INEER BUILT IT SOONER.

D, DUAL CAPSTAN CASSETTE DECK THAT OFFERS -DOLBY,® A DIGITAL BRAIN AND BIASING BY EAR.

ontrol what you monitor.

The CT-F900 allows you to bias by r. Which means you have almost as ch control over your tape deck as would over any other musical strument.

By simply switching between the Source and Tape monitors and adjusting your bias control, you can make sure that what comes out of your cassette deck is as clean and crisp as what went into it.

FEATURES OTHERS DON'T EVEN OFFER.

These are just a few of the features that will soon change the face of all cassette decks. The CT-F900 also offers features like a double Dolby® noise reduction system that eliminates noise in both record monitoring and playback. And reduces tape hiss to −64 dB. Solenoid push button controls that give you direct function switching so you can go directly from one mode to another without damaging the tape. A two motor, dual capstan drive system that gives you stable head contact, constant tape movement, and an inaudible 0.04% wow and flutter. And circuitry that lets you hook the CT-F900 to an external timer so you can make recordings even when you're not there.

Obviously, all that went into the CT-F900 sounds impressive. But it's not half as impressive as what comes out of it.

Given all this, it's not surprising that sooner or later all cassette decks will be built along the lines of the CT-F900.

But even then there will be that fine line that has always separated Pioneer from the competition.

Value.

PIONEER®
We bring it back alive.

Wood cabinet optional.

ONCE AGAIN, PI

THE CT-F900. THE FIRST 3-HEADE FLUROSCAN METERING, DOUBLE

Innovation is nothing new to Pioneer.

We were the first to introduce the high power receiver. Sooner or later everyone followed.

We were the first to create the front loading cassette deck. And the first with a quartz lock loop turntable that was as easy on the budget as it was on the ear. Again, our competition had no alternative but to follow.

So now that Pioneer introduces the CT-F900, we expect that soon there'll be a few rushed-through imitations that have our look. But not our value.

This is no small coincidence. And it's nothing we're unaccustomed to. It's a simple case of follow the leader.

A METERING SYSTEM AS FAST AS THE SPEED OF SOUND.

Conventional cassette decks are all plagued with the same problem. Either they have slow to react VU meters that give you average readings or slightly more advanced LED's that give you limited resolution.

Pioneer offers a better resolution. A Fluroscan metering system that's so fast and so precise, it provides a more accurate picture of what you're listening to.

It covers the range of −20 dB to +7 dB in 20 easy-to-read calibrations. And while other meters may work within that same range, in terms of precision they're not even in the same neighborhood.

The CT-F900 has a Peak Button that lets you register all the peaks in the incoming signal. And lets you register an unheard of level of harmonic distortion. Less than 1.3%.

A Peak Hold Button that retains the highest peak level in each channel. So you can record at the highest level possible without fear of overload.

And an Average Button that makes the Fluroscan meter respond like an ordinary level meter.

A DIGITAL BRAIN WITH AN INCREDIBLE MEMORY.

All cassette decks have tape counters. Even the most respectable ones have mechanical counters you can't really count on.

Pioneer's designed the most precise electronic way of keeping track of your tracks.

As the take up reel rotates, pulses are fed to a microprocessor which provides a three digit readout on an electronic tape counter.

The terminology may be difficult to understand, but the benefit of all this is simple. Precision. Dependability. And convenience.

Many of these "better" cassette decks also claim they have advanced memories. But there are functions that even the best of them haven't been programmed to remember.

The CT-F900 has the first electronic memory of its kind that performs four different functions.

Memory Stop automatically stops the tape wherever you select. Memory Play rewinds the tape to this spot and then automatically goes into the play mode. Counter Repeat rewinds the cassette when the end of the tape is reached. Then begins replaying the tape wherever you want it to begin. End Repeat automatically rewinds the tape. And then replays it from the beginning for endless listening.

WE'RE HARD HEADED, BUT SENSITIVE.

Every audiophile will agree that to achieve professional quality recording, three heads are better than two.

