

Audio

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**REVOX B261 TUNER:
"REMARKABLE"**

**PSYCHOACOUSTICS:
HOW WE HEAR DIRECTION**



**INTERVIEW:
THE DOORS'
KEYBOARDMAN
RAY MANZAREK**

**NOISE REDUCTION GURU
DICK BURWEN**

DIGITAL RECORDING

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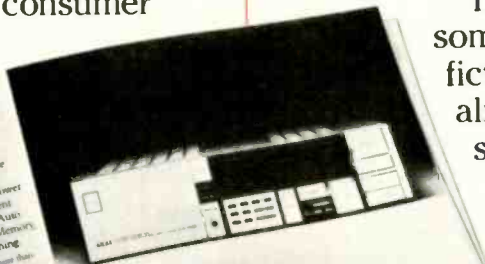
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The A40 is 13½" x 8¼" x 7¾" deep.

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Richard C. Heyser

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The New York Times

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Hans Fantel

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Stereo Review

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TAPE GUIDE

HERMAN BURSTEIN

Taping FM on Metal

Q. I use my cassette deck mostly to record FM programs. Would there be an advantage to using metal tape for such material, or would this be overkill?—Rob Canaday, Northwood, Ohio

A. It appears that metal tape chiefly warrants its higher price when taping live material with strong transients. Such tape is less subject to saturation by these transients than are the other types (ferric oxide, chromium dioxide, cobalt-modified, ferrichrome). But when taping FM material, which is generally subject to substantial compression or limiting that subdues the transients, the non-metal tapes appear to do a satisfactory job, leaving little room for improvement.

However, this situation may change as phono discs, FM transmission equipment and techniques, and FM tuners improve. Hence, FM broadcasts and phono discs may possess a dynamic range which challenges the capabilities of the non-metal tapes. On

the other hand, technological progress continues to bring us improvements in the latter tapes, so that they may still be able to cope.

Sensitivity Adjustment

Q. My cassette deck has provisions for adjusting both the bias and record sensitivity. How are these two factors interrelated?—Hillel Brandes, Grantsville, Md.

A. They are essentially independent of each other. The bias adjustment, which varies largely with tape type (ferric oxide, chromium dioxide and ferricobalt, ferrichrome, or metal), aims at the optimum combination of low distortion and extended treble. As bias is increased, distortion tends to decrease (up to a point), but treble response tends to drop also. Hence it may be necessary to accept a (usually slight) increase in distortion to permit adequate treble response.

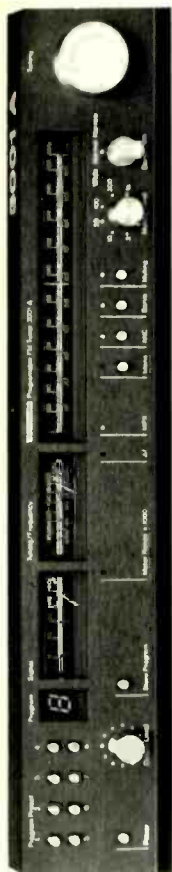
The purpose of the sensitivity adjustment is to meet the requirement of

Dolby noise reduction, namely that a given signal fed to the tape in recording produce a given output in playback. Accordingly, the Dolby emphasis (mostly in the treble range) provided in recording will be matched by corresponding treble de-emphasis in playback, restoring flat response. Improper matching, called mistracking, adversely affects treble response, usually causing a loss.

One Channel Missing

Q. I have owned my cassette deck for a year and a half, and the only tape I used with it was TDK SA. While I kept the tape type (bias) switch in the CrO₂ position, I kept the equalizer switch in the 120- μ S position, although SA tapes are supposed to be played with 70- μ S equalization. Recently I bought TDK D

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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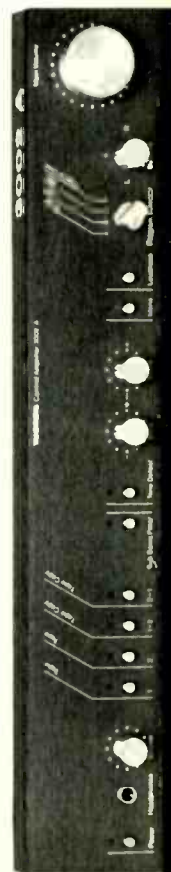
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tapes, and in playback noticed that one channel was missing. What is the problem? Did my constant use of SA tapes on the wrong equalization lead to this?—John McHugh, Rockaway Park, N.Y.

A. No, your constant use of the same type and your use of the incorrect playback equalization could not produce the problem you describe. Apparently, something has gone wrong in the electronic circuitry of one channel, and it will require the services of an audio shop to find the problem's cause and cure.

Old Open-Reel or New Cassette

Q. I've had an open-reel tape deck for many years and have enjoyed its trouble-free operation. Most of my recordings have been made at 3 $\frac{3}{4}$ ips; I recognized that this speed might not give the very best reproduction but afforded results decent enough for my purposes. I have begun to upgrade my audio system and would like to record

more classical music from FM and phono discs. It is suggested that I get a new cassette deck, which is generally apt to be better than the old open-reel decks. What is your advice?—Steven Rannels, Philadelphia, Pa.

A. It is difficult to advise you on the desirability of buying a new cassette deck. If the old open-reel deck still works well and gives you full pleasure, perhaps you should stay with it. The decision can be made only by you. Before deciding, visit your local audio stores and listen to their cassette decks. I realize that it is not easy to make a comparison between your open-reel deck operating in your home with a particular speaker, and a cassette deck operating in a store with, in all probability, another speaker. Perhaps you can borrow a cassette deck from a friend and try it in your home. Or perhaps you can obtain one on a trial (money-back) basis from an audio store, particularly if you are purchasing other components from that store.

Puzzling AM Noise

Q. When I record AM with Dolby NR on, although the incoming AM signal sounds clear with no noise, the signal is noisy in playback. This happens with five different cassette decks I have tried. This does not occur when recording from FM or phono.—Robert Patterson, Des Plaines, Ill.

A. I do not have a sure answer. It may be that noise components of the AM signal, although close to or entirely inaudible, are causing the Dolby circuit to encode when recording but not to decode in playback. This would mean treble boost, and therefore noise accentuation, in recording, without corresponding treble cut in playback. Have you tried another AM source? (Editor's Note: Also try switching in your tape deck's multiplex [MPX] filter to cut these high-frequency noise components. An equalizer could also be patched between the AM tuner and tape deck, to cut off high-frequency noise at an even lower point—I.B.) Δ

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Flickering Lights

Q. I have a receiver rated at 50 watts per channel. I have a small lamp on the same household circuit. Every time I turn on the receiver, the lamp flickers. Is there any danger to the house from turning on the receiver? Is there any device which can eliminate the flickering? What causes the flickering in the first place? I read that such flickering is a sign of bad wiring, but so far no circuit breakers have tripped.—Robert Patterson, Des Plaines, Ill.

A. When your receiver is turned on, there is an instantaneous surge of current until the back EMF is established in the power transformer—at which time the receiver draws its normal current. This is quite normal.

Any time that current flows in a conductor (your house wiring in this instance), there will be a voltage drop across that conductor. The greater the current flow, the greater this voltage drop will be. Because the current flow is momentarily high when the receiver is turned on, the voltage on its circuit will be low. Any device connected to this same circuit will also experience low voltage for an instant.

If you have a light-gauge extension cord connected to your wall outlet, and both the receiver and the lamp are connected to this line, this can account for the lamp's flickering, even though your house wiring may be adequate.

With no extension cord in use, a 50-watt receiver should not draw so much current that the voltage drops enough to cause the flicker. You should investigate the gauge of wire used to feed that outlet, replacing it with a gauge at least one size heavier. This will be especially desirable if your house was originally wired with aluminum wire. When such wiring ages, junctions and splices tend to oxidize, leading to either intermittent circuit operation or high-resistance connections (which will cause excessive voltage losses with light loads).

The fact that your breakers do not trip is not an indication of the quality of house wiring. When a breaker does not trip under load, it only indicates that the current drawn is below the rating of the breaker. In rare cases I have seen breakers which, because of repeated tripping, fail to trip at their proper time—requiring greater and greater

amounts of current to trip them. If the only equipment on your circuit is the receiver and the lamp, do not be concerned about a defective breaker. The current flows involved are below values needed to trip a normal breaker.

Signal Processors

Q. Is there a limit to the number of signal processors one can put into a tape loop without degradation or distortion of the signal? In what order should one hook up an equalizer, range expander, decoder, and rumble filter in a tape loop?—Roger Ross, Peshastin, Wash.

A. I do not believe we can say just where the limits are to the number of processors which can be cascaded in a single tape loop. By the very nature of signal processing, however, distortion is added. If the idea of high fidelity is to reproduce faithfully all sounds fed into the equipment, an equalizer distorts the sound by upsetting its frequency balance. A range expander distorts the sound by tampering with its dynamics. Many people consider distortion only in terms of IM or THD and the like, but any alteration of signal is distortion.

A typical playback loop with the equipment you mentioned would be connected from beginning to end as follows: Decoder, rumble filter, range expander and equalizer. By altering the relative positions of these devices, the range expander (for example) might be fooled into acting on a light cymbal crash because of its increased high-frequency content because of treble boost added by the equalizer. The equalizer, ahead of the decoder, will give a false idea of original levels and will result in poor rendition of the original dynamics and perhaps even of frequency balance versus instantaneous program level.

High-Pass Filter

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

A. The high-pass filter reduces response at very low audio frequencies to reduce rumble which may be present as a result of problems with the turntable or with a disc recording. The 78-rpm recording was especially prone to rumble. Such a filter also serves to reduce the amplitude of low-

frequency pulses which will be present when playing moderately or severely warped phonograph records. Even though no sound may be produced as a result of the warps, the subsonic pulses may cause excessive woofer cone excursions which, if severe enough, could damage the woofer.

Some of these filters begin rolling off low frequencies at a sufficiently high frequency as to reduce bass from such program sources as organ recordings. If you do not need the filter, don't use it.

75- and 300-Ohm Connections

Q. Please explain the difference between the "hookup" of a 300-ohm antenna to a TV set versus a 75-ohm coaxial antenna.—S.R. Creacey, Redlands, Cal.

A. Most TV sets (and many FM tuners) can be connected to either 75- or 300-ohm antenna systems.

The 300-ohm system, which is more common, uses flat "twin-lead" cable, the ends of which are stripped to be wrapped around the two screw terminals provided on the receiver. The system is a balanced line, with both sides of the line equidistant from ground, so you may connect either conductor to either input terminal.

The 75-ohm system uses coaxial cable whose outside shield is grounded. On TV sets, the cable usually attaches via a screw-on "F" connector; prefabricated cables usually have such connectors already attached, but it's possible to cut cable to size and attach your own. On FM sets, you're about as likely to find screw terminals to which the cable attaches directly; if so, be sure to connect the shield to the ground terminal. Since 75-ohm systems are shielded, they reduce interference pickup. If you therefore wish to convert a 300-ohm system to 75-ohm, you can get transformers made for that purpose.

On rare occasions, you'll find 75-ohm r.f. inputs using audio-type phono connectors. More commonly, such connectors are used for direct video signals, which bypass the tuner stages. ▲

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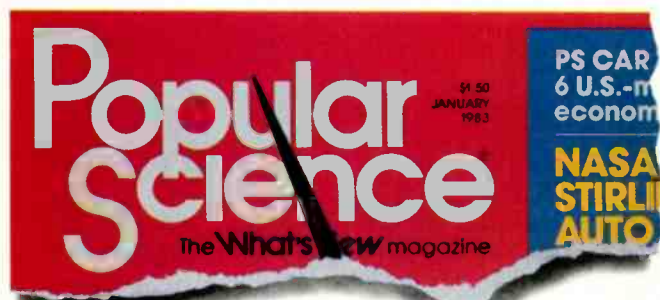
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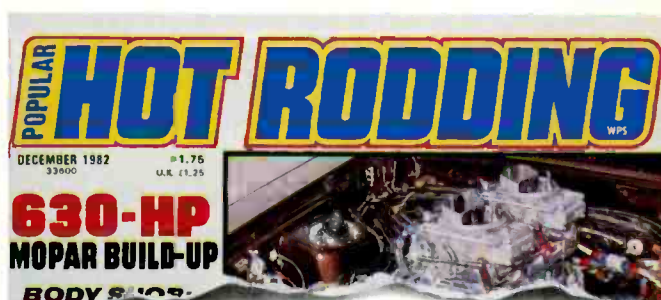
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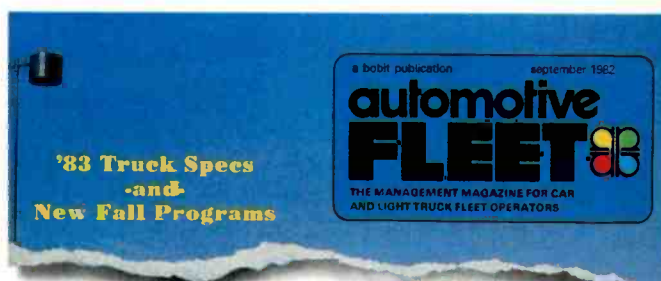
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"... (a) system which purists and novices alike will appreciate."



"Believe every rave you've read, and then some."



"... one of the sweeter bargains of the year."



"... a car stereo the quality of which is, in a word, stunning."



"I've experienced all kinds of car stereos, but nothing like this system."



"... Delco-GM/Bose deliver a knockout punch!"



"... this sonic paradise ..."

"... a truly outstanding advance in automotive sound."



"The performance . . . was astounding . . . I can't imagine anyone (buying) one of these cars . . . without the music system."

Will you have the same reaction as the press? Our recent experience has convinced us that, regardless of your interest in music, you will require less than one minute of listening to know that you want the Delco-GM/Bose Music System in your next car.

Hear it now in selected models of General Motors automobiles.

The most highly acclaimed automotive option. Available only on GM cars.

Our computerized listener enables us to match the Music System to the individual acoustics of each model automobile.

Sound so real it will change how you feel about driving.



IVAN BERGER

SHOW 'NUFF



To continue my report from the October issue on what was new in car stereo at the Summer Consumer Electronics Show, I should start with Yamaha's new line. The most obvious new touch is that the Yamahas load their tapes at the bottom of the panel, so ejected cassettes won't block the controls and dust and dirt will fall out of, not into, the mechanism. All units have Yamaha's hallmark, continuously variable loudness compensation; some also have a Spatial Expander circuit.

On several models, "Blank Skip" automatically zips past long gaps between selections—including the tape-end gap, which speeds auto-reversing. A light glows every 20 hours as a reminder to clean the heads; if you haven't cleaned them after 40 hours of play, a second indicator lights up and "Blank Skip" stops working till you do your duty. Though you'll never see it unless you do your own installation, the wires and cables emerge from the corners of the units, so they can be dressed to the sides or straight back, whichever there's room for.

Sony showed their new XR-100 in-dash unit, with diversity reception—a system which automatically selects the better signal from each of two antennas, to combat multipath and other reception problems. After CES, Clarion

introduced a new premium line, Audia, whose top model also has this feature. This is only new to car stereo; hams have used it for years, and H. H. Scott once used it in a home tuner.

JVC has taken the idea of Sony's removable-transport Music Shuttle even further, with the KS-Q8 Executive. Its removable transport is a stereo recorder, with battery compartment and headphone jack built in. Like the Sony, its tuner (which has 10 presets) stays in the car when the tape's travelling separately, so you'll always have a car radio if you leave the tape section home. (But why not rechargeable batteries, with a trickle-charger in the dashboard?) In the meantime, StereoSchuttle, a new company, is offering quick-release in-dash housings to hold other stereo units.

Yamaha's new YGE-600 equalizer, like Alpine's 3015, has automatic volume levelling, which adjusts the system's sound level as ambient, low-frequency noise changes—no more having to crank down the volume control when asking directions. But unlike Alpine's seven-band, auto-equalizing unit, Yamaha's is a five-band model, with a very flexible combination of preset curves and manual adjustments. The "Acoustic EQ" button gives one preset curve designed to compensate for the average car's acoustics. Press

the "Bass," "Middle" or "Treble" buttons, and you get preset boosts on those ranges. By pressing a rocker switch, you can accentuate, flatten or even reverse any of these preset curves. Three "Tone" memories hold curves you've preset for yourself. You can also, of course, do conventional band-by-band equalization.

Blaupunkt has two five-band equalizers on flexible stalks, like the controls of their Berlin head unit. MetroSound's EQ-3170 seven-bander has DNR noise reduction.

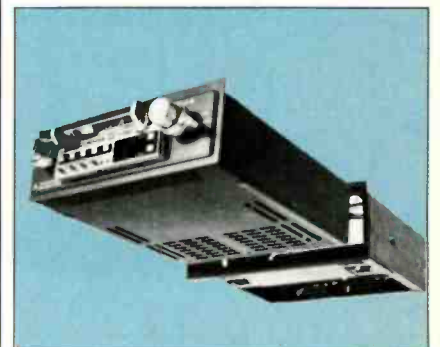
AudioMobile lets you combine amps and crossovers into one sleek unit with their MDX (Modular Docking Expandable) system. The available modules include amps delivering 20, 50 or 100 watts/channel at 4 ohms, plus electronic crossovers and fader modules, all of which dock together with no visible interconnecting wires. The faders and crossovers can be remotely mounted up front for adjustment, then moved back if desired. The amps use a new circuit, which allows a dash-mounted switch to cut the amplifiers' power output, preserving your speakers from volume-happy kids or parking-lot attendants, and lowering battery consumption when you listen with the engine off.

Proton's new 222 and 250 amps offer Soft Clipping, like the home amps from sister company NAD.

Sales of the Delco/GM/Bose car-stereo system have surpassed expectations, and competition for it is already starting to emerge, from K40 and from Alphasonik.

Alphasonik's approach is to present clinics at dealers throughout the country, where Fritz, a microphone-eared

StereoSchuttle quick-release housing protects car stereos against theft.



Virtuoso

**THE NEW AIWA AD-F990
3-HEAD CASSETTE DECK:
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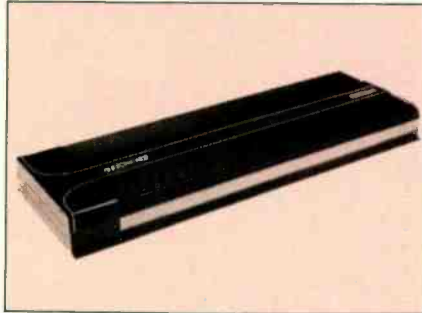
AIWA AMERICA INC., 35 Oxford Drive, Moonachie, New Jersey 07074. In Canada, Shrim (Canada) Ltd.

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AudioMobile's MDX (Modular Docking Expandable) amps and crossovers dock together to make one sleek unit.

dummy, sits in your car, transmitting to a nearby Apple computer. The computer analyzes frequency response, background resonances, dynamic range and changes in frequency response from driver to passenger position, delivering a printed analysis to guide you in dealing with any problems Fritz might uncover.

K40 (a sister firm to AudioMobile) advertises that its amp and speaker system has more speakers, more power, less distortion and more sound output than Delco/Bose for about the same price (\$899), and that it can be used with any signal source, not just Delco's. The system incorporates four



AudioMobile MDX amp/crossover

key-slot mountings that won't let them pop off when mounted in often-slammed doors. AR is the latest home-speaker company to go mobile, with two new flush-mount models and optional brackets for last year's AR1MS mini-box home speakers.

Three new self-powered subwoofers showed up at CES. Audio Pro's \$595 Model B2-07 uses two 4½-inch drivers in push-pull configuration. The built-in, 30-watt amplifier uses the Ace-Bass principle to control driver parameters; response is rated from 40 to 250 Hz, +0, -2 dB; the built-in, active crossover can be set anywhere between 50 and 250 Hz. Fujitsu Ten's Air Transfer Super Woofer (\$230) uses two 120-mm (4.7-inch) drivers pushing a single large diaphragm. Its 22-watt amplifier has phase, gain and level controls and a crossover-frequency selector. Like the Audio Pro, it's designed for use on a car's back shelf. So is the even smaller TEI Extra Bass, whose 25-watt booster amplifier can be mounted under the dash for access to its level and frequency controls.

Linear Power now offers its Bass Vent subwoofer with its 2601 amp/crossover, delivering 60 watts to the woofer and 30 per channel to the upper drivers, all for \$500. The Bass Vent has two drivers feeding a narrow plenum which feeds the passenger compartment via a slot in the car's rear deck.

I didn't hear the Audio Pro, but I did hear the other three. I'd estimate the Bass Vent (heard in Autotek's demo car) as going very low, and cleanly, with the Fujitsu stopping a bit further up the scale. TEI's woofer sounded more suitable for beefing up the thump of rock than enriching the low tones of classical organ or cello. **A**



Linear Power Bass Vent and amp

two-way satellite systems and two subwoofers, plus three electronic crossovers and 160 watts of amplifier power (80 watts to the subwoofers, 40 watts/channel to the satellites), and is said to be easily installed. There's none of the Delco/Bose custom equalization, says AudioMobile's John Bishop; instead, "We use direct rather than reflected sound. So we don't have to equalize each car, because the speaker's direct response is the major influence on the sound, and reflected sound contributes relatively little."

In speakers, Pioneer's Maxxial Tilt-axial and Sansui's FlexAxis speakers are surface-mount units with tiltable tweeters. Blaupunkt and Audiovox added models with stick-up (but fixed-angle) tweeters. Sansui's surface-mount models have dual passive radiators. Norelco's NCS-1000 "hatchbox" is a roughly triangular box with a side-firing woofer and front-firing tweeter, for deckless hatchbacks and station wagons. Jensen's 3000-series speakers have frequency response tailored to overcome road noise, which is strongest at mid-frequencies, plus grilles with

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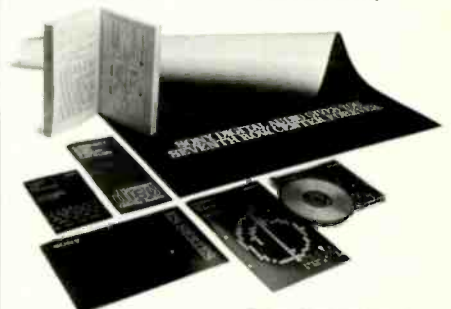
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TOKYO, Oct. 1, 1982—In one of the most eagerly anticipated events in the history of high fidelity, Sony engineers today introduced the world's first digital audio compact disc player. A dramatic departure from conventional audio technology, the new player uses a laser beam and several microprocessors.

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Then Sony engineers created the CDP-101 digital audio compact disc player—"the most fundamental change in audio technology in more than eighty years."*

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Predictably, the Sony CDP-101 spawned a host of imitators. But while these other versions seemed to spring up virtually overnight, the process of creating the CDP-101 was considerably more deliberate.

Along the way to the CDP-101,

for example, Sony invented digital audio processing.

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And Sony developed the world's widest range of professional digital audio equipment. Including the digital mastering system used in the mastering of every compact disc made today.

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track access and greatest immunity to shock in the industry.** As well as convenient horizontal loading and supplied wireless remote control.

So if you're confused by the current deluge of compact disc players, your choice is actually much clearer than you think.

You can buy one of the players inspired by Sony.

Or you can buy the inspiration itself.

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BERT WHYTE

UP WITH TUBES

In the world of audio amplification, the transistor has been predominant for many years. Before the transistor, we had vacuum tubes. Surely you remember tubes? They were those big glass gizmos with the glowing filaments that are still in heavy use throughout Russia and the Iron Curtain countries.

High-fidelity sound—"hi-fi"—is generally reckoned as having become a recognizable entity in 1948. Tube amplifiers in those days typically had power outputs of 10 to 15 watts, and that wasn't "per channel," friends, because all of our sound was monophonic. Around 1950-51, the first really high-fidelity amplifiers were introduced. There was the Brook amplifier, with 10- and 30-watt models. These were triode amplifiers, using 2A3 tubes. Then came the McIntosh 15- and 20-watt amplifiers, and a bit later, the famous 50W-2, a 50-watt "brute," beloved of the power-mad "hi-fi nut" (as audio aficionados were called in those days). If I recall correctly, the McIntosh amplifiers used beam pentode tubes like the 6L6 and, later on, the KT-66.

Arguments raged between the triode and the beam pentode advocates, with the former claiming lower distortion for their amplifiers, and the latter stating their distortion was just as low, but with higher power. Along about 1955, the triode-design Marantz appeared, and from then on the McIntosh and Marantz power amplifiers were considered state-of-the-art.

The tube preamplifiers of those days were fairly primitive devices. For example, there were ongoing arguments about the "correct" curve for phono equalization, so the preamplifiers had to be able to switch between the NAB, LP, AES and several other curves. Tone controls were very simple affairs, and, of course, there were no tape monitoring facilities.

At the peak of the tube era, in the late '50s, tube amplifiers had acquired considerable sophistication. In addition to the established 40-watt Marantz Model 9, and the 75-watt McIntosh, there were various modifications of the famous British Williamson amplifier circuit. Special transformers were offered for do-it-yourself builders—the Partridge Transformer Co. of England reg-



Illustration: Philip Anderson

ularly advertised their products in *Audio*, and David Hafler's Ultralinear transformers were highly regarded. By this time there were tube receivers, but the heat generated by the tubes in the relatively confined spaces of a receiver caused reliability problems.

When the transistor came into general use in amplifiers, around 1961, it was hailed as a great technological advance over tubes. The transistor was very small, thus making amplifiers and preamplifiers more compact, to say nothing of its ideal suitability for receivers. It didn't require an output transformer, didn't require any fussy bias adjustments, didn't generate any heat, and had the potential for very high output power.

However, when the first transistor amplifiers appeared, many audiophiles felt that the transistor had some characteristics they didn't find very pleasing. In their opinion, those amplifiers had a coarse, grainy, over-bright and hard sound, and when clipping occurred, the most horrendous distortion was heard. While there was rapid improvement in transistor amplifiers, especially in ameliorating the harsh-sounding qualities, many audiophiles were still not altogether pleased. Thus, the continuance of tube amplification was assured. Even with the ultra-clean, smooth sound of the best current tran-

sistor preamplifiers and amplifiers, there are many audiophiles still fiercely loyal to vacuum tube amplification. Perhaps the most ardent groups championing tube preamplifiers and amplifiers are the various so-called underground hi-fi magazines and their readers. In their opinion, the modern vacuum tube preamplifier and amplifier designs of today are far smoother and much more musical than their transistorized counterparts.

Although it must be close to 20 years since a tube amplifier has warmed my listening room, I have to respect the advocacy of tube amplifier designs by people for whom I have a very high regard. Not having a closed mind, especially where audio is concerned, I recently decided to listen to several modern tube components to find out why some audiophiles are so enamored of their sound.

Today's vacuum tube preamplifiers and amplifiers are the products of a number of small specialist companies. Oddly, as the most "transistorized" country on earth, the United States is a major producer of tubed audio equipment, along with England and, of all places, Japan. Among those available in this country are tube amplifiers and preamplifiers from Audio Research, Conrad-Johnson, Esoteric Audio Research, New York Audio Laboratories,

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Even with the ultra-clean, smooth sound of the best current transistor amps and preamps, many audiophiles are still loyal to tubes.

Luxman, David Berning, Counterpoint, and Eidolon, to name just those which come immediately to my mind. Although there is some mid-priced tube equipment, much of it is high-priced. I decided to sample models from both categories, and so have been listening to a Counterpoint SA-3 tube preamplifier

(\$795) and the Conrad-Johnson Premier Three preamp (\$2,850), as well as the Conrad-Johnson Premier One tube amplifier (\$4,350), which delivers 200 watts per channel into 4, 8 or 16 ohms. The Premier One is considered the *ne plus ultra* of tube amplifiers by the underground press; it's a 135-pound

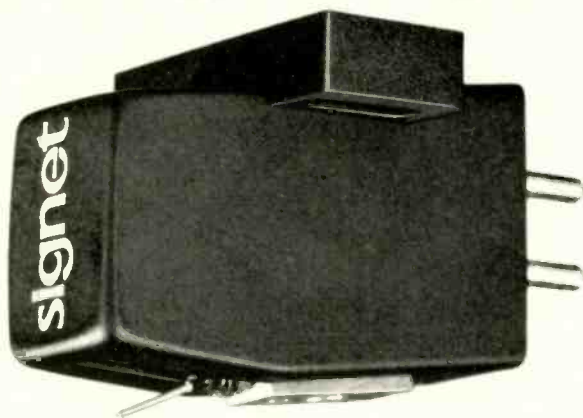
monster that is rack-mountable (provided the rack is strong enough!).

The Counterpoint SA-3, by contrast, is a compact, slim-line design, thanks to horizontal mounting of the tubes. It uses one 6DJ8 dual triode tube per channel in its RIAA amplifier section, with no voltage feedback in or around this circuit. The line amplifier uses one 6DJ8, shared by the two channels. Today's designers of tube equipment utilize solid-state components when they can be of obvious advantage. Thus, the power supply has four 1N4007 solid-state rectifiers, four Zener diodes, and several transistors to ensure steady voltage regulation.

The front panel has a 41-detent step control for level, a balance control, a program selector, and a tape-output defeat switch (to prevent possible signal interactions with the tape deck when it's not in use), but no tape monitor loop. There are power, mono/stereo, and muting switches. The power supply is outboard of the main chassis. Even after many hours of use, this preamplifier never gets uncomfortably hot. Signal-to-noise ratio (often a problem with tube equipment) was quite good, with just a small amount of hiss using medium-output phono cartridges and playing back at fairly loud levels. As to the sound, the most immediate reaction is to its smoothness, its impressive stage width and sense of depth, and open, airy transparency. While the warm sound is especially notable in the smooth reproduction of string tone, the transient response on percussion is still fast, although not quite as sharply etched as in the best transistor preamplifiers. I would say the Counterpoint SA-3 is very non-fatiguing and easy to listen to, and would probably be good to soften the sonic contours of some of the brighter-sounding transistor amplifiers. Listening to this unit, I can understand why it is so well regarded for its sheer, musical sound.

As to the Conrad-Johnson units, I have not yet fully explored their potential, and I want to describe the unique circuitry of these superb units. But that will have to wait for a column in the near future. For now, I can say that after listening to the Conrad-Johnson's very high sound quality, I know why their musicality is so treasured by the underground magazines. **A**

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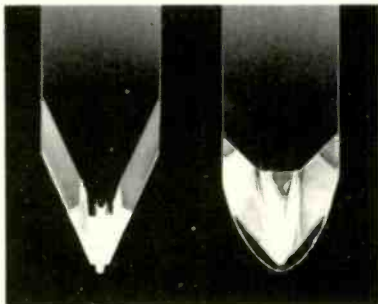


With the Signet TK10ML you probably won't care!

Until you hear the Signet TK10ML, you may not fully appreciate how superb today's analog recordings can be. And how little may be gained by going all-digital.

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Visit your Signet dealer. Peek into his microscope to see this fantastic stylus. Then get the real proof. Listen.

signet

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Sneak preview

The other day one of our engineers made an interesting observation.

He was trying to illustrate how much better the new ADS speakers sound.

"Think of the speaker as a camera lens," he said. "What we've done is improve resolution, extend depth of field, magnify detail, produce a finer image."

Not a bad analogy, we thought, and asked him to go on.

"We've done it with a lot of new technology," he explained, "but precision is critical. Take voice coil gaps. Ours are no thicker than your business card. About twice as fine as the gaps in most drivers, which has a lot to do with improving efficiency and reducing high end distortion.

"We've improved power-handling in the high end, too, by using a new high-gravity cooling fluid made to our own specifications.

"We've developed a new Linear Drive, long-voice-coil woofer which really improves bass response. The cone is Stiffite, an expensive, low-mass material used only by ADS. The result is a woofer with very high force-to-mass ratio, which means it goes lower, is more accurate and has more dynamic range."

As you read this, new ADS speakers are on their way to an ADS dealer near you. For his name write us: Analog & Digital Systems, Inc. 222 Progress Way, Wilmington, MA 01887. Or call toll free: 800-824-7888 (in CA 800-852-7777) and ask for Operator 483.

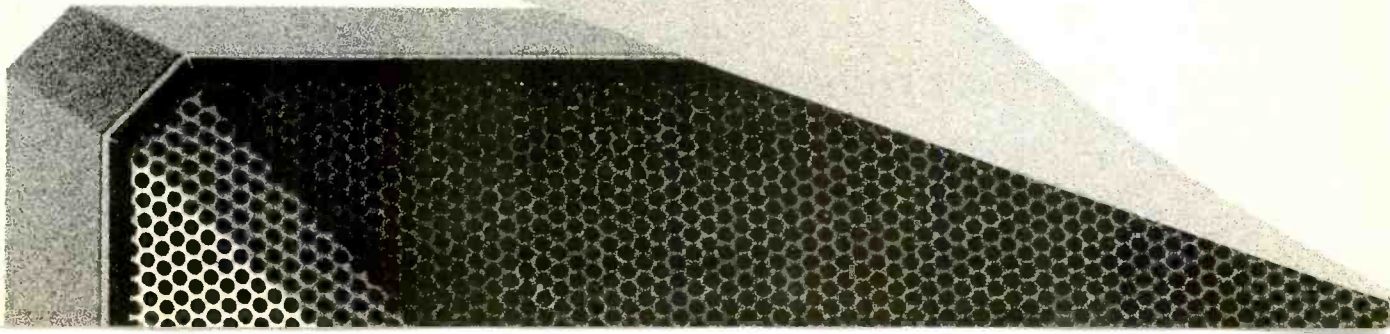
They're truly magnificent speakers. Sneak your own preview soon.

ADS Audio apart.

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ADS

The new L780 is one of seven new ADS speakers available in black or walnut finish. You'll recognize it by the new angled corner and distinctive deep-drawn metal grille.



AUDIOPHILE FILE™ XL-S

● GREATER DYNAMIC RANGE

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

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

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

How did we achieve this?

● IMPROVED EPITAXIAL PARTICLES.

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

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

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

IMPROVED EPITAXIAL PARTICLE CHARACTERISTICS:

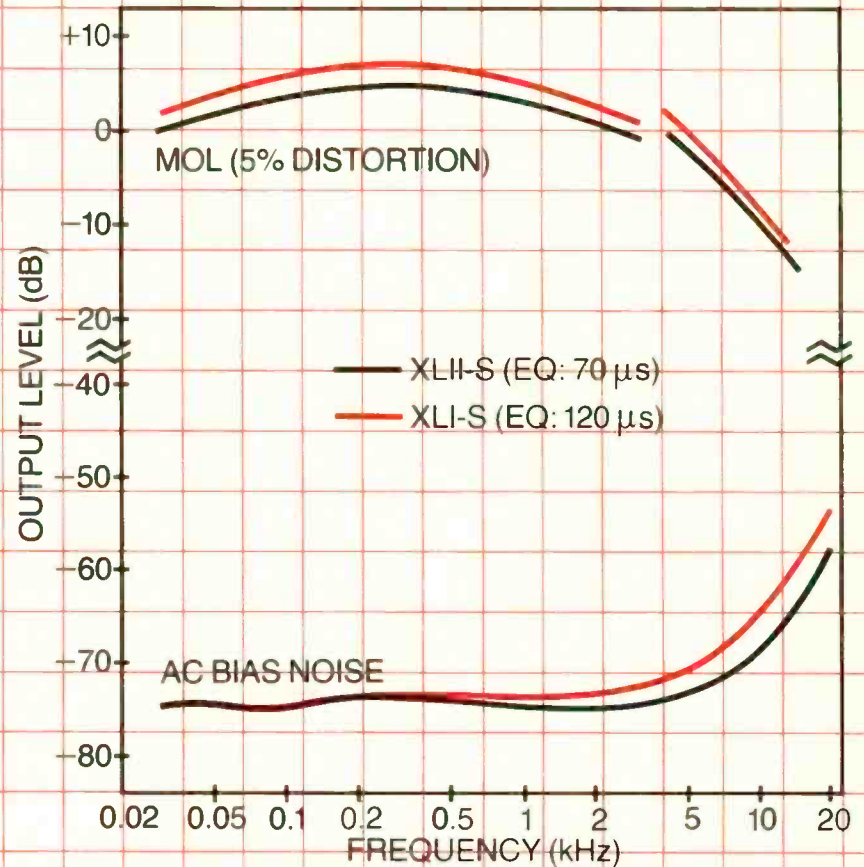
MORE UNIFORM COBALT-FERRITE LAYER

SMOOTHER PARTICLE SURFACE

GAMMA-FERRIC OXIDE

470Å

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



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

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

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

You'll see both these improvements covered in detail in future Audiophile

Files. In the meantime, we suggest you listen to them.

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

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



IT'S WORTH IT.

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SILVA-TONGUED COMPUTER

Before I leave Silva Hall in Eugene, Oregon, with its electronically assisted acoustics (see October and November), it's only proper to give credits—I simply omitted them in my earlier enthusiasm. That'll be taken care of this time.

You will remember that, in addition to the relatively standard "house" sound system in Silva Hall, there are two interacting but very different electronic layouts for the architectural processing of live sound within the concert space, both operating in effect as a part of the hall's architecture. AR, Assisted Resonance, has those 90 tuned mikes and 90 speakers in tightly controlled feedback loops or "channels." ERES, Electronic Reflected Energy System, operates through carefully timed delays to give, variably, apparent shape, size, warmth, presence to the concert space. These two systems work intimately together but their origins are distinct and different.

