in the new decoder (as opposed to a rectangular, switching waveform), the PLL circuitry needed to generate that subcarrier

differs somewhat from the conventional phase-lock loop arrangement. A block diagram of this new type of PLL is shown in Fig. 2. The output frequency of the voltage-controlled oscillator is 76 kHz. This output is divided down to 38 kHz by a frequency divider. A band-pass filter converts the rectangular wave to a sinusoidal waveshape. The sine wave is again converted to a rectangular wave by a zero-crossing detector and is divided down to 19 kHz. The phase difference between the 19-kHz signal and the incoming pilot carrier in the pulse train is detected at the phase detector. The phase-lock loop is completed by feeding the output of the phase detector through the loop filter and d.c. amplifier to the VCO. Any possible deterioration of separation due to phase error is eliminated, since any drift in the band-pass filter of the PLL is corrected by this feedback loop.

Measurements

As so often happens with tuners that I am asked to test for *Audio*, the usable sensitivity of the F-90 sample I received was not quite as good as claimed by the manufacturer. I measured a mono usable sensitivity of 15.0 dBf (3.1 μ V across 300 ohms), as opposed to 10.8 dBf claimed. Some of the discrepancy may be due to the matching transformer which I had to use between the output of my generator and the antenna terminals of the tuner. In any event, of far greater importance than usable sensitivity is 50-dB quieting, and here the tuner did very well indeed, reaching 50 dB of quieting with an input signal of only 16 dBf (3.5 μ V across 300 ohms) in mono and 36 dBf (34.7 μ V across 300 ohms) in stereo.

Even my Sound Technology FM generator is unable to confirm FM signal-to-noise ratios above 90 dB, as claimed (for mono) by Pioneer for this tuner, but I was able to obtain incredibly high S/N readings of 87 dB in mono and 82 dB in stereo—as high as I've ever read for any tuner. Harmonic distortion was a very low 0.02% in both mono and stereo (again, the readings may have been at the limit of my test equipment) when the "IF-Band" switch was set to the wide position. As I expected, when the narrow i.f. setting is selected, distortion rises somewhat, to 0.1% in mono and 0.15% in stereo, even at 1 kHz. Noise and distortion at 1 kHz are plotted as a function of input-signal strength in Fig. 3 for the wide setting. Very little difference in signal-to-noise performance was observed when switching to the narrow i.f. position; the chief differences observed were in selectivity, distortion, and high-frequency separation.

A significant benefit directly attributable to Pioneer's Direct Digital Decoder circuit is obvious from an examination of Fig. 4. Here, I have plotted distortion versus frequency, in mono and stereo, for the wide i.f. mode. Conventional tuners normally exhibit a steep rise in distortion at the high-frequency end of the spectrum when operating in the stereo mode. In the case of the F-90, harmonic distortion remained extremely low, measuring only 0.08% at 10 kHz.

Figure 5 is a spectrum-analyzer plot of frequency response and separation for the tuner. Response was flat from 20 Hz to 15 kHz, within 0.3 dB—even better than claimed by the manufacturer. The two lower curves of Fig. 5 are extremely interesting. The flatter, upper curve of these two is the crosstalk-plus-noise observed at the output of the un-

Separation remained well above 50 dB across the entire audio spectrum, in the wide-i.f. mode.

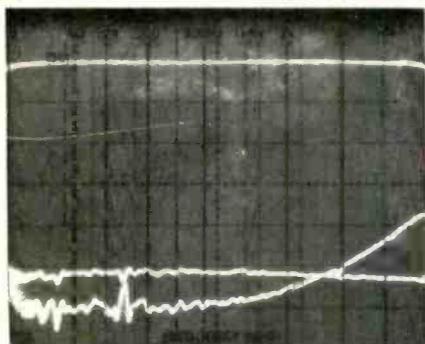


Fig. 5—FM frequency response (upper trace) and stereo separation (lower traces). Note unusually uniform crosstalk in wide-band mode, and increasing crosstalk with rising frequency in narrow-band mode.