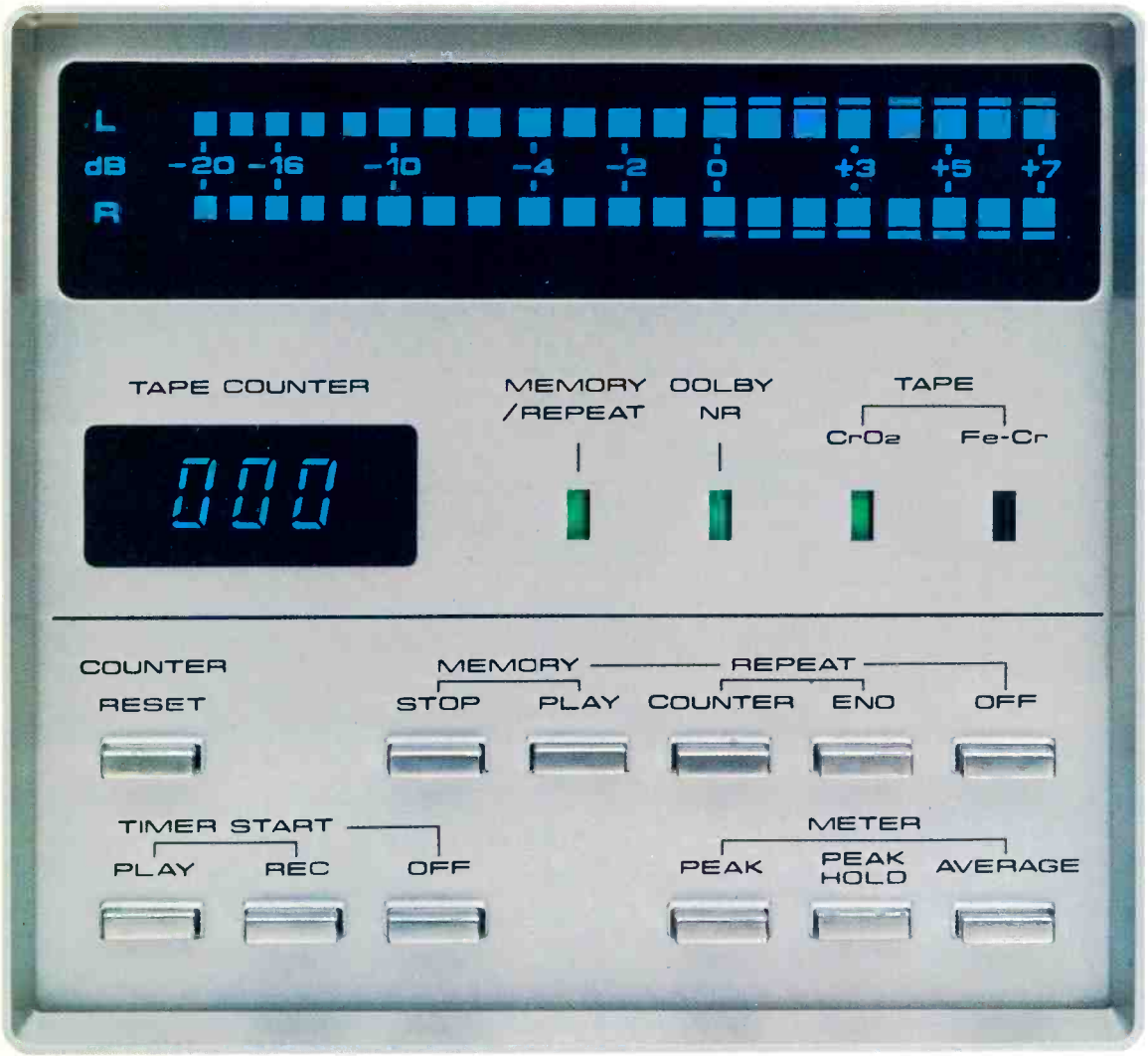
And while you can expect three heads from most reputable cassette decks, you can also expect that they're either made of ferrite or permalloy.