AR comes from England, out of the Royal Festival Hall of 1951 and the pioneer work of P. H. Parkin in 1964. That concert space was one of the earliest of the new modern concert halls and hence, perhaps, the most naively dreadful, a surprising acoustic disaster. For a dozen years its musical sound limped along spinelessly, criticized by performers, audiences, critics, yet never much improved. Then came Parkin, an audio consultant, who quietly installed—strictly on the Q.T.—his original version of AR. He used only a few of his so-called "channels," the narrow-band feedback loops, and these mostly in the lower frequencies; this was a circumspect and carefully limited trial run for a radical new architectural principle, not publicly announced.

The thing was turned on without fanfare and nobody, neither musicians nor audience, knew it was there. But there was improvement! It was noticed, happily, by those who were important—and, if they had understood, would have been prejudiced against any form of electronics. The silliest reasons were put forth—the hall had "mellowed" with age, and so on. No matter! The experiment had worked admirably. And so in 1969 Parkin put in an immensely more complex and sophisticated version, with no less than 168

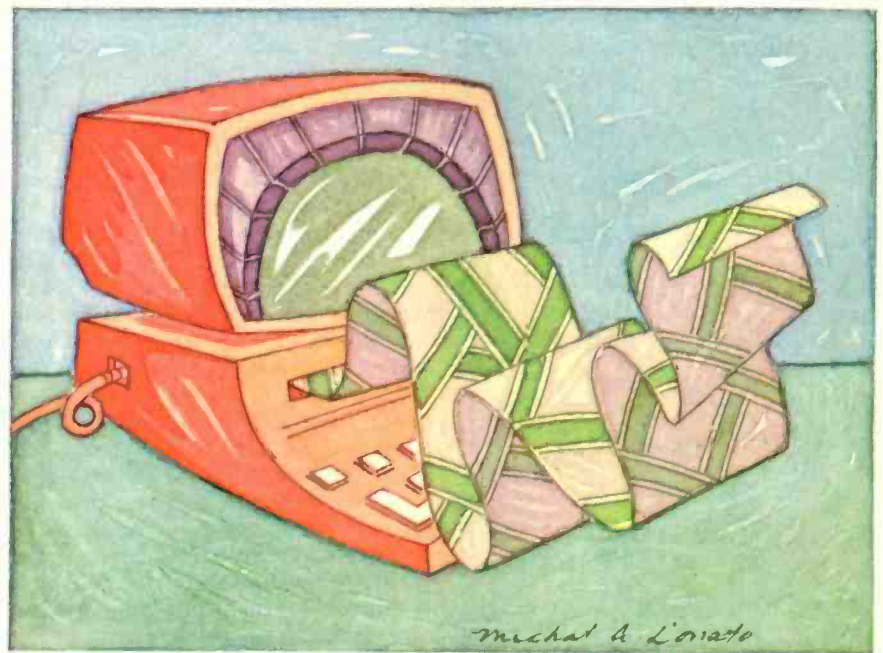


Illustration: Michael A. Donato

mike-to-speaker resonant channels, each covering a different narrow frequency band, each separately adjustable in loudness/decay (those two factors being locked together in a resonant relationship of the sort). That many were necessary because the Festival Hall acoustics were so remarkably deficient in themselves.

Now, with a better understanding of the contribution of the hall itself to the system, AR has been reduced in complexity, seldom going beyond the 90 channels that were designed ahead of time into Silva Hall in Oregon. AR continues as a proprietary system, manufactured in England by AIRO, Acoustical and Investigation Research Organisation—very British. AIRO sends out the parts and the technicians to do each installing job, but the specific designing and the later operation are up to the local experts.

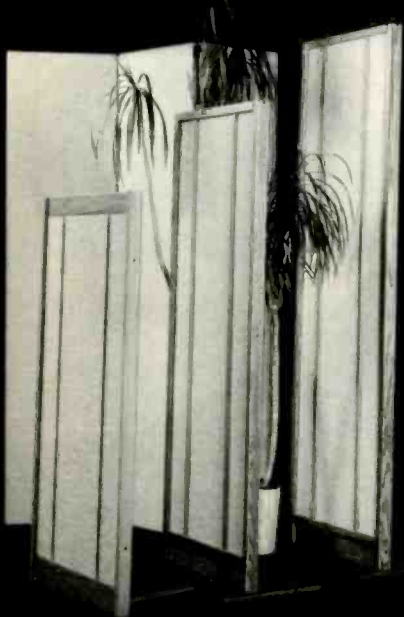
Meanwhile (as the old flicks used to say), an American acoustics man, Christopher Jaffe, based in Norwalk, Connecticut, became deeply involved in this field not only as local designer and supervisor for AR installations (each one, of course, custom-tailored for its building) but also, on his own, in a quite different delay-line-oriented approach that led to the overall concept of ERES as used, with AR, in Silva Hall.

Jaffe's digital delay complex, with only one operating mike and various spaced arrays of speakers, uses standard available components familiar to every reader of this magazine.

Jaffe, then, has had his fingers in both pies, AR and ERES, and I assume that it was quite naturally his idea to combine and integrate the original British concept with his own approach in ERES—adding for good and useful measure the facilities of the "house" system whenever desirable. The interconnections between these three elements in Silva are more than I could ever get into, but the combined operation is surely the present state of the art for electronic architectural acoustics, thanks to Jaffe.

Which brings up a vital aspect, computerization. I suppose, these days, that computer control of all this complexity goes without saying. Manual control, even as beautifully laid out as in our audio mixing boards of recent years, would be next to impossible. With computer, the entire inner works of the vast AR and ERES systems are housed compactly in a few cabinets. Even the regular sound system connects in here, though it has its own mixing boards (for two different halls), of a type familiar enough in recording and broadcast.

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Computer control of all this complexity goes without saying. Manual control would be next to impossible.

Last July I had a look at the computer center. It looked no more formidable than your home Apple or Osborne or IBM. There are millions of possible combinations, electronically speaking, that might be set up for the three systems in Silva—that's easy to understand. Any one of them may be programmed into the computer's memory, whatever sort it is, and then recalled at the touch of a few keys and put into instant action—the big green CRT tells you what you have and maybe what you've forgotten, just like the home models.

But where does one start? All those variables! From its opening last year, Silva has been a hard-working professional music space, and thus, obviously, some quick and immediately workable combinations must have been set up in a hurry, anticipating the first audiences and the many more to come. No time to become lost in heady or involved experiment!

In July, after a half year or so of operation, I checked out the then-current alternatives. (Not all of the AR-ERES interconnections were completed at that point.) Interesting to see how the thinking went, though I wasn't able to get in the hall and actually hear each one. Too busy. I wrote down on a scrap of paper no more than seven alternatives, though there might have been a few others—lecture or panel discussion, for instance, or maybe cathedral sound, for the Berlioz Requiem with its distributed brass or music from St. Mark's Cathedral in Venice. Here's what I got.

Punch G-Zero (no—not GO) on the keyboard and you have what is labelled Maximum Attenuation. If I read the engineering jargon, that is another way of saying OFF—always use polysyllabics if you can. Then come three codes for varying concert hall acoustics: G1, G2 and G3; they are called simply High Concert, Medium Concert and Low Concert. Practical minded, you see. They are more concerned with the sound level than with subtleties such as Baroque versus Rococo. (Maybe they'll get to that later.) Codes G4, G5 and G6 may surprise you, but not me—they are *rehearsal* positions that correspond to the above, High, Medium and Low. You might not have thought that electronic hall resonance

must also cover such situations as rehearsals—very different from concerts (no audience, lots of talk) but ever so directly related, just the same. Rehearsal sound is always a major problem, and one reason for padded hall seats is to compensate for the lack of audience. Now you can do something about it, via electronics.

Last on my list is G7—Opera and Ballet. For a moment that had me confused. Why this combination? Opera has singers creating sound on the stage; ballet's dancers merely emit breathy noises and thumping footsteps, not really audience fare. But the reasoning is simple enough. We in audio are familiar with recorded opera, but that's not the way it sounds in the opera house, which is normally rather dead, with what we may call "pit" acoustics. Only the singers are on stage; the orchestra is subdued by its low position in a trough below stage level. Not good for recording but that's the way it is in opera itself. Ballet in the flesh is very similar. Once again the music is not on the stage but down in the pit. So—for live performance, opera and ballet take the same acoustic setting in Silva Hall. Absolutely correct.

Perhaps these few alternative settings are all that Silva will ever need, but I suspect that many more will come, all in due time. The facilities, like Mt. Everest, are there! What can be done, will be done, the Murphy Reciprocal. All it takes is curiosity, imagination, the yen to try, and a bit of cooperation from management. Silva has come far but has plenty of room to go onward. Its versatility and effectiveness should continue to grow for years.

Our personal tour director in Silva Hall must get extra credit. This was Steve Hangebrauk, a regular working operator in the hall who knew the entire electronic equipment inside and out; he was listed as Sound Engineer and Technical Director for the Oregon Bach Festival's concerts. Steve is also an associate of JES Audio Design (James E. Swirczynski) in Eugene. This outfit furnished some interesting new-type mikes of their own design for the Bach Festival, but these aren't, or weren't, yet commercialized to the point where I can give you details. (Write JES, P.O. Box 11015, Eugene, Ore. 97440 to see what they have.)

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You've watched tonearms weave while tracking a disc; you've heard pitch vary; you've closed your eyes and listened to instruments wander in space. Perhaps you thought it was your imagination! Some days the problem seems worse than on others.

It's not your imagination. It's groove eccentricity. Records aren't perfect. Disc center holes may be too large, off center, or both. Unless you mount a disc perfectly, the groove won't be concentric with the axis of rotation, and, if the spindle hole is off center, the groove will be eccentric no matter what you do.

As the stylus tracks an eccentric groove, it weaves back and forth changing relative speed and generating wow. And, as the stylus deflects from side to side, interchannel phase and separation vary (so does distortion!), and instruments wander about. *Even if the disc and turntable meet international standards, groove eccentricity can produce peak wow of as much as 1/2% at the inner groove—far more than you'd expect from a turntable!*

DRAGON-CT *solves* these problems. Its Absolute Center Search System measures actual groove eccentricity and relocates the disc so that the groove is concentric within 20 microns! The procedure is automatic and takes only a few seconds. Once DRAGON-CT has relocated the disc, eccentricity wow vanishes, pitch stabilizes, and instruments remain fixed in space.

DRAGON-CT is an *integrated* disc-playing system designed for today's finest cartridges. It's high-rigidity, low-mass, semi-automatic tonearm has extraordinary warp-tracking ability thanks to its precision bearings and viscous damping system. A unique double-cabinet, dual-suspension construction isolates the disc from external vibration and acoustic feedback and ensures remarkable sonic clarity.

You'll find DRAGON-CT at select Nakamichi dealers. You owe it to yourself to find out how good your records can sound!

For more information, write Nakamichi U.S.A. Corporation, 1101 Colorado Avenue, Santa Monica, CA 90401.



Nakamichi

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The hall *looks* as if it would sound terrible—but it is, deliberately, a tissue of visual falsehoods.

One extra technical point to add, on which I am not yet entirely clear, though it is obviously important. The AR resonant channels, the pairs of mikes and speakers each covering a very narrow frequency range under controlled feedback, are placed so as to be at peaks in the hall's acoustic pressure response—presumably frequency by frequency. I am not at all clear as to how this works out in Silva Hall—the mikes were in a row overhead on one catwalk and the speakers on another, further back—but you can see that in this way the electronic sound is even more closely tied to the actual hall itself; the electronic and natural characteristics are thereby made a *single entity*, one sound, indivisible, though electronically variable.

The visible impact of Silva Hall is overwhelming and comes first. But after you have found your highbacked seat, you are just another concertgoer and you may be struck by conflicting impressions even before a note is sounded. The hall *looks* as if it would sound terrible. That deep, very wide stage with the cave-like shell on it for concert use—how can good sound emerge? The wide expanse of audience and the curious lack of side walls, in all that curvy basketwork—doesn't this invite poor sound?

Of course it does as you look at it, but you are forgetting the electronics! It took me days to put aside these visible falsehoods—for the hall is a tissue of them, deliberately. The big, black, handsome proscenium arch doesn't really exist; it is just a lot of sound-transparent grillwork with equipment, including loudspeakers, behind. So, too, with the solid structural bands overhead; they are the catwalks, with mikes and loudspeakers, and like the basketwork they are hung, not structural. All this, mind you, is visually handsome enough. But some day we will be able to put our electronics more honestly out in the open. Not yet. We must latch onto concert tradition, pretend the electronics aren't there. It's a practical necessity and Silva does it well.

I have one fault to note and it is not small. The audience is wonderfully served with sound, but not so the musicians. I found a consensus among friends, performers, architects, that the excellent intimacy and realism of the

audience sound is somehow one-way; the people on stage find themselves remote, and they are not helped by the present electronics. It would seem that the present shell, of some absorbent plastic, rough surfaced, is unfortunate; a better stage shell (with, I presume, consequent adjustments in the elec-

tronic systems) would do a lot. This, plus some of the audience's sound brought to the stage performers. It is aesthetically necessary, in Silva and other halls to come. As in recording, we must let our musicians hear what they sound like if they are to perform intelligently. Electronics or no. **A**



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GONE CLUBBING

Audio isn't just a way of listening to music well; for many, it's also a serious hobby. And since serious hobbyists like to get together, we've spent the past few months working up a directory of clubs and societies where they can.

The list that follows isn't alphabetical, but organized by ZIP code. We've found this to be one of the most logical ways to find which clubs are really near you, and which ones are not.

ZIP 0-

Boston Audio Society

P.O. Box 7
Boston, Mass. 02215
(Newsletter, \$16/year.)

Connecticut Audio Society

c/o John J. McBride
33 Perry Dr.
New Milford, Conn. 06776
(203) 355-2032
(In process of formation.)

Northwestern New Jersey Audio Society

c/o Kevin Carter
14 Irving Place
Summit, N.J. 07901
(In process of formation.)

ZIP 1-

Audio Engineering Society, International Headquarters

60 East 42nd St.
New York, N.Y. 10165
(212) 661-8528
(Professional society; \$40/year incl. Journal; student rate, \$20. Local sections throughout the world.)

Audio Engineering Society, New York Section

60 East 42nd St.
New York, N.Y. 10165
Secretary: Sidney Feldman
(212) 877-1730
(Meets 2nd Tuesday of each month, various locations.)

Quad Owners Club

39 North Riverside Ave.
Croton-on-Hudson, N.Y. 10520

The Audiophile Society

Larry Greenhill
9 Country Rd.
Mamaroneck, N.Y. 10543



New York Audio Society

P.O. Box 125
Whitestone, N.Y. 11357
(212) 544-1222, 289-2788
(201) 647-2788
(Membership, \$20/year; incl. quarterly publication.)

Long Island Audio Society

P.O. Box 113
Smithtown, N.Y. 11787
(May be inactive.)

ZIP 2-

Eastern Virginia Audio Construction Society

c/o Bryan Hefner
P.O. Box 6601
Newport News, Va. 23606
(In process of formation.)

ZIP 3-

Central Florida Audio Society

c/o Bill Boswell
3914 West Robinson St.
Orlando, Fla. 32805
(305) 298-1640
(Meets 2nd Tuesday, George Stewart Building, Orlando.)

Audio Engineering Society, Nashville Section

c/o Johnny Rosen
Fanta, Inc.
1213 16th Ave. South
Nashville, Tenn. 37212
(615) 898-2813, Christian Haseleu
(Meets 3rd Tuesday, various places.)

ZIP 4-

Audio Engineering Society, Indianapolis Section

c/o Dave Wright
5912 North Tuxedo Ave.
Indianapolis, Ind. 46220
(Membership, \$40/year.)

Southeastern Michigan Woofers and Tweeter Marching Society

P.O. Box 1464
Berkley, Mich. 48072-0464
(Usually meets 2nd Saturday of odd months, at members' homes; \$2.50 refreshment charge at door; newsletter, \$6/year.)

ZIP 5-

Minnesota Audio Society

P.O. Box 3341, Traffic Station
Minneapolis, Minn. 55402
(Meets monthly; newsletter.)

ZIP 6-

Chicago Acoustical and Audio Group

c/o Arthur Kathan
Knowles Electronics, Inc.
3100 North Mannheim Rd.
Franklin Park, Ill. 60131
(Meets 3rd Wednesday, except April; membership, \$10/year.)

Worldwide TV-FM DX Association

P.O. Box 97
Calumet, Ill. 60409

Saint Louis Audio Society

7435 Cornell St.
Saint Louis, Mo. 63130
(Meets monthly)

ZIP 7-

Fort Worth Audio Society

c/o Richard P. Machos
6201 Onyx Dr. North
Ft. Worth, Tex. 76118
(In process of formation; send SASE for more information.)

ZIP 8-

Central Colorado Audiophile Group

c/o James S. Upton
2631 17th Ave.
Greeley, Colo. 80631

Colorado Audio Society

6225 Snowbird Dr.
Colorado Springs, Colo. 80918
(Membership, \$10/year; quarterly journal; send SASE for more information.)

**Audio Engineering Society,
Phoenix Section**

P.O. Box 13503
Phoenix, Ariz. 85002
(602) 968-8675, Ed Vogt

ZIP 9-

**Audio Engineering Society,
San Diego Section**

P.O. Box 15882
San Diego, Cal. 92115-0790

Bay Area Audio Hobbyists

c/o Scott Marovich
300 East O'Keefe St. #1
Palo Alto, Cal. 94303
(Newsletter)

Audio Society of Honolulu

1902 South King St.
Honolulu, Hawaii 96826
(808) 941-1060

Pacific Northwest Audio Society

P.O. Box 435
Mercer Island, Wash. 98040
(206) 232-8130, Bob McDonald
(Meets 2nd Wednesdays, 7:30 to 9:30, at 4545 Island Crescent Way, Mercer Island, Wash.)

Canada

Sforzando

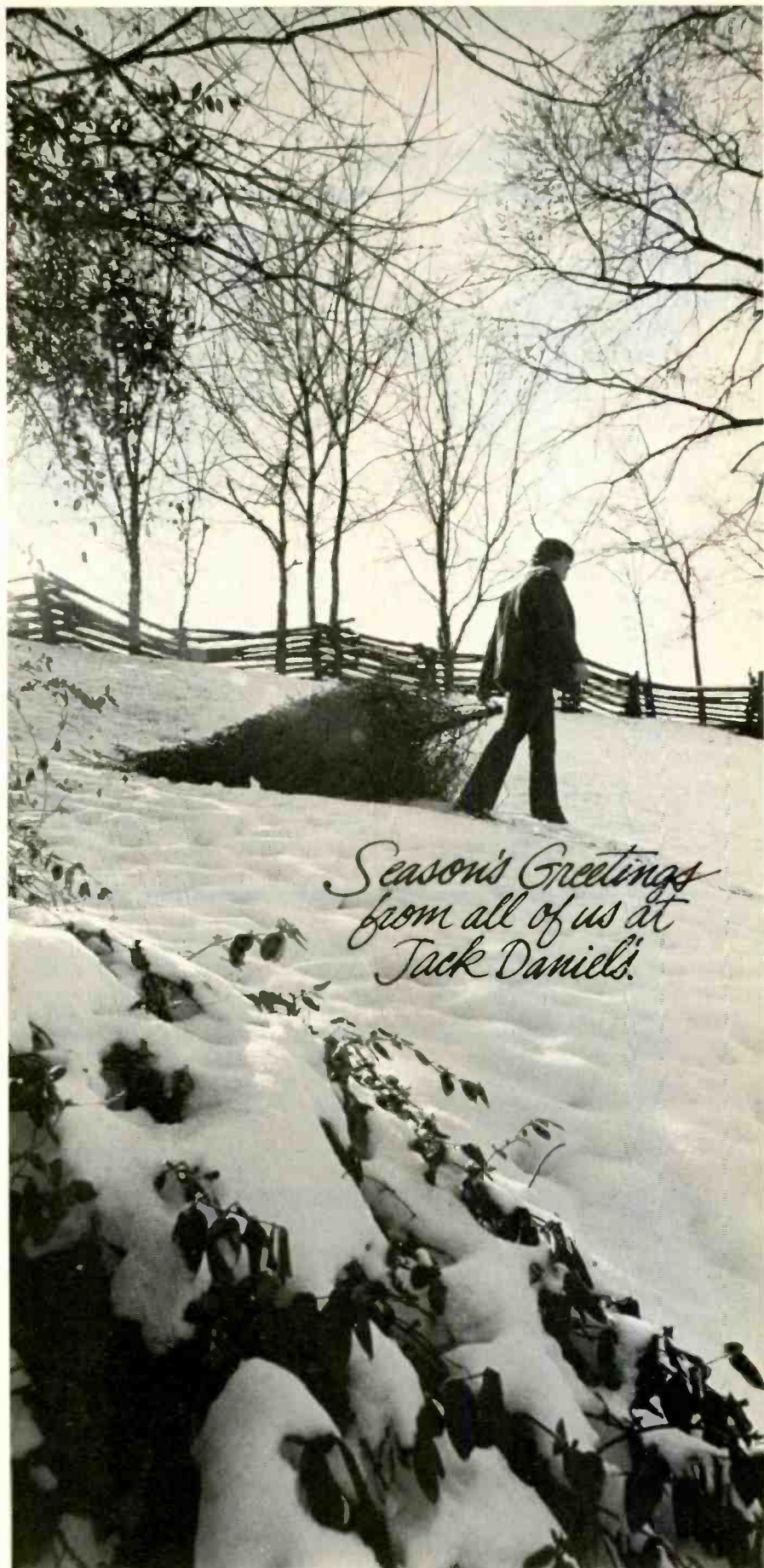
c/o E. A. Rawlings
5411 Bocage St.
Montreal, Que. H4J 1A2
(Mail group, lends live recordings of theater organ music.)

Toronto Area Audio Society

c/o Neelam Makhija
212 Kerr St., Suite 902
Oakville, Ont. L6K 3B1
(416) 842-2606
(In process of formation.)

Vancouver Audio Society

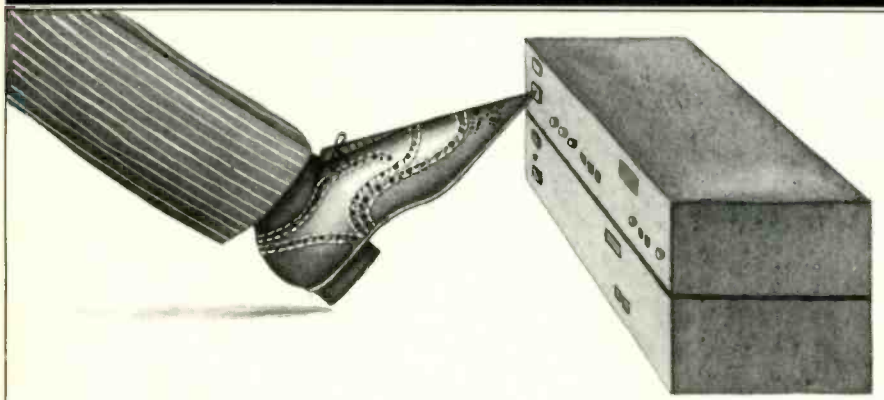
Box 4265
Vancouver, B.C. V6B 3Z7
(604) 874-3225
(Meets 1st Wednesday, 7:30;
949 Hornby St.; monthly newsletter;
membership, \$15/year.)



*Season's Greetings
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NO KICK COMING

Illustration: Jennifer Skopp



Put Your Amp on Automatic

My power amp sits at the bottom of my rack, and draws more current than I want my preamp's power switch to handle. So I haven't hooked it to my preamp's switched a.c. outlets, which meant the only ways to turn my power amp on were to bend, stoop, or kick its switch button. I could just leave it on, of course—but New York has the nation's most expensive electricity.

But now, I just push the preamp's

button and the amp comes on, too, thanks to an accessory Radio Shack sells for its computers. The SW-301 Automatic Control Power Strip (#26-1429, \$69.95) is designed to switch on up to five computer peripherals when you turn on your computer—but it can just as easily switch audio components when you turn on your preamp. It handles up to 6.28 amps, or 750 watts, which seems to be more than enough for my 400 watt-per-channel power amp.

Watts Up, Docked

The NAD 2150, like many stereo power amps, can be bridged into a mono amp of greater power (125 watts instead of 50 watts per channel). For stereo, you then add a second amp. Ho-hum.

It's rather unusual for an integrated amp to be bridgeable, though. Who wants to buy a second one, and pay

for duplicate controls? Nonetheless, NAD's 3150 control amp is also bridgeable; for the second channel, you add a bridged, control-less 2150. The two don't have to dock together physically; all you need is to run a connecting cable from one of the 3150's preamp outputs to one 2150 input, and you're in business.

Future Tone Controls

Purists don't like tone controls, on the sensible assumptions that (a) every extra circuit can degrade the signal and (b) tone controls only cover up for defects elsewhere. Pragmatists do like them, because they feel the minor degradations are more than compensated for by the ability to improve bad recordings of good performances.

With digital, the war may end. Digital filters are not so much extra circuits as extra program loops through which the signal passes as data. "It's a perfectly linear process," says Bob Berkovitz, lately of Acoustic Research. "You're dealing with numbers, so you can check to see that the numbers haven't changed." So it should be possible to filter digital signals digitally with precision but no degradation.

A year or two ago, AR showed prototypes of an add-on digital filter system, the Adaptive Digital Signal Processor. The ADSP is not a tone control, but an automated equalizer. Unlike such automated graphic equalizers as the dbx 20/20 and Sansui SE-9, though, it works in the time domain instead of the frequency domain. This gives it the ability to separately correct for response problems in the speaker's output and in the room's reflections, a fraction of a second later.

A few years back, I saw another futuristic equalizer, at Matsushita's Osaka labs. The response curve was shown on a computer screen, redrawn with a light pen, and the response changed to match its picture. It looked good, but was agonizingly slow; drawing just the right curve took a very steady hand.

Combine the AR and Matsushita approaches, shake well, and you get a new tone-shaping system. First set the system and the room response to "flat" with the ADSP, then add in whatever tonal modifications you like with a broad sweep of the light pen. (It might still be faster and more practical, though, to dial your desires in with plain, archaic knobs.) If your system could record digitally, it might even let you store tone and equalization information at the head of the recording, for automatic playback.



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0 to 50 in 5.78 seconds. Now, while you're re-reading Turbo Colt's acceleration number in wide-eyed amazement, let us remind you that there's much more to Turbo Colt than a turbocharger. Turbo Colt is equipped to give you all the fun, the great handling, and the looks that should go along with its kind of acceleration. It rolls on Michelin XVS 165/70 HR 13's, with non-linear,

high-control springs, solid front and rear stabilizer bars (.79" up front, .57" out back), heavy duty transmission and clutch, and front gas-filled shocks. Front air dam, rear spoiler, tachometer, halogen headlamps and a sport braking system are all standard.

Check out the rest of Turbo Colt's stats and go grab hold of one at your Dodge or Plymouth dealer.

TURBO COLT: VITAL STATISTICS

ACCELERATION: Zero to 50 mph...5.78 seconds
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TURBO BOOST: 7.5 lbs. psi
POWER: 102 bhp @ 5500 rpm
POWER TO WEIGHT RATIO: 19.77 lbs per hp
TORQUE: 122 lbs-ft. @ 3,000 rpm
TRANSMISSION: 4x2 Twin Stick



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SOLUTION.

Dear Bob Carver,

I bought a tuner four weeks before you introduced your TX-11 tuner. Now that I've read the AUDIO, STEREO REVIEW and HIGH FIDELITY reviews and have heard a demo at my audio dealer, I could kick myself. Couldn't you *please* put that special FM noise reduction circuit into an add-on unit? By the way, I have the C-4000 with Sonic Holography and your M-1.5t and I love them.

"Pleading in Suburbia"

Dear Bob Carver,

I am satisfied with my present receiver except when I try to listen to FM. The stations in this city are fantastic but the noise from multipath interference makes stereo listening almost impossible for me. However, several friends in my building have your TX-11 tuner and they get beautiful stereo FM reception. Is it possible for you to build your special FM circuit as a separate device so receiver owners can benefit from your technology, too?

"Hoping in Manhattan"

Dear "Pleading" and "Hoping."

I just did it! The Carver TX1-11, Asymmetrical Charge-Coupled FM Decoder, designed to be used in the stereo mode of *any* FM tuner or receiver, will give you a 20 dB improvement of the stereo quieting (that's 10 times quieter!) and a 10 dB improvement in multipath noise reduction. And you'll still have fully separated stereo FM reception with space, depth and ambience.

Both my TX-11 and TX1-11 use the Asymmetrical Charge-Coupled FM Decoder circuitry which very significantly reduces the multipath noise and distant station hiss to which FM stereo is extremely vulnerable.

To get virtually noise-free stereo FM, simply connect the TX1-11 through the tape monitor or external processor loop of your existing system.

Good listening!



Bob Carver



TX1-11

CARVER

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I'm still waiting for that gadget which would mute your stereo system when the phone rings or is picked up.

Book Review: Shack Catalog

Radio Shack's 1984 catalog is, as usual, short on plot and characters but long on gadgets and parts of interest to the audiophile. Among the new additions are ferrite beads, which I've often seen recommended for reducing r.f. interference pickup, but didn't know where to get; the Shack has 'em, at 10 for 89¢. Also of potential interest: A \$50 timer settable for 12 on/off events, either every day or on specific weekdays (pg. 162); a \$40 PZM mike (pg. 51); solderless RCA phono plugs with strain relief at four for \$1.39 (pg. 131), and a leaf tweeter (\$15, part of a two-page spread on separate drivers, pp. 22-23).

A few other items caught my eye that aren't new, but can be hard to find. If you want to upgrade someone's old phonograph to mid-fi, there's a fixed-gain stereo preamp which lets you use a magnetic cartridge in a ceramic phono or AUX input (\$20, pg. 26). If you have more tape decks and signal processors than tape monitor or EPL jacks in your preamp, you might be interested in the three-deck switcher (\$25) on the same spread. And if you want to use the comfortable phones from your portable stereo tape player on a mono radio or TV, you'll find the right adaptor, for \$1.19, on pages 32 and 130.

Though Radio Shack has stores all over, not all stores have every item at any given time. But the odds on your finding at least some of this stuff on any given visit are high.

Hold the Phone

Not all the good ideas one sees at trade shows like CES get into production. One I'm still waiting for is a gadget called Tele-Mute, which showed up a few years ago. It would mute the stereo system just before the phone rang or if you picked up the phone to make a call. The price was to be about \$50, from a company called Sound Mate (which I can no longer find). As I run through old CES notes, I'll doubtless find more good but lost ideas; I'll pass them on when I do.

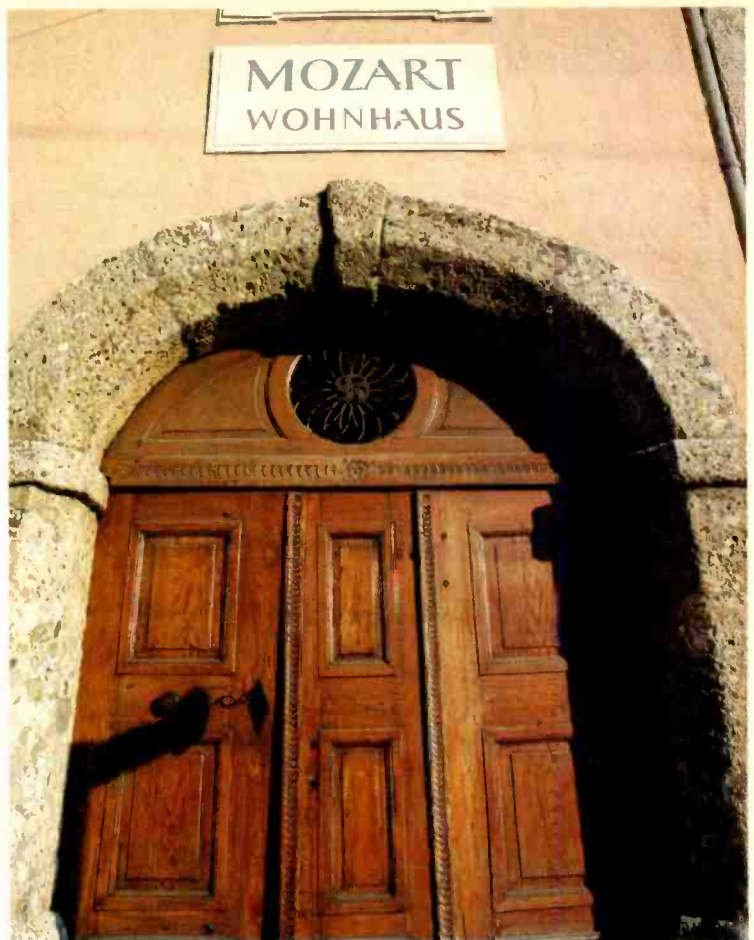
It took a touch of
genius to fill this
house with music.

As you might expect, the curators of Mozart's residence in Salzburg, Austria, attach considerable importance to the quality of music reproduction in the museum. Their overriding concern is the faithful re-creation of Mozart's works.

They chose JBL loudspeakers.

JBL engineers share the concerns of the curators. JBL loudspeakers deliver not only the notes but the spirit of great musical performances. From wax cylinders to the latest digital and advanced analog recordings, JBL loudspeakers will help you appreciate musical genius.

For a demonstration, visit the audio specialists at your nearest JBL dealer. Or the Mozart museum in Salzburg.



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QUAD COMPONENT SYSTEM



Photograph: Susanne Buckler

No, this is *not* a "rich man's one-brand system"! It's just that the Editor and I found out that anyone who purchased the Quad 34 control unit and the 405 amplifier would probably purchase their matching FM4 tuner. Quad styling is so different from the usual, anodized-aluminum front-panel design approach that trying to mate such components with other Quad units simply wouldn't look right. I also discovered audio enthusiasts either love the Quad component styling or they hate it; there seems to be no in-between. Finally, I found that Quad electrostatic speaker enthusiasts (whose numbers have grown substan-

tially since the introduction of the ESL-63) are more apt to choose Quad components to power them than are people who favor more conventional dynamic speaker system designs. All this is by way of explanation as to why we chose to report on *four* Quad components in one review; five, if you count the loudspeakers as two components.

Tuner Layout

The buff-colored front panel of this FM4 tuner is most unusual in appearance as well as in the layout of its control functions. Tuned-to frequencies are digitally displayed (though the

electronic tuning is *not* frequency synthesized), and continuous tuning is accomplished by means of a large knob at the right of the front panel. Nearby is a power on/off button, while to the left of the display area are eight pushbuttons, identified as 1 through 7 and "Tune," plus eight LED indicator lamps. The buttons and lights are used to preset and call up any of seven of your favorite stations, once they have been stored in the tuner's memory circuits. The display area indicates not only frequencies of received signals but signal strength and correct center-channel tuning. Both of these useful bits of information are supplied by a

double bar-graph. Its height denotes signal strength, while equal height of both bars denotes correct center-channel tuning. Grasping the tuning knob causes interstation muting and a.f.c. to be switched out, but they are activated when you let go of the knob. Stereo transmissions light up an indicator just to the right of the frequency numerals in the display area.

The tuner's antenna input uses a coaxial connector that's apparently standard in Britain, but not here. The correct connector is supplied with the tuner, but you must solder it to your transmission line. The British, apparently, expect this sort of extra work when they buy an upscale audio product; in fact, I suspect that they rather enjoy doing this bit of home assembly, for I

find that many British (and, for that matter, European) audio products require one to assemble or solder before they can be used. Happily, that was the only thing on the FM4 requiring extra assembly work. Quad did supply an adaptor cable for converting the confounded DIN plug to our more usual phono tip plugs. A prewired a.c. line cord suitable for the U.S. was also supplied, as were interconnecting a.c. cords which enable you to hook up all three of the audio components so that the control unit, Model 34, turns them all on from its front panel.

MANUFACTURER'S SPECIFICATIONS

FM4 Tuner

30-dB Quieting Sensitivity, Mono: 1.0 μ V (11.2 dBf), 75 ohms.

50-dB Quieting Sensitivity, Mono: 2.7 μ V (19.84 dBf), 75 ohms.

S/N: Mono, 76 dB; stereo, 70 dB.

THD, 1 kHz: Mono, 0.15%; stereo, 0.15%.

Selectivity: 53 dB.

Capture Ratio: 1.5 dB.

Frequency Response: 20 Hz to 15 kHz, +0, -1.0 dB.

Crosstalk (Separation), 1 kHz: 40 dB.

Dimensions: 12.64 in. (32.1 cm) W x 2.52 cm (6.4 cm) H x 8.15 cm (20.7 cm) D.

Weight: 6.6 lbs. (3 kg).

Price: \$625.00.

34 Preamplifier/Control Unit

Rated Output (Main/Tape): 0.5 V/100 mV.

Input Sensitivity: MM phono, 3 mV; MC phono, 0.3 mV; radio and AUX, 100 mV; tape playback, 300 mV.

Maximum Input: MM phono, 150 mV; MC phono, 15 mV; radio and AUX, 5 V; tape playback, 15 V.

S/N, A-Weighted: MM phono, 75 dB; MC phono, 70 dB; radio and AUX, 88 dB; tape playback, 87 dB; minimum volume (residual), 105 dB.

THD: 0.05%, 30 Hz to 10 kHz, worst case.

Frequency Response: High level, 30 Hz to 20 kHz, \pm 0.3 dB; phono, RIAA \pm 0.5 dB.

Dimensions: 12.6 in. (32.1 cm) W x 2.5 in. (6.4 cm) H x 8.2 in. (20.7 cm) D.