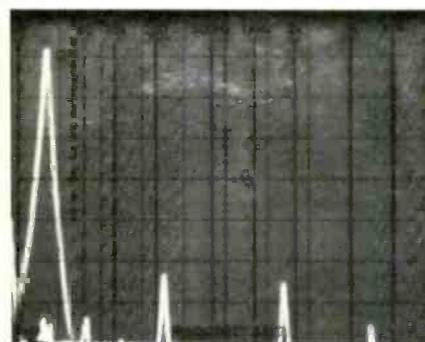
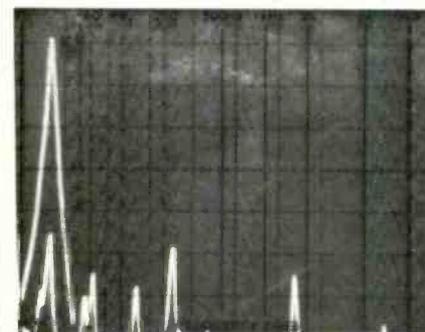


Fig. 6—Analysis of 5-kHz distortion and crosstalk for wide-band (A) and narrow-band (B) i.f. settings.



A

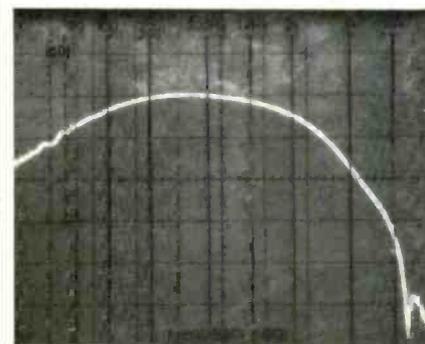


Fig. 7—AM frequency response.

modulated channel, in the wide-i.f. stereo mode. Separation remained well above 50 dB across the entire audio spectrum. While separation seems to be a bit higher in the narrow setting of the "IF-Band" switch for low and mid-frequencies, it decreases rapidly at the high end, actually crossing the plot taken for the wide i.f. setting. This is the first time I have ever run into such a condition in tuners featuring wide and narrow i.f. settings. It is also the first time in my recollection that I have encountered a separation characteristic (in the wide setting) so uniform in its low crosstalk from one end of the spectrum to the other. Clearly, this, too, must be a direct result of the new multiplex decoder circuit pioneered by Pioneer (sorry about that!).

I twice measured crosstalk and distortion components for a 5-kHz modulation, once for the wide i.f. setting and again for the narrow mode. Results are pictured in Figs. 6A and 6B. Notice how much lower in amplitude the crosstalk and distortion components are (all "blips" within and to the right of the tall, "desired output" blip at the left) in Fig. 6A (wide i.f.) compared with those shown in Fig. 6B (narrow i.f.).

While I could not quite get a measurement of 0.8 dB for capture ratio (this is a tricky measurement to make, especially when results are such low numbers), I did manage to read 1.0 dB for this important characteristic. Alternate-channel selectivity measured exactly 85 dB, as claimed, for the narrow i.f. setting, decreasing to around 50 dB in the wide setting. Image, i.f., and spurious rejection, though not specified by Pioneer, were all safely above 90 dB, and I had no problems with such interference either during my bench tests or in subsequent listening tests.

As impressed as I was with the FM performance of this tuner, I was equally unimpressed with its AM section. The AM frequency response, plotted in the spectrum analysis 'scope photo of Fig. 7, tells about as much as one needs to know concerning this minimal AM section. Still, the F-90 is an excellent value—even if you never switch to AM; just think of it as a fine FM-only tuner.