The CT-F900 has recording and playback heads made of a newly developed Sendust Alloy. This remarkable bit of technology gives you higher frequency response (20-19,000 Hz.) and lower distortion than ferrite. And better wear-resistance than permalloy.

BIASING BY THE MOST SOPHISTICATED AUDIO EQUIPMENT KNOWN TO MAN. HIS EARS.

While many of today's "equipped" cassette decks let you monitor during recording, what they don't do is let you

SOONER OR LATER,
ALL CASSETTE DECKS
WILL BE BUILT
ALONG THESE LINES.



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April 1979 Vol. 63, No. 4

Audio

"Successor to RADIO Est. 1917"

Feature Articles

Equipment Profiles

Record Reviews

Audio in General

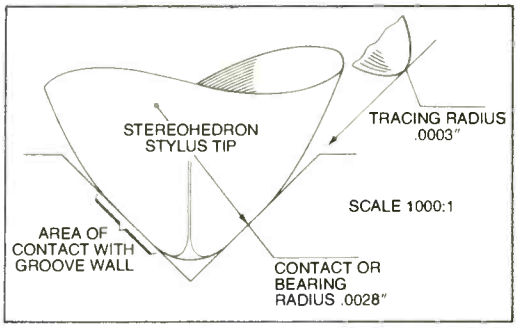
About the Cover: You don't need a pair of knitting needles to get tight, close-knit sound from your tape deck. Catch up the raveled ends in your tape system by reading "Phase, Time, Ears, and Tape" by William A. Manly and "Build a Tape Deck Switching Box" by John T. Peer. Photo by Photographic Illustrations, Philadelphia.

Audio Publishing, Editorial, Subscription, and Advertising Production offices, North American Building, 401 No. Broad St., Philadelphia, Penna. 19108. Telephone: 215/574-9600. Postmaster: Send Form 3579 to above address.

The XSV/3000 is the source of perfection in stereo sound!

Four big features ... all Pickering innovations over the past 20 years ... have made it happen.

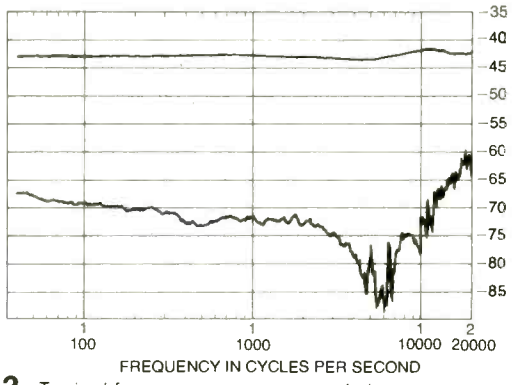
1976: Stereohedron® This patented Stylus tip assures super traceAbility™, and its larger bearing radius offers the least record wear and longest stylus life so far achievable.



1. *Technical drawing of the Stereohedron shape.*

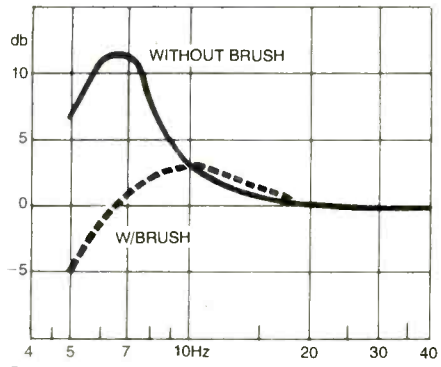
1975: High Energy Rare Earth Magnet
Another Pickering innovation, enabling complete miniaturization of the stylus assembly and tip mass through utilization of this type of magnet.

1968: Dustamatic® Brush
This Pickering patented invention dynamically stabilizes the cartridge-arm system by damping low frequency resonance. It improves low frequency tracking while playing irregular or warped records. Best of all, it provides record protection by cleaning in front of the stylus.



2. *Typical frequency response and channel separation curves of the XSV/3000.*

1959: Record Static Neutralizer
The patented V-Guard Record Static Neutralizer has been a feature of all Pickering cartridges since 1959. It eliminates electrostatic dust attraction at the stylus and discharges record static harmlessly into the grounded playback system.