Weight: 7 lbs. (3.2 kg).

Price: \$625.00.

405 Amplifier

Power Output: 100 watts per channel, 8-ohm loads, 100 Hz to 10 kHz.

Rated THD: 0.01% (0.05% at 10 kHz).

Input Sensitivity for Rated Output: 0.5 V rms.

Frequency Response: -1 dB at 20 Hz, -0.5 dB at 20 kHz, and -3 dB at 50 kHz.

Crosstalk: 80 dB at 100 Hz, 70 dB at 1 kHz, and 60 dB at 10 kHz.

S/N: 95 dB, A-weighted; 90 dB, unweighted.

Dimensions: 13.4 in. (34.05 cm) W x 4.5 in. (11.5 cm) H x 7.7 in. (19.5 cm) D.

Weight: 20 lbs. (9 kg).

Price: \$675.00.

ESL-63 Electrostatic Speakers

Nominal Impedance: 8 ohms.

Sensitivity: 86 dB SPL, at 1 meter, on axis, for 2.83-V rms input.

Dimensions: 26 in. (66 cm) W x 36.4 in. (92.5 cm) H x 10.63 in. (27 cm) D, including 5.9-in. base.

Weight: 41.1 lbs. (18.7 kg).

Price: \$3,310.00 per pair.

Total System Price: \$5,235.00.

Company Address: 425 Sherman Ave., Palo Alto, Cal. 94306.

For literature, circle No. 98

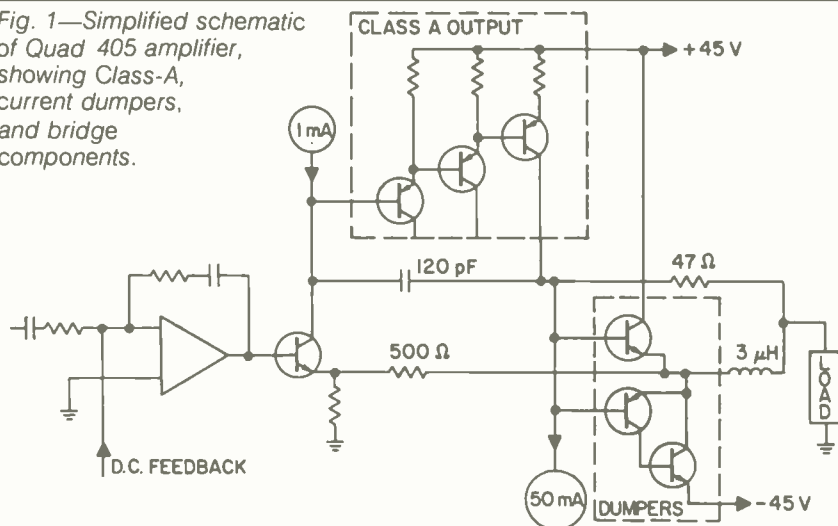
Control Unit Layout

This preamplifier/control unit looks, for all the world, just like the tuner. Its volume control replaces the tuning knob. The power on/off button is located in the same spot as on the tuner. In place of the display area is an opening in the front panel which houses a "Bass Lift" control and a "Tilt" control, two unique tone compensation controls developed by Quad. The eight buttons at the left of the panel (along with appropriate LED indicators) now serve as program selection switches ("Radio," "Disc," "AUX," "Tape") and mono/stereo, high-cut filter, and slope selection switches. A balance control in the form of a lever is mounted concentrically with the Model 34's main volume control.

I encountered no kit-building requirements when I installed this component, and all necessary DIN-to-pin-plug adaptor cables were supplied, as well as another a.c. patch cord. Phono inputs were already of the phono-jack type and were, in fact, part of a subassembly which is easily removed by loosening two screws, thereby permitting the user to substitute phono equalizer/preamplifier modules for moving-magnet or moving-coil cartridge inputs. Quad has a variety of these available, each with a predetermined gain factor and a specified input impedance. The two modules supplied as standard equipment with the Model 34 handle moving-magnet cartridges rated at 3-mV input sensitivity and requiring 47-kilohm/220-pF loads and, for moving-coil pickups, a module having an input sensitivity of 100 μ V and presenting a load of 100 ohms and 22 nF. When substituting one preamplifier

The 405 amplifier responded well to all of the difficult source material to which it was subjected during many days of listening tests.

Fig. 1—Simplified schematic of Quad 405 amplifier, showing Class-A, current dumpers, and bridge components.



module for another, a flat multi-conductor cable connected to the preamp module in use has enough slack so that disconnection and reconnection of the new module can be comfortably made without having to open it up and get inside the chassis.

Power Amplifier Layout

The last electronic audio component of this group, the 405 amplifier, has no controls and can therefore be installed out of sight or in close proximity to the control unit and the tuner. Spring-loaded speaker terminals are used for connection of speaker cables. The amplifier may be limited to an output of 20 V rms (that would work out to 50 watts across a true 8-ohm resistive load) by inserting supplied shorting links in each amplifier p.c. board module. This precaution should be taken if the speakers used with the Model 405 are incapable of handling a full 100 watts of power. Specific note is made in the amplifier owner's manual that this limiting feature is not required if the amplifier is going to be used with Quad ESL-63s, the speakers I ultimately used in the listening tests.

Like most electrostatic loudspeaker systems, the ESL-63s require a polarizing voltage, and that means connections by means of a line cord to an a.c. outlet, in addition to the usual signal connections made via color-coded loudspeaker terminals. The speaker systems incorporate protection circuitry which either compresses overly large input signals (over 40 V rms) or

shorts out the signal input from the driving amplifier. Amplifiers which are not short-circuit protected should therefore not be used with the ESL-63 speakers.

Circuit Highlights

The Quad 405 has been termed a "current dumping" amplifier by its designers. In such an amplifier there is, in effect, a low-powered, ultra-high-quality amplifier plus a high-powered, heavy-duty amplifier (Fig. 1). The low-powered amplifier controls the loudspeakers at all times, calling upon the high-powered section only when high-powered peaks to the speaker load are called for. The small amplifier is operated so that, provided the larger power transistors (the "dumpers") get within range of the required output current, it will fill in the remainder of the signal waveform accurately and completely. Reproduced sound *quality* is therefore solely dependent upon the smaller, more accurate amplifier. In this arrangement there are no internal adjustments, nor is alignment required, and the choice of power transistor types is less critical.

The most unusual circuits found in the Quad 34 control unit are the "Bass Lift" and "Tilt" circuits, which replace the more common bass and treble boost and cut circuits found on most amplifiers and receivers. When the "Bass Lift" control is operated in any of its lift settings, it acts as a smooth progressive booster for use with small loudspeakers having limited bass re-

sponse. In its "Step" mode, the control acts as a step filter, producing a 5-dB drop at either 100, 170, or 300 Hz. This characteristic, according to Quad, is especially useful in minimizing the effects of standing waves in a room, particularly when speakers have to be positioned in corners.

The FM4 tuner owner's manual tells us little about its circuitry. I have discussed the design philosophy of this relatively lackluster component with executives of the company. According to them, its design is essentially an attempt to make the component easy to use, have it deliver sound quality that is at least as good as what is likely to be transmitted over FM stations, and, in general, to keep it as simple as possible. More about whether or not these goals were met later on.

Measurements

After connecting an antenna transmission line in order to access the 75-ohm input (there's no provision for 300-ohm twin lead connections), I was surprised to find errors in Quad's listed specifications for sensitivity. I have corrected them in our "Manufacturer's Specifications" section (see sidebar); however, 2.7 μV across 75 ohms is not 8 dBf, as Quad claims, but 19.84 dBf, and 25 μV across 75 ohms is not 28 dBf, as claimed, but 39.17 dBf. Given the corrected figures, the FM4 actually did better than claimed. The result for 50-dB quieting in mono was 17 dBf (2.0 μV), while in stereo it measured 38.45 dBf. Usable mono sensitivity was 1.1 μV across 75 ohms or 12.04 dBf; in stereo, the 3% noise-plus-THD point (usable sensitivity) was reached with a signal input of 2.0 μV or 17 dBf. Signal-to-noise ratio measured 76 dB in mono, as claimed, and was 3 dB better than claimed in stereo, or 73 dB. Mono THD for a mid-frequency modulating signal was 0.15%, and 0.11% in stereo. Plots of noise and distortion, in mono and stereo, versus signal strength are shown in Fig. 2, and a plot of distortion versus modulating frequency is shown in Fig. 3. Selectivity measured just over 60 dB, while capture ratio was 1.5, exactly as specified. AM suppression fell 2 dB short of the 60 dB claimed, although image rejection, which measured 85 dB, exceeded claims by 5 dB. The i.f. rejection was 95 dB.

The most outstanding component in the group, the Quad 34 control unit, operates in a way that is meaningful to music listeners.

When I began to plot frequency response, I got a surprise. In order to speed this review, Quad originally air-shipped equipment direct from England to *Audio*—including a tuner that was factory set for 50- μ S de-emphasis, rather than the U.S. standard of 75 μ S. Since the U.S. importer stocks tuners with the right de-emphasis, I obtained a second sample, whose frequency response yielded the upper curve shown in Fig. 4.

Separation versus frequency is also depicted in Fig. 4. In the unit tested, separation was unbalanced. When the left channel was modulated, crosstalk into the right channel was down 45 dB at 1 kHz, 47 dB at 100 Hz, and 27 dB at 10 kHz. With the right channel modulated, crosstalk into the left channel measured 40 dB at 1 kHz, 38 dB at 100 Hz, and 27 dB at 10 kHz. Figure 5 displays crosstalk and distortion products appearing at the output of the unmodulated channel when a 5-kHz, 100% modulating signal is applied to the opposite channel. Here the sweep is linear, from 0 Hz to 50 kHz, the tall spike at the left is the desired 5-kHz output signal, and all other observed components are undesired outputs from the opposite channel, including a small amount of 38-kHz subcarrier component signal appearing just to the right of the center of the display. Vertical sensitivity in this photo is 10 dB per division.

Based on my measurements, the most outstanding component in this group is without a doubt the Model 34 preamplifier/control unit. I tested it using both the MM and MC phono modules, and RIAA equalization was very nearly perfect for each. In fact, for the MM module, I detected no deviation from 30 Hz to 20 kHz. The MC unit had a minor amount of roll-off (around 0.5 dB) at 15 kHz. My sensitivity and S/N measurements were conducted in accordance with IHF standards, and are therefore not easy to correlate with the figures quoted by Quad. But however you measure S/N on this preamp, the results will be excellent in terms of audibly perceived hum and/or noise. Phono S/N measured 87 dB below 5-mV input for 0.5-V output with the MM module, and 84 dB with the MC module. High-level S/N measured 92 dB with reference to 0.5-V in and out.

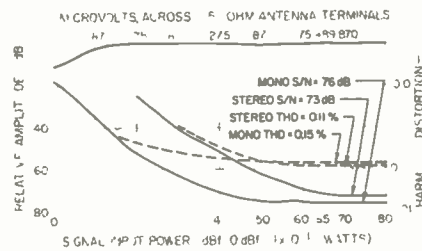


Fig. 2—Mono and stereo quieting and distortion characteristics, FM section, FM4 tuner.

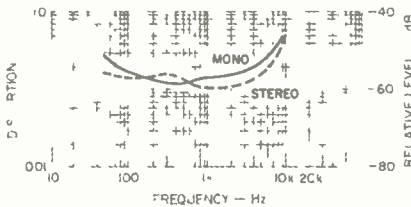


Fig. 3—THD vs. modulating frequency, Quad FM4 tuner.

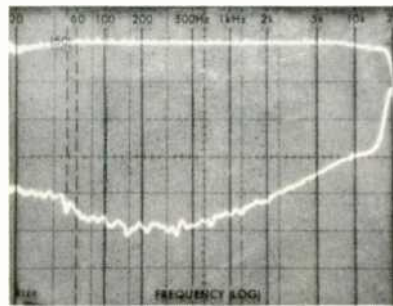


Fig. 4—Frequency response, FM4 tuner (upper trace) and separation vs. frequency.

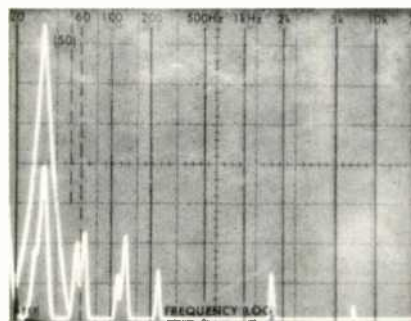


Fig. 5—Crosstalk and distortion products at the unmodulated channel's output, with a 5-kHz, 100% modulating signal applied to the opposite channel of the FM4. Sweep is linear from 0 Hz to 50 kHz.

High-level frequency response was flat to within 0.1 dB from 20 Hz to 20 kHz. Worst-case THD measured 0.01% for a 1-kHz test signal, 0.02% for a 20-Hz signal, and 0.05% for a 10-kHz signal. The SMPTE IM measured 0.03%. Input sensitivity was 3.4 mV for the MM phono module, 120 μ V for the MC module, 100 mV via the high-level "Radio" or "AUX" inputs, and 300 mV for the "Tape Play" inputs.

Figures 6, 7, and 8 all depict logarithmic frequency sweeps, from 20 Hz to 20 kHz, in which vertical sensitivity is 10 dB per octave. Figure 6 shows the response of Model 34 for the various settings of the high-cut filter switch. Figure 7 shows multiple plots of response for the various settings of "Lift" and "Step." Figure 8 shows plots of the unique "Tilt" control, which affects both bass and treble frequencies. Depending upon the setting, the "Tilt" control boosts bass while cutting treble (in minute selectable steps) or cuts bass while boosting treble. Despite the relatively small amount of compensation provided by this control, its audible effect is quite discernible, and it could be quite effective in compensating for deficient room acoustics and even for deficiencies inherent in many speaker systems. To present a clearer picture of just how the "Tilt" control works, I expanded the sensitivity of the spectrum analyzer display to 2 dB per division in the photo of Fig. 9 and plotted a separate response curve for each of the control's settings.

The power output rating of the 405 power amplifier is not given in accordance with FTC requirements. Though nominally rated at 100 watts per channel, continuous power, different distortion ratings are given for different frequencies. And, since the highest frequency for which THD is quoted is 10 kHz, if I had to translate this into a standard power rating, I'd have to call it "100 watts continuous power per channel, 8-ohm loads, from 100 Hz to 10 kHz, with no more than 0.05% THD." In fact, the amplifier does better than that at the low end, but it does not produce 100 watts at 10 kHz for that quoted lower level of harmonic distortion. At mid-frequencies, the 405 can deliver more than 110 watts for the quoted 0.05% THD. At its nominal 100-watt output level, for a 1-kHz test sig-

Though I made no lab measurements, I find the new ESL-63s a big improvement over the earlier Quad ESLs.

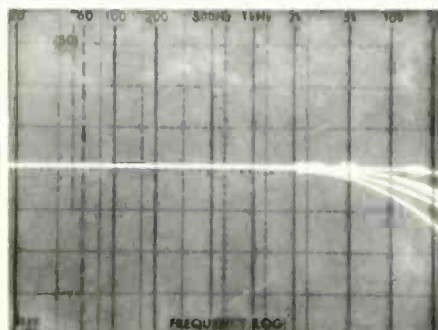


Fig. 6—Frequency response characteristics of the various high-cut filter settings on the Quad 34 control unit. Sweep is logarithmic, from 20 Hz to 20 kHz, and vertical sensitivity is 10 dB/octave.

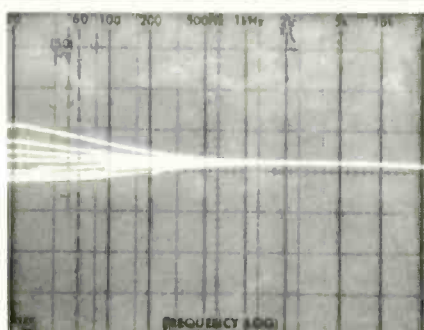


Fig. 7—"Lift" and "Step" response characteristics of the bass control, Quad 34. Frequency sweep is logarithmic, from 20 Hz to 20 kHz, and vertical sensitivity is 10 dB/octave.

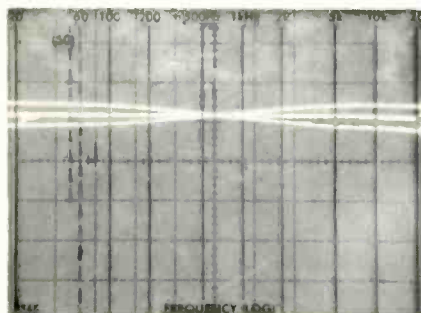


Fig. 8—"Tilt" control setting of Quad 34 alters bass and treble response simultaneously. Logarithmic frequency sweep, 20 Hz to 20 kHz, and 10 dB/octave vertical sensitivity.

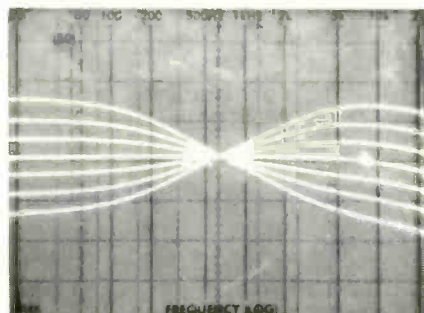


Fig. 9—Expanded view of "Tilt" control action of Quad 34. Logarithmic frequency sweep, 20 Hz to 20 kHz, but 2 dB/octave vertical sensitivity.

nal, THD measured only 0.007% while SMPTE IM measured 0.008%. Damping factor was greater than 100. CCIF IM was 0.0088%, and IHF IM (twin-tone measurement) was less than 0.03%—the lowest level that I can resolve on my spectrum analyzer. Signal-to-noise ratio measured 84 dB below 1 watt out, for 0.5 V in, unweighted. Using an A-weighting network, S/N increased to 101 dB.

System Evaluation and Listening Tests

Let me state at the outset that I made no attempt to perform any lab measurements on the ESL-63 loudspeaker systems which formed part of this total component package from Quad; I used them simply to listen to the other components. (I'm told that my good friend and colleague Dick Heyser will be doing his usual thorough job of

measuring these highly respected electrostatic systems in a future issue.) Nevertheless, like any true audiophile, I feel I have the right to offer a subjective opinion concerning these bigger, younger relatives of the earlier ESL speakers (which, incidentally, are still in Quad's line).

To my ears, the ESL-63s are a big improvement over the earlier ESLs. Their overall tonal balance is better, though I find that bass response is still not what I would like it to be. Here's a case where the "Tilt" control on the Model 34 can really help—at least in my listening room and for my ears. In terms of power needs, the 405 amplifier seemed ideally suited to the speakers, with enough power to deliver good, realistic sound levels, but not enough to damage the systems or to activate the protection circuitry. The fact that the 405 amp is unconditionally

stable (and it is—I confirmed this with capacitive, open-circuit, and short-circuit loads) is a boon, too, when driving electrostatic speakers. Speaker placement was found to be extremely important with the ESL-63s, as indeed it would be with any dipole speaker system. I found that the speakers wanted to be further apart than I would have suspected, but stereo imaging was excellent. The "Tilt" control also served to reduce the somewhat overly brilliant treble response which, to my ears, has always been characteristic of earlier Quad ESLs and continues to exist in the ESL-63s.

As I said above, if I had to rank the order of the other three components in terms of performance, ergonomics and general merit, I would place the Model 34 control/preamp at the top of the list. Its phono preamp modules represent an ideal solution to a matching problem that is always with us, and its controls operate in a way that is meaningful to music listeners, rather than just to technicians and engineers.

The amplifier is certainly a close runner-up in my personal ranking. It responded well to all of the difficult source material to which it was subjected during my many days of listening. The 405 not only drove the ESL-63s very well, it also supplied clean, undistorted power to my reference loudspeaker systems and to some less costly speaker systems that were passing through the lab during the period of testing.

That puts the FM4 tuner at the bottom of the list. I'm afraid the situation with FM in Great Britain (and in the rest of Europe) is very much unlike the complex FM picture we have in this country. There are fewer stations, and long-distance reception is not usually a problem thanks to "network" and relay arrangements which exist in many European countries. To be sure, under many (if not most) listening conditions in the U.S., and given the present quality of FM broadcasting, the FM4 is probably good enough. However, in my listening area at least, there are a number of really fine signals available. So I think I would pass on the FM4 and choose another fine tuner, even if that meant breaking up the matching cosmetics of this distinctively European component group. *Leonard Feldman*

15 mg. "tar", 1.0 mg. nicotine av. per cigarette, FTC Report MAR.'83.

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Miniature coin (at bottom right) reproduced 4 times larger than actual size to show fine detail.

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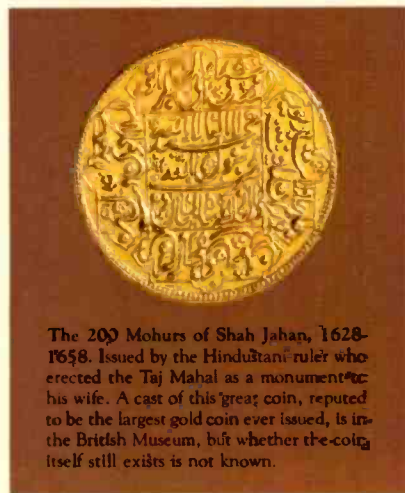
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But, remember: subscriptions will be accepted in strict sequence of receipt and once the numbered limit of 25,000 has been reached, the edition will be closed forever. It is therefore important that you return the accompanying subscription application promptly—and, in any event, by December 31, 1983.



The 200 Mohurs of Shah Jahan, 1628-1658. Issued by the Hindustani ruler who erected the Taj Mahal as a monument to his wife. A cast of this great coin, reputed to be the largest gold coin ever issued, is in the British Museum, but whether the coin itself still exists is not known.

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PAUL LAURENCE

Ray Manzarek

The Doors' keyboardman talks about pianos, Morrison, and why the legendary track "Rock Is Dead" never got released.



1983

Ray Manzarek In
Manhattan

More than a decade after their breakup, The Doors are still very much with us, their sales and airplay respectable even for a current act. An audiophile disc, *The Doors*, was released on Mobile Fidelity. A new book, *The Doors: The Illustrated History*, by Danny Sugerman has just been released by Quill, a division of William Morrow & Co., and a video of "Love Me Two Times" premiered on MTV in early October.

Joining vocalist Jim Morrison in The Doors were Ray Manzarek on keyboards, Robby Krieger on guitars, and John Densmore on drums. The group

had no regular bass player in the early days; the parts were generally played by Manzarek on his Fender-Rhodes keyboard bass, and later on by various session bass guitarists. Rounding out the team were Paul Rothchild for production and Bruce Botnick for engineering.

Manzarek, always the group's most articulate spokesman, is tasteful and meticulous, as his keyboard playing would suggest. He lives today in the hills above Los Angeles with his wife, Dorothy, and son, Pablo. Recent endeavors include producing local bands such as X and The Zippers, recording Carl Orff's cantata, *Carmina Burana*,





Photograph: Robin Holland © 1983



1967

**Manzarek
playing
keyboards in
New York City**

Photograph: © Joseph Sia 1967

and acting in a film comedy on the international arms business with Chevy Chase and Vince Edwards called *The Deal of the Century*.

What do you think of as being the different kinds of piano sounds you hear on records? Some people speak of an "English" piano sound, which is heavily compressed, thin. Do you think in those terms at all?

I think of it not so much in terms of the sound of a grand piano, but in terms of the instrument itself, like a tack piano, an upright piano, a spinet piano, a grand piano, a baby grand, a 7-foot grand, a 9-foot concert grand. Or also in terms of make of the piano.

The sound that I always try to get is the fattest, richest kind of sound. And with brightness, of course, so that it doesn't get muddy. But I don't like too much compression. I like a good, fat piano sound.

You touched on the different tones and qualities of the different brands of grand piano. People have said Yamaha has the crispest, most trebly sound. What about the other ones?

Yamaha is very good. The Bösendorfer that I've been using has five extra notes to it, so even if you don't use those notes, just the length of the keyboard and the size of the harp gives it a fatter sound. It tends to have a little more bottom to it.

The Yamaha is definitely a brighter piano. Tends to lose it a little bit in the bottom, though. You can get some great glissando on it and great rock & roll triplets going. It washes out a little bit in the high end, too.

It gets unclear as you go up?

It doesn't really have the definition. It tends to just "tink" rather than have the bell of the note.

The Steinway action is real great, all-around great piano. I'd say the Steinway is probably the best overall piano. *Robby referred to some "inside the ear piano fooling around" on "Horse Latitudes." What was that?:*

That's a standard Doors trick. Getting your hands on the strings. Just getting in there and scraping on them, plucking them, hitting on them with drumsticks, . . . and putting a delay on it, so if you hit it once, the delay sound keeps happening. So if you're in there just plucking those strings or whatever,

it sounds like a lot of people doing it.

We probably got a couple of people in there at the time. I imagine everyone probably got their fingers in for a couple of plucks; it was too much fun.

Did you ever just pluck a couple of strings?

Let me see, what did we do that on? I don't know whether or not I actually did that. I've always fooled around doing it, but whether we marked them off . . . I don't think so, I don't think I marked any off to actually pluck. Although on *An American Prayer*, I did a couple of little things on the inside of the piano.

How about those other little kinds of pianos?

Yeah, well the little celeste, of course, for little "effect" kind of things. The smaller things, the smaller pianos would just be for music-box effects. Where you'd want something evocative of a child playing a piano. The spinet I never really got around to using on anything. Nothing really came up that quite worked for it.

What is a celeste?

A celeste is a very, very tiny little keyboard instrument, for those little bell-like sounds. I don't know what is in the back. It's a struck something; it's not plucked. Probably struck bells in there. Tiny little tuning rods of some sort or another.

I can't remember what a celeste is on; I'd have to listen to the stuff. We didn't do too much of that. The celeste was always around in the studio. It seems to be a standard part of a studio's equipment, and you always sort of fiddle around with it, thinking that when you need some little bell-like effects you'll put it on. But by the time you get around to finishing the records, somehow you always seem to forget about the little bell-like effects. Makes a lot more sense in a movie or on TV, or background stuff.

Let's talk about tack piano.

I've always liked to play the tack piano. Elektra Records used to have a great one. It was a brand-new Yamaha upright, new in '68 or '69, and somebody put tacks in it. The thing just had one of the brightest, liveliest sounds I've ever heard. Somehow we got the piano in our possession at The Doors' office, and it stayed there for a long time, five years. They never realized it was gone; we moved it over for something or oth-

er and just left it there. Then one day somebody went crazy and said, "Where's that tack piano? Gotta have that." Some guy was producing at Elektra's studio, and he had to have it, absolutely had to have it. I tried to stall them as long as I could, but they caught up to us. They wheeled it across the street, took it into the recording studio, and when I went over there a couple of days later to see about getting it back, the guy had taken the tacks out of the tack piano. It was never the same, ever again.

You mean he made it into a normal upright piano?

Just a regular piano, right. He could have rented a piano, he could have done anything. He could have gotten any old piano to sound the way that one sounded; the piano without the tacks was nothing. Then when the tacks went back in, it just wasn't the same anymore. This guy had *had* to have it, and I had thought, "Well, I can understand why he has to have it. It's such a fabulous piano; I love that piano!" But he messed the whole thing up.

I was really happy to see you do as many tracks with the tack piano as you did. It's got a very evocative sound.

Yeah, "L.A. Woman"—the song itself—is tack piano, "Love Her Madly"—on the *L.A. Woman* album—is tack piano. And back on the second album, *People Are Strange*, "My Eyes Have Seen You" is tack piano. . . .

"You Make Me Real."

Yeah, right. "Strange Days" is a tack piano at Sunset Sound, which I think is still there, but it's been so banged-on by now that it really doesn't have it anymore.

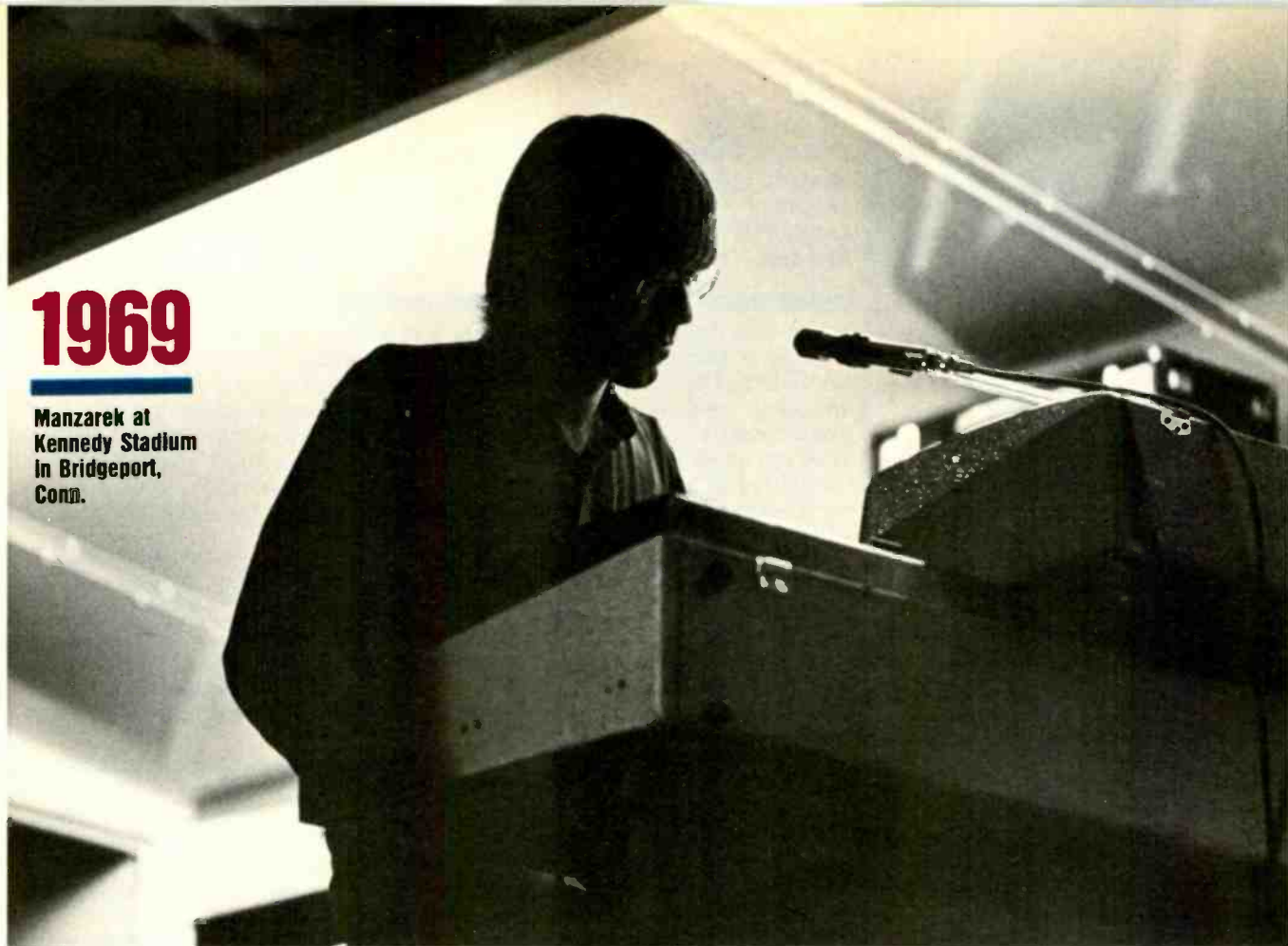
I think maybe my favorite thing to play is tack piano, rather than a big acoustic—although I love the sound of a big grand piano. I guess the percussive quality is more in keeping with rock & roll. Even a ballad, there's just something really nice about the tack piano. Probably a very "American" sound somehow; seems like a banjo or something.

"Queen of the Highway"—Wurlitzer electric piano, with tremolo?

Yeah, Wurlitzer, right. That's a great sound, and people don't use that. That still hasn't been used enough. I love the sound of a Wurlitzer with that tremolo; it's really great. It's all built right in.

1969

**Manzarek at
Kennedy Stadium
in Bridgeport,
Conn.**



Photograph: © Joseph Sia 1969

It's right there; just click the thing on and use it.

I used the Wurlitzer also on some of the blues songs on *L.A. Woman*—"Crawlin' King Snake." I've never owned one. Curious, I don't know why I don't have one. It was the first electric piano too, the Wurlitzer electric piano.

It came out in the '50s. I saw the first one in '57 or '58. Local club bands and jazz guys were playing one in some club in Chicago. That was the first one. Fender-Rhodes came out quite a while after. Couldn't have been 10 years, but a good seven years after. Ray Charles' "What'd I Say" was a Wurlitzer.

Let's talk about organs.

I started with a Vox Continental on the first album. The reason we used the Vox was because it was portable, small. I liked it, a terrific organ. I liked the fact that you could plug a lot of things into it if you wanted to, wah-wah pedals and whatever existed then. Not that there was that much to plug in actually at the time; there weren't any phase-shifters or anything. Plus you could plug into the amplifier

I didn't want to use a Hammond organ; I couldn't afford a Hammond organ! A Hammond organ I'd always considered to be a blues organ anyway, for the most part. Jimmy Smith and all that and all those Hammond

jazz kind of people, Richard "Groove" Holmes. . . .

Vox only made that one. I wish I had one. I could put it right over there; what a great coffee table it would have been! It was red and black, the keys were inverted—black and white were just the opposite as they are on a normal piano—and the chrome legs on the sides were a "Z." They were sharp! Sharp in a '50s sense.

What kind of amp did you play through on the first LP?

Whatever we could get our hands on. Sometimes I used a Sears Silvertone when we first started out, which was actually a very good amplifier. And then some Fender stuff, and Jordan amplifiers when they existed for a while. What else? A Univox for a while. Acoustic. It didn't really matter. I'd plug into anything, you know, as long as I could get a big fat sound out of it. I liked the sound of a Fender Bassman and a Twin Reverb coupled together.

We used that here in Los Angeles and when we played the Cheetah down in Santa Monica, on the pier, the place that's torn down. We played with the Jefferson Airplane and, boy, what a gig THAT was. God. Jefferson Airplane and the DOORS. Like late '67 and early '68. That was really great.

So on the first LP, which I understand



was cut in some very small number of days, there was no particular amp you used

I can't even remember what amplifier I used. Probably that first album was just various little scrounging-around amplifiers that we might have had.

Any direct on that LP?

No, they didn't know about direct. I hate direct. Direct is all right for a Fender-Rhodes, but for the most part I hate direct. Engineers love it because "It's clean."

People thought you played a Farfisa for a while.

Yeah, they did, right, but that was the Gibson. I think they confused the two because the colors were relatively the same, and the Farfisa was a good organ. I didn't use it because all the controls were on the top. It was that matter of not having any place to put the Fender-Rhodes bass. I couldn't put it on top because controls were up

1972

Manzarek at a concert in Central Park in New York



Photograph: © Joseph Sia 1972

there, so there's no way. I just never used it. But it's got a very similar sound to the Gibson. I think the Gibson was better.

You went to the Gibson after the Vox? Yeah, then I went to the Gibson. The reason I went to Gibson is because Vox was taken over by some other company but still was called Vox. The story I heard was that the English company was taken over by an Italian company. I guess they started making the organs in Italy, and they didn't stand up anymore, they just broke down, just could not be maintained. The first organ I had, man, I carried that thing around and knocked it around—must have played a hundred gigs on that thing. It finally gave up the ghost, as any organ would, so I went out and bought another one, and four or five gigs later it broke. The keys would stick, the keys would break. I didn't really play it that hard—maybe I did play hard but I didn't pound on it or anything. All of a sudden I'd find myself with stuck keys and I'd have to be lifting up the white notes and the black notes. So I got another one and the same thing happened. I tried three organs and it happened with every one. Single-manual, double-manual, and I said, "Well, so much for that, can't use a Vox anymore."

That's just the Gibson organ?

Gibson Kalamazoo.

The Hammond organ on *Strange Days*—do you know what model that was?

The C3. That's "C" for "church." This one was the same as a B3, except it had little church designs on the little strip of wood on both sides. That was the only difference. It was a good organ. I have since had that one electrified and made portable. Transistorized and portable-ized. It lost some of the fat of the organ, but that thing has lasted—I've still got it. It's been to Europe three or four times, it's been all over, I've been on tours. That thing has never broken, it's amazing! Keyboard Products did it, way back—must have been about a dozen years ago now.

Is that a backwards organ on "*Unhappy Girl*"?

A backwards piano. Boy, that was a bitch. I wrote the whole song out backwards. They played the song, the tape came back to me in the earphones,

backwards. But the beat was there. Actually, I didn't write the song out backwards; I wrote out a chord chart with each measure, and started, and just followed it.

Were you playing the same chords in a normal sort of manner?

Right, except everything had to be reversed. Crazy, it was just absolutely crazy, but it sounds great. And I got it after a couple of passes. Just the kind of thing like, "Don't think about it too much and just sit down there and do it." You know, hope your Zen luckiness is on, and it was, and I got it.

What do you think of as the different kind of organ sounds? You talked about the blues organ sound, which you associate with the Hammond. What is the jazz organ sound?

The Hammond organ was never really used for blues in the Muddy Waters, Chicago Blues, John Lee Hooker, Jimmy Reed sense. It was never used in that. It was always used in a jazz context. They played blues changes, blues chords, a blues pattern or blues progression. It wasn't blues, it was jazz. The Hammond organ was a jazz organ.