Use and Listening Tests

I never cease to be amazed at what has happened to FM tuner technology in the past decade. Tuners costing five and 10 times as much as this one in the 1970s couldn't do as well. The only fair way to do a listening test with a tuner such as this is to create a pure, "closed-circuit" signal, using digital program-source material fed directly to the modulation inputs of an FM generator, with the generator's output connected directly to the antenna terminals of the tuner. Under these closed-circuit conditions, it became possible to differentiate between the performance of the F-90 and the tuner that I keep as a "reference" (and which originally sold for around \$500). The Pioneer won out in terms of clarity, low noise, and openness of sound. Only one station in my area comes close to duplicating these closed-circuit conditions, and when that station broadcasts CDs (as it occasionally does), I am also able to appreciate the superior performance of the Pioneer F-90. Clearly, it's a tuner ideally suited to the digital audio era that is upon us—at least until authorities in Washington provide us with a new FM service truly up to the task of handling the new digital program sources (if that ever happens). Leonard Feldman

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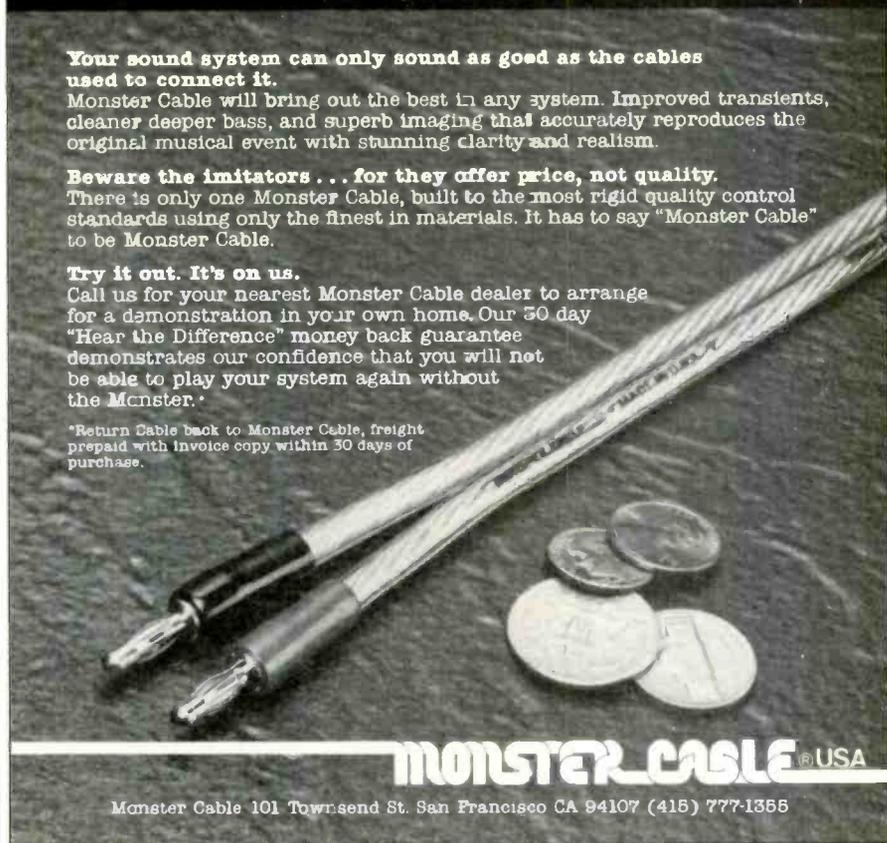