3. *Damping effect on tonearm resonance.*

4. *V-Guard Static Neutralizer, "Where the Stylus meets the groove."*

PICKERING
"for those who can hear the difference"

For further information write to Pickering & Co., Inc., Dept. A , 101 Sunnyside Blvd., Plainview, N.Y. 11803

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INTRODUCING THE EMPIRE EDR.9 PHONO CARTRIDGE. IT SOUNDS AS GOOD ON A RECORD AS IT DOES ON PAPER.

It was inevitable . . .

With all the rapid developments being made in today's high fidelity technology, the tremendous advance in audible performance in Empire's new EDR.9 phono cartridge was bound to happen. And bound to come from Empire, as we have been designing and manufacturing the finest phono cartridges for over 18 years.

Until now, all phono cartridges were designed in the lab to achieve certain engineering characteristics and requirements. These lab characteristics and requirements took priority over actual listening tests because it was considered more important that the cartridges "measure right" or "test right"—so almost everyone was satisfied.

Empire's EDR.9 (for Extended Dynamic Response) has broken with this tradition, and is the first phono cartridge that not only meets the highest technological and design specifications—but also our demanding listening tests—on an equal basis. In effect, it bridges the gap between the ideal blueprint and the actual sound.

The EDR.9 utilizes an L. A. C. (Large Area Contact) 0.9 stylus based upon—and named after—E. I. A. Standard RS-238B. This new design, resulting in a smaller radius and larger contact area, has a pressure index of 0.9, an improvement of almost six times the typical elliptical stylus and four times over the newest designs recently introduced by several other cartridge manufacturers. The result is that less pressure is applied to the vulnerable record groove, at the same time extending the bandwidth—including the important overtones and harmonic details.

In addition, Empire's exclusive, patented 3-Element Double Damped stylus assembly acts as an equalizer. This eliminates the high "Q" mechanical resonances typical of other stylus assemblies, producing a flatter response, and lessening wear and tear on the record groove.

We could go into more technical detail, describing pole rods that are laminated, rather than just one piece, so as to reduce losses in the magnetic structure, resulting in flatter high frequency response with less distortion. Or how the EDR.9 weighs one gram less than previous Empire phono cartridges, making it a perfect match for today's advanced low mass tonearms.

But more important, as the EDR.9 cartridge represents a new approach to cartridge design, we ask that you consider it in a slightly different way as well. Send for our free technical brochure on the EDR.9, and then visit your audio dealer and listen. Don't go by specs alone.

That's because the new Empire EDR.9 is the first phono cartridge that not only meets the highest technological and design specifications—but also our demanding listening tests.

Empire Scientific Corp.
Garden City, N.Y. 11530 EMPIRE

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Audioclinic

Joseph Giovanelli

Transducer Origins

Q. The literature included with my headphones states "the transducer is a microphone-derived device." How can a microphone element be used in a headphone? — Timothy Balogh, Kingston, Pa.

A. A transducer is simply something which converts mechanical energy into electrical impulses (microphone) or converts electrical impulses into mechanical energy (loudspeaker) through movement of a coil of wire across a magnetic field. The headphone contains a miniature speaker, and an engineer for the firm that put out the literature found that a microphone assembly could be adapted for use in the headphones as a speaker element.

Delay Systems

Q. Please explain the purpose of an analog or digital delay system in high fidelity or public address applications. — James Mauro, New Brunswick, N.J.

A. A delay system can be used in quite a number of applications, depending upon the amount and type of delay it is capable of producing. In the most popular current applications, these delay systems are designed to delay sound a small fraction of second before feeding it into a pair of speakers located in the rear to create the reverberation heard in a concert hall. Most such delay units produce this effect from the standard two-channel recordings, rather than a four-channel source.

Another application is for people seated in the rear of relatively large rooms who will hear the sound from the PA in the back of the room *before* they hear the "live" sound from the stage. This is often confusing and annoying. To overcome this problem, the PA's rear sound is delayed so that the sound from the speakers and the sound from the stage are heard at the same time. In such PA installations, speakers for listeners sitting close to the stage will not be fed the delayed signal.