The only thing you can use a Hammond organ for is that and jazz and church kind of stuff. Those are the only things I see it really useful for, although I've played some other things on it.

Is there a "rock" organ sound? Is Stevie Winwood's a rock organ sound?

No, that's a Hammond, just a big fat Hammond, with a lot of "gravel" to it, maybe a little more break-up, a little more dirt on the contacts, an older one. Elektra had an old organ at the studio. It was a Hammond, as a matter of fact, not the big B3, a smaller model but really funky. It was an old, dirty-pickup thing that was very good for playing rock, bluesy-rock kind of organ. But it's still basically a Hammond sound.

Any memories of interesting techniques that we haven't touched upon?

Like I remember on "*The End*," Jim sang some of the vocal out in the room and some of it in the booth; he would run back and forth.

"The End" is interesting, two takes cut together. There's a distinct sound change, but fortunately it comes right at the point where Jim says, "The killer awoke before dawn." We made a cut

right there, right at the beginning of it. Right on the word "the" or just before, maybe a measure before. There were two takes, and we didn't think it was at all possible to cut those two together. And there is a sound change, but the sound change works because the whole tone of the piece changes at that point.

The first album was pretty straight-ahead. The first album was done on four-track, so there really wasn't much we could do as far as overdubs. But the second album was eight tracks, which is funny, because today eight tracks is like nothing, but to us, it was great.

Why don't you give us a little rundown on *An American Prayer*.

Lots of poetry, and poetry and music, and sound effects. And that's about all. Nothing much you can really say. . . .

Is "*Rock Is Dead*" there? Did you get that together ever?

No, "*Rock Is Dead*" doesn't really exist in a form worth putting out, at the moment. I don't know, maybe someday we might be able to do something with it. But when we recorded it, it was just a bunch of drunks fooling around in the studio. And jamming, and then we started to get into something. Unfortunately the tape ran out halfway through it and by the time they got the tape back on, you know, a good five minutes had elapsed and we were right in the middle of doing surf music. We went back into the control room and said, "Gee, that was really great, hope you guys got that down on tape." And they said, "Well, we got all of it down except we missed some of that last '*Rock Is Dead*.'" And I said, "That was the only thing that was any good." For the first half-hour all we did was play a lot of dumb blues and things and just mess around and then we finally got into something. And we missed it.

So we have a few parts of it, maybe 65% of it, but not some of the choice stuff in the middle that would make it into what it was. It was a piece doing parodies on various styles of music, and I don't even remember what was left out. I don't know what we'll ever do with that.

The Doors seemed to have their cake and eat it too. You had great commercial success, yet you always seemed to be artists first and foremost.

1969

Jim Morrison at Kennedy Stadium in Bridgeport, Conn.



From a money-making standpoint that's the way to do it, you know? If you really are setting out to do something that needs to be done, doing something right, doing it good, and doing it to the best of your ability—that's when somehow the Fates have it so that you have done your proper work, here is your reward, your desserts. Here's the money. That's how it was for The Doors. We said, "Hey, we're gonna do it the right way and that's all. We're gonna do it the way we want to do it; we know how it's supposed to be." We've all got enough musical and literary talent, we've been doing it all of our lives more or less—Jim was writing poetry all his life, Robby played the guitar for years, Densmore drums for years, I played piano since I was seven years old. I knew what I wanted, I knew how I wanted it to sound, and I knew that if we did it the best we could, and made it as intelligent and as good as we could possibly make it, that the music would be there, and the rewards would be there. And they were. And the music is timeless because of it.

Yeah, there were some good times at the Whisky a Go Go. Boy, that's for sure. We played with Them; the first gig we played at the Whisky was Van Morrison and Jim Morrison—on the same stage. And Van Morrison was insane. You know how he got into just kind of standing there and singing? I haven't really seen him in a long time but when he was with Them, the guy was all over the stage, man. Absolutely insane. Did that thing of holding the microphone stand upside down and singing, and *smashing* the microphone stand into the ground and just... God, was he incredible! He was so good. Then the last night we played we had a jam. We got a couple of photographs of that somewhere, but nobody recorded it. The Doors and Them, together, on stage, the two Morrisons. Mmmh! God, that was great.

Do you know the story about Jim hosing down the studio? After "The End"... God knows what he'd ingested... we did two takes of "The End," and couldn't do anymore, it was just too insane. We all left, and later that night Jim came back and went into the studio, and took the fire extinguisher and hosed the whole place down.

You mean the control room too?

No, thank God, not in the control room, just in the area where we were, our side of the window. Just fire-extinguished, just blasted the whole place, man, just to cool it down. That's what he was doing. I know he was doing that, just calming the whole thing down. "Wait a minute. Too much heat in here, man." Stoned out of his mind. And the studio people came in the next morning; they didn't even know anything about it. Somehow he just snuck in there, past the guard and everything. Thank God—he'd've been in jail!

Your first album!

First album on top of it. And the studio people just absolutely freaked. Paul Rothchild said, "Uh, don't worry, don't worry, Elektra will pay for it, no, there's no reason to call the police, no, just some minor vandalism, don't worry about it, Elektra'll take care of all this."

Did he know who did it?

Oh, he knew right away, you know. He went "Oh no!" He knew. We all knew right away what had happened.

I have heard that Jim occasionally used to fall or jump out of second-story windows.

He was known to hang out of windows a lot. He was always threatening to jump. When he'd have a fight with his old lady, he'd say, "Well, you don't love me anymore, okay, I'm gonna... I'm gonna jump." And he'd crawl out the window and just hang onto the ledge and he'd be hanging there. "You better be nice to me or I'm gonna let go."

And one time, unfortunately, he slipped. That was like a falling-offstage thing too. The first time he did it, he slipped. But then it was so successful that he kept it as part of the act and used it every once in a while. When there were a lot of people up against a stage, he could fall and they'd sort of catch him. He'd just sort of let himself go, and fall off into the audience, and invariably they'd all just sort of grab him and break his fall so nothing really happened.

Except one time at the Fillmore. Fill-

more East had a light pit, and I knew something was gonna happen. I thought, "God no, he's gonna fall in the damned light pit." And he was just really stoned, and sure enough... I used to play with my head down so I really didn't see a lot of the things that he did. At one point I'm playing and he's supposed to start singing and he didn't sing and I looked up... and he was gone. And then sure enough, a hand, another hand, and then out he comes, crawling out of the light pit.

But he was fine. Couldn't hurt that guy. Nothing really hurt him. Until the end. Maybe he's still running around somewhere.

Photograph: © Joseph Sia 1969

CONFESSIONS OF A DIGITAL RECORDIST

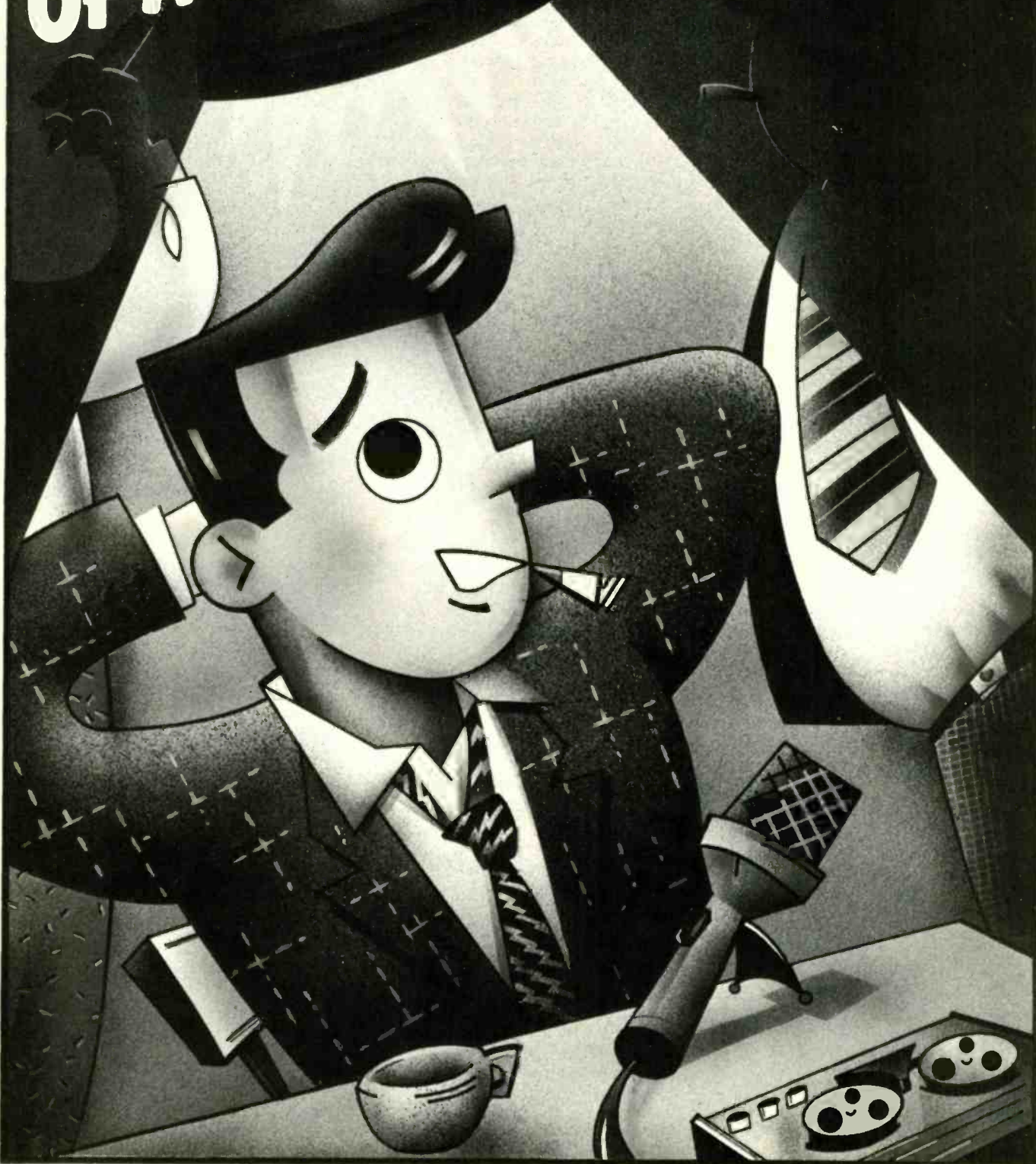


Illustration: Robert Scott

A digital recording can sound better than analog, but only when you refine your recording techniques and equalization.

RICHARD S. BURWEN

How does 16-bit digital recording compare with high-quality analog recording for live and studio use? Very well, and noticeably different, I find from my experience with Sony's PCM-F1 digital audio processor and SL-2000 portable videocassette recorder.

For the past three years, I have been making four-channel analog recordings with 110 dB of unweighted dynamic range. These recordings were all made on quarter-inch and half-inch tape at 7½ and 15 ips using the Burwen Model 2000 Companding (3 dB/dB) Audio Processor.

Accustomed to such noise-free analog recordings, I wondered what it would be like to work with a digital system, considering that it would give me just two channels, and only 93 dB of unweighted dynamic range. (That's the 16-bit figure; 14-bit operation didn't interest me.) I acquired two of the Sony systems. Now that I have made over 75 digital cassettes with this outfit, my experiences may be helpful to others who are just starting out in digital recording.

Since the VCR's input signal is passed through to its output jacks during recording, the PCM-F1 lets you monitor the action of the digital circuitry, first encoding the signal digitally then decoding it back to audio. Except for any uncorrected errors that might occur during playback, the output signal during recording is exactly the same as the playback signal. While running a variety of my "noise-free" analog tapes through this process, the only difference I heard between the input signal and the system output was additional noise, 93 dB down.

The monitoring system caused a problem in live recording, though. Stopping the machine after playback in the studio, I nearly blew myself sky-high with feedback into the micro-

phones from my 20,000-watt sound system (*Audio*, April 1976). I had not realized that the PCM-F1 delivers its monitor signal even when it is not recording or playing. This is convenient when you are wearing headphones while recording, but with speakers in the same room as the microphones, watch out!

At first, fractional-second losses of signal occurred on both my digital systems. Cleaning the heads did not completely solve the problem. From Bert Whyte and my own experiments, I learned how to avoid dropouts: Use only high-grade videocassettes, up to L-750; avoid the unrecommended Beta-III slow speed; use a head-cleaning cassette, such as Sony's L-25CL, for 40 seconds after every two hours of operation, and for two minutes after every 50 hours, and adjust the VCR's playback tracking control for each cassette, using the tracking level meter on the PCM-F1. Since I began following these rules, the dropout problem has virtually disappeared. Nevertheless, for important live recordings I always use two VCRs, as insurance against a damaged or defective cassette.

The only tape to suffer ticks or static from brief, uncorrected dropout errors was my first. On that, I had used the VCR's pause and slow-motion controls, which make the heads scan one section of the tape repetitively, causing extra tape wear there.

Having heard about loss of ambience, harmonic distortion at low signal levels, and ringing caused by anti-aliasing filters, I listened carefully to the effect of the PCM-F1 system on room ambience and piano notes dying out. The only difference I could hear between the input and output was a little noise, slightly more erratic than FM hiss.

Voices and a drum set, picked up by a microphone remote from my monitoring room, were listened to direct and through the PCM-F1, through headphones and speakers. I recorded first at normal level, then 35 dB down, with matching extra gain in playback. Again, I heard no difference between the microphone and monitor signals except added noise.

Sine waves, recorded 70 dB down and played back with matching gain, seemed to have picked up only noise,

not distortion. But in the 14-bit mode, as the signal approached the noise level, I could plainly hear the noise changing in steps and, at one particular level, quite a bit of distortion. Apparently, in the 16-bit mode, the white-noise "dither" signal, added to mask bit-level distortion by randomizing it, works quite well. This also contributes to the system's accurate handling of ambience.

Making simultaneous analog and digital live recordings, I was at first distressed to find that the digital recordings, although very clear, had somehow lost the excitement of the analog tapes. The problem wasn't in the digital recorder (which accurately reproduced what the microphones fed in), but in the analog system's imperfections which, to me, enhanced the music. Although my analog machines have been modified for very flat response, small variations in frequency response remain, affecting both tone quality and dynamics. Bass drum energy at 30 Hz is amplified about 1 dB more than middle high frequencies. With the 3:1 playback expansion, each beat is emphasized, giving an apparent increase in clarity.

I can simulate this effect by boosting the bass of the digital signal slightly, and passing it through a special volume expander actuated mainly by low frequencies. I can also simulate the analog signal's apparent extra sweetness, by tilting the digital frequency response down about 1 dB through the midrange. (It's surprising how small a change in midrange frequency response can noticeably affect harshness and stereo imaging!) Also, without expansion, the digital signal seemed slightly more reverberant than the analog.

What about the PCM-F1's limitation to two channels? Until recently, I have never been able to find a combination of two front channels plus time delay that equalled my genuine four-channel recording. But after a month of experimenting with piano microphone techniques, equalization, and time delay, I finally arrived at setups for two-channel piano recordings which I find as satisfying as four-channel (Fig. 1).

Digital piano recordings can be better than analog ones, because there is no wow and flutter (most audible on

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When listening carefully, the only difference I could hear between input and output was a little noise.

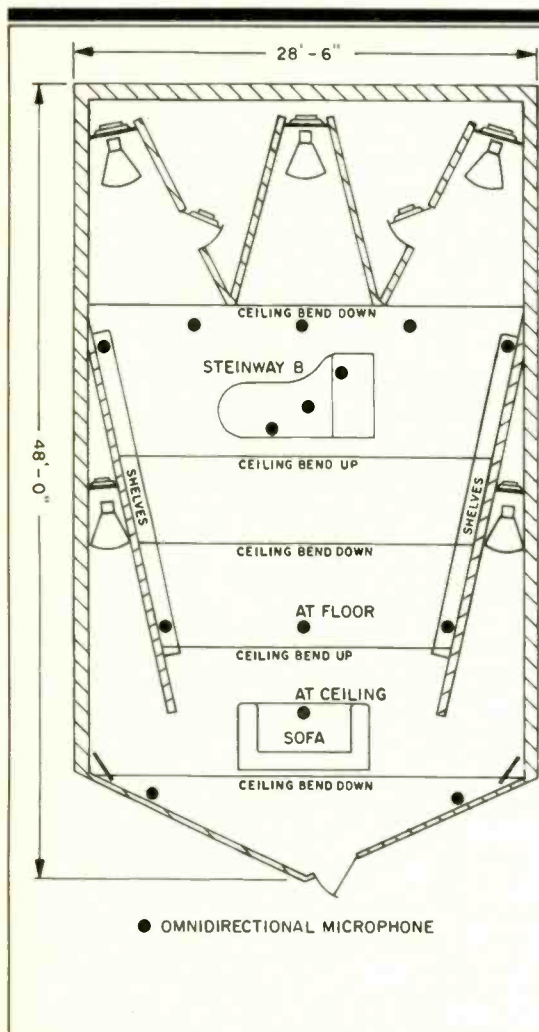


Fig. 1—Microphone setup for two-channel piano recording in the author's studio. For jazz, pickup is mainly from the three microphones over the piano. For classical recording, most sound is picked up at the junctions of the rear walls and ceiling; each microphone is equalized individually, with 6 to 27 dB of boost at 20 Hz and 6 to 18 dB at 20 kHz. The 14 omnidirectional microphones at varying distances from the piano simulate wall reflections, making the piano sound larger.

when all harmonics above that frequency are cut off by the anti-aliasing filter) and an 11-mS time delay in passing through the encode/decode and error-correction systems. I tried using the PCM-F1 as a short, wide-band time-delay system, to add some liveness to stereo signals. Results were best when I fed some of the PCM-F1's left output into the right channel, and vice versa, but the effect was small, because of the short delay. Increasing the feedback enough for a reverberant effect caused buzzing, due to repetitive delays at 11- and 22-mS intervals.

The PCM-F1 system reverses signal phase 180°. However, in my live studio, where I'm equipped to reverse phase, I have not yet found any musical program material on which I can hear any effect.

I was particularly impressed by the lack of visible distortion on 'scope traces of sine waves near the noise level—confirmation that the dither signal really randomizes bit-level distortion. At 14 bits, the bit steps and distortion were clearly seen, but at 16 bits the waveform showed only noise. The system even preserved a 20-Hz sine wave below the wide-band noise level. It is in this low-level accuracy and flatness of response near the high-frequency cutoff that I expect measurable and audible differences between equipment.

A nice feature of the Sony PCM-F1 is that you can make perfect copies in video form, using its error-corrected copy output. One of my Burwen Studios demonstration tapes includes a fourth-generation copy made this way, and I cannot hear the slightest difference from the original. Editing, however, is pretty much limited to copying selections from one machine to another, and you have to cope with a 4-second start-up delay, sometimes by using the pause control and risking tape wear.

The main reason digital recording does not sound the same as analog is imperfection in the analog recording system. A digital recording has the potential of sounding better than analog, but only when you have refined your recording techniques and found the optimum equalization—in my case, very slightly closer miking and a bit more bass.

the piano's sustained tones), and relatively little noise during signal. When there is little or no signal, my analog system with companding noise reduction has less noise than digital. But at high signal levels, the companding system gives only a few dB of tape improvement. To the average ear, the high-level signal masks the noise. However, after years of designing noise-reduction systems and listening for their imperfections, I can tell that the noise is still there at high levels, and that digital signals are cleaner.

My measurements of the PCM-F1 basically confirm the maker's claims, including a huge signal-to-noise ratio for a tape machine (in the 16-bit mode, 93.3 to 94 dB unweighted, 95.5 to 95.9 dB with A-weighting and filtering below 20 Hz and above 20 kHz). But I find the S/N marginal for live symphonic re-

ording, and I would welcome another 10 to 15 dB.

Because this dynamic range is barely sufficient for my purposes, many recordings must closely approach overload, and an accurate peak-level indicator is essential. Sony's bar-graph indicator is accurate from 0 to -10 dB, but its resolution of 3 dB per step at lower levels is insufficient for my use; I use my own peak-reading analog meters, calibrated with a tone. Sony's "Over" indicator reads the signal after high-frequency pre-emphasis, and so is an accurate clipping indicator. But the bar-graph fails to read peaks on some high-frequency signals which clip after pre-emphasis, such as trombone or cymbal, and may read as much as 5 dB too low.

Square-wave tests showed both ringing at 22 kHz (to be expected

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How We Hear Direction

DENIS VAUGHAN

For many years, the ability to locate a sound's origin was thought to be solely due to loudness or intensity; a softer sound seems farther away. As applied to recording, a slight increase in the volume of one channel will shift an image in the direction of the louder channel, and if both channels are raised simultaneously, the image will seem nearer to us.

Later on, it was realized that relative timing of the two channels could be used to affect location of the recorded stereo image. The incredible speed of the brain allows us to perceive time differences as short as only 0.007 mS, which is equivalent to the sound source moving just 1° to the side. In my own monitoring of recordings, I am able to place an oboe, for example, within 1° or 2° of a fixed spot; the mechanics of this common feat requires rather infinitesimal perceptions by the brain.

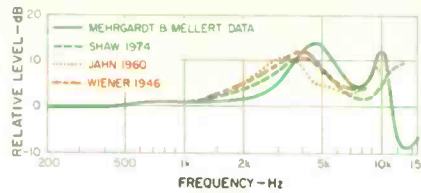
In addition, the ear and brain can tell us whether the origin of the sound is above or below us, and in general,

stereo technology has taken little account of this fact. There are fail-safe mechanisms in various parts of the body, and I would therefore dare not say that our perception of a sound's elevation is based exclusively on a single system. However, as far as I can ascertain, the chief system seems to be associated with our perception of timbre. The recent data on the transformation characteristics of the outer ear by Mehrgardt and Mellert [1], shown in the figures, plot how the outer ear functions as a filter between a constant-level sound field and the inner ear. These changes are made in everything that we hear, and so we are used to making allowances for them. This is why we often use a weighting filter in making a measurement.

Figures 2 through 4 show how the perception of various frequencies of constant level vary with angle. The first

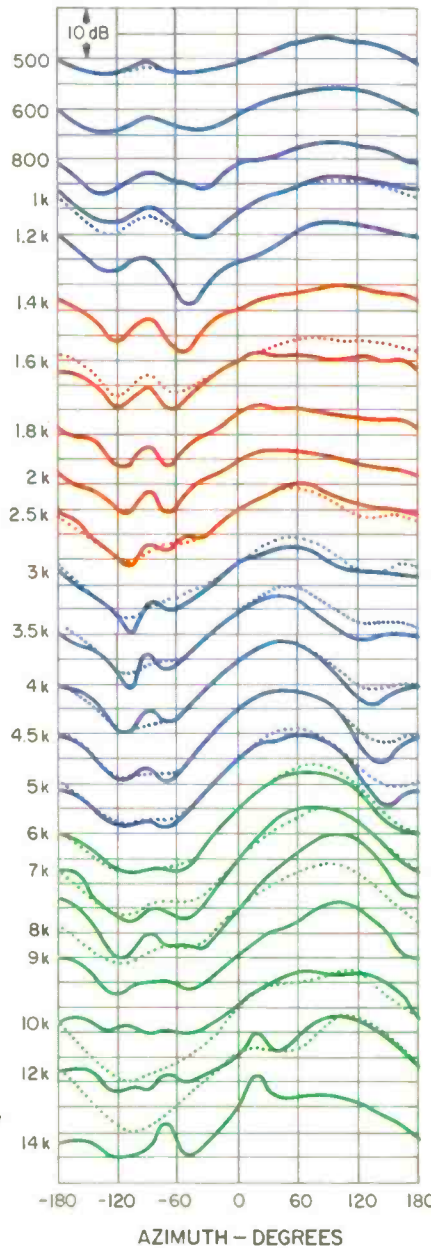
Denis Vaughan is the Musical Director of the State Opera of South Australia in Adelaide.

Fig. 1—How the ear canal filters sound frequencies en route to the eardrum, as measured by various researchers. (After Mehrgardt and Mellert.)



Our brains tend to localize some frequencies in one direction only. This changes less from person to person than ears do.

Fig. 2—How the ear's response to different frequencies varies with the sound source's lateral (azimuth) angle to the right ear, from 0° (in front of the listener) through 180° (behind listener); positive angles are on right side of head, negative angles on left. (After Mehrgardt and Mellert; dashed lines show earlier results by Shaw.)



fact to be drawn from these graphs from Mehrgardt and Mellert is that we hear a perceptibly different timbre at every angle of reception. These timbre changes are clarified, I hope, by the respective Tables. (In order to interpret these readings properly, we must not forget that the ear canal imposes another curve on all our listening, which compensates for some of the extremes in the curves listed above; see Fig. 1.) However, only when we analyze the Tables in detail is it possible to see that there is always some frequency for any two adjacent angles of reception that fluctuates quite substantially—sufficient to help us identify one angle's timbre from its neighbor's. The quickest test of the veracity of this is to rub your fingers lightly together, and then move them in a circular motion about one ear, while still rubbing. It is always possible to tell where they are, without any help from the other ear which, if plugged, does not perceive the signal. A further look at the comparative timbre readings also shows that at no angle can we hear anything resembling "flat" response. We can, therefore, ask, "Is there any point in creating a flat response if *no one* can hear it?" To facilitate quick study, the Tables have dark shading over any reading +5 dB or above; Table I has a light tone over any negative quantity under -5 dB, and Tables II and III have a light tone over all negative quantities. This throws into prompt relief the extremes of each timbre, which are never less than 15 dB apart and sometimes as much as 21.5 dB (at 180°). What is surprising is the extent to which the mind registers and discriminates between all these fluctuating curves, sufficient to tell us whether we are being attacked from directly above or from, say, 47° elevation on one side.

Before examining some of the mechanisms involved, it is worth looking at a fundamental finding which Blauert described in his 1969 article, "Sound Localization in the Median Plane" (*Acustica*, Vol. 22, pg. 211). He writes, "The direction of sound sensation can be altered merely by altering the spectrum of the sound signal that reaches the eardrum, at least when visual cues are not available. If the spectrum at the eardrum is constant, the sound incidence does not play any role for the direction of the sound sensation. To determine a certain direction of the sound sensation, the sound signal must obviously be linearly distorted in such a way as is normally done by the head and pinna, when the sound wave reaches the observer from that very direction from which the sound sensation is desired to appear."

There are some frequencies which our brain tends to localize in one direction only, and they tend not to change from person to person as much as external ears (pinnas) appear to change. A very rough schematic summary is given in Fig. 5, which is taken from Blauert's book, *Räumliches Hören* [2]. It is maddening to tune a frequency generator to 8 kHz, only to find that no matter where the speakers are placed, or how one turns one's head, the sound is always overhead. This effect disappears for me quite shortly above and below this frequency. However, it does indicate that there are certain stable points of reference. The extent to which that frequency, 8 kHz, is filtered into or out of our reception by the pinna, helps our brain identify the extent to which the arriving sound is coming from above (or at least appears to be).

A further tendency in all listeners is one which Roffler and Butler reported [3]; specifically, that out of 50 subjects, almost all identified higher frequencies as coming from higher angles. In their test, no one pointed to the loudspeaker actually emitting the sound but, to a very common degree, at the angles depicted in Fig. 6. I assume that no one ever pointed to the lowest speaker, because no sounds below 250 Hz were used in the test. The angles were not fixed, because when the test subjects were placed further from the speakers, the angles decreased in nearly all cases, which suggests that visual stimuli also play a part. However, the general identification of high frequencies with higher elevation still persists.

To me, as an orchestra conductor, the collation of this material illuminates a number of hitherto total mysteries, as well as helping to explain why I obtain great satisfaction from certain musical and aural stimuli. The feeling of being truly surrounded by sound, if there are sound sources or strong reflections from sufficient angles, will base its satisfaction on at least three elements: (1) A much wider frequency range will be audible. Frequencies which had been filtered out by the pinna at one angle will stand a chance of being transferred louder at another angle; (2) All the network of my direction-finding faculties will be involved, so that my sensory participation in the sound is greatly increased, and (3) The arrival times of so many impulses will perforce be scattered, and the more impulses I receive, the richer the sound will seem to be. (The further one progresses from the simultaneity of mono, the better!) A conductor worth his salt could thus distinguish between the arrival times of

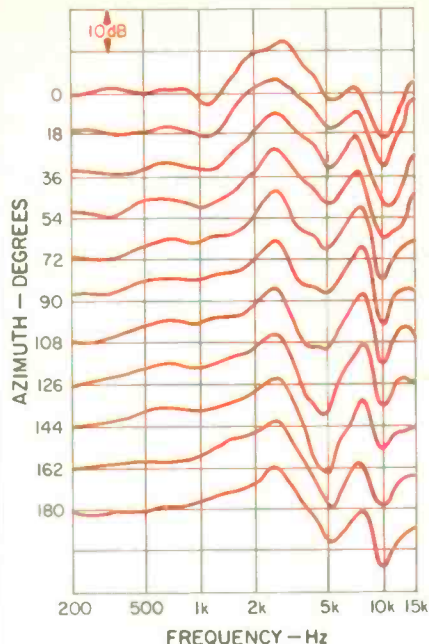


Fig. 3—Frequency response of the ear at different azimuth angles from 0° (straight ahead) through 90° (on the side of the ear being measured) to 180° (behind the head). (After Mehrgardt and Mellert.)

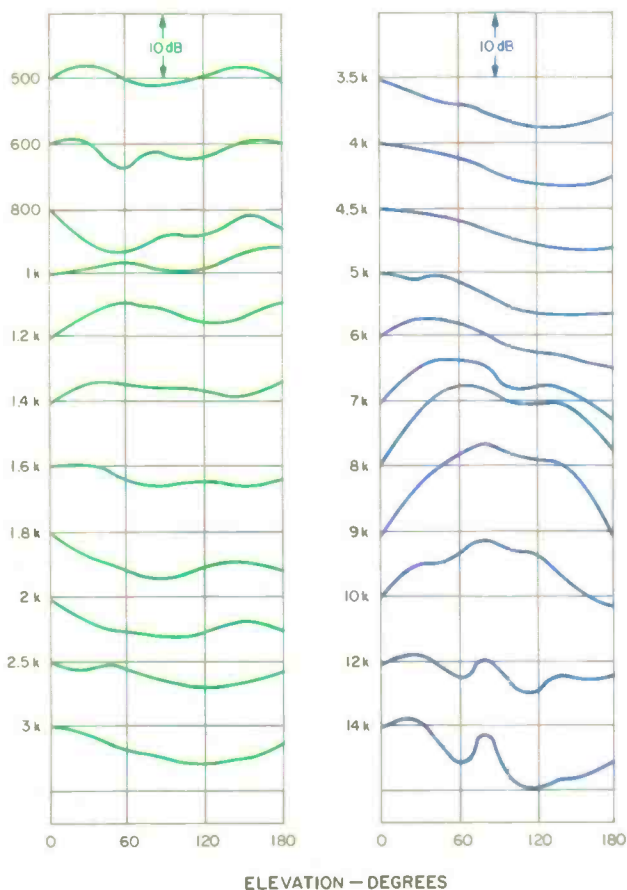
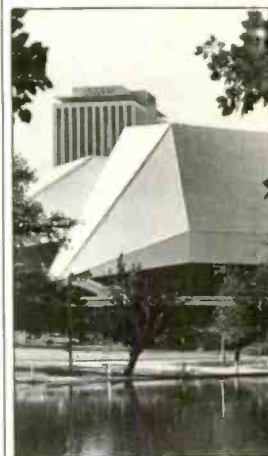


Fig. 4—How the ear's response to different frequencies varies with the vertical angle (elevation) of the sound source, from 0° (ear level) to 180° (above the listener's head). (After Mehrgardt and Mellert.)

Architects should get away from the tyranny of long reverberation times when they design acoustical spaces.



Adelaide Festival Theatre, Adelaide, South Australia

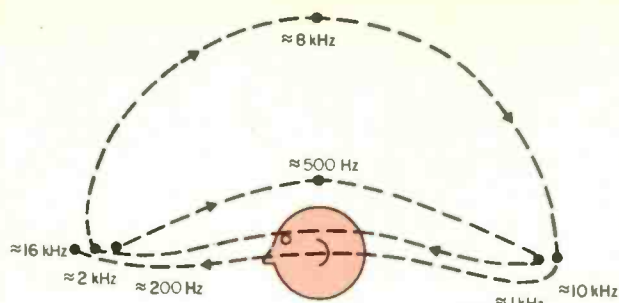


Fig. 5—Human interpretation of the direction of sound sources at various frequencies. (After Roffler and Butler.)

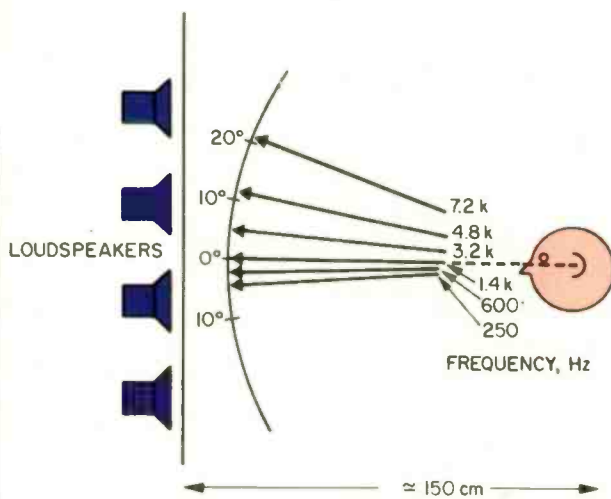


Fig. 6—Identification of elevation with frequency. (After Roffler and Butler.)

It is maddening to tune a frequency generator to 8 kHz and find that it always sounds overhead, regardless of its true direction.



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

Table 1—How the outer ear's response varies at different frequencies and sound-source azimuth angles. Heavy shading indicates areas where response rises by 5 dB or more; light shading indicates where response dips by -5 dB or more. (After Mehrgardt and Mellert.)

the sound of each of 20 violinists, all of them sitting at least 4 mS from each other. This is a huge time, at least in comparison with the 0.007-mS minimum audible time difference mentioned near the beginning of this article.

However, the fact of the wider and more complete frequency range, heard only when the sound comes from all angles, arouses some serious new thoughts about the reproduction of music. For example, it appears that we hear ultra-high frequencies better when they come from the side!

What qualities do we need to hear most in music? Well, it seems to me that architects should get away from the tyranny of trying to get long reverberation times when they design spaces for acoustical uses. This has caused several overly large halls to be built in the last few years. In addition, I have drawn up a list of musical qualities in sound, and I've given them a certain aesthetic order, along with a brief description of their physical counterparts. It reads thus:

Richness: Powerful multiple reflections from all angles shortly after the arrival of the original sound.

Density: A large number of reflections (impulses) in a short interval of time.

Warmth: A bass-heavy frequency response curve, with a peak between 125 and 250 Hz, and a smooth falling away above that.

Intimacy: An adequate number of lateral reflections of frequencies above 10 kHz, which are absorbed noticeably by the atmosphere after travelling only 15 meters.

Clarity: An adequate number of early lateral reflections, so that the upper frequencies are adequately presented, and an absence of confusion due to the predominance of reverb rather than first reflections.

Singing Tone: A peak in the reverb curve, usually with a rise-time of about 75 to 100 mS, a plateau of 50 mS, and then a smooth decay starting 150 mS after the original sound.

I have shown this list to many recording producers, technicians, conductors, and acousticians, and I am gratified to note that most of them agree that richness is the most desirable quality. Jordan pointed out in his recent book on concert halls and theaters that satisfactory acoustics had been obtained with reverberation times which ranged from 1.4 to 2.8 seconds, so that obviously should not be the controlling factor. In an article for a British publication [4], I listed a number of speculations about how multi-source reproduction of sound might be developed comparatively inexpensively, to give a stereo picture which no

longer required the listener to remain in a fixed position in relation to the placement of the speakers.

But other fields are also waiting to be explored. If a headphone eliminates the functioning of the pinna, can some signals be fed to it which, using Blauert's system, restore a fully detailed stereo picture, one with the frontal elements firmly fixed? The frontal spectrum in my lists is so widely divergent from the rear spectrum, that there must be a way to simulate its position clearly by electrical means. Can we hoist various instruments up and down by increasing or decreasing the amount of 8 kHz in their reproduction?

At this point I'd like to recount one of my own experiences which I feel will be useful to all readers; it does not always coincide with the recommendations from loudspeaker manufacturers. I have found that if I place stereo speakers at least 4 feet from an end wall, the resultant reflection from that far wall helps the image come to life, as it allows an effect to take place which cannot be achieved with speakers set in, on, or near the wall. In a reverberant room, with my Tannoy's 6 feet from the rear wall, I was able to recreate the impression that the orchestra sat behind the speakers at exactly the same distance as the real orchestra actually sat behind the microphones during the recording session. In this way, for me, the speakers disappeared entirely in the final image. I therefore feel the timing of the first-frontal reflection in a room may be decisive to the fixation of a three-dimensional stereo image, if the timbre fluctuations outlined above can be incorporated into the reproduction. **A**

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2. Blauert, J., *Räumliches Hören bei einer Schallquelle*, Hirzel-Verlag, Stuttgart, 1974.
3. Roffler, S. K. and Robert A. Butler, "Localization of Tonal Stimuli in the Vertical Plane," *J.A.S.A.*, Vol. 43, No. 6, pg. 1260, and "Factors that Influence the Localization of Sound in the Vertical Plane," *J.A.S.A.*, Vol. 43, No. 6, pg. 1255.
4. Vaughan, Denis, *Musical Times*, Jan., Feb., Mar. 1981.
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6. Shaw, E. A. G., "Transformation of Sound Pressure Level from the Free Field to the Eardrum in the Horizontal Plane," *J.A.S.A.*, Vol. 56, No. 6, pg. 1848.