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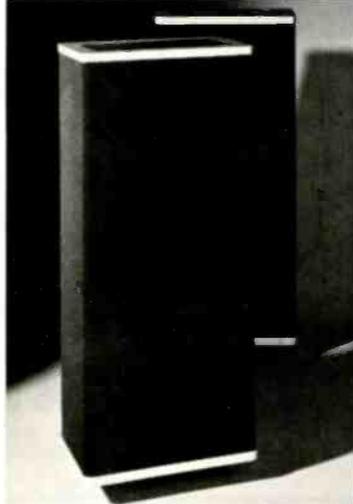
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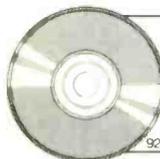
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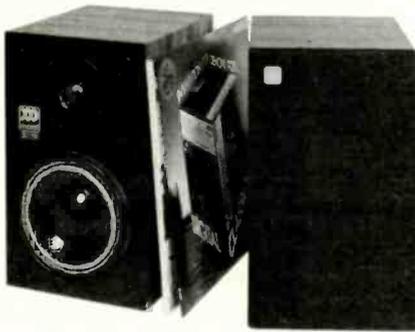
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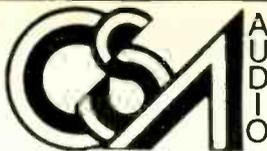
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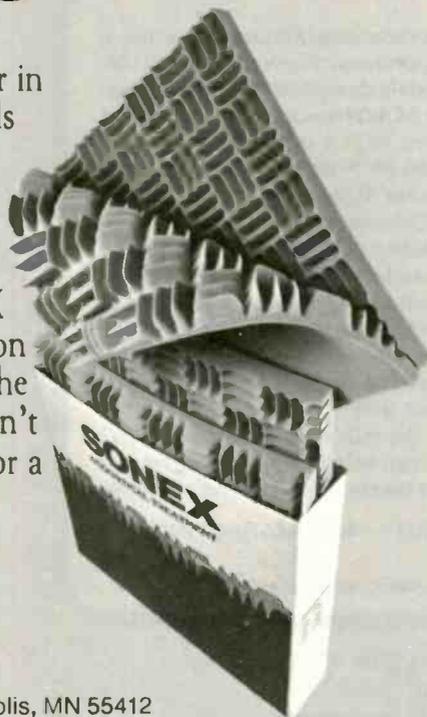
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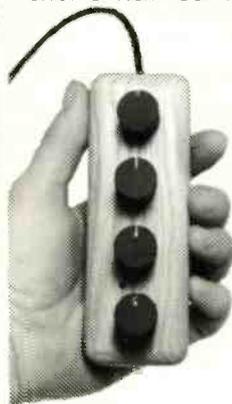
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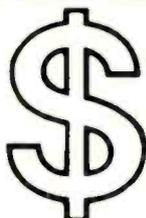
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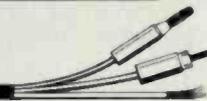
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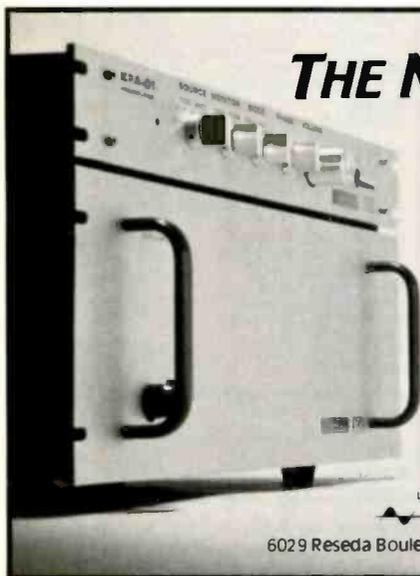
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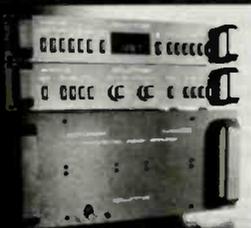
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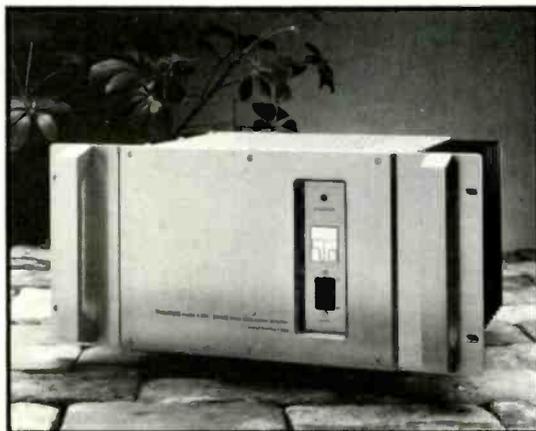
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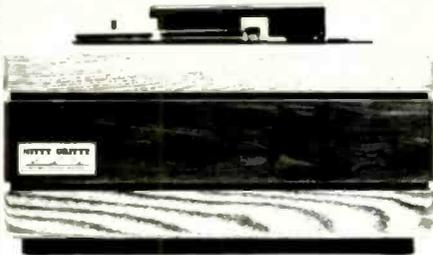
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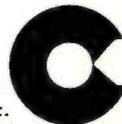
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