There are several all-electronic means by which delay is introduced. In some devices the signal is converted into digital information and shifted through a series of electronic circuits. The time needed to shift from one circuit to the next is determined by a "clock," and the speed of this clock or oscillator is variable. Thus, the time used to shift the digitized signal from one circuit to the next can be varied to produce the variable delay times. Because the signal is shifted from one circuit to another, any one of these circuits can be used as the final signal point, rather than merely extracting the signal from the far end of the chain of many such circuits or "shift registers." By extracting the signal from a point other than the far end of the chain, we have another means of varying the time delay. The output signal is then reprocessed into analog information and processed, as with any other audio signal.

The other major means of making such delay lines uses "charge coupled" devices, which are strictly analog, to produce the delays. For a discussion at this level of sophistication, there is no essential difference in what the two basic circuit types do.

As described, these arrangements would produce a single delay. You could either listen to a delayed signal alone or you could listen to the main, or direct, signal mixed with this delay. However, it is possible to introduce signals from several of the "part-way" points in the circuit, mixing all of them with the direct signal. This tends to create a more densely reverberant sound. The greater the number of such included delay points, the closer the sound will be to true reverberation, rather than distinct repeats of the original signal.

Another early and very basic delay system used two or more tape play heads, generally for PA systems where distinct repeats are called for. The space between the successive heads is often adjustable to create whatever delay times are required. Where the head spacing is fixed, the tape speed is varied to produce the same result.

Other delays can be produced by feeding the signal into something like a coiled garden hose and then extracting it at the far end. The delay is determined by the length of the tubing and the speed of sound in air. (See, "Construction of a Madsen-System Delay Tube," *Audio*, April and May, 1971.)

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 401 North Broad Street, Philadelphia, PA 19108. All letters are answered. Please enclose a stamped, self-addressed envelope.

Introducing the system that can tape itself. Tune itself. All by itself. For up to a week.

Up to now using a tape deck to record Tchaikovsky's 4th at 4 PM on one station and Beethoven's 5th at 5 PM on another was easy. As long as you were home. Now Technics makes it just as easy when you're not, with the ST-9038 quartz synthesizer FM stereo tuner and its matching SH-9038 microprocessor.

When used with the ST-9038, the SH-9038 microprocessor can be programmed to tune eight FM stations in any order, at any time, on any day for one week. In fact, the SH-9038 can be programmed to remember 32 individual steps. Starting with the day of the week, the time, the FM station and AC line on/off.

All you do is simply select the "write" mode and the SH-9038's computerized memory does the rest. Then select the "read" mode for a readout of the programs you have selected. You can also override your preselected program by switching to the manual mode. What's more, the SH-9038 can be programmed to turn on or off three other components in addition to the ST-9038 tuner.

That's what the SH-9038 microprocessor can do. What the ST-9038 quartz synthesizer tuner can do is just as impressive. Unlike conventional tuners which use a series of variable capacitors to tune in FM frequencies, the ST-9038 uses the quartz synthesizer tuning system. With this system the quartz crystal, one of the world's most accurate reference devices, becomes the reference for the local oscillator frequency and the broadcast frequency. The results: Only the frequencies on which a broadcast signal might exist can be received. At precisely spaced 200 kHz steps. And that means you don't have to worry about drift or misalignment due to temperature, time or mistuning.

The SH-9038 microprocessor and the ST-9038 tuner. Because you can't beat the memory of a computer or the accuracy of quartz.

SENSITIVITY: 1.2 μV (75Ω). 50dB QUIETING SENSITIVITY (New IHF): Mono 18.1 dBf. Stereo 38.1 dBf. THD (100% modulation): Mono 0.1%. Stereo 0.15%. FREQ. RESP. 20Hz to 18 kHz +0.1dB −0.5dB. SELECTIVITY: 75dB. STEREO SEPARATION: 45dB (1 kHz), 35dB (10 kHz). IMAGE REJECTION AT 98 MHz: 105dB.