Frontal Spectrum (dB)	Frequency in Hz	0°	18°	36°	54°	72°	90°	108°	126°	144°	162°	180°
-0.5	200	0	1.5	2.5	2.0	1.0	2.0	1.0	0.5	0.5	0.5	0
+0.5	500	0	1.0	2.5	4.0	4.0	5.5	4.5	4.0	3.5	2.0	-0.5
+1.0	700	0	1.0	2.5	3.5	4.5	5.0	5.0	4.5	3.5	1.0	-0.5
-2.0	1k	0	2.5	4.0	4.5	6.5	7.5	7.0	6.5	5.5	5.0	4.0
+10.0	2k	0	2.0	2.0	1.5	1.5	0	0.0	-1.5	-2.0	-2.0	-3.5
+12.0	3k	0	1.0	2.0	3.0	2.0	-1.0	-2.0	-2.5	-2.5	-3.0	-3.5
+5.0	4k	0	3.0	4.0	3.5	1.5	-2.0	-5.5	-6.5	-8.0	-6.5	-5.5
-1.5	5k	0	3.5	4.0	5.0	4.5	3.5	0.5	-5.5	-9.0	-8.0	-7.0
-0.5	6k	0	4.0	6.5	7.0	7.5	7.0	5.5	2.5	-3.0	-4.5	-5.0
+1.5	7k	0	4.5	8.5	10.0	11.0	10.0	8.5	6.5	2.5	-1.0	-2.5
-2.0	8k	0	4.5	8.0	11.0	14.0	15.0	14.5	12.0	7.5	3.5	2.5
-8.0	9k	0	3.5	5.5	7.0	8.5	11.5	11.0	8.0	4.5	1.0	-0.5
-10.5	10k	0	3.0	5.5	7.0	7.0	6.5	7.0	6.5	4.5	2.5	-2.5
-10.0	11k	0	3.0	3.5	6.0	7.5	7.0	7.5	7.0	6.5	2.0	-2.0
-7.0	12k	0	5.0	1.5	3.5	7.0	8.5	8.0	6.5	3.5	1.5	-2.5
-2.0	13k	0	4.0	0	1.5	5.0	5.5	6.0	5.0	1.0	0	-4.5
+2.0	14k	0	6.5	2.0	2.0	2.5	2.0	1.5	-0.5	-2.5	-4.0	-7.0
+3.5	15k	0	5.5	2.5	3.0	1.5	0.5	-1.0	-2.0	-3.5	-5.0	-7.5

Table II—The data of Table I, adjusted to show in-pinna lateral response relative to frontal response at the same frequencies. Here, light shading indicates all areas where response is lower than response to sounds dead ahead; dark shading indicates where response rises by 5 dB or more.

Frontal Spectrum (dB)	Frequency in Hz	0°	9°	27°	45°	63°	85°	99°	117°	135°	153°	171°	180° (Rear)
-0.5	200	0	-0.5	-0.5	1.5	1.5	-1.5	-1.0	0	1.0	-1.0	0	0
+0.5	500	0	0.5	2.0	1.5	-0.5	-1.5	-0.5	0	1.0	1.5	0	-0.5
+1.0	700	0	0	-1.0	-4.0	-4.5	-5.0	-3.0	-2.5	-2.0	1.0	0	-0.5
-2.0	1k	0	0.5	1.0	1.5	2.0	0.5	0	0.5	1.5	3.5	4.0	4.0
+10.0	2k	0	-2.0	-4.0	-5.0	-5.5	-6.5	-7.0	-5.5	-4.5	-4.0	-4.5	-3.5
+12.0	3k	0	-0.5	-2.0	-3.0	-4.0	-4.5	-5.5	-6.0	-5.5	-5.0	-3.5	-3.5
+5.0	4k	0	-0.5	-1.0	-2.0	-2.5	-4.0	-5.5	-6.5	-7.0	-7.0	-6.0	-5.5
-1.5	5k	0	-0.5	-1.0	-0.5	-2.0	-4.5	-5.5	-6.5	-7.0	-7.0	-7.0	-7.0
-0.5	6k	0	1.0	3.0	2.5	2.0	-0.5	-2.0	-2.5	-3.5	-4.0	-4.5	-5.0
+1.5	7k	0	1.5	5.0	7.0	6.5	4.0	2.0	2.5	2.0	0.5	-2.0	-2.5
-2.0	8k	0	2.0	8.0	12.0	12.5	12.0	10.0	9.0	10.0	7.0	4.0	2.5
-8.0	9k	0	1.5	7.0	10.0	12.5	13.5	12.0	11.5	11.0	7.0	1.5	-0.5
-10.5	10k	0	1.0	5.0	5.5	8.0	8.5	7.5	7.0	3.5	0.5	-1.5	-2.5
-10.0	11k	0	0.5	1.0	-1.0	2.0	4.5	0.5	1.5	-4.5	-4.5	-2.0	-2.0
-7.0	12k	0	0.5	2.0	-1.0	-2.5	0	-3.0	-5.5	-2.5	-3.0	-2.5	-2.5
-2.0	13k	0	1.0	2.0	-3.5	-7.5	-4.0	-7.5	-10.0	-6.0	-8.0	-7.0	-4.5
+2.0	14k	0	0.5	1.0	-3.0	-7.0	-2.0	-8.0	-10.0	-8.0	-7.5	-7.0	-7.0
+3.5	15k	0	0	0	-3.5	-8.0	-0.5	-8.5	-11.5	-8.0	-7.0	-7.5	-7.5

Table III—How the ear's response varies with frequency and the sound source's vertical angle, relative to its response to sounds straight ahead. Heavy shading indicates response rises of 5 dB or more; light shading indicates response dips.

Denis Vaughan



To me, as a conductor, this material illuminates some mysteries, and helps explain my satisfaction from certain aural stimuli.

1

REVOX B261 TUNER

Manufacturer's Specifications

Usable Sensitivity: Mono, 10.8 dBf; stereo, 31.2 dBf.

S/N: Mono, 80 dB; stereo, 76 dB.

THD: Mono, 0.10% at 1 kHz; 0.15% at 100 Hz; 0.2% at 6 kHz.

Frequency Response: 30 Hz to 15 kHz, ± 1 dB.

Stereo Separation: 40 dB at 100 Hz; 43 dB at 1 kHz; 40 dB at 10 kHz.

AM Rejection: 72 dB.

Capture Ratio: 2.0 dB.

Alternate Channel Selectivity: 78 dB.

Image Rejection: 106 dB.

I.f. Rejection: 110 dB.

Spurious Rejection: 106 dB.

Subcarrier Suppression: 73 dB.
Output Level: Fixed, 2.0 V; variable, 8.8 V maximum.

Headphone Output Level: 6 V at 220-ohm impedance.

Power Requirements: 115 V, 50/60 Hz, 30 watts.

Dimensions: 17.72 in. (45 cm) W \times 6.02 in. (15.3 cm) H \times 13.07 in. (33.2 cm) D.

Weight: 18.7 lbs. (8.5 kg).

Price: \$1,500.00.

Company Address: 1425 Elm Hill Pike, Nashville, Tenn. 37210.

For literature, circle No. 90



Photo: Robert Lewis

My first encounter with the Revox B261 FM tuner was during a visit to the Studer-Revox facilities near Zurich, Switzerland. I was extremely impressed with the unit then, even though I had a very short time to put it through its paces during that multi-city whirlwind tour of what Dr. Willi Studer had wrought since the founding of his world-renowned company. I ran into the B261 again, briefly during the Summer Consumer Electronics Show last June, in Chicago. During that encounter, I learned a bit more about its amazing capabilities and convenience features, and about the long research and development program that preceded its realization. And now, at last, I have been able to check it out at my leisure, in my own lab. With superb tuners available at a fraction of the cost of the Revox B261, my chief concern was whether or not the \$1,500.00 price of this Swiss-crafted tuner is justified. In two short words: It is!

Like the matching integrated amplifier developed by Revox as a companion piece to this tuner, the B261 is meant to be customized by the dealer (or by yourself, if you are willing to spend a few moments with the owner's manual, pushing the appropriate buttons on the front panel). By "customizing," I don't just mean entering the station frequencies in the tuner's 20-station memory (which can be in increments of as little as 12.5 kHz, necessary for some cable FM transmissions). You can also enter each station's call letters (up to four alphanumeric characters) so that next time you call up the station it will be identified in this manner (if you so choose) rather than by frequency.

You (or your dealer) can also program into the tuner's memory each of four operating modes to be associated with each of the memorized stations. These include stereo, high blend (to reduce noise when listening to weak stereo signals), mono and muting. If you have the optional second antenna input (a most impressive feature which I really regret was not included in my test sample), you can store the antenna input selection with each station's frequency in memory, so switching will be automatic. This can be useful if the stations in your area require two antenna orientations, or if you're getting some stations off the air and some from cable. All these programmed settings are protected from loss due to power failure or inadvertent disconnection, because they are stored in EAROM (Electrically Alterable Read Only Memory), which is non-volatile and requires no battery backup. The 20 memorized stations can be scanned from the front panel or from the optional, infrared remote control, with the tuner sampling each station for a few seconds till you halt it.

There's also a 400-Hz calibration oscillator, whose output level is set at 6 dB below 100% modulation. This can be used to set tape recorder levels before the start of a program you want to tape.

Control Layout

The front-panel controls of the B261 are arranged in two distinct groups. The most frequently used controls are located in the upper half of the panel. Less frequently used controls (such as programming buttons, manual tuning buttons, etc.) are located in the lower section of the front panel, which can be covered with a clear, acrylic plastic panel to prevent tampering with preferred settings.

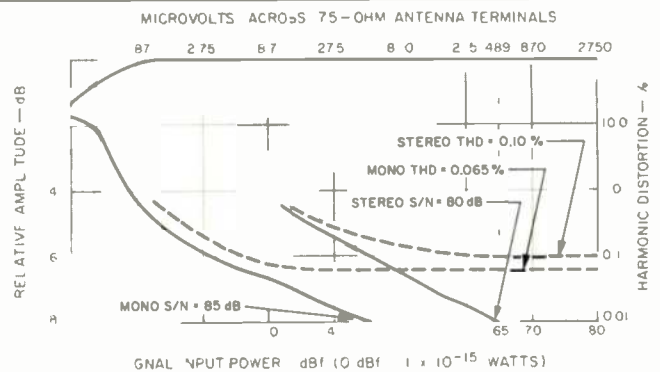


Fig. 1—Mono and stereo FM quieting and distortion characteristics.

Signal-strength and center-of-channel tuning meters are at the extreme upper left of the front panel. Why a center-of-channel tuning meter for a frequency-synthesized tuner? Because if you are tuning to a cable FM signal, for example, and its frequency is not exactly what you thought it was, displacement of the center-tune meter needle from its center position will tell you to tune in smaller, 12.5-kHz increments for best reception.

A three-function display area near the meters shows either the selected station's frequency, its memory-key number or its call letters, selected by a knob immediately below. Twenty memory buttons occupy the rest of the panel's upper section. They can be used not only to recall stations but to input either station frequencies or call letters, according to the way the "Keyboard" switch below is set. With that switch in "Character" mode, buttons 1 through 10 input the letters "A" through "J," while buttons 11 through 18 input either the letters "K" through "R" or, using button 20 as a shift key, the letters "S" through "Z." With the "Character" function turned off, buttons 1 through 10 are used to input the digits 1 through 0. Two other, unnumbered buttons handle back- and forward-space/Clear. Pressing a station button when the tuner is off will turn it on and bring that station up immediately; touching the large "Power" button at the upper right of the panel will turn the tuner on and recall the last station listened to.

Controls along the lower section of the front panel include an output level control, stereo and muting threshold controls, a display mode selector (station number, frequency or call letters), a stereo headphone jack and its associated output level control, up and down auto-tuning bars for station search, and, at the extreme right, a bank of 14 more small touch buttons, arranged in two rows of seven each. In the upper row, a "Recall" button activates the last station tuned with auto tuning. Two buttons provide incremental tuning in 12.5-kHz steps, while two more offer manual tuning in 50-kHz steps, up or down. Another button recalls the most recent manually tuned station. Still another button is used to change from character to number function for the upper keyboard.

The lower row of touch buttons includes a 400-Hz calibration tone switch, muting on/off switch, "Stereo Only" switch,

Why a center-of-channel tuning meter for a synthesized tuner? Because cable FM signals may use non-standard frequencies.

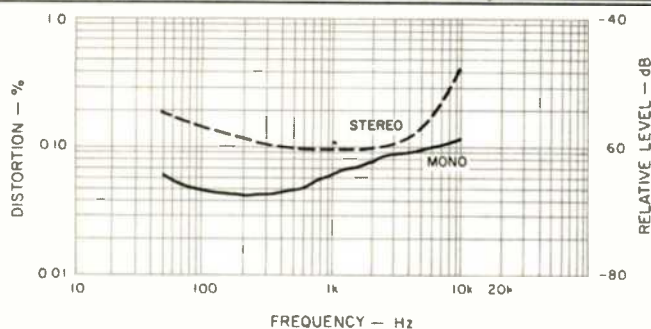


Fig. 2—Harmonic distortion vs. frequency.

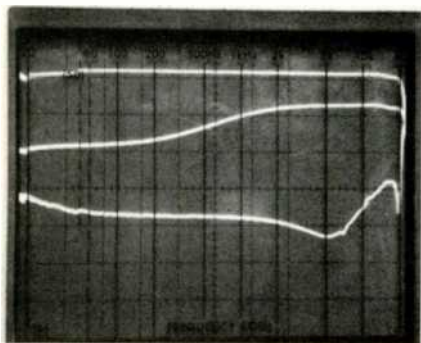


Fig. 3—FM frequency response (upper trace) and stereo separation vs. frequency with "High Blend" control on (middle trace) and off (lower trace).

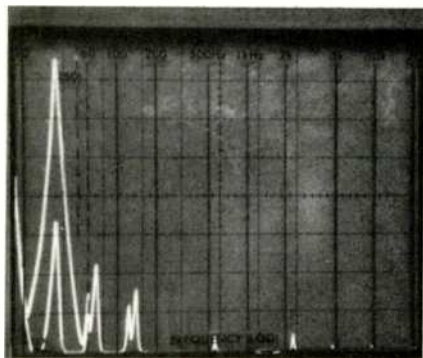


Fig. 4—Analysis of 5-kHz distortion and crosstalk.

"Separation/High Blend" switch, a "Mono On" selector, "Antenna" selector (active only if the dual-antenna option has been purchased), and a "Store" button which enters frequencies or call letters into the tuner's memory.

The rear panel of the B261 houses fixed and variable output jack pairs and a coaxial antenna input, for which a mating unwired plug was supplied in our sample. When I pointed out to the people at Revox in Nashville that most U.S. consumers don't like to have to do any wiring to start using an audio component (apparently Europeans revel in this sort of "do-the-final-hookup-yourself" routine), I was assured that production units reaching dealers would have a suitable type of adaptor/transformer included, which would eliminate this nuisance. A European-style DIN connector (which would be handy for hookup to a tape deck) is provided in addition to the single-jack outputs. The rear panel also has a socket for connection of a remote power-on cable from Revox's Model B710 cassette recorder. The optional remote-control unit will operate the tuner individually, as well as Revox's turntables, B251 amplifier, cassette recorder and even their B77 reel-to-reel tape recorder (which can be retrofitted for such remote operation).

According to Revox, the wider utilization of microcomputer control in this tuner has made possible considerably simplified wiring. Serial buss connections result in fewer wires, contacts and solder connections, which should improve reliability.

Measurements

When I read the specifications in the owner's manual, I saw that specifications were quoted in accordance with European FM broadcasting techniques and standards. Realizing that American readers would not be able to compare these specs with my measured results, I quickly phoned Revox in Nashville to try to obtain equivalent U.S. performance specs. I was informed that none were presently available, but that they would telex Switzerland that day. With typical Swiss efficiency, the Revox factory telexed the answers back within 12 hours, and the manufacturer's specs appearing at the beginning of this report are per EIA/IHF U.S. standards.

Usable sensitivity measured 11.0 dBf in mono and 35 dBf in stereo, determined largely by the stereo switching threshold. It was necessary for me to use a transformer to get from my 50-ohm generator output impedance to the 75-ohm input impedance of the Revox B261. I suspect that this transformer introduced some losses, but the usable sensitivity figure obtained is certainly good enough. In any event, of far greater importance than usable sensitivity is the 50-dB quieting sensitivity, which Revox does not include in their published specifications. I measured 13.0 dBf for mono (that's equivalent to a very low 1.23 μ V across 75 ohms) and 35 dBf (15.5 μ V across 75 ohms) in stereo. Mono signal-to-noise measured a very high 85 dB, while in stereo the best S/N obtainable for a 65-dBf input signal was 80 dB. Harmonic distortion for strong signals measured a low 0.065% in mono and 0.1% in stereo. Noise and distortion at 1 kHz are plotted against input signal strength in Fig. 1, while Fig. 2 is a plot of harmonic distortion versus frequency for mono and stereo operation of the tuner, with a 65-dBf input signal.

According to Revox, microcomputer control has made possible simplified wiring, for improved reliability.

Figure 3 is a spectrum analysis 'scope photo of a frequency response sweep (upper trace) and sweeps of unmodulated stereo channel outputs (separation) with the high blend turned on (middle trace) and with the high-blend circuitry disabled (lower trace). Mid-frequency separation measured 42 dB, which is not unusually high for a modern stereo tuner, but, more remarkably, separation was maintained virtually at this high level across the entire frequency spectrum. I measured 40 dB of stereo separation at 100 Hz and 41 dB at 10 kHz.

Figure 4 is a linear sweep-frequency presentation, in which a 5-kHz signal modulated the left channel (represented by the tall spike at left). This was followed by a sweep of the output at the unmodulated channel, which shows dynamic 5-kHz separation (the shorter spike nested inside the taller one) of around 40 dB (each vertical division in the 'scope photo is worth 10 dB) and higher frequency crosstalk and subcarrier output products. Horizontal calibration is 5 kHz per linear division, and the 19- and 38-kHz "blips" representing subcarrier product output were about the lowest I have seen for any tuner ever tested—around 70 dB below 100% modulation. Using this tuner to record FM programs on tape, you are never likely to have to turn on a multiplex filter on your tape deck!

I was able to measure a far better capture ratio for this tuner than was claimed by typically conservative Revox. The best figure I obtained was 1.0 dB; it is possible that our measurement methods differed. Selectivity measured better than the 78 dB claimed. I was able to obtain a reading of 83 dB for alternate channel selectivity. As for the various rejection ratios (spurious, i.f. and image), they all measured better than 100 dB, the limits of my test equipment. Muting level, for suppression of interstation noise and elimination of weak signals, was adjustable over a range from 27 to 51 dBf, while stereo threshold was adjustable over a range from 35 to 70 dBf. SCA rejection, like subcarrier product rejection, was better than 70 dB. A point-by-point check of frequency response, using more sensitive instrumentation than was used for Fig. 3, revealed that deviation from perfectly flat response (based upon 75- μ S pre-emphasis and de-emphasis) never exceeded 0.5 dB from 30 Hz to 15

kHz. When I limited the frequency range to 100 Hz to 10 kHz, deviation was never more than 0.1 dB from flat.

Use and Listening Tests

Whether the Revox B261 is suitable for you or not depends a great deal upon how you listen to FM radio and how you feel about the luxurious features which this tuner provides. There's the matter of long-term reliability to consider too. If you are at all familiar with Revox tape recorder products, you know they are as close to being indestructible as any electromechanical product can be. A Revox tuner, built with the same precision and the same margin of safety and conservatism, has the additional advantage of not having any moving parts. One could therefore expect it to operate perfectly for an even longer period of time than is the case with Studer and Revox tape equipment.

Clearly, the performance capabilities of the B261 were beyond those of any FM station that I can receive in my listening area, and that's likely to be true wherever you happen to be. But then again, that there are few roads in the United States on which you can extract the full performance of a Rolls-Royce or a BMW or a Mercedes automobile, doesn't stop thousands of lovers of fine cars from buying and driving them. I'll admit that I happen to have a particular fondness for good FM tuner products. Perhaps it dates back to the days when I worked with one of the greatest FM design engineers who ever lived, Murray Crosby. In any event, I confess that I am turned on by a tuner such as this Revox B261—by the thoughtfulness that went into its design, its layout, and the way it obeys my every wish. I would guess that two types of FM listeners will flock to this remarkable tuner: Those who are affluent enough not to have to worry about its price, and those who appreciate the superb blending of computer and r.f. technology that went into its design. The former group may well allow the dealer to "program" the tuner for them, as Revox suggests, and will leave the clear acrylic cover on the bottom half of the panel. The latter group (and that includes this reviewer) won't leave that cover on for five seconds, as they explore the remarkable versatility and adjustment capabilities of this extraordinary product.

Leonard Feldman

Controls for those tuner operating parameters which are usually seldom adjusted, have been placed beneath a transparent acrylic plastic cover to protect them from casual or inadvertent changes.





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2

MAS Mk. I TURNTABLE/ MAS-282 TONEARM

Manufacturer's Specifications Turntable

Drive System: Belt.

Motor Type: 16-pole synchronous.

Speeds: 33 $\frac{1}{3}$ and 45 rpm.

Speed Accuracy: 0.2%.

Wow & Flutter: 0.06% DIN wtd. peak.

Rumble: -77 dB, DIN B weighted.

Dimensions: 18.8 in. (47.8 cm) W x 14.5 in. (36.8 cm) D x 5.9 in. (15 cm) H.

Price: \$289.00 without arm, \$459.00 with MAS-282 tonearm.

Tonearm

Type: Low-mass, straight, statically balanced.

Effective Mass: 6.5 grams without cartridge; 7.3 grams with accessory counterweight.

Headshell Offset Angle: 25.5°.

Tracking Force Range: 0 to 2.5 grams; to 3.6 grams with accessory counterweight.

Allowable Cartridge Weight: 3 to 10.5 grams; to 14 grams with accessory counterweight.

Price: \$195.00; accessory counterweight, \$18.00.

Company Address: Music & Sound Imports, 30 Snowflake Rd., Huntingdon Valley, Pa. 19006.

For literature, circle No. 91



In a world full of turntables made of aluminum and plastic, it is a pleasure to encounter one made of good old-fashioned wood. I'm not just talking about the wooden top plate, with its attractive oiled finish; the MAS Mk. I turntable is manufactured almost *entirely* of wood and wood derivatives. The only metal parts in the system are the motor, bearing assembly, springs, and a few odd screws. This is one turntable, you can be sure, in which the sound will not be colored by metallic ringing.

The base is made of thick, high-density particleboard, as is the spring-suspended subchassis on which the platter

and tonearm are mounted. The heavy, inert 4.4-pound platter is machined from a disc of Tufnol, a dense resin-bonded paper matrix similar to Bakelite. In the words of the turntable's designer, Colin Walker, "Tapping this platter in an attempt to induce ringing will result in (a) failure and (b) a sore knuckle."

The MAS Mk. I turntable is manufactured for Music & Sound Imports by the firm of C & J Walker in England, using essentially the same drive and platter system as the highly regarded Walker CJ55. Its design is traditional: The platter and tonearm are suspended together on a floating subchassis.

The arm exhibited very low friction and no detectable play, consistent with the claimed bearing tolerance.

sis, which is suspended from the top plate via three compliant coil springs that isolate the record-playing system from external vibrations. The low-speed synchronous motor is fastened to the base, its rotation transmitted to the platter via a pulley and a thin rubber belt. Compared to many of today's more exotic designs, the interior of the Mk. I looks simple, even crude; but what matters is its performance, which in most respects is very good indeed.

The Mk. I is available in two versions; one has a blank tonearm board, while the version reviewed here is pre-cut to accept the MAS-282 tonearm. The MAS arm requires only a single mounting hole; a drilling template and fastening wrench are included in the package. It is a straight arm with desirably low mass and an ADC-type detachable headshell. Mounting and aligning a cartridge in this headshell is relatively easy, and an alignment protractor is included to assist in optimizing the lateral tracking. Anti-skating bias is provided by a small weight hanging from a thread which passes over a pulley to five fastening points, to match bias and vertical tracking force in 0.5-gram increments. The captive signal cable, emerging from the bottom of the tonearm pillar, is 1 meter (39 inches) in length, and terminates in gold-plated RCA plugs plus a ground wire.

A chart provided with the arm shows how the frequency of the infrasonic arm/cartridge resonance is related to the cartridge compliance and the total effective mass (cartridge plus arm). The instructions recommend that the resonance should fall between 8 and 13 Hz. If it's above 13 Hz, brass weights (weighing 2.2 and 4.4 grams) are available to be mounted between the cartridge and headshell; this will raise the effective mass and lower the resonant frequency.

The instructions supplied for setting up the turntable, and installing and adjusting the tonearm, are skimpy to the point of inadequacy. Audiophiles with experience in setting up other manual turntables will manage without difficulty, but if your experience is limited to turntables that come out of the box ready to run, you may need to depend on the skills of your dealer. The procedures are straightforward: Remove the fiberboard bottom panel, locate and drill the mounting hole for the tonearm, mount the arm, remove the transit screw to free up the spring suspension, put oil into the main bearing, install the drive belt, and put on the platter and mat. The final step involves adjusting the compression of the three coil springs until the platter is level and floating at the correct height.

Since the Tufnol platter is acoustically "dead," there is no need for a thick rubber platter mat to suppress metallic ringing; a thin felt mat is supplied with the turntable to cushion an LP disc and damp its microphonic vibration.

The MAS Mk. I is a "manual" turntable, pure and simple; it doesn't automatically cue the beginning of a record or switch off at the end. It has exactly one operating control—a pushbutton to start and stop the platter rotation. To change from 33½ to 45 rpm, you must lift off the platter and move the drive belt to the larger of the two pulleys.

Measurements

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

The turntable speed, which is not user-adjustable, was 0.47% fast at 33½ rpm, and was unaffected by variations in a.c. line voltage from 75 to 130 volts. The wow and flutter was 0.065% unweighted and 0.04% DIN-weighted, well below the threshold of audibility. The platter torque was rather low, evidently because of belt slippage; the drag of a Discwasher brush slowed it to a crawl, and it even slowed noticeably under a 10-gram load. So if you plan to use a Dust Bug brush, you probably should reduce drag by tapping a quarter on its rear end to serve as a counterweight.

The indicated vertical tracking force was accurate to within 0.1 gram. Although the anti-skating is adjustable only in 0.5-gram steps, it proved satisfactory, since skating compensation can only be approximate anyway. The arm cueing was well damped, providing a gentle descent of the stylus into the groove with no sideward drift. The arm exhibited very low pivot friction and no detectable play, a result which is consistent with the claimed bearing tolerance of only 10 microns. The capacitance of the tonearm wiring and signal cables was measured as 100 pF in each channel.

While the overall rumble was very low, the motor's fundamental vibration frequency of 120 Hz is transmitted to the record and was audible via headphones, especially when playing records whose own surface noise was very low. However, this hum-like sound was not noticed at any time via loudspeakers, even at quite high playback levels.

The tonearm's infrasonic resonance behavior was assessed with a Shure V15 Type IV phono cartridge. Since the MAS-282 tonearm has very low pivot friction and no provision for damping, the arm/cartridge resonance was very pronounced, rising to a 30-dB peak at 11 Hz with the Shure's damping brush disengaged. Engaging the damping brush brought the resonance down to a 10-dB peak from 15 to 19 Hz.

One of the major byproducts of an undamped resonance is exaggerated cantilever deflection in response to surface irregularities and disc warps, and a consequently large variation in the effective vertical tracking force that acts to hold the stylus in contact with the groove. A strain-gauge cartridge was installed in order to observe these effects directly; on a visibly flat record, peak-to-peak variations of 0.8 gram in effective tracking force were detected, and on a severely warped disc the effective VTF went negative as the stylus departed the groove and went into free flight. Therefore, it is recommended that the MAS tonearm be used with an external damping device or with phono cartridges having internal stylus damping. (This advice, of course, applies to all tonearms that have low pivot friction and no provision for their own damping.)

In an informal test of a turntable's acoustical and mechanical isolation, we normally turn the preamp volume control to maximum and then stimulate the turntable with acoustic and mechanical excitations to measure the resulting hangover and feedback. But the MAS system immediately went into feedback when the volume control was advanced, even without excitation. This shouldn't happen, of course, especially in view of this turntable's theoretically "correct" suspension system, but evidently the severity of the arm/cartridge resonance was enough to overcome the suspension filtering.

Even at thunderous bass levels, textures were clearly defined, noise was low and details were transparent.

The basic "bounce" frequency of the suspension is about 5 Hz, and it is moderately well damped by foam cores in the coil springs, making it less sensitive to footfalls than some turntables of similar design. The 5-Hz frequency is low enough to provide a valuable degree of vibration filtering at the usual tonearm/cartridge resonance frequencies (8 to 14 Hz). As usual with spring-suspended turntables, tapping on the top plate produces only a slight thump in the loudspeakers, while tapping on the side or front edge produces a severe thump or even groove-skipping. Regardless of a designer's good intentions with respect to mechanical and acoustic isolation, it is still important to place the turntable on a stable support that is as vibration-free as possible.

The tonearm signal cable emerges straight down out of the tonearm pillar, forms a short loop, and is fastened to the turntable base. Since the cable is not particularly limp, it may provide a significant path for conducting vibrations from the base into the tonearm, bypassing the spring suspension. (It was even possible to produce an audible thump in the loudspeakers by tapping the cable.) The old AR turntable had a better arrangement 20 years ago, with very limp, flexible wires running from the tonearm to connectors on the base, where the main signal cables were attached.

Since both the MAS Mk. I turntable and MAS-282 tonearm are of British origin, it seemed appropriate to install a British phono cartridge for a final extended listening test—in this

case a Goldring 920-IGC, which has a modified van den Hul stylus and a significant amount of internal stylus damping. The Ortofon and NAD test records confirmed that the arm/cartridge vertical resonance was now centered at 13 Hz and, while quite pronounced, was not extreme. Because of the concerns noted earlier about motor vibration and acoustic feedback, the turntable was installed in a wide-range playback system containing the excellent ADS PB-1500 powered subwoofer system. Several low-bass "torture" records, featuring subterranean pipe organ pedals and the well-known Telarc bass drum, were played at high volume levels. Flutter and groove-skipping could be induced by pounding on the floor or rapping on the side of the turntable, but no feedback problems arose from the musical sound, even with the volume control at maximum.

Most important of all, the reproduced sound was excellent. Even at thunderous bass levels the instrumental textures were clearly defined, the background noise was very low, small details were heard with exceptional transparency, and the stereo imaging was both deep and stable.

Peter W. Mitchell

Peter W. Mitchell is a writer specializing in the areas of audio, video and microcomputers as well as a consultant who provides design advice and technical writing services to NAD and other manufacturers.

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Z28 is a powerhouse – but Laser XE is the sophisticated new wave. Its multi-point injection system "spritzes" fuel in at four points. Its water-cooled bearing reduces a critical turbo temperature by 500°F. Its turbo engine boosts h.p. 45% and moves Laser like light. With 5-speed over-

drive stick your time to 50 mph is 5.8 seconds. Z28, Trans Am, Supra and RX-7 are in your remote-controlled side-view mirrors.

We gave it high-performance braking. Laser XE stops where Trans Am doesn't. We think total performance calls for performance braking. So we gave Laser XE semi-metallic brake pads, power brakes all around and optional wide 15" alloy wheels with Goodyear Eagle GT radial tires. Result: Laser stops quicker than Z28, Trans Am,



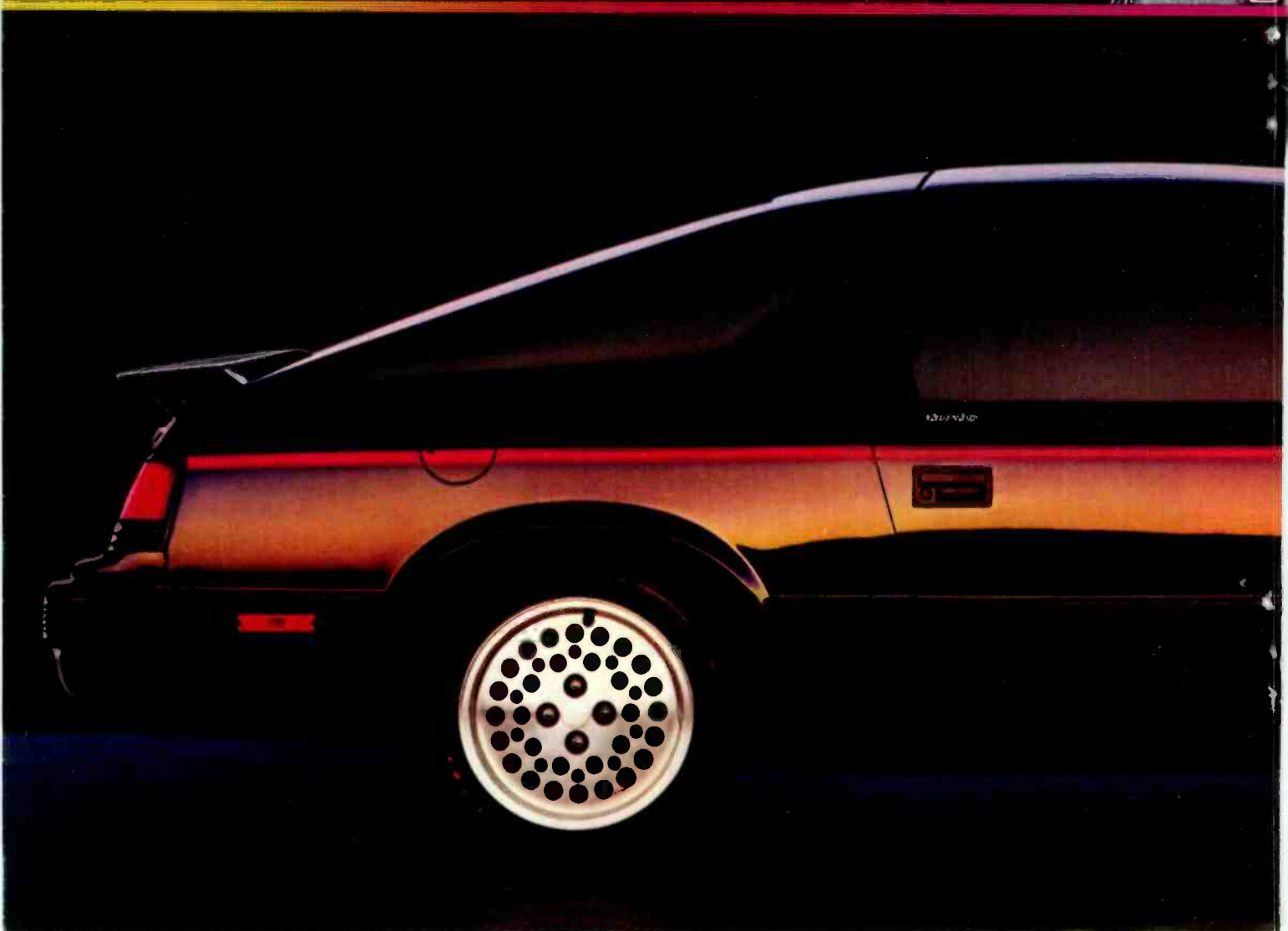
Laser beats Porsche in the slalom.



Laser outperforms Trans Am in braking.



Laser is faster than Camaro Z28 from 0-50 mph.



that had to outperform the competition.

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Chrysler believes a performer should be a survivor. We build for that. And back your engine and powertrain for 5 years or 50,000 miles, and give you outer-body rust-through protection.** What competitor does that? None. See dealer for details. Buckle up for safety.

35 Est. Hwy. [22] EPA Est. MPG
Base Laser: \$8,648**
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Based on overall results of USAC Sports Car Certification tests versus 1983 models. Laser XE equipped with optional handling suspension, Turbo package and 15" Road wheels tires. 5 years or 50,000 miles, whichever comes first. Limited warranty. Deductible required. Excludes leases. †Use EPA est. mpg for comparison. Actual mileage may vary depending on speed, trip length and weather. ††Heavy mileage less. ††Sticker price. Taxes, title and destination charges extra.

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Lee A. Iacocca



3

TOSHIBA XR-Z90 COMPACT DISC PLAYER

Manufacturer's Specifications

Frequency Response: 5 Hz to 20 kHz, ± 0.3 dB.

Dynamic Range: Greater than 90 dB.

S/N: Greater than 90 dB.

Harmonic Distortion: Less than 0.004% at 1 kHz.

Channel Separation: Greater than 90 dB at 1 kHz.

Output Voltage Level: Fixed, 2.0 V; variable, 0 to 5.0 V.

Number of Searchable Selections: Up to 99 for both track and index numbers.

Access Time: One second (average).

Power Requirements: 120 V, 50/60 Hz, 55 watts.

Dimensions: 16.54 in. (42 cm) W x 5.3 in. (13.5 cm) H x 13.4 in. (34 cm) D.

Weight: 21.56 lbs. (9.8 kg).

Price: \$1,000.00.

Company Address: 82 Totowa Rd., Wayne, N.J. 07470.

For literature, circle No. 92



If fast random access to selections on a Compact Disc is what you're after, the Toshiba XR-Z90 CD player is for you. I have never worked with any CD player that could find a given spot on a Compact Disc more rapidly. And if any record producer should ever decide to set a new record (no pun intended) for the greatest number of selections on CD, the Toshiba player will be able to find any of 99 such "tracks." The rapid access achieved by this player is attributed by Toshiba to what they have dubbed a "one-beam time-difference detection system."

Up to eight selections may be programmed in the unit's memory, and that many tracks can be played back in any sequence you choose. A repeat function allows you to play an entire disc over again or to repeat-play memorized selections, all at the press of a single button. Player operations are controlled by light-touch pushbuttons, and discs are loaded vertically into a disc compartment, via a door that opens out like the doors on front-loading cassette decks.

While I had very little information on hand regarding the circuitry in the player, I did learn that it employs an 11th-order low-pass filter, with its cutoff frequency tuned to 20 kHz, to eliminate any noise above that frequency generated by the D/A conversion process. Following D/A conversion, the analog audio output stages use Lambda capacitors and copper-foil Styrol capacitors in a low-impedance output circuit that does not degrade the sound quality.

Control Layout

Just to the left of the disc compartment are an eject button (which opens the disc compartment) and the power on/off button. The major disc transport and play buttons at the upper right of the front panel are "Rev," "FF," "Play," "Pause" and "Stop." The "Next Play" and "Repeat" buttons are located just below a multi-function display area to the right of the disc compartment.

The display area provides a veritable wealth of information to the user. At the left are three word displays ("Eject," "Search" and "Error") which illuminate at the appropriate times. Large numerals in the center of the display area show the track number being played, plus the elapsed time in minutes and seconds for that particular track. Adjacent to the track numbers are smaller numerals which display the "index" number within a given selection. Some discs, especially those containing long classical selections such as movements of a symphony, may subdivide such selections into "index" numbered subsections, and these may be accessed using this track-plus-index number scheme.

Words to the right of the track and time display illuminate to denote "Repeat," "Manual," "Auto" and "Memory," as these functions are called into play. Small rectangles below the track and time digits, numbered from 1 to 8, glow or flash to show which track number is being stored in which numbered memory or, during playback, which numbered memory selection is then being played.

Because the operating buttons of this unit are of the ultra-light-touch variety, it isn't always easy to tell whether you have actually depressed a button enough to cause the appropriate action to take place. Accordingly, Toshiba has incorporated a little "chirp" sound which is heard whenever you touch any of the many buttons just described. A switch

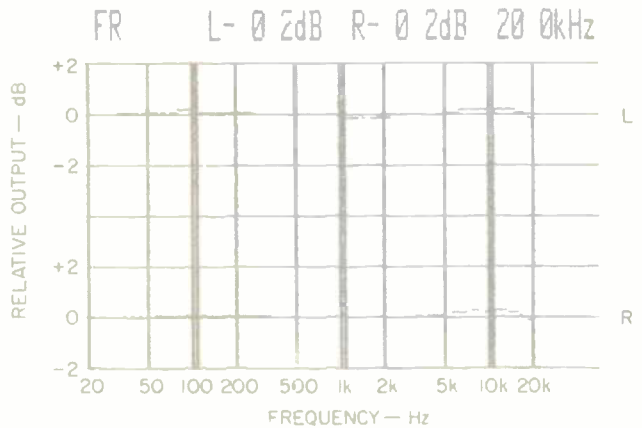


Fig. 1—Frequency response, left (top) and right channels at 0 dB (maximum) level.

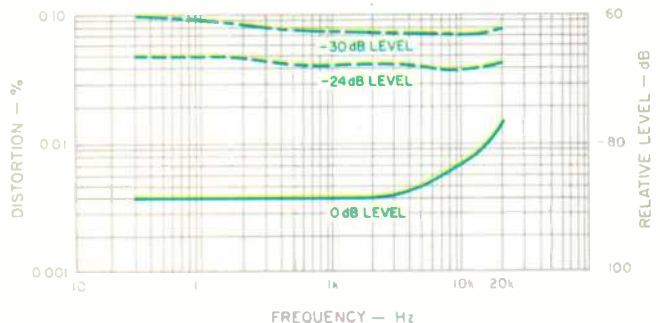


Fig. 2—Harmonic distortion vs. frequency at levels of 0 dB (bottom curve), -24 dB (middle curve), and -30 dB (upper curve).

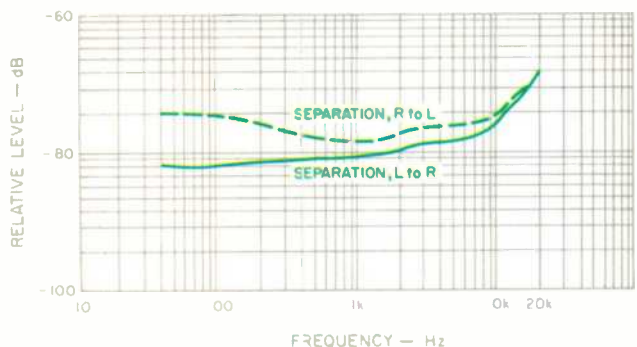


Fig. 3—Channel separation vs. frequency.

The square-wave ringing is typical of CD players using sharp-cutoff filters, but phase error seemed a bit lower than usual.

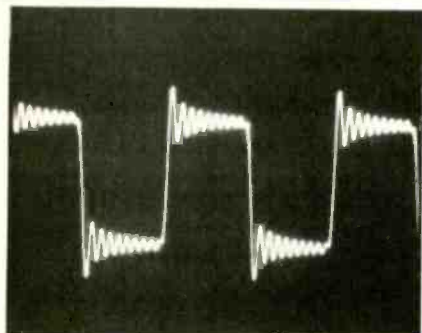


Fig. 4—Reproduction of 1-kHz square wave.

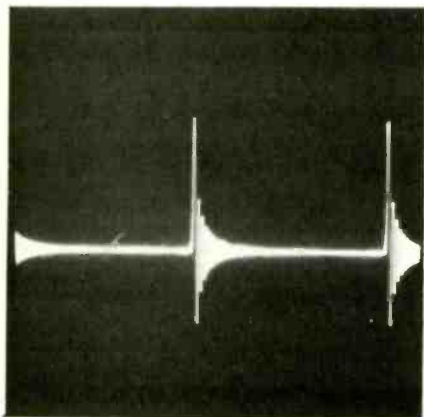


Fig. 5—Pulse test.

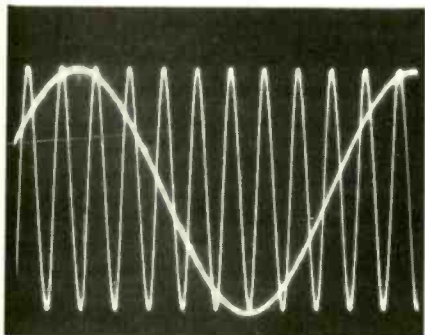


Fig. 6—Phase-linearity test, 2- and 20-kHz signals.

on the rear allows you to deactivate the chirp if you wish. Two sets of output jacks are also found on the rear panel. The first pair provides fixed output levels of left and right channels, while the second pair provides variable output, controlled by an adjacent output level control.

Measurements

Figure 1 is a plot of frequency response for the left and right channels of the player, using the Philips test disc sweep signals which extend from 20 Hz to 20 kHz. Frequency response was extremely uniform on this player, varying by only ± 0.2 dB up to the 20-kHz test point. Harmonic distortion at mid-frequencies for maximum recording level was exactly 0.004%, as specified by Toshiba, rising somewhat at the high-frequency end as shown in the graphs of Fig. 2. Also plotted in Fig. 2 are curves of harmonic distortion versus frequency for lower test signal levels of -24 and -30 dB. As you would expect for any digital system of this kind, distortion at lower levels rises, but even at the -30 dB level, THD was well below 0.1%.

Stereo separation hovered well above the 70 dB mark for all of the test frequencies. A graph of stereo separation versus frequency is reproduced in Fig. 3. Output linearity was extremely accurate from maximum levels all the way down to -80 dB. Intermodulation distortion measured 0.0033% at maximum recorded level output, increasing slightly to 0.006% at a -20 dB recorded level. Signal-to-noise ratio measured a very high 95 dB, without any weighting network, increasing to nearly 100 dB when an A-weighting compensation curve was introduced.

Figure 4 is a 'scope photo of a 1-kHz square wave as reproduced by the Toshiba player from the appropriate band on the Philips test disc. The apparent high-frequency "ringing" is typical of that which I have seen on all CD players that employ post-D/A, sharp-cutoff, low-pass filters. The same holds true for the single-pulse signal reproduced by the XR-Z90, shown in Fig. 5.

The phase-check signal, consisting of a 2-kHz sine wave on one channel and a 20-kHz tone on the other, was used to ascertain phase delay. Phase error between mid- and high frequencies caused by the multi-pole, sharp-cutoff filter seemed a bit lower than usual, as can be seen in the 'scope photo of Fig. 6. In a system with no phase error, the low-frequency signal's positive crossing of the zero axis is supposed to coincide with the high-frequency signal's positive crossing of the zero axis. In the Toshiba player, an error of about 25° (for the higher frequency, 20-kHz signal) seems to be present. This corresponds to a time-delay error of approximately $3.5 \mu\text{s}$.

In connection with all three of these tests, Clyde E. Wade, Jr., a reader from Little Rock, Arkansas, has written to me asking whether the Philips test disc that I have been using was made with or without anti-aliasing filters in the recording channels. He points out that if anti-aliasing filters were not used, "then some of the tests that you have conducted were not really valid. Real audio encounters both sets of filters. It is not only CD players that are under test, but the whole digital recording and playback system."

To answer Mr. Wade (and also to clear up some lingering misconceptions concerning the Philips test disc), let me

The XR-Z90 is easy to use and program. For its price, it offers outstanding performance and convenience features.

state, again, that all of the signals on this disc are computer-generated (with the exception of the pink-noise band, which I do not use). That is to say, they are generated from the start as a series of binary number signals, rather than as waveforms which are then sampled and converted to digital format by an A/D converter. Accordingly, no anti-aliasing filters are involved in the creation of this test disc. Mr. Wade's second point is valid, in that indeed, in the real world of audio, signals would not have been encoded onto a Compact Disc in this manner. However, as the title of this test report suggests, I *am* testing only the CD player.

Since the digital tape masters used to make a CD master may have been created using any one of a number of professional digital recording techniques (some not even operating at the CD sampling frequency), there is no "standard" way to interpose what happens at the recording end. Each studio's output may introduce varying degrees of phase error, time delay, etc. My purpose has been, and must remain, evaluation of the performance of the player, since I fully expect that future discs may well solve some of the problems now being noticed by some listeners with today's CDs.

Getting back to the subject at hand, I next used my error-correction test disc to see what levels of defects in a CD the Toshiba player could handle without audible problems. Error-correction capabilities were not as good as those found on some other machines. With the wedge which simulates scratches in a disc, some sound muting was heard when the width of the wedge reached 600 microns; however, the error-correction circuitry worked very well when tracking black dots on the test disc, which simulate specks of dust. In that instance, even the widest dots (900 microns) caused no noticeable interruption in reproduced sound. The laser was able to "read" and play right through the fingerprint smudge simulation on the test disc as well.

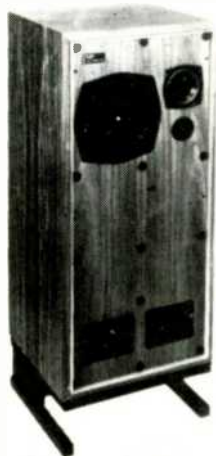
Use and Listening Tests

The Toshiba XR-Z90 CD player is extremely easy to use and to program for automatic memory play. In terms of suggested retail price (\$1,000.00), it offers outstanding performance and a surprising number of convenience features found in more expensive players. Reproduced sound is, as you might expect, beyond reproach.

I particularly appreciated the variable output jacks which are controlled from the back panel. Many CD players without level controls tend to deliver rather large output levels. While these are usually not high enough to cause first-stage problems in most amplifiers, they do make it necessary to operate amplifier volume controls very near their counter-clockwise settings, where fine control of volume levels is difficult. By adjusting the level control on the Toshiba player so that the output levels from the unit more nearly approximated those from other hi-fi program sources (such as my tuner or tape deck), I was able to keep the volume control at or near its more desirable mid-setting. This not only gave me better control of overall volume levels, but helped to avoid the extra-loud levels that I would encounter when switching to CD if I forgot to turn down the master volume control on my reference amplifier before switching. A minor point perhaps, but an important one in the day-to-day use of a CD player.

Further evidence of the high quality built into the XR-Z90 is the fact that Toshiba is a prime manufacturer of its own player (many companies are simply buying the players from other prime manufacturers) and is supplying versions of their machine to other highly regarded companies to sell with their own names affixed to them. Targeted to sell at just about the same retail price as most other players I have been testing of late, the Toshiba XR-Z90 is a very worthy example of how a well-designed CD player should look and work.

Leonard Feldman



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4

SUMO MODEL NINE AMPLIFIER

Manufacturer's Specifications

Power Output: 60 watts per channel, continuous, 8 ohms (120 watts, 4 ohms), 20 Hz to 20 kHz.

Rated THD: Less than 0.25%, 20 Hz to 20 kHz at 8 ohms; less than 1%, 20 Hz to 20 kHz at 4 ohms.

IM Distortion: Less than 0.25%, from 0.25 to 70 watts at 8 ohms.

Damping Factor: 150 from 20 Hz to 1 kHz.

Rise Time: 3 μ S at 8 ohms and at rated output.

Hum and Noise: 100 dB (wide band) below rated output.

Input Sensitivity: 1.0 volt rms for 70 watts output, 8 ohms.

Dimensions: 19 in. (48 cm) W x 8½ in. (22 cm) H x 7 in. (18 cm) D.

Weight: 35 lbs. (16 kg).

Price: \$779.00.

Company Address: All-American Audio, 31316 Via Colinas, Westlake Village, Cal. 91362.

For literature, circle No. 93



The Sumo Model Nine stereo amplifier is an interesting attempt at producing a Class-A amplifier, not least because of its suggested retail list price of \$779, which is far less than the \$3,000 the firm puts on the previous Class-A model, The Gold. The circuitry achieves some cost effectiveness by utilizing only two active stages. James Bongiorno, a designer credited with the classic Dynaco 400 and GAS Ampzilla amplifiers, engineered the Nine's circuitry and holds a patent on its special method of Class-A operation.

Physically, the Nine's sixteenth-inch anodized aluminum chassis is bent into two touching U-shaped sections which form the top, bottom, front and back of the unit. Eight-inch-high heat-sinks are joined to both sections, forming the

sides. The U-shaped top, which holds the single-speed fan, is attached to the heat-sinks, front plate, and bottom chassis by 20 bolts. Opening this amplifier involves removing the top section, not an easy or quick task. Since there are no user adjustments inside, this should not be considered a problem. The four internal 5-amp fast-blow power-supply fuses serve as last-ditch protection from abuse and prevent accidental electrical fires should a user insert an oversized line fuse. A rack-width, 8¾-inch-high x 5-mm-thick front panel is bolted onto the front of the chassis with 12 hex-socket bolts. With an additional front-to-back brace inside and the large handles on the front, the assembly is quite rugged.

The internal layout is clean and symmetrical, but the point-to-point wiring is not particularly neat. A large toroidal power transformer has been mounted with acceptable care at the center of the chassis bottom. Thermal cutout switches are installed at either side of the transformer to sense overheating there or excessive output-stage heat-sink temperatures. The single power supply p.c. board, containing rectifiers, four 10,000- μ F capacitors, four output stage supplies, and a regulated ± 20 V input circuitry supply, is suspended in a somewhat wobbly fashion from the front-to-back chassis brace.

Audio circuitry for each channel is contained on a single circuit board running the full height of each heat-sink and parallel to it. Output-transistor signal connections are kept as short as possible by soldering their sockets to these master p.c. boards. Mounting bolts pass through the output transistors and heat-sinks to the circuit board/socket assembly. All circuit boards are high-quality, sixteenth-inch epoxy-glass with single-sided traces. The soldering quality is satisfactory but traces of flux remain. The high-current traces are very wide, and there are no tight or clumsy areas in the artwork. Component designator screening (helpful in servicing) and solder masking (useful in preventing air contaminants from shorting out or causing leaks between adjacent p.c. traces) are missing. Parts quality is mixed, with ceramic disc capacitors next to 1% metal-film resistors. (Ceramic discs have been criticized by some for their temperature sensitivity and for high dielectric absorption. [*Editor's Note:* The manufacturer points out, however, that these capacitors are not used in the signal path.]) Certain mechanical connections, including push-on terminals, covered but not sealed trim pots, and clip-in fuses should not pose a reliability problem. However, faulty mechanical connections are one of the most common causes of equipment breakdown and bad sound. Power supply and speaker output wiring (here, recessed banana jacks) connect to the amplifier boards via push-on terminals. Input signals run directly to the p.c. boards from input jacks, with no level controls, via twisted pairs of leads. The internally mounted fan has a protective screen but no filter. Contaminants, inhaled by the fan, could find their way into the resistance tracks of the six non-sealed, preset trim pots, possibly causing problems in the unlikely event that these pots must be reset.

Externally, the large, anodized faceplate contains an on-off switch, an LED power-on indicator, and the company logo. The rear panel has the signal input RCA jacks and a pair of recessed banana-jack speaker terminals. While more cost effective than five-way binding posts, banana plugs must be added to use this amplifier.

The Nine's output terminals are balanced (both "hot"). Unlike conventional bridged amplifiers in which the "hots" are both referenced to common, the Nine's outputs are referenced to common through a high-impedance network which determines bias. It is especially important to avoid any leakage from ground or a voltage to either side of the output terminals, as the bias point may change. This means that conventional speakers are acceptable but power meters, speaker switchers, or other devices that attach to the output must be inspected to be certain that they are floating, i.e., not referenced to ground.

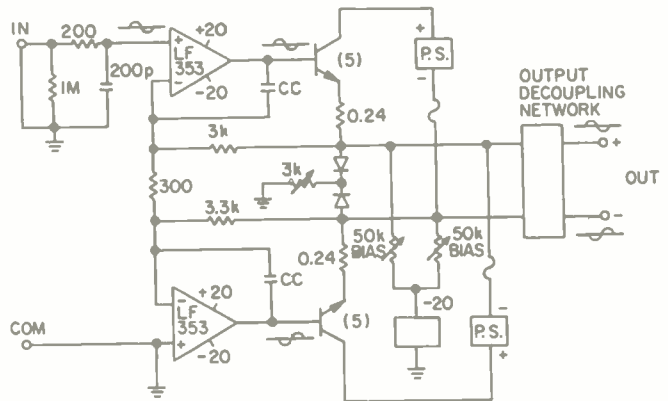


Fig. 1—Simplified schematic of one channel of the Sumo Model Nine.

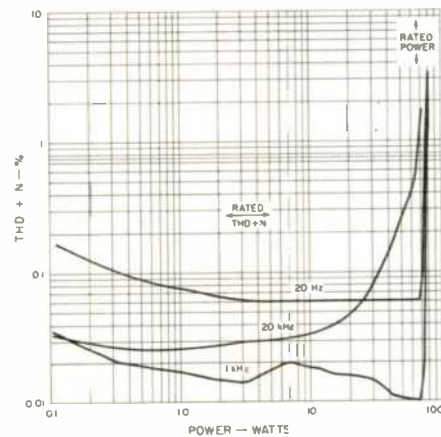


Fig. 2—Total harmonic distortion plus noise vs. power into 8 ohms at 20 Hz, 1 kHz, and 10 kHz.

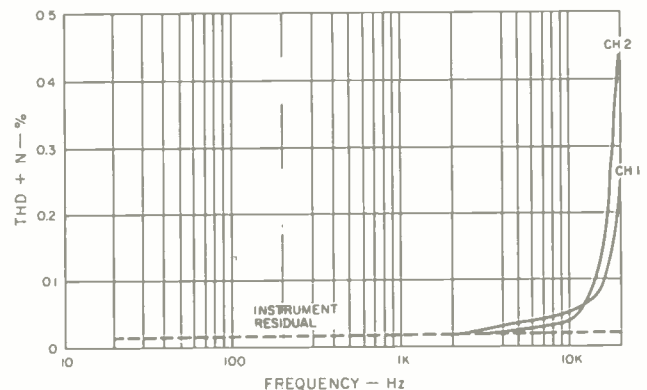


Fig. 3—Total harmonic distortion plus noise vs. frequency for 60 watts into 8 ohms

The Sumo Model Nine is an interesting design, achieving some cost effectiveness with only two active stages.

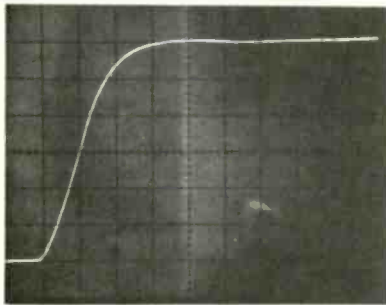


Fig. 4—
Large-signal rise time measures 3.4 μ S. Scales: 2 μ S/div., 10 V/div.

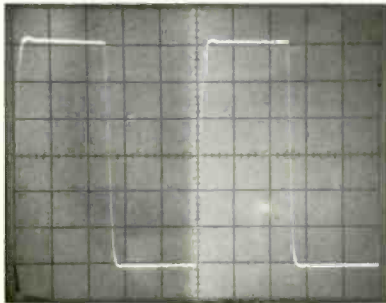


Fig. 5—
Response to 10-kHz square-wave input. Scales: 20 μ S/div., 10 V/div.

Circuit Description

The Nine's basic circuit topology for one channel is illustrated in Fig. 1. The input jacks are connected to National Semiconductor's LF353 op-amps by a simple r.f. filter network. This provides an unusually high, 1-megohm input impedance at low frequencies. Although this op-amp is rated ± 18 V max., ± 20 V regulated supplies are used, which might mean a marginal life for this IC. At low frequencies, all but 20 dB of the op-amp's 100-dB open-loop gain is fed back, resulting in approximately 80 dB of negative feedback. By 20 kHz, falling open-loop gain of the LF353 reduces feedback to only 26 dB, partially explaining the rise in THD at high frequencies. As shown in Fig. 1, capacitor CC provides stability by routing feedback only around the op-amp itself above 500 kHz. Unity-gain bandwidth of the LF353 is 4 MHz, which is less than the bandwidth of the output stage. The use of a regulated supply to these op-amps provides clean clipping before the output follower stage. The op-amp's drive capability to the base of the output transistors is only 20 mA. Since as much as 8 amps may be required to drive a 4-ohm load, the output transistors must have a beta of at least 400—a tall order!

The designer has utilized a large number of special super-beta, high-frequency output transistors, with an f_t of 30 MHz, in an attempt to achieve the unusually high current gain (approximately 400) required. Ten TO-3 type output transistors, in two parallel groups of five, are used per channel. Multiple paralleled transistors tend to maintain beta linearity (current gain) at high currents and low voltages. Since the output circuitry operates without reactive load protection, a larger number of devices also affords the extra safe-operating area needed to maintain reliability. Furthermore, Class-A operation is less efficient than the usual Class AB and requires more power handling, and thus more output devices, in the output stage.

The output stages, with their floating power supplies, form

a fully symmetrical, balanced bridge configuration using NPN transistors only. Each op-amp, output stage, and floating power supply acts as an independent Class-A amplifier (two per channel); one supplies most of the current for the positive half cycle, and the other for the negative half cycle. Since each amplifier stays partially "on" during the other's half cycle, the circuit qualifies as Class A. These positive and negative push-pull amplifiers must be painstakingly matched to reduce asymmetrical distortion products. The power supplies for the op-amp drivers are highly regulated, whereas the floating output stage supplies are unregulated.

Measurements

The Nine breezed through the FTC's one-hour, one-third power preconditioning at 8 and 4 ohms without "thermalling out," although the front panel and heat-sinks became fairly hot at 52° C and 83° C, respectively. To carry out power-distortion tests, it was necessary to replace the 5-amp line fuse with an 8-amp fuse. The Nine then delivered 71 watts of continuous power per channel at 1 kHz for its rated distortion of 0.25% into 8-ohm resistive loads.

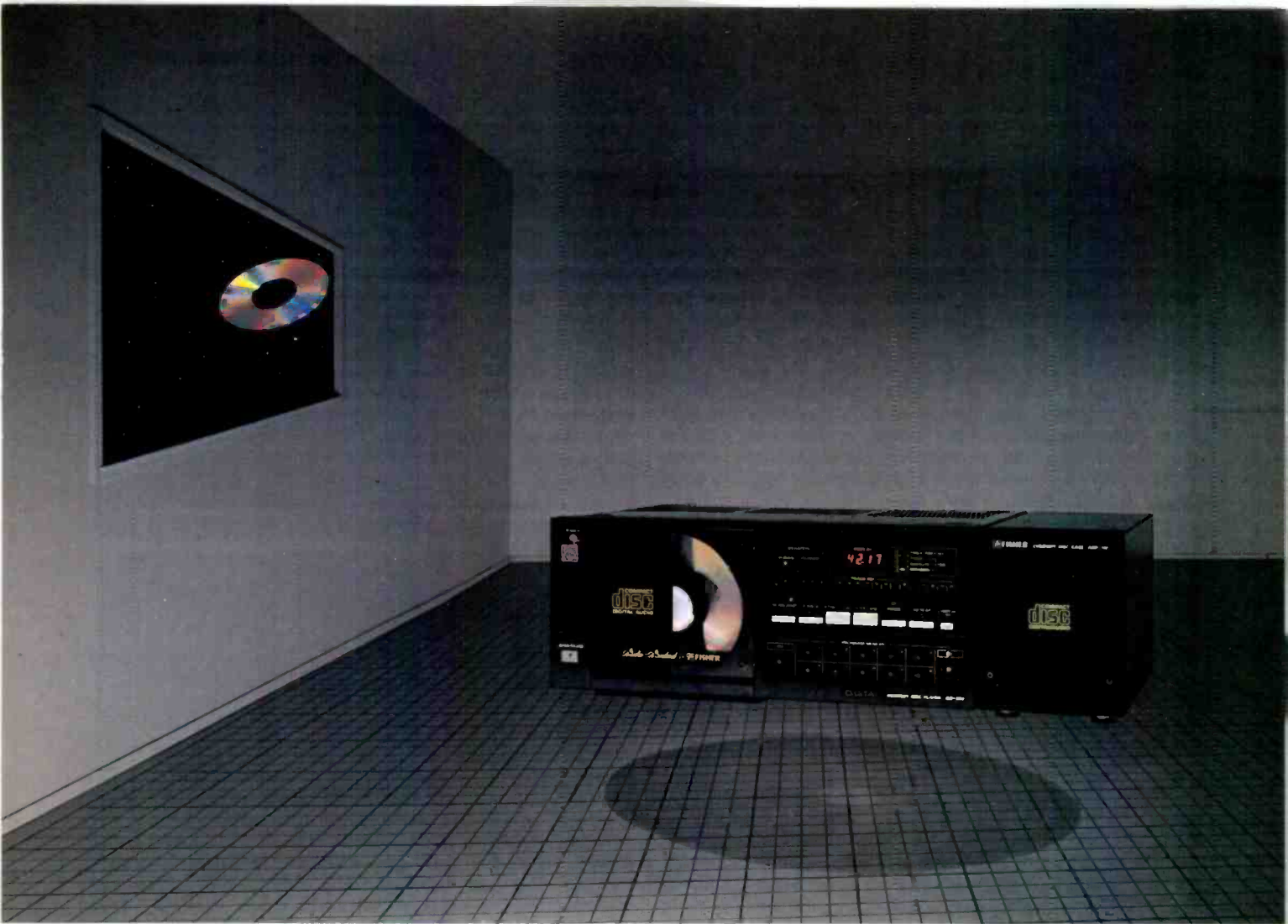
As shown in Fig. 2, the amplifier delivered 62 watts per channel at 20 kHz and 69 watts at 20 Hz into an 8-ohm load for its rated 0.25% distortion at its rated 60 watts. With a 4-ohm load, the amplifier delivered around 126 watts per channel at mid-frequencies, 120 watts at 20 Hz, but decreased to 76 watts at 20 kHz, for its rated 1.0% THD. Into 2-ohm loads, which the designer does not recommend, a visible distortion of the 1-kHz sine wave was seen above 17-watt (8.3 volts) power levels. Probably, the op-amp driver's current-output limits are the major performance drawback, producing an increase in distortion at 20 kHz. In some other audiophile amps, higher distortion results because of the use of low feedback around the output stage. In the Nine, output-stage feedback is used, but falls at 6 dB/octave. At 20 kHz the feedback is very low and, as a result, nonlinearities are higher. Figure 3 shows this rise in distortion at the upper frequency extreme.

The amplifier proved stable with both inductive and capacitive loads, with no reduction of maximum power before

Table 1—Clipping products with amp set for 10% THD overdrive with 300-Hz test tone.

Spectral Component	Level (dB)
Power-line hum (60 Hz)	-70
Power-supply ripple (120 Hz)	-46
Ripple-modulation difference (300 - 120 = 180 Hz)	-62
Fundamental (300 Hz)	0
Ripple-modulation sum (300 + 120 = 420 Hz)	Not measurable
Second harmonic (600 Hz)	-40
Third harmonic (900 Hz)	-20
Fifth harmonic (1.5 kHz)	-30
Seventh harmonic (2.1 kHz)	-42
Ninth harmonic (2.7 kHz)	-39

(Fourth, sixth and eighth harmonics were not measurable.)



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Gain-matched with a Dyna 400, the Sumo was clearly superior to the older but more powerful amplifier.

visible clipping when a 2- μ F capacitor was connected across the 8-ohm load in each channel. The 300-Hz clipping test showed excellent performance, with hum and side bands down more than 60 dB. In fact, the envelope of harmonics fell steadily as their frequency went up, which indicates a lack of sticking (an amplifier's tendency to continue clipping after the input signal has fallen back below the level which would normally make it clip). Table I shows that the Nine's clipping spectrum is superior to many other amps, and of particular note are the low levels of 60- and 120-Hz hum, sum and difference products, and even-order harmonics (though there is some second), with no glitches, sticking or parasitics, as evidenced by the steadily falling distortion-spectrum envelope. While all distortion sounds bad, it is generally felt that small amounts of low-order odd harmonics sound reedy or suppressed, that low-order evens sound brassy, that high-order products of either type sound irritating and unmusical, and that modulation products sound dissonant, as they are not harmonically related. Twin-tone or CCIF-IM measurements (mixed 19- and 20-kHz signals) also showed products more than 60 dB down (i.e., below 0.1%), from 1 to 60 watts.

Figure 4 shows the large-signal rise-time, which was measured at 3.4 μ S. The maximum slew rate is 15 volts per μ S (symmetrical). The measured IHF slew factor, when rating the amp at 60 watts into 8 ohms, is 5.0. Figure 5 illustrates the Nine's square-wave response for a 10-kHz input signal driving the amplifier to just below clipping; there's only slight overshoot at the leading edge.

Signal-to-noise ratio, referred to 1-watt output, measured 91.75 dB (A weighted), somewhat poorer than claimed. Input sensitivity for 70-watt output was 1.19 volts. A 0.132-volt input signal was required for 1-watt (2.28 volts) output. Damping factor was 181 at 50 Hz, and exceeded 15 on wideband measures, about what Sumo claims. Power bandwidth extended from 3.2 Hz to 50 kHz.

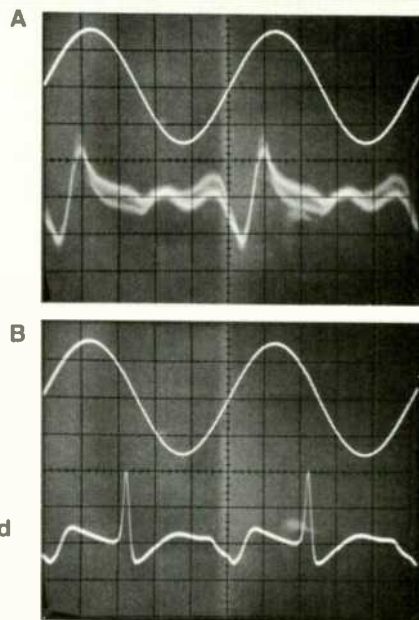
On the 20-kHz sine-wave distortion measurement, as shown in Fig. 6A, a major distortion notch occurs at the positive-going zero crossing. Strangely enough, it has the visual appearance of crossover notch distortion, which is illustrated in a typical Class-AB amp in Fig. 6B, but it occurs only once per cycle. It is probably due to beta nonlinearities in the output transistors and the restricted current output capability in the op-amp driver.

Dynamic headroom, as specified by Sumo, showed a 0.0 dB reading at 4 and at 8 ohms. This is due to the regulated supply of the op-amp being fixed at 20 V.

Use and Listening Tests

The Sumo Nine was installed in Greenhill's home system and used to drive Dahlquist DQ-10 and Snell Type A/11 electrodynamic loudspeakers. The amplifier was also auditioned in Clark's system, where it was inserted into one loop of an ABX RM-2 relay and compared to a Dyna 400 (an earlier Bongiorno design). Both amps were driving a low-impedance, highly reactive speaker, consisting of an AR-1W woofer, a JBL 5-inch 2105 midrange, and an Electro-voice EV-ST350 tweeter. Although rated at a nominal 4 ohms, the impedance dips to near 3 ohms each side of the bass resonance. Listening to the "Jungle Song" on Mark

Fig. 6— Distortion in Sumo Nine (A) looks much like crossover notch distortion in a Class-AB amp (B), but at much lower level—0.04% vs. 0.25% THD. Both sine waves are 15 W, 20 kHz. Scales: Horizontal, 10 μ S/div. (all traces); vert., 5 V/div. (both upper traces), approx. 5 mV/div. (lower trace, A) and approx. 50 mV/div. (lower trace, B).



Levinson Presents (dbx record RTS-1), the Sumo amp played percussion passages smoothly and clipped unobtrusively. The gain-matched Dyna 400 clicked audibly on the same recording as its V-I limiting was triggered. The Sumo was clearly superior to this older, traditionally designed, but more powerful amplifier.

During listening, several operating characteristics of the Model 9 amplifier were noted. Hum and line frequency harmonics were audible at a low level until input leads were rerouted. The acoustical noise output of the fan was measured at 30 dBA at 1 meter when the amp was mounted on a shelf near a wall. Using a heavy-duty remote relay to turn the amplifier on, in order to place the amplifier away from the listening location, caused the Nine's 5-amp line fuse to occasionally blow from a turn-on surge.

This amplifier drove all three speaker systems with good overall definition and smooth, non-irritating clipping characteristics, though its power was inadequate for certain audiophile recordings of wide dynamic range, leading to frequent clipping.

The Sumo Model Nine amplifier is an intriguing design. The symmetrical topology of its circuitry is appealing, and the design of its output stage does allow for Class-A operation in a cost-effective though limited manner. While the balanced outputs and frequently blown fuses on bench testing made measurements a challenge, the Nine functions smoothly when driving speakers in the listening room. Sumo's recommendation for the 5-amp line fuse will limit the continuous power of this amplifier to 23.3 watts into 8 ohms and 46.7 watts continuous into 4 ohms—more of a problem during bench testing than home listening.

Clearly, the transient behavior of this amplifier, its clean clipping characteristics, its ability to drive reactive loads, and its wide power bandwidth make the Nine a good performer irrespective of the measurements.

Laurence Greenhill and David Clark



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5

SAE E101 PARAMETRIC EQUALIZER

Manufacturer's Specifications

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

Distortion: 0.02%.

Signal-to-Noise Ratio: 100 dB.

Rated Output: 2.5 V rms.

Maximum Output: 9 V.

Impedance: Input, 100 kilohms; output, 500 ohms.

Dimensions: 19 in. (48.3 cm) W \times 3.5 in. (8.9 cm) H \times 12.5 in. (31.8 cm) D.

Weight: 20 lbs. (9.1 kg).

Price: \$650.00.

Company Address: P.O. Box 60271, Terminal Annex, Los Angeles, Cal. 90060.

For literature, circle No. 94



The Model E101 parametric equalizer is one of the units in the microprocessor-controlled "01" series from SAE, known by some as Scientific Audio Electronics. Because equalization information is stored in the unit's memory, the E101 needs to be plugged into a live, unswitched outlet. When this is done, a red LED on the "Standby" (power) switch turns on. Pushing the switch turns on power for the circuitry,

illuminates the digital displays for the two equalizer sections, and turns the "Standby" LED off.

Each display shows the memory selected, the amount of boost or cut, the center frequency of the filter, and the filter bandwidth in octaves. There are 10 positions in memory, from "0" to "9." The boost/cut can be set to any of the following: +16, +13, +10, +8, +6, +4, +2, 0, -2, -4,

-6, -8, -10, -13, or -16 dB. The low-band center-frequency choices are: 20, 30, 40, 50, 65, 80, 100, 150, 200, 300, 400, 500, 650, 800, 1,000 and 1,500 Hz. The center frequencies for the high band are: 0.2, 0.3, 0.4, 0.5, 0.65, 0.8, 1.0, 1.5, 2.0, 3.0, 4.0, 5.0, 6.5, 8.0, 10.0 and 15.0 kHz. Thus, with just a few exceptions, each filter can be shifted in close to $\frac{1}{3}$ -octave steps, which gives good resolution without excessive complexity. There is a good selection of bandwidths as well, from narrow to wide: 0.3, 0.7, 1.0, 1.3, 1.7, 2.0, 2.5 and 3.0 octaves. The bandwidths apply to the filter responses at maximum (+16 dB) boost; below that point the actual bandwidth is greater than is indicated in the display.