Technics SH-9038 and ST-9038. A rare combination of audio technology. A new standard of audio excellence.

Technics
Professional Series

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Portable Auto Equipment

Q. I am working on a portable music system using equipment designed for use in my car. For home use, what kind of d.c. adaptor would I need? How much power is needed to keep the system running efficiently? — John Keller, Chicago, Ill.

A. Each separate component in your system requires a certain amount of power (of course, the speakers are not considered, for the power they require is supplied by either your amplifier or receiver, rather than from a special power supply). Because the various components are designed to operate on 12 volts d.c., we know that they must be supplied with that kind of d.c. power. The instruction manual which accompanies each piece of equipment will supply you with information as to current — number of amps — required to operate each piece of equipment. Add together the number of amperes required by each component you plan to use. Actually, the power supply should be capable of handling a somewhat higher current than the combined drain of all your equipment — this is a safety margin designed to keep the power supply from overheating.

Power supplies of this kind are available from stores selling equipment to amateur radio operators. These power supplies are then plugged into the home a.c. socket, and each component will automatically draw the amount of current for which it is designed.

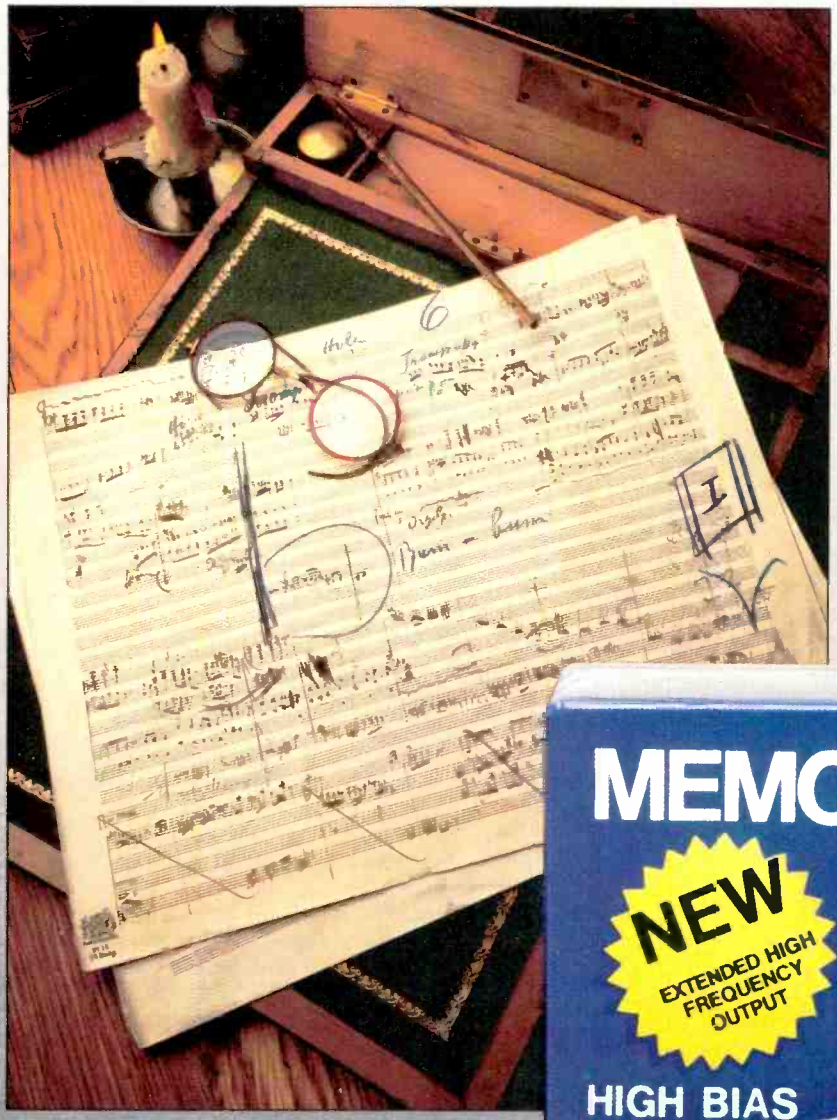
Batteries are capable of delivering current for a specified amount of time. For example, if the automotive battery is capable of delivering 35 ampere-hours, and your equipment takes 10 amperes, then the battery will have to be recharged after 3½ hours. The dealer from whom you purchase your battery should be able to assist you in obtaining the correct battery charger.