"Memory Scan" and the three filter parameters ("Level," "Frequency," "Bandwidth") are controlled by large push-bar switches, pivoted at the center. A push on the right of the bar causes an increase in memory number, level, center frequency or bandwidth. Similarly, a push on the left brings a decrease. The digital readouts show the results of any switching at all times. The E101 equalizer's memory is different than in many other components: Whatever is shown with a particular memory number is already in that memory; there is no need to push some sort of "enter" button. Changes in any parameter can be made in single steps with one push of a button, while holding the button in will get additional changes at a half-second rate. Any of the filter parameters will stop at the extreme values, but "Memory Scan" will count through zero in either direction. The whole combination is an excellent design, and the layout helps the user to make changes without confusion.

At the right end of the front panel are three rocking-bar switches of similar design, but with status LEDs built into the ends of the bars. The topmost one, "Tape EQ," sets the equalizer to "Post" (playback) or to "Pre" (record). The "Output" rocker switches the equalizer in and out of the line and turns the "Tape Mon" on and off; these two functions, unlike those for "Tape EQ," work independently. The third switch controls the "Low Filter" (useful, with low-end filter boost) and the "Standby" power switch mentioned earlier. The status lights are essential here, as the bar positions do not indicate how the switches are set. All of the designations are in white and stand out very clearly against the black of the panel. There are small, red figures on the filter-control bars, and they are hard to see, but that is of little import as the user will quickly learn to push on the right for higher, push left for lower.

On the back panel are the stereo pairs for line and tape recorder in/out, and an in/out pair for "Standby Control" interconnections with other SAE "01" series components. There are also a screw-type fuseholder (not hidden inside like most) and an output level control with a short, slotted shaft—obviously not for day-to-day diddling.

One of the side covers and the top cover were removed for inspection of the interior. Immediately I was struck by the chassis-size p.c. board, with its open and orderly layout; the quality of parts used added to the favorable impression. The soldering was excellent, and interconnections were made with multi-pin cabling. The transformer was quite large, and the power supply section caught my eye with its good-sized heat-sink.

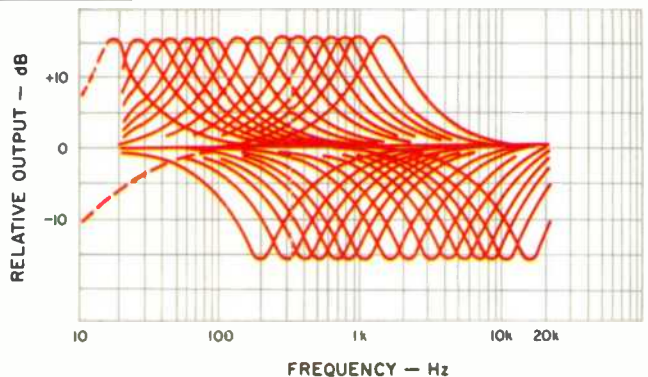


Fig. 1—Center-frequency adjustment ranges of low- and high-band filters, both at bandwidths of 0.7 octave. Low-band filter is set at +16 dB and high-band adjustment ranges of low- and high-band filter at -16 dB. Dashed lines show lower part of 20-Hz filter and low-cut filter responses.

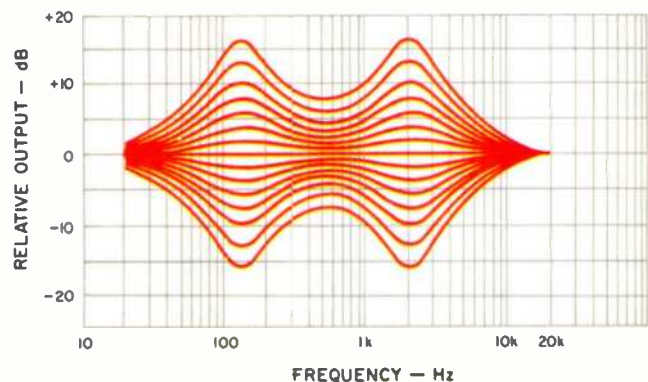


Fig. 2—Swept-frequency response curves for both filters at all boost and cut positions from +16 to -16 dB. Low-band filter is set at 150 Hz, and high-band filter at 2 kHz.

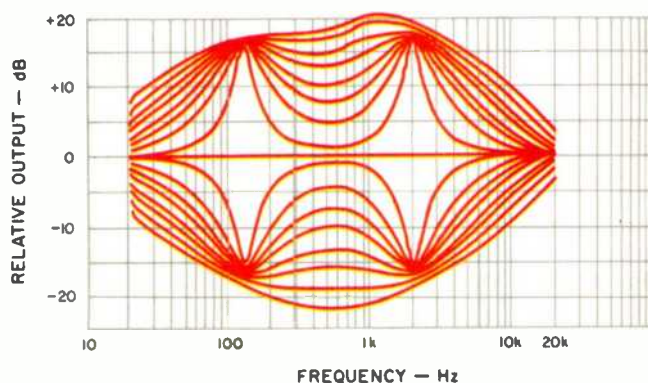


Fig. 3—Bandwidth adjustment ranges of low- and high-band filters, from 0.3 to 3.0 octaves, at maximum boost and maximum cut; center frequencies set at 150 Hz and 2 kHz.

The range and resolution of the levels, frequencies and bandwidths were excellent for making sonic improvements.

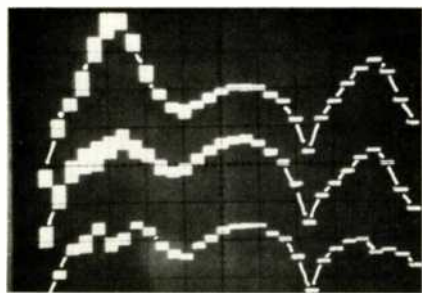


Fig. 4—Effect on simulated three-way loudspeaker response curve. Simulated response (top), after first attempt at correction with E101 (center), and improved response after changing levels and bandwidths (bottom). Vertical scale: 5 dB/div.

Measurements

The 20 Hz to 20 kHz responses with and without EQ (levels at zero) were within 0.2 dB at all points, usually within 0.1 dB. The 3-dB down points were at 2.3 Hz and about 180 kHz with EQ, and at 2.0 Hz and at least 1.9 MHz without EQ. There is no practical way to show the almost 2,000 filter combinations possible. Figures 1 to 3 indicate the kinds and range of variation the E101 can generate. The first figure plots the low-band filter at +16 dB and 0.7 octave and the high-band filter at -16 dB and 0.7 octave—with each filter set successively from its minimum to its maximum frequency. It is quite apparent that the spacing is close to 1/3 octave a good part of the time, making for good resolution in this adjustment. The dashed lines in Fig. 1 are hand plots of the lower part of the 20-Hz filter response and that for the low-cut filter, which is rather mild in its action.

Figure 2 shows responses for the low-band filter at 150 Hz and the high-band filter at 2 kHz, each set to 1.0 octave, with the levels stepped from -16 to +16 dB. Particularly worthy of note is the accuracy of the boosts and cuts, usually within 0.5 dB—*much* more accurate than the calibration of the great majority of equalizers of *any* type. Notice also that the ends of the responses converge on zero at the end points—in contrast with other less satisfactory designs, which exhibit considerable offset. Figure 3 shows the responses obtained with the 150-Hz and 2-kHz filters for the entire range of bandwidths from 0.3 to 3.0 octaves, both at maximum boost and maximum cut. There is a small anomaly for the widest bandwidths in boost, but the curve shapes are generally very consistent. Once again, take note of the excellent convergence on zero, which is most obvious above 10 kHz.

The low-band center frequencies were 5.6% low on the average, but since all of the errors were in the same direction, the spacing remained very good. The high-band filters were more accurately placed, within 3.2% of specified center frequencies, on the average. With a 1-octave bandwidth ($Q = 1.4$) set, checking over a range of boost levels revealed that $Q = 1$ (the non-ringing limit) was reached somewhere between +10 and +13 dB. With narrower bandwidths, of course, the maximum boost for a $Q = 1$ limit would be lower.

The change in gain with EQ in and out was 0.1 dB or less, *provided* that the level control on the back panel was set to its maximum. This control affected just the equalized level, so it could be used for gain matching, but only if the equalization increased the level. If the equalization is primarily cut in nature, it is not possible to make the equalized level match that without EQ. The maximum input/output voltage was at least 10.0 V over most of the band, but it dropped to 6.9 V at 20 Hz—both figures open-circuit. With a 10-kilohm load the maximum input/output voltages were 9.5 and 6.5 V, respectively. As would be expected, boosting or cutting levels caused at least some reduction in the maximum levels before clipping.

The output impedance was very close to the specified 500 ohms for most of the band, rising to 615 ohms at 20 kHz—an unimportant change. The input impedance, on the other hand, was 8.0 kilohms or less, a great deal lower than the 100-kilohm specification. An indication of the loading effect was the fact that the output of the generator (600-ohm source impedance) dropped by 0.6 dB when connected to one channel of the E101. The drop would be much greater, of course, for source impedances of 2 to 3 kilohms (which quite a few tape recorders have).

The harmonic distortion with a 2-V drive was 0.015% or less between 20 Hz and 20 kHz; with hum and noise included, the figures were 0.067% or less over the same range. No slew-rate limiting was observed out to 100 kHz. The signal-to-noise ratio was 96.9 dBA relative to the rated output of 2.5 V, somewhat lower than the 100-dB specification. With a 0.5-V reference, the ratio was 82.9 dBA, and with the probable effects from various filter settings, a typical operating figure would be about 81 dBA, which is quite good.

Use and Listening Tests

The instruction manual was of fair length, but it was disappointing in its lack of pertinent detail and the inclusion of puzzling information, such as figures showing levels, frequencies and bandwidths which cannot be selected on the E101. The instructions (Methods 1 and 2) on adjusting the equalizer would be best ignored. The user should review the listed frequency-range characteristics to be related to SAE's Method 3: Adjust while listening, and take time to learn what the effects are. My final carp about the manual is that in a section to "explain" decibels, there are errors: Decibels are abbreviated as "dB's" (dB is always singular, period).

The use of all of the controls was very easy: The combination of the light-touch rocker-bar switches, the status lights, and the digital displays was very convenient and informa-

The E101 can be thought of as a super tone control with the capability to modify the spectrum at any point desired.

tive. Personally, I would have liked the display just a little brighter, but I know I have lower red sensitivity than many. I used the same simulated speaker response that I have used in testing other equalizers. In this case, as there was no level readout or associated RTA, the $\frac{1}{3}$ -octave RTA display on another component was used as the basis for adjustments. Figure 4 shows the original response (top), the results after the first try at equalization (middle), and the final result (bottom) after further adjustment of the parameters. The first try used the low-band filter at 100 Hz with 10 dB of cut and a bandwidth of 0.7 octave. The final settings were 100 Hz, -13 dB and 0.3 octave; it can be seen that the peak was flattened better with less relative attenuation at 40 and 160 Hz. For the high-band filter, the first settings were -6 dB at 10.0 kHz with a 2.0-octave bandwidth. The excessive tweeter peak was lowered, but the shape was not improved. With the final settings of -8 dB at 10.0 kHz and 0.3 octave, the tweeter response became much flatter. With the exception of the 3-kHz crossover notch, the response was flattened within ± 2 dB from 40 Hz to 16 kHz. The high-end roll-off shown was purposeful.

The E101 was then connected into my reference system, which has a much flatter response than that simulated. It was in this listening series that the SAE unit really shone. By the use of memory scan from one to another, alternative equalizations could be compared immediately. I brought

out some dull, pop-music vocals with +4 dB at 3.0 kHz and 0.7 octave, and restrained an over-bright harpsichord with -2 dB at 6.5 kHz and 1.7 octave. I also improved the low-end sound, but it was the high end that really needed attention in these two cases.

The E101 can be thought of as a super tone control with the capability to modify the spectral balance at any point desired. There were a few times when I would have liked to have had a third section to adjust, but the improvements were immediate and obvious with the use of the two provided. To me, the 2-dB level shifts were quite apparent, and I would have given up ± 16 , ± 13 and ± 10 dB in exchange for ± 5 , ± 3 and ± 1 for more gentle changes around zero. Outside of that preference, I found that the range and resolution of the levels, frequencies and bandwidths were excellent for the task of making sonic improvements in musical reproduction (though the low input impedance may be a limitation for some). The flexible memory system and the easy return to exact EQ were important contributors in this regard.

The SAE E101 has a fairly high price for a two-band parametric equalizer, but it is a very flexible unit of high performance, with accurate and exactly repeatable equalizations. Because of its advantages, it is worthy of consideration by audiophiles, and by professionals for some applications.

Howard A. Roberson

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MICHAEL TEARSON
JON & SALLY TIVEN

ROCK BEGINS AT 40?

Undercover: The Rolling Stones Rolling Stones Records COC 90/20.

Sound: A Performance: A

If you were expecting drum machines, synths, or any pandering to the current trends from The Rolling Stones, then perhaps the sound of *Undercover* will shock you. It's a wall of unpolished guitars, raunchy lyrics, and crude rhythms that bear little or no resemblance to the "state of the radio 1983"—thank goodness. This being the last album of their Atlantic distribution agreement (except for a greatest-hits compilation package due mid-1984), The Stones have delivered a recording that breaks little new ground but certainly will do nothing to hinder their reputation as the nasty band of rock 'n' roll. *Undercover* is, like *Some Girls* and *It's Only Rock 'n' Roll*, a winning testament to the survival of The Rolling Stones as a band which has no need to pay any real attention to what anyone else is doing.

Unlike *Tattoo You*, the songs on this album are all culled from the same recent vintage, and many sound like they were long jams which, after much editing and lyrical consideration, were turned into songs—particularly the title track, "Too Much Blood," and most of side two. The exceptions are "She Was Hot," "Tie You Up," and Keith's song; these all seem much more solidly conceived and coherent from the word go and will probably hold up better over the years than, say, "Too Tough" (formerly titled "Triple X," due to the nature of its lyrics). Mick Jagger singing about a girl being cut up and put into a fridge (in "Too Much Blood") isn't going to win them any more friends with feminists. But since they've had encounters with the Women Against Pornography groups (due to S & M advertisements and early lyrics), they really don't have much to lose.

The most important musical change in the band is that they seem to be listening to a great deal of Stax/Volt stuff lately, as the guitar figures are rooted heavily in 1966 Otis Redding/Steve Cropper horn lines and guitar figures. The Stones haven't been so blatantly derivative of this genre since "I've Got the Blues" (from *Sticky Fingers*). It's not surprising that Mr. Richards is listening to this sort of stuff, but



Illustration: Rick Tulka

it seemed like Mr. Jagger was so stuck on Smokey Robinson that he'd never get out of his updated "Just My Imagination" groove. To add some new textures to their sound, The Stones have seen fit to use African and British percussionists (including the very talented Martin Ditcham), a little bit of Sly & Robbie, and the esteemed saxophone of David Sanborn. But no major sonic alterations are made to the by-now-familiar Ron Wood/Keith Richards guitar din, semi-buried Jagger vocals, reliable Bill Wyman bass playing, and never-solid-but-always-right Charlie Watts backbeat.

Undercover isn't the greatest Stones album ever, and certainly no one could accuse it of being stylistically experimental. Yet it rocks hard pretty relentlessly, and sounds like them the way no one else does. Pretty good for a bunch of 40-year-olds who have been dismissed as has-beens for over a decade.

Jon & Sally Tiven

The Real Macaw: Graham Parker Arista AL3-8023, \$8.98.

Sound: A — Performance: A —

Somewhere around *Stick to Me*, Graham Parker's recordings lost their fire, and his artistic downfall was hastened by his decision to record in America.

Parker's chip on the shoulder was born and nurtured in England, and the factory-like atmosphere of U.S. studios undercut whatever edge he presented on *Howling Wind* and *Heat Treatment*. Perhaps chucking Brinsley Schwarz was the last step in this musical devolution. Although you can't call us fans of Brinsley's playing, the recording reunion of these two seems to work for the betterment of Graham Parker's sound. Whether it be this reunion, the decision to record in England, the chucking of his manager, or the encouragement of producer David (Duran Duran, Joe Jackson) Kershensbaum, the latest effort from Graham Parker brims with a renewed sincerity. One would have thought it impossible after hearing his last two (or even four) albums.

The Real Macaw will come as a relief to fans of the old Graham Parker who they feared might have shot his creative wad on his first three LPs. Luckily time (and maybe marriage) have brought our hero almost full-circle. Although the songs on this LP aren't the vintage Parker pub-rockers, they are generally outstanding examples of composition and presentation. Parker is such a strong vocal stylist that his melodic talent is sometimes overlooked (the pomp obscuring the message, as it were). But the relaxed ap-

Parker is such a strong vocal stylist that his melodic talent is sometimes overlooked (the pomp obscuring the message, as it were).

proach to the tunes enables us to savor their melodies—it's not another case of Parker, the Angry Young Man, ramming his ire down our throats. The most salient aspect of *The Real Macaw* is the understated production policy. Just an album or two back, our boy was still trying to corner a trend by

grafting his rock 'n' soul tunes to the Big Dancerock Beat. This time out, the songs show themselves in clothes that barely nod at current production fashion. When an artist as good as Parker is back in control of his craft, we can only expect that more classics such as "Heat Treatment" and "Fool's Gold"

will soon follow. It's good to have G.P. back on track, especially since mate Elvis Costello hit a slump on his latest record. Two lapsed standard-bearers of musical integrity would be too much for one season. *Jon & Sally Tiven*

First Strike: Cobra
Epic BFE 38790.

Sound: C+ Performance: C

Cobra is a new metal clone of Judas Priest, complete with Tom Allom, the producer of that band's best moments. Not bad for what it is, but there's nothing at all new. Only the faces of these bands change. They keep getting younger. And they sound the same.

And there's always a fresh market. Metal music is, if nothing else, surely some rite of passage for the time when sexuality begins to rear its head.

Michael Tearson

Next Position Please: Cheap Trick
Epic FE 38794, \$8.98.

Sound: B+ Performance: B+

At their worst, Cheap Trick is the most intelligent head-banging group in the Universe. At their best, they're simply the logical update of The Move, the world's most misunderstood (and greatest) '70s band. *Next Position Please* is somewhere in between—not consistently paralyzing as they can be live, but rather an underproduced and delightful work. The attack is less sledgehammerlike than Cheap Trick has been known to use, but with chord sequences like those Rick Nielsen (and Robin Zander this time as well) come up with, the songs can sell themselves. The subtle arrangements tend to grow on you, rather than showing everything they've got upon first listening.

This time the group has teamed up with producer Todd Rundgren, and compared to many of his productions (and most Cheap Trick albums) you barely know he's there. It sounds the way you expect the band should, though not quite tailor-made for the heavy-metal audience. Nielsen and Rundgren—longtime members of the great-minds-think-alike club—share a great admiration for The Move, and if there are production references to any mentor, it's Roy Wood. Even though

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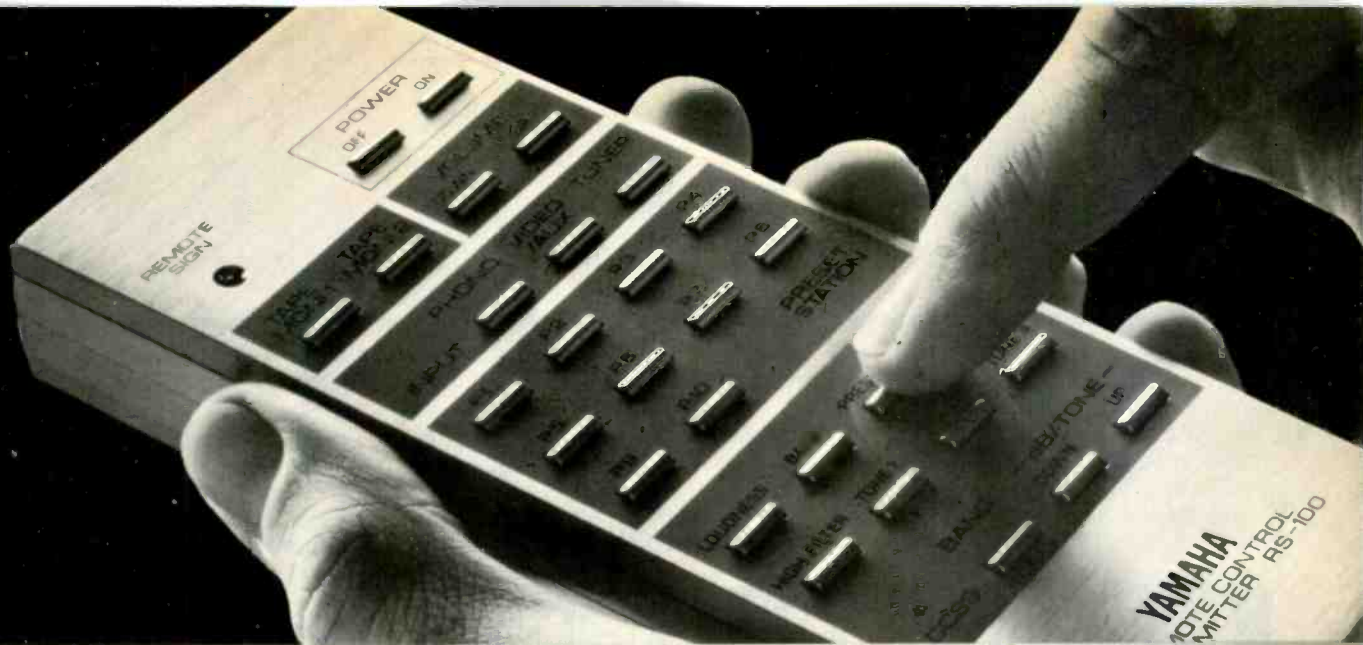
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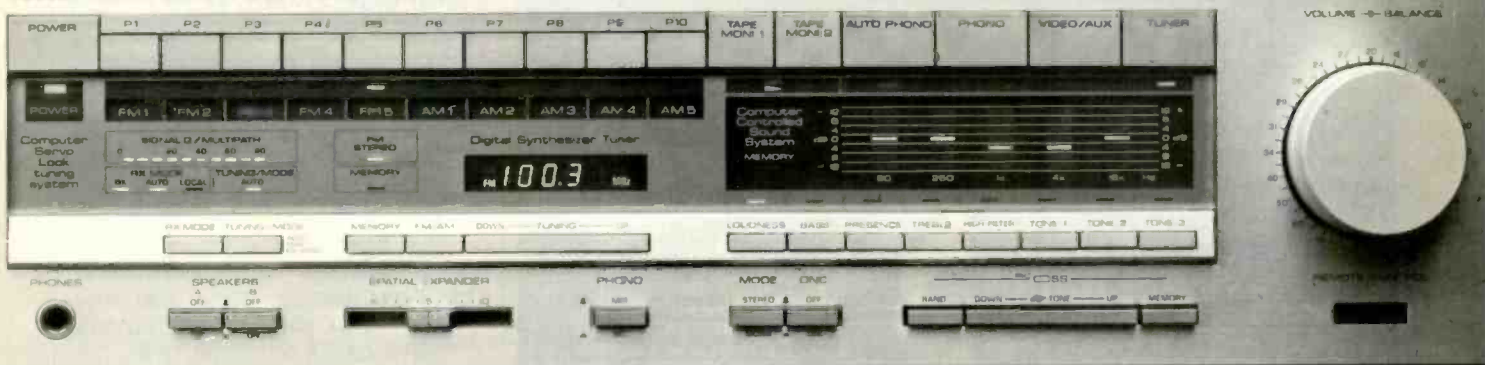
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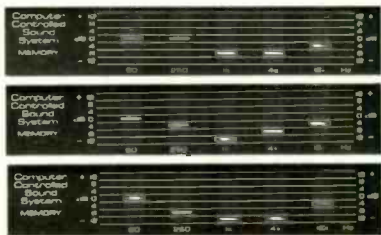


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FOR THE MUSIC IN YOU.



ZZ Top may not be headed into the vanguard of the Neuvo Wave, but they produce quality music with ease, grace, and style.

the natural sound of his pipes bears an uncanny resemblance to John Lennon's, Zander doesn't really emulate the Beatle's inflection. Instead, he starts to sound like ELO's Jeff Lynne. Nielsen's sense of humor adds that distinctive touch that makes Cheap Trick quirky instead of predictably

pompous—their stance is enough to make them a threat. The title track of the album is an absolute classic, and they always manage to throw in infectious hooks that'll make you swear you've heard the song before.

Cheap Trick may never be considered as important as bands like The

Who, The Kinks, or Fleetwood Mac, and they'll probably never sell as many records. Even though they aren't particularly influential, being too openly derivative to be taken that seriously, they're certainly making music every bit as creative, distinctive and exciting as those "important" bands ever have.

Jon & Sally Tiven

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Conventional driver



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
SL-6 driver



But first, a word of caution: only a limited number are planned for production. Which means its pleasures are limited to a privileged few. That select group of music lovers with the sensory and, yes, the financial resources to appreciate it. If the idea of being among them intrigues you, write or call for more information.

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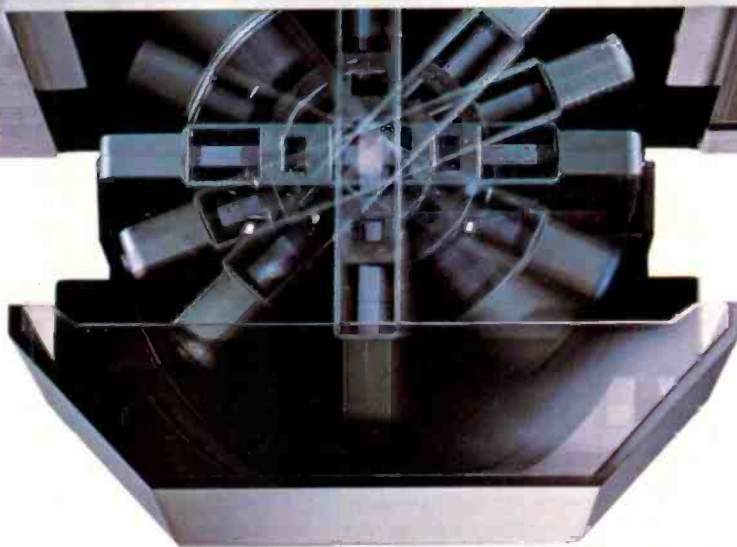
Sound: B Performance: A-

Consistency is tough to come by in a rock/blues band without achieving boredom. Usually when one thinks of a workmanlike group that's consistent, it implies stagnation—Rainbow and Rory Gallagher are both fairly consistent, but their albums are good for two listenings, tops. ZZ Top doesn't sound particularly different today than they did when they started out (they are somewhat better produced now), but the millions they've made haven't phased the music or lyrics one bit. ZZ Top may not be headed into the vanguard of the Nuevo Wave, but these Texans manage to produce music of quality with ease, grace, and style.

They may never mean the same to children of the '70s and '80s as The Rolling Stones did to the '60s generation. However, Billy Gibbons' persona of the cool blues hound is truer to The Stones' roots music (Jimmy Reed, Muddy Waters) than anything else. They're a contemporary boogie band along the lines of the late-'60s British blues revival (Peter Green's Fleetwood Mac, Eric Clapton's Bluesbreakers) that's remained more or less oblivious to whatever trends have come along the way since. Although not entirely, as several tracks on *Eliminator* sport synthesizer ("Legs") and drum machines ("Thug"), just in case you thought Billy Gibbons had his ears closed the past two years. Actually, the last two ZZ albums have had one or two semi-experimental tracks with weirdo rhythms and ultra pitch-altered vocals, but this album is pretty much straight-out rock.

Gibbons' guitar attack is the focal point, a trademark due to his substitution of a 25¢ piece for the usual pick, and he plays fiercely but with economy

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A progressive technician, Belew obviously likes nothing better than to tinker with studio gadgetry, getting odd sounds out of the instruments.

as well. The rhythm section is as sturdy as ever, and the band sounds pretty much the way this three-man outfit sounds live (excepting the rhythm guitar track which continues through the solo).

A truer blues band playing to America's youth is not to be found anywhere. Their musical chops and funky personality go unmatched in the world of rock, and their success should multiply and go unbegrudged.

Jon & Sally Tiven

Twang Bar King: Adrian Belew
 Island 90108-1.

Sound: B+ Performance: B

Twang Bar King kicks off with a searing version of Lennon-McCartney's "I'm Down," and it's all downhill from there. Not that this is a stinker of an album, but it doesn't rock. Belew is far from a pop songwriter, but he rather avoids all traditional rock chord patterns and song structures in search of something fresher and, we suppose, more expressive of his own musicality. As a progressive technician who obviously likes nothing better than to tinker with studio gadgetry, Belew concentrates on getting odd sounds out of the instruments (guitar, guitar synthesizer, sax, piano, percussion, bass and drums on this LP) without even attempting, it would seem, the pop artist's goal of conveying a song. In fact, we'd venture to call him less of a songwriter than a conceptualist in the field of music.

Some of the pieces work—notably "Sexy Rhino," "Twang Bar King," "The Rail Song," "She Is Not Dead," and "The Ideal Woman"—because the music is married to an understandable message and conveyed with humor and/or emotion. Belew's wit is one of his strong points: The title track, which also proves he can rock out when he cares to, is like a cartoon for the ears, full of funny noises and theatrical stops. On "The Rail Song" a nostalgic tale is spun out over Springsteen-esque chord changes that Belew breaks out of before any chance of familiarity can creep into the song. But the outstanding selection here is probably "She Is Not Dead." Built atop an Indian beat and percussion section, the guitar and guitar synthesizer play raga-like fig-



Adrian Belew

ures while the hypnotic vocal emulates an Indian chant. With the reputation of an inventive guitar whiz, Belew lets the gadgets do a lot of the work for him—whether it's tremolo bar or guitar synthesizer—and gives us only a few glimpses of his technical chops, mainly on the acoustic sections and Indian tribute. Since he makes only one small concession to commerciality (the fail-safe Beatles number), we don't know why Belew wasn't more long-winded in the guitar solo. If you're going to do an *auteur* record, play all your cards, especially since the success of these tunes depends more upon inspired presentation and arrangement than on the solidity of the compositions.

Jon & Sally Tiven

Flick of the Switch: AC/DC
 Atlantic 80100-1, \$8.98.

Sound: A- Performance: A-

AC/DC is arguably the best heavy-metal band on the scene today. Sure they don't have (at least on record) quite the instrumental flash of Eddy Van Halen or the progressive chordal orientation of a Ritchie Blackmore, but what they do represent is the zenith of simple head-banger heavy metal. Taking into account the genre this band embodies more than adheres to, *Flick*

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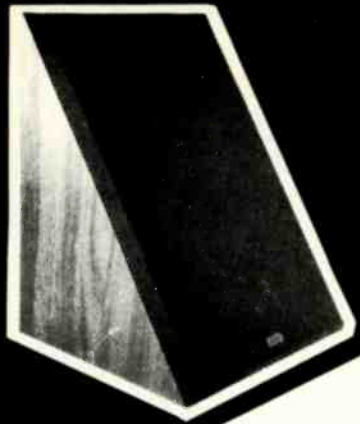
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Southside Johnny makes a real effort to modernize his traditional Jersey bar sound, but he flounders in search of a direction.

of the Switch is a state-of-the-art affair, because it effectively conveys the spirit and sound of a group that really exists for the sake of live performance. Many records of this type are overloaded with instrumentation and end up sounding muddy, but the group presents itself here as a pared-down version of Led Zep, circa "Whole Lotta Love." Keeping their chord patterns simple and allowing lead guitarist Angus Young much less space than is usually allotted to heavy-metal axemen, AC/DC conveys their songs in tidy packages. They realize that it's the beat, the vocal, heavy rhythm guitar, and flashy fills/leads (in that order) which will hook the listener.

From a commercial point of view, the homogenous sound of this record is a smart move: Why upset their worldwide slew of fans by deviating from the live act that won them so much attention? But from a critical standpoint, you could say the band is musically limited. There seem to be no more than two beats used on this album, almost every song uses the same ending, and the rhythm-guitar patterns do become predictable.

Aesthetics aside, this band is unbeatable at what it does. *Flick of the Switch*, which achieves a clean sound with laudable separation between instruments, is an authentic representation of a group that gives the dinosaur of heavy metal a good name. Upstarts like Def Leppard may try to duplicate their sound, but only the originals do it with authority. *Jon & Sally Tiven*

Trash It Up: Southside Johnny and The Jukes
Mirage 90113-1, \$8.98.

Sound: B+ Performance: B-

On his latest LP, Southside Johnny seems to be making a real effort, with the help of producer Nile Rodgers, to modernize his traditional Jersey bar-band sound. From the sound of this record, you can't call him a Springsteen clone or spin-off, and he's out of the Spector pop of yore. What we get is an artist floundering in search of a musical direction and coming up, for the most part, with a mishmash of would-be soul singing to pop/R&B tunes written mainly by the group's gui-



Southside Johnny

tarist Billy Rush. Unfortunately, the guy isn't much of a songwriter, though he does contribute some nice guitar lines. Most of the mid-tempo numbers seem to be pale imitations of the kind of talky vocal/groove tunes that were almost throwaways on the groovemaster Rodgers' own solo album. (The rhythm chops and attitude of the artist-as-singer saved these tracks from being boring, but Mr. Chic could hardly be expected to make a black act out of a very white one.)

Which brings us to the production and contributions of Rodgers in particular. This is a good-sounding record from a technical standpoint, and it contains what could be considered a hit single. The tune "Trash It Up" is a strong J. Geils-type rock number whose arrangement, with answering backing vocals and modern, punctuating keyboard figures, augments Johnny in the kind of song his voice is most suited for. *Trash It Up's* uptempo party tunes are only two in number, which makes this album less than a consumer bargain. The title track could well win this act some new supporters, but whether the old fans will stand by their man as he struggles for a more contemporary style is something else again. *Jon & Sally Tiven*

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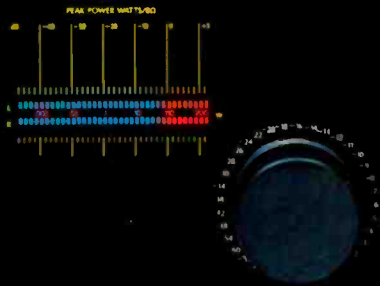
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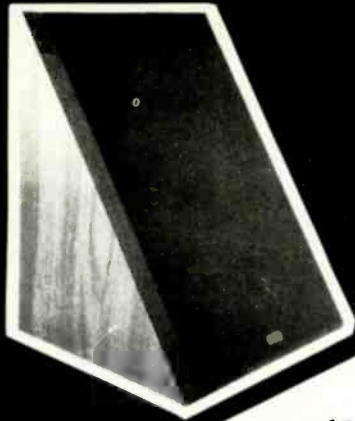


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Clearly T-Bone Burnett's finest work yet, *Proof through the Night* is fully dosed with startling, vivid imagery.

Living in Oz: Rick Springfield
 RCA AFL1-4660, \$8.98.

Sound: B+ Performance: B+

There is a notion about pop music stars like Rick Springfield—teen idols and the like—that whatever music they create is invalid, that it's simply product made to fill the marketplace. Springfield hasn't exactly broken the field wide open, as his bets are placed on safe musical territories, but he has struck a blow for integrity in the teen-star music world. The reason why he is so popular (and why he's been able to maintain a career where Leif Garrett, John Schneider, and David Cassidy have ultimately failed) is because he possesses integrity and a genuine musical sense. Regardless of how basically conservative this album is—there isn't as much adventuresome spirit here as one would wish—Rick Springfield is a strong musical talent; the more this talent is allowed to shine through, the better his records are.

Unlike his last album, *Living in Oz* contains only original songs and is self-produced. The guy has been in the music business for well over 10 years, with sporadic success, and still he has to fight for artistic control! This time he's got it, and the album rings true in far more cases than on previous outings. The groove on "Alyson" or the strings on "Like Father, Like Son" display Springfield's better artistic judgment, and, although side one may be a little light, side two rocks pretty steadily and features some arresting guitar work.

Even if Springfield's only achievement were to upgrade "teenybop" music, he'd have done something. But the promise of early works is renewed on *Living in Oz*, and someday he's destined to make really important records. This ain't one, but he's back on track and getting closer—let's hope they let the leash out a little more.

Jon & Sally Tiven

Proof through the Night: T-Bone Burnett

Warner Bros. 23921-1, \$8.98.

Sound: B Performance: A

Proof through the Night is an album full to the brim of some of the most



T-Bone Burnett

literate and exciting songwriting this side of Elvis Costello or *Blonde on Blonde*-vintage Bob Dylan.

T-Bone Burnett was a prominent member of Dylan's '77-'78 Rolling Thunder tour and then a member of the Alpha Band, with other Rolling Thunderers, through that group's three albums. Subsequently, he did a solo album for Takoma which Jon Tiven raved about in these pages, and about a year and a half ago a six-song mini-album for Warners which Tiven and I both loved. *Proof through the Night* is clearly his finest work yet.

Burnett's songs are fully dosed with startling, vivid imagery, such as "The Murder Weapon" which is "Lethal as a stiletto and as easily concealed." And his intense portrait that can only be Marilyn Monroe, who he describes perfectly as "Fatally Beautiful." And those guests of "a beautiful wealthy divorcee," namely "Hefner and Disney," who her mother describes as "the latest Russians to defect." And the pathetic, affluent, post-hippie whose late rebellion was inspired by visions of "pot parties with those suntanned girls in halter tops with their cutoffs slit to their belt loops." And another, more tender portrait of someone who might be star- and spy-crossed Jean Seberg, whose career was severely damaged by interference and who still looks beautiful "After All These Years."

Much of the success of *Proof* goes to Burnett's band, which includes Alpha alumni David Mansfield and David Minor plus some brilliant work from Peter Gabriel's drummer Jerry Marotta. Guest musicians include former Bowie sidekick Mick Ronson, Tom Petty's

drummer Stan Lynch on one cut, Ry Cooder on another, Richard Thompson on mandolin on yet another, additional Alpha Band alum Steven Soles, and, most notably, Pete Townshend on three cuts. Reportedly, Townshend liked "Fatally Beautiful" so much that he insisted he be allowed to play on it if Burnett got to use him at all. On that cut, he delivers a scorching, signature lead-guitar part. I can understand Pete's insistence, for this is one song he probably wishes he had written himself.

On this album's cover is a pair of *film noir* detective shots, with Burnett properly attired in trenchcoat and sideways glances. These shots set the tone for the album's cynical, gritty sideways points of view. *Proof through the Night* is not an album of pretty songs and cheery thoughts. It is an album of songs with substance that will come back and haunt you, as only the most probing and daring do.

Michael Tearson



Heart

Passionworks: Heart
Epic QE 38800.

Sound: B Performance: B

To describe the last couple of Heart albums as disappointing is a massive understatement. Not only was there great upheaval in personnel, but Ann and Nancy Wilson's gift for lacy-edged hard rock was replaced by a very self-conscious and precious artsiness.

Passionworks happily corrects the misdirection, as it's one of the band's strongest albums. "How Can I Refuse"

is a song that only improves with repeated listenings, insinuating itself into your memory. In other words, it is a natural-born hit song. "Sleep Alone" works similarly, while "Allies" is a touching and lovely ballad.

Keith Olson's production has helped the band clarify and simplify the material. Thus, his role is much the same as it was on the breakthrough albums of Fleetwood Mac.

Understand that I still can't see Heart as a heavyweight, important band, but the world needs welterweights, too.

Michael Tearson

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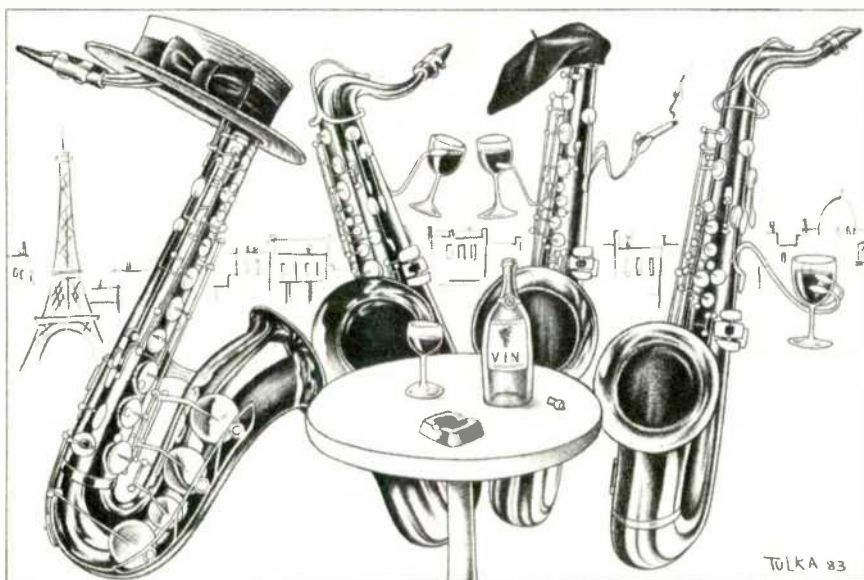
While this display may give the SX-60 a futuristic appearance today, you can rest assured that 10 or 15 years from now, it will fit right in.



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Illustration: Rick Tulka



Glazunov: Saxophone Quartet; Du-bois: Quartet; Bozza: Andante and Scherzo. Netherlands Saxophone Quartet.

Nonesuch 71410, \$5.98.

The old Nonesuch, the first major importer of classical European tapes for low-cost American LPs, continues as one of three current Nonesuch lines, from digital LP down. The cost of the low-priced line is even more economical, allowing for inflation, than the original releases of the early 1960s, as you will note above.

Suddenly—why? There has been a great spate of saxophone recordings, strictly classical. At one point a few months back I counted something like 17 waiting for my attention. (No—I will not write about all 17. Too much.) We seem at last to remember that the sax was originally a classical instrument and nothing else, used by many composers, mainly in France (Monsieur Sax himself was French) but also wherever French music was esteemed, as in Russia. Then, in the 1930s and earlier, the sax became the ubiquitous and indispensable sound for practically all pop music, from commercials to low-down jazz—do I remember that eternal silvery-croon sound, going right along with the tenor crooners of the time! Almost nobody knew of the classical sax.

I've really been delighted with the

revived sax ensembles, such as this slightly unlikely quartet out of Dutch country. This is one of the few instruments that can play effectively together in a whole family of sizes, minus outside help, the outstanding such group being the violin family. In earlier times there were more—sackbuts (trombones), recorders, viols, krumm-horns (sounding a bit like an assemblage of black crows). Now we see that the sax is particularly apt for this—it has extraordinary classical agility, a sweet, almost vocal tone and at the same time a perfect blending; the music is very easy to listen to, the sense gets over effortlessly. To be sure, the sound is on the fruity side—but not nearly as much as you might expect. The classical sax can be as pure, almost, as the classical clarinet—which shared with its sax relatives in the big-band jazz era and before. (But there are very few clarinet-family classical works; they mix with other instruments.)

French is the overriding word in sax music—it is a very French instrument. This recording is basically French, even the Glazunov, composed in his last years, but in a style that is pre-Impressionist, with nice echoes of César Franck and D'Indy and such. Glazunov was Russian, and a Theme and Variations here will remind you of that, a touch o' Tchaikovsky and Arensky and Glière and Borodin! So—interest-

ing, glib, easy music, beautifully played, well constructed. All hail the Sax family.

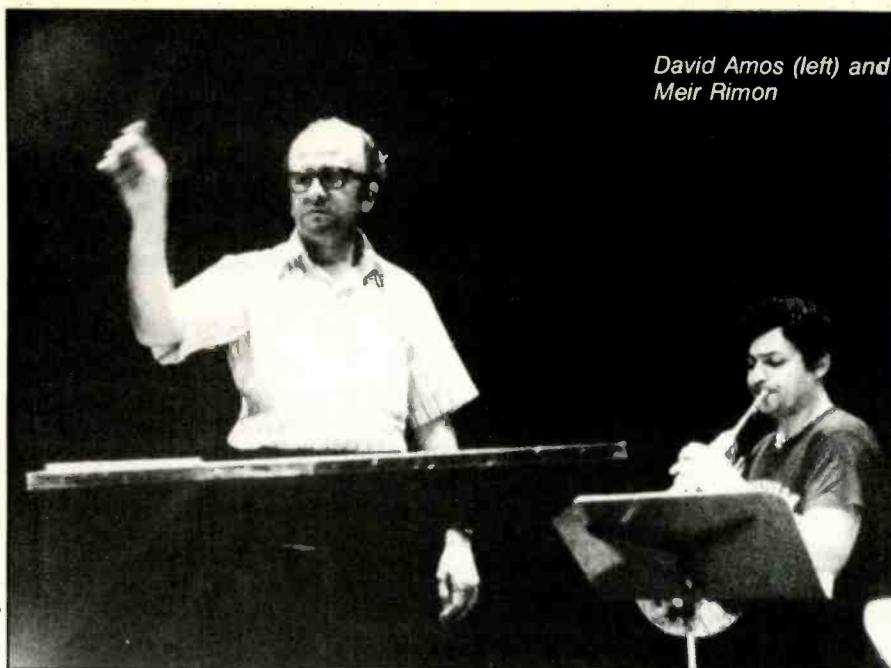
Richard Adler: Wilderness Suite. The Utah Symphony Orchestra, Ketcham. **RCA ARL1-4726, \$9.98.**

Dedicated to the National Park Service and to wildernesses in general (we assume before Mr. Reagan's administration), the goals of the music are worthy and, of course, very much of the moment. The composer is out of big-time TV, Presidential advisorships and much, much more. The music is the most dismal classical corn I have heard since the last similar sort, the day before yesterday.

It seems we must shave down our new and really popular classical music to match our nationally low classical appreciation. The average! What you do is to compose stuff that *sounds like* classical music in a moody sort of way (and has all sorts of non-music connections, like the detailed scenery in this piece, all described in detail on the album's back side)—yet the stuff has no observable musical content. Just a bunch of slick, smooth platitudes at 27th remove, handed down from the legendary past or something. It is what I can only call *nothing music*—written, performed, sponsored and recorded with enormous effort and at great expense. It'll sell, no doubt.

Charles Ketcham





David Amos (left) and Meir Rimon

The Hovhanness shouldn't be good music; it isn't modern at all. Yet it pleases beyond expectations.

The originator of this sort of music would seem to have been Ferde Grofé in the Grand Canyon Suite, sometime way back in the '30s. My youthful ears didn't even like that one (I being a college music student), but at least it was an original that started a trend, if a downward one. Compared to this stuff (my poison, remember), Grofé's rambles in the big ditch are sheer Beethoven. See for yourself.

Quiet Moods. Music of Hovhanness, Glazunov, Saint Saëns, Rooth and Zorman. Members of The Israel Philharmonic, Amos; Meir Rimon, horn.
Crystal S507, \$8.98.

Some record producers seem unaware that an LP or equivalent cassette is not merely a reference filing of pieces of music. Rather, it is basically a show, an entertainment, with shape,

continuity, contrasts, cohesion and so on. Crystal understands. This label is particularly good at working up a show out of related material, which is one good reason I keep coming back to their records.

Quiet Moods—exactly. All the music is for French horn, with orchestra. The music exploits the kind of horn sound that is pensive, thoughtful, almost far away and unfathomable, coming from who knows where, so to speak, to visit with the orchestra.

The major work is an unusual one by that curious, Boston-based, American composer out of Armenia, Alan Hovhanness—just one more of his dozens of moodful, vaguely oriental works, languid colors and counterpoints floating around a few simple repetitive harmonies. It shouldn't be good music; it isn't modern at all. And yet he always pleases beyond expectation. Like Sibelius, not as obvious as he may seem at first. On side one, this music is followed by a fruitier, juicier bit by Saint-

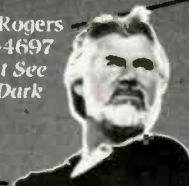
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RCD1-4459 Tchaikovsky: Capriccio Italien; Mussorgsky: A Night On Bald Mountain; Dukas: Sorcerer's Apprentice; Enesco: Roumanian Rhapsody No. 1; Eduardo Mata, Dallas Symphony Orchestra

RCD1-4550 Orff: Carmina Burana, with Hakon Hagegard, Barbara Hendricks, John Aler; Eduardo Mata, London Symphony Orchestra and Chorus

RCD1-4551 Gershwin: An American in Paris, Cuban Overture, Porgy And Bess—A Symphonic Picture; Eduardo Mata, Dallas Symphony Orchestra

RCD1-4621 Mozart: Die Zauberflöte (highlights); Cotrubas, Tappy, Boesch, Talvela, Vienna Philharmonic Orchestra, Vienna Staatsoper Chorus, James Levine

RCD1-4622 Handel: Messiah (highlights); Richard Westenburg, Musica Sacra: soloists Judith Blegen, Katherine Cesinski, John Aler and John Cheek

RCD1-4748 Williams: Return of the Jedi (music from the John Williams score); Charles Gerhardt, National Philharmonic Orchestra

RCD1-4194 "Hooked On Classics," Louis Clark conducting the Royal Philharmonic Orchestra

PCD1-4681 "Sweet Dreams (Are Made Of This)," Eurythmics

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You can imagine in the sound the careful French posture, the almost-too-upright head, the pursed mouth. . . .



Jean-Claude Malgoire

Saëns (who composed music as a pear tree produces pears, he said of himself), which makes a good companion. The three short works on side two are somewhat more varied, perhaps on a mildly lower plane, but with just the right amount of contrast to keep you awake (but quiet) and never bored by too much horn sound. The Israeli performance—really excellent horn—is matched by knowledgeable recording, placing the solo where it blends easily with the orchestra. Very fine mood music.

L'Apothéose de la Danse à Versailles. French dances by Rameau, Lully, Couperin, Marais, Rébel. La Grande Ecurie et la Chambre du Roy, Malgoire.
CBS M 37822.

Curious how French the French manage to be! In the very sound and organization of a recording like this one, not to mention the terminology.

Even the "authentic" old-timey orchestra, as of mainly Louis XIV and the court centered at Versailles, is titled out of the period itself—The Grand Stabile and the King's Chamber. They had fancy names for everything.

Well, we've had plenty of old music played by orchestras with assorted instruments of this period or that, but in half a minute you'll know this is—somehow—different. It's *French*. A different sound! Not to be described in words, but interesting. It is (for a try) sharp-edged, brittle, intense and precise, stylized, not a bit relaxed, brilliant if you wish. The opposite of German music. You can almost imagine in this sound the careful posture, the almost too-upright head, the slightly self-conscious look, the pursed mouth, the neat, controlled walk, that to this day characterize most French, of almost any type from farmer to Parisian. It comes straight through in the way the music is played—and, of course, in the music itself, just a sampling from a

considerable list of grand dramatic court productions that were full of formal dance music. You may find all this requires a bit of getting used to. Let it play a good while, though, and you will begin to adjust to the French way, whereupon things begin to please, not perplex.

Don't be scared by CBS's dizzily inconsistent menu for the music, about as confusing a layout as I've ever seen. Just listen. It's Baroque, French-style.

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COMPACT DISCS

BERT WHYTE
JOHN M. EARGLE
C. VICTOR CAMPOS

HUNGARIAN GOULASH



Digital Masterpiece Series, Disc Two. The Philharmonia Hungarica, Zoltan Rozsnyai.
RealTime RT-2003.

This is another of RealTime's Compact Discs featuring a potpourri of selections recorded by the Philharmonia Hungarica conducted by Zoltan Rozsnyai.

Thus, there are such works as Tchaikovsky's "Romeo and Juliet," Debussy's "Fetes" and "Prelude to the Afternoon of a Faun" and Rimsky-Korsakov's "Procession of the Nobles from Mlada." The really unusual work is Alberto Ginastera's "Panambi Suite." This work, by an Argentinian composer, has often been referred to as the South American "Rite of Spring." It does indeed employ some atonality and dissonances in the manner of Stravinsky, especially in the second movement, scored solely for brass and percussion. (I recorded "Panambi Suite," with Sir Eugene Goossens conducting the London Symphony Orchestra, in 1958. I can attest to the difficulty of obtaining the exotic percussion instruments for the "Invocation of the Powerful Spirits" movement!)

The sound on the Compact Disc is very clean and wide in dynamic range.

This is especially apparent in "Panambi Suite," whose exotic and colorful scoring greatly benefits from these qualities as well as from the noiseless surfaces.

Here again, engineer Kenny Kreisler used a simple spaced-array stereo mike setup with his modified AKG C-414 microphones. The acoustical perspective is the same as in the other Philharmonia Hungarica recordings in this series—spacious, but not over-reverberant.

Finally, I must say that while the performances and the orchestral playing leave something to be desired, the sonic values are really excellent. At least one can hear decent, clean string tone in these recordings! *Bert Whyte*

Lalo: Symphonie Espagnole; Berlioz: Reverie et Caprice. The Orchestre de Paris, Daniel Barenboim; Itzhak Perlman, violin.

Deutsche Grammophon 400 032-2, \$17.95.

This CD showcases the outstanding virtuosity of the great Itzhak Perlman. As we have come to expect from this consummate violinist, the performances are near definitive in their musicality and execution. Perlman has

perhaps a shade too much projection in front of the orchestra. Unfortunately, his glorious tone has been altered by something in the microphone setup, for his violin sounds honky and nasal and as if it were in a somewhat different reverberant field than the orchestra. To add to the sonic woes, while orchestral detail was good, there was once again the problem of over-bright, wiry first and second violins. DGG is going to have to address this problem—and soon.
Bert Whyte

Mozart: Eine Kleine Nachtmusik (Serenade in G Major) K.525; Grieg: Holberg Suite, Opus 40; Prokofiev: Symphony No. 1 in D Major "Classical" (1916-1917). The Berlin Philharmonic, Herbert von Karajan.
Deutsche Grammophon CD 400 034-2, digital.

Performance: Variable Recording: C

The first thing that strikes me is that the Viennese character that is so wonderful in this universally loved Mozart piece is completely supplanted by a fundamentally Germanic flavor. Though von Karajan seems able to do no wrong, he dispatches this piece almost superficially, with perhaps too much familiarity. The orchestral playing is su-

Itzhak Perlman



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Mamba Percussions uses an incredible array of instruments, including many exotic varieties.

perb and the balances are excellent, although it is such a clean recording that the peaks in the microphones are clearly heard, putting a sharp edge on the strings. In turn, this is exacerbated by close microphoning. There is also very little energy above 10 kHz in the recording, while the hall appears dry.

The Holberg Suite probably fares the best in this collection. Lovely as the music is, as presented, it bores, almost as if von Karajan were not into playing this music; and the second movement is a little too rushed for my taste. Although the balances are very good, the wonderful sense of the roundness

of a string orchestra is missing here. The extreme top end is missing, and there is very little hall sound.

The "Classical" Symphony is listed as having been supervised by Michael Glotz (von Karajan's manager) as opposed to Gunter Breest for the previous selections. And the sound is different. This is a very dry recording, with almost no hall sound, no extreme highs, exaggerated dynamic contrasts (probably the result of very close microphone technique which magnifies the differences between pianos and fortes), and shrieking strings. The overall sound was unpleasant, particularly over headphones.

The orchestral playing here is superb but it lacks charm, and the interpretation appears detached. The third movement, the Gavotte, sounds musically elephantine.

A comparison with the analog disc revealed the same sonic character. The only things different were the slight surface noise and pops not missed in the CD playback. C. Victor Campos

Mamba Percussions: Jean-Claude Kerinec, Staff Elmeddah.

disques Pierre Verany PV78291. Available through AudioSource, 1185 Chess Dr., Foster City, Cal. 94404.

Although it is well known that there is a shortage of CD software and that many record companies are having difficulties in converting their master tapes into CDs, it is amazing to find them issued by some small and generally offbeat record companies.

AudioSource of California, a well-known record importer, has been bringing in the recordings of disques Pierre Verany, a small French audiophile label which has released three of their recordings in the CD format—*Mamba Percussions*, *Sortileges de La Harpe* and *Vivaldi: Quatre Concertos Pour Orgue*. I must say, I am quite impressed by the sonic qualities of these CDs.

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Freddie Hubbard's *Back to Birdland* is a pop CD recording of outstanding realism which showcases the players' talents.

semble which uses an incredible array of instruments, including many exotic varieties. All are used in various combinations in the 11 selections on this CD. Thus, we hear drums of every type—congas, bongos, tom-toms—along with cymbals of every kind, various blocks, rattles, ratchets, bells, whistles,

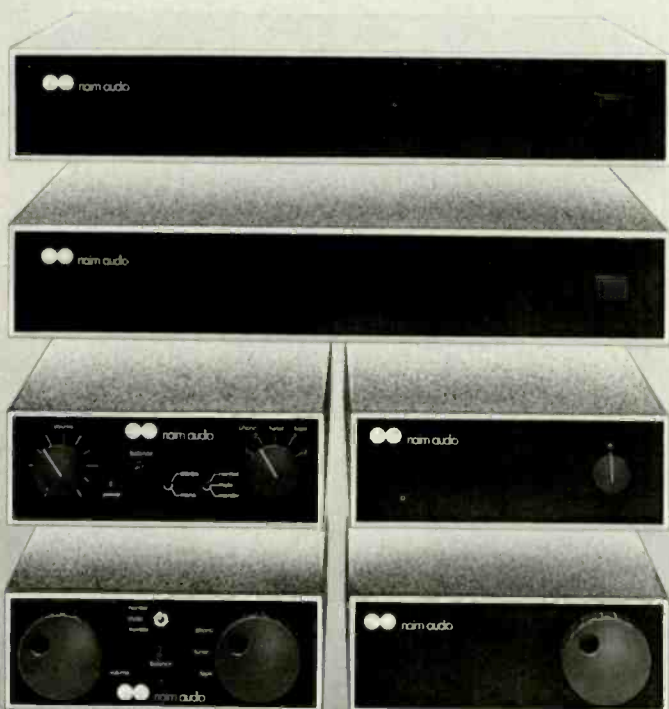
gongs, and others too numerous to mention. These instruments are recorded rather close-up but in a spacious, artificial, reverberant field. The recording is ultra-clean with very high definition. The characteristic timbres of the various drums, etc. are reproduced with startling fidelity. There are num-

bers in which the drums are projected with great power. There are other numbers where exotic bird calls, whistles, and bells at very high frequencies are used in very quiet and subtle ways which would not be possible in their proper perspective without the noise-free background of this CD.

Musically, there is not much substance here, but for an exciting sound with a veritable feast of percussion transients, this disc is highly recommended.

Bert Whyte

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Freddie Hubbard

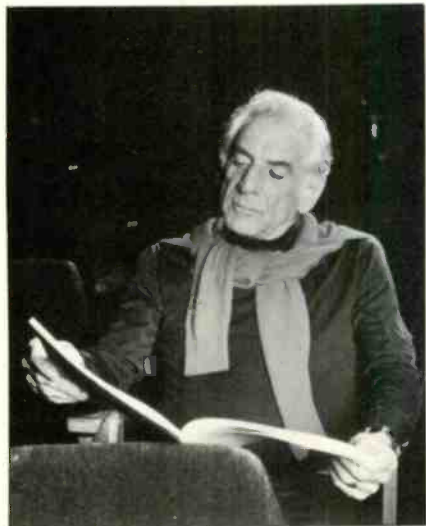
Freddie Hubbard: Back to Birdland. RealTime RT-3005.

This is a pop CD recording of outstanding realism. Freddie Hubbard is an exceptional trumpet and flugelhorn player who has brought together some fine sidemen, including the redoubtable John Dentz on drums, to form a really swingin' group.

Of the six numbers on the disc, only "Star Eyes" and "Stella by Starlight" are familiar to me, with the latter featuring superb, darkly sonorous double trombone playing by Ashley Alexander. The other four numbers apparently are originals. All get hard-driving, uptempo treatment that showcase the talents of the players. You'll not find any raucous "fuzz-boxes" here, but good straightforward jazz with punchy, clean sound instead. From the bril-

Bernstein offers an unabashedly romantic performance of Franck's Symphony in D Minor, without oversentimentalizing it.

liance of Hubbard's trumpet to the sharp, explosive transients of Dentz's drum set, the sound has compelling realism. The acoustic perspective is close up, with just a smoothing touch of reverberation. Enthusiastically recommended. *Bert Whyte*



Leonard Bernstein

Franck: Symphony in D Minor; Saint-Saëns: Le Rouet d'Omphale. The Orchestre National de France, Leonard Bernstein. Deutsche Grammophon 400 070-2, \$17.95.

Franck's D minor symphony is not performed much these days. With its cyclical structure, a less skillful conductor will make this work seem rather turgid and overblown.

No problems of this sort with Leonard Bernstein. He offers an unabashedly romantic performance, but avoids oversentimentalizing the work, and thus sustains interest. He also coaxes some fine playing from the Orchestre National de France, with notable quality from the low strings which are so important in this score.

Alas, in matters of sound, Maestro Bernstein continues to be poorly served on CDs. The sound here is not as bad as it was on his recordings of the Shostakovich and Prokofiev 5th Symphonies, but it still is not fully satisfactory. As usual, the main drawback is the stridency and wiriness of the high strings and, to a lesser degree, the

trumpets. Too bad, for there are some fine sounds as well. For example, the opening of the second movement has the string body, along with a harp, playing a hushed pizzicato which is very clean and detailed and wonderfully atmospheric. Another good point is the rich sonority of the cellos and con-

trabasses. The filler on this CD is the rarely played "Omphale's Spinning Wheel," which receives a neatly structured reading that inexplicably fares better in matters of sound than the symphony.

This was recorded during a concert at the Theatre des Champs Élysées in

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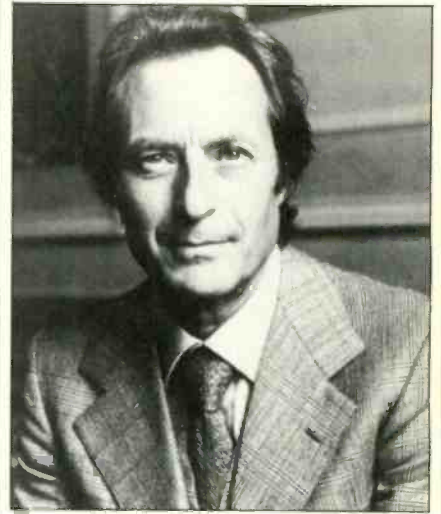
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Paris, with hardly a hack or cough from the astonishingly quiet audience. In sum—a fine performance marred by sonic anomalies. *Bert Whyte*



Carlo Maria Giulini

Schumann: Symphony No. 3 (Rhenish); Manfred Overture. The Los Angeles Philharmonic Orchestra, Giulini. **Deutsche Grammophon 400 062-2.**

This recording has a somewhat distant perspective which is unusual in recent DGG recordings, but it is entirely appropriate to this music. The strings have a lovely burnished sound, and woodwinds and brass are aptly balanced with them. Giulini finds himself entirely at home with the music, and his reading clears many of the thickets in Schumann's orchestration.

I know of no hall in the Los Angeles area which has as long reverberation time as is apparent in this recording. I will infer, therefore, that some artificial reverberation has been added quite effectively. This was once taboo, but today's high-quality signal processing equipment makes it possible to an extent that might shock many audiophiles. *John M. Eargle*

Haydn-Boccherini: Cello Concertos. The Netherlands Chamber Orchestra, Michi Inoue; Mari Fujiwara, cello. **Denon 38C37-7023, \$17.95.**

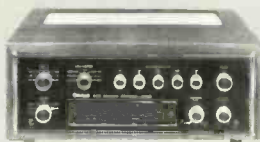
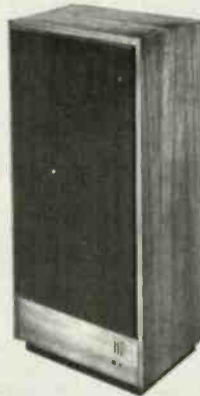
A pleasant little recording of the Haydn D major, Op. 101, and Bocche-

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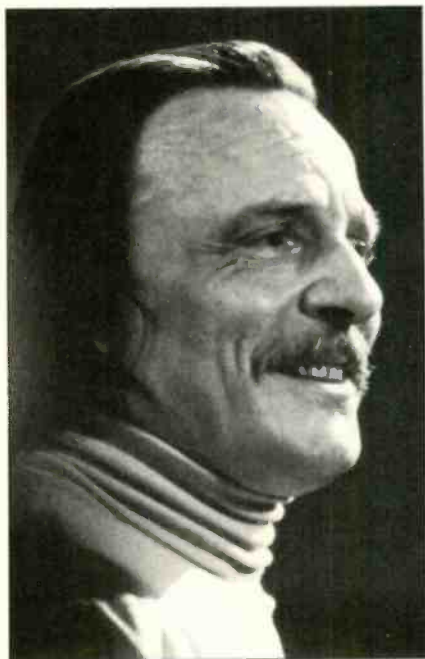
Giulini finds himself entirely at home with the music, and his reading clears many of the thickets in Schumann's orchestration.

rini B flat major cello concertos. Mari Fujiwara is the cellist, and Michi Inoue conducts the orchestra.

This is most likely a pickup orchestra organized for this recording, but no matter. The accompaniment is quite good, and they have a fine rapport with Miss Fujiwara. The lady plays and furnishes enjoyable performances, even if her tone is not on a par with the likes of Rostropovich.

Laudably, the Denon engineers tried to keep the cello sound from being excessively forward. They went a shade too far the other way at times, however, and the cello was a bit swamped by the orchestra. Otherwise a good balance is struck in a warm, spacious ambience. Sound is generally clean, with high strings just a bit overbright. These small-scaled works benefit greatly from the noise-free recording.

Bert Whyte



Arturo Benedetti Michelangeli

Brahms: Four Ballads, Op. 10; Schubert: Sonata, A Minor (D.537). Arturo Benedetti Michelangeli, piano.
Deutsche Grammophon 400 043-2.

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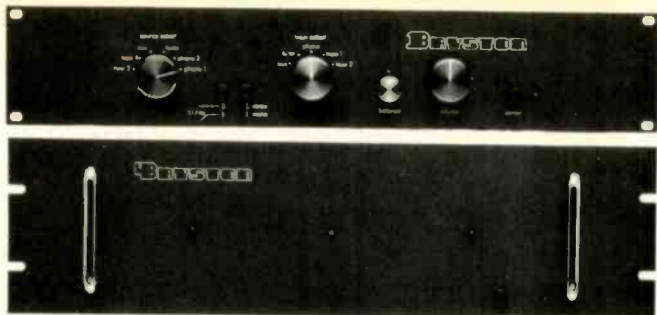
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out, and always some residual off-center in the pressing operation, which produces wow or once-around pitch variation. Here, we can enjoy a real piano sound with no distortion or noise and with rock-solid time base stability. Most listeners will have never heard a piano recording as clean as this one.

Michelangi's introspective playing is stylistically on course, and the Brahms is ravishing. A CD triumph.
John M. Eargle



Herbert von Karajan

Richard Strauss: An Alpine Symphony. The Berlin Philharmonic, Herbert von Karajan.
Deutsche Grammophon 400 039-2, \$17.95.

The monumental Alpine Symphony of Richard Strauss is rarely performed, one of the major reasons being the requirement for a huge, 135-piece orchestra.

This sprawling work abounds in atmosphere, from ethereal depictions of various aspects of nature, to the terrifying sonorities (including shrieking wind machines) of a tremendous thunderstorm! The violently contrasting dynamics of the score are easily handled by this CD recording.

The Berlin Philharmonic plays magnificently, and von Karajan's performance is inspired. Alas, however, the sound is not satisfactory, being marred by the excesses of close-up multi-miking. The first and second violins are so fiercely strident they'll make your ears bleed! I simply cannot understand how DGG engineers and producers can listen to this quality. Surely, even the poorest monitor speakers would enable them to hear this catastrophically bad string sound. What a shame!
Bert Whyte

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FILLING THE VACUUM

Saga of the Vacuum Tube by Gerald F. J. Tyne. Howard W. Sams & Co., \$9.95.

I had expected *Saga of the Vacuum Tube* to be another, rather typical radio collector's booklet, chock full of old advertisement reprints, photos of old tubes, and "gee whiz, weren't they funny looking" statements. No way! Gerald F. J. Tyne wrote this book as an associate of the Smithsonian Institution. Its 494 pages consist of detailed histories of every manufacturer of vacuum tubes in our first three decades. Careful attention is paid to the early development stages and physics of the vacuum tube. Many laboratory pages are reprinted along with their sketches.

If I were to compare *Saga of the Vacuum Tube* with any other work in the technical historical field, I would have to compare it with *From Tinfoil to Stereo* by Read and Welch, first published a generation ago. That book is probably still looked upon by phonograph collectors and historians as the most authoritative and detailed work ever published on the subject. *Saga of the Vacuum Tube* is definitely the most scholarly book ever written on the development of the vacuum tube. While its style is very reminiscent of *Tinfoil*, I found its technical information to be greater.

I do not expect another book on this subject published in the near or distant

future to cover the subject as well as this one. *Saga of the Vacuum Tube* is definitely the most authoritative book to date on the subject, and one that cannot be too highly recommended.

Michael N. Stosich

How to Make & Sell Your Own Record by Diane Sward Rapaport. Quick Fox, \$9.95.

The Musician's Guide to Independent Record Production by Will Connelly. Contemporary Books, \$6.95.

The phenomenon of the small, independent record company pops up every few years during a surplus of talent and a scarcity of record-industry signings. Small entrepreneurs, who see the possibility of big bucks or who have friends with talent, realize that the amount of money needed to press a record is relatively small, and believe the gain from a successful record can be absolutely enormous. This, along with bands which have a grand or so to spare and are frustrated with current record industry disinterest, created a spate of records released by totally unknown record labels. Although this may seem like an easy way to deal with the situation, nobody gets rich off these records and, at best, the indie is a vehicle for promotion which may get one the attention of a major label. The record industry is simply too well-organized and run by too many big-money interests to allow serious competi-

tion from outsiders. And if you think that you can have a hit because your music sounds like it'll go, even if there's no money behind you, you are sadly mistaken. Success in the music business requires a strong financial base.

With this in mind, books such as these may be useful for anyone who wants to put out his own record. The Rapaport book is by far the better of the two, as it has a well-researched, expertly organized, and realistic approach. It is relatively complete, and even has sample forms of the paperwork involved. Ms. Rapaport is well aware of the state of the industry and doesn't advise the reader to expect the world from one record. She describes the process by which one can get the most out of an effort, how to cut costs effectively, and what the priorities ought to be. The Connelly book, on the other hand, is written by someone unfamiliar with the ins and outs of record production and manufacturing in the 1980s, and it is loaded not only with outdated information but also with misinformation. The author seems to have the ludicrous notion that anyone with good music has a decent shot at a hit record via independent record production. That simply isn't true. Putting out your own record is basically a rewardless task. One should expect the least, otherwise there's almost bound to be disappointment.

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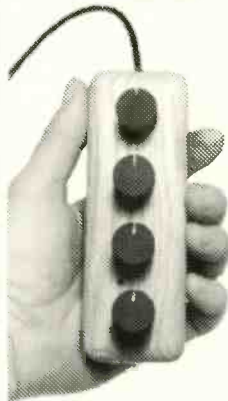
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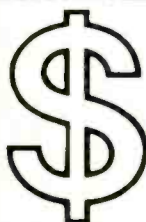
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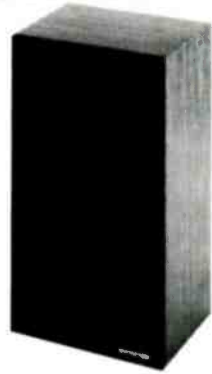
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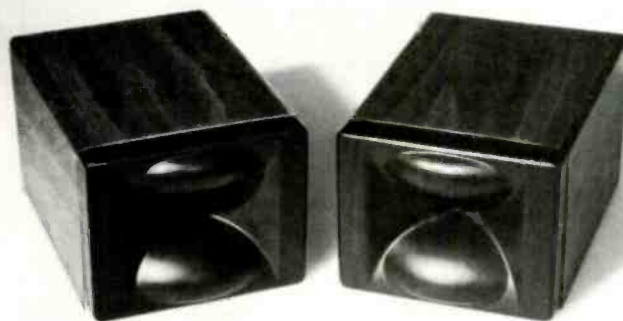
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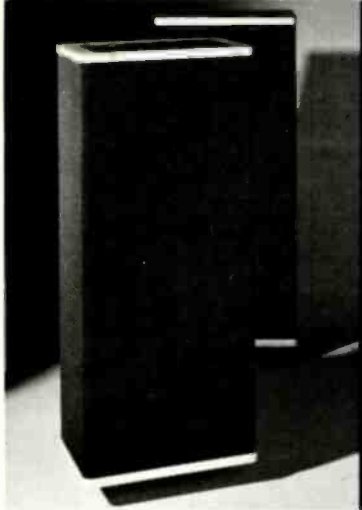
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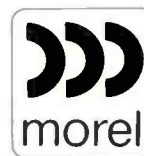
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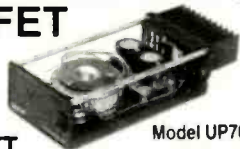
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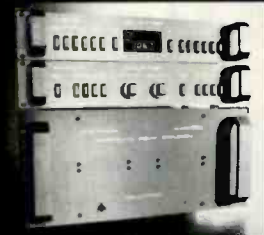
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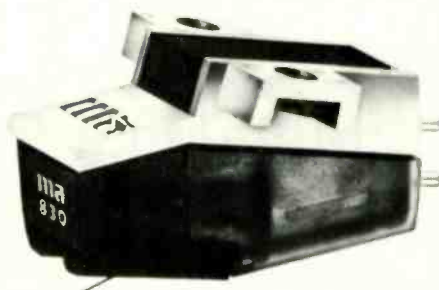
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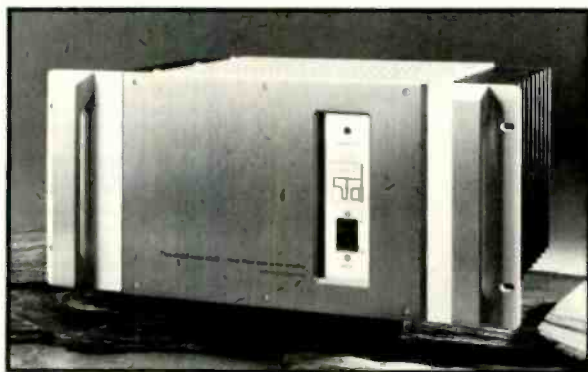
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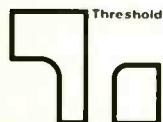


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