Smeared Sound

Q. I have noticed that on many of the tapes I have recorded in the past several years that the "s" sound is smeared. I record at 3¾ ips and clean and demagnetize my heads regularly. Do you suspect that there is anything wrong with my tape deck? — Howard Eiserike, College Park, Md.

A. Your problem is probably due to recording at too high a level, resulting in tape saturation. Saturation is most likely to occur at the high frequencies where the "s" sound occurs, and because of the substantial amount of treble boost provided by the record electronics at 3¾ ips. Try reducing your recording level by about 3 to 6 dB.

WHICH NEW HIGH BIAS TAPE WINS WITH MAHLER'S FOURTH SYMPHONY?



Original manuscript sketch for the first movement of Gustav Mahler's Fourth Symphony. Courtesy of The Newberry Library, Chicago.

Choose eight measures of Mahler's Fourth that are really rich in the high frequencies. The type of passage that high bias tapes are designed for.

Record it on your favorite high bias cassette, using the Chrome/CrO_2 setting. Then again on new MEMOREX HIGH BIAS.

Now play back the tapes.

We're convinced you'll have a new favorite.

New MEMOREX HIGH BIAS is made with an exclusive ferrite crystal oxide formulation. No high bias tape delivers greater high frequency fidelity with less noise, plus truer response across the entire frequency range.

In short, you can't find a high bias cassette that gives you truer reproduction.

MEMOREX
Recording Tape and Accessories.
Is it live, or is it Memorex?

Enter No. 25 on Reader Service Card

Behind the scenes

Bert Whyte

After trying to cope with too many "winters of their discontent," in the arctic clime of Chicago, the powers that be in the Consumer Electronic Show decided to hold their annual winter pow-wow in Las Vegas. I missed the inaugural event in 1978, but with the year 1979 still in its swaddling clothes, I spent January 6th through 9th at the Winter Consumer Electronics Show in Las Vegas.

Ah, Las Vegas! A tacky tinsel town, full of tawdry temples of titillation and temptation, with an infinite capacity for rapacity and rip-off. (How's that for alliteration!) Getting around the town is an onerous task . . . taxi fares are outrageously high and there are interminable delays in getting one at every hotel. This factor alone was responsible for our inability to cover many events and keep up with a very tight schedule. In Las Vegas there are two kinds of deserts . . . one is the sandy wastes surrounding the town . . . the other is the gastronomic desert that is Las Vegas itself. You can get two kinds of food in Las Vegas . . . cheap awful food and expensive awful food. Well, why go on . . . if you are a gambler, the town is paradise . . . if you are not, it can be a purgatory. Considering amentities, attitudes, and prices between Las Vegas and Chicago, one almost longs again for the latter's stinging sleet and frozen feet!

In spite of the vicissitudes of Vegas, it must be admitted that at the convention hall, the WCES was both well organized and well laid out. If you wanted to concentrate on audio and avoid the watches and games, these areas were better isolated from each other than previously. So it was with the other areas of interest. As usual, the sound demo rooms suffered from sound transmission through their walls, but better that than trying to demo on the open floor of the convention hall. There were isolated exhibits in many of the hotels around town, but the bulk of the so-called "esoteric" audio demonstrations were concentrated at the Jockey Club, an expensive cab ride from the convention hall.

With the economic situation in this country, 1978 was considered a "soft year " for the audio industry. Thus, manufacturers and dealers came to this WCES with a certain amount of trepidation, looking for hopeful signs that the bottom wasn't going to drop out of their business in 1979. Well, this WCES certainly wasn't the up-beat, ebullient, optimistic gathering of some past years. However, attendance was very good, said to be the best ever, and there was enough new technology introduced and generally aggressive marketing plans unveiled to buoy confidence in the industry, which was reflected in a respectable amount of buying.

As noted, this WCES was a tough show to cover. There were many things I just didn't get the opportunity to see. Needless to say, I've had to give priority to those items which are currently in the prime areas of interest.

Metal Particle Tape

Whether metal-particle tape and cassette decks capable of recording this new tape would have reached their present state of development without the stimulus of the audio sales slowdown in 1978 is debatable. In any case, metal-particle tape is on the market in the form of the 3M "Metafine," and a committment to manufacture this type of tape was announced by TDK, Maxell, Fuji, and BASF. There is little reason to doubt that Memorex and Ampex will climb onto this bandwagon as well. Some manufacturers had some actual samples of metal-particle tape at the show, and there were even a couple of demonstrations, with that of JVC making a notable impression, showing the difference in dynamic range and headroom between a high-bias ferric tape and the metal-particle tape in the recording of a small jazz combo. As for cassette decks equipped with the special erase and record heads and bias and equalization circuitry to record metal tape, the pioneering deck of Tandberg has been joined by models from JVC, Nakamichi, Aiwa, Teac, Sanyo, and B•I•C/Avnet. In fact, B•I•C stole a march on some of its rivals by unveiling their model C-1, the first car stereo cassette to handle metal-particle tape. Both the C-1 and the B•I•C T-4 metal compatible deck are of the two-speed variety recently introduced by B•I•C. The combination of metal tape and a cassette speed of 3¾ ips should really satisfy those looking for widest possible frequency response. Technics was showing its Model M-95 cassette deck, which at $1300 was the highest priced metal compatible unit at the show.

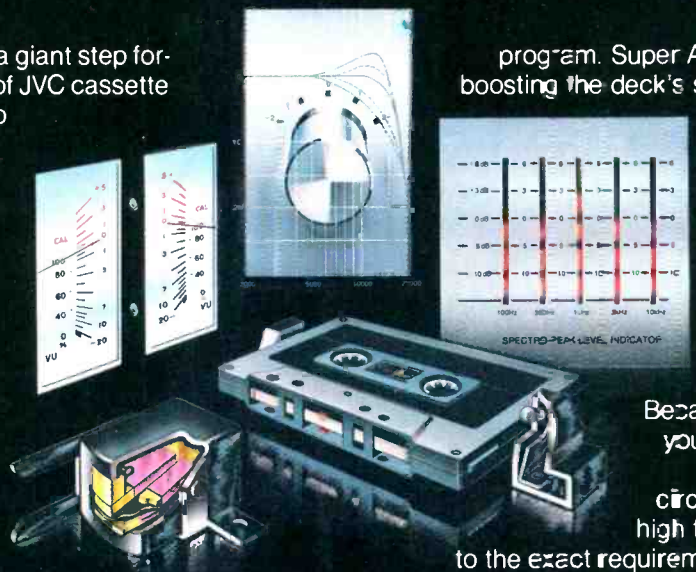
THE JVC CASSETTE DECK.

It gives you more of what the others wish they could.

Cassette recording takes a giant step forward with the new series of JVC cassette decks. Each is designed to give you everything you need to get the most out of any tape. And there are totally new features to help you make better-sounding cassettes.

Exclusive Spectro Peak Indicator System.
With almost recording studio vigilance, 25 instant-responding LED indicators offer fail-safe protection against distortion produced by tape over-saturation. For the first time, you can constantly visually monitor the levels of five low-to-high musical frequency ranges. Then, on playback, the Spectro Peak Indicator actually lets you see how accurately the deck has performed.

Expanded Dynamic Range and Better Noise Reduction.
Our Super ANRS circuitry applies compression in recording and expansion in playback to improve dynamic range at higher frequencies. So distortion is eliminated in sudden high peaks of any musical program. Super ANRS also reduces tape hiss by boosting the deck's signal-to-noise ratio by as much as 10dB over 5000Hz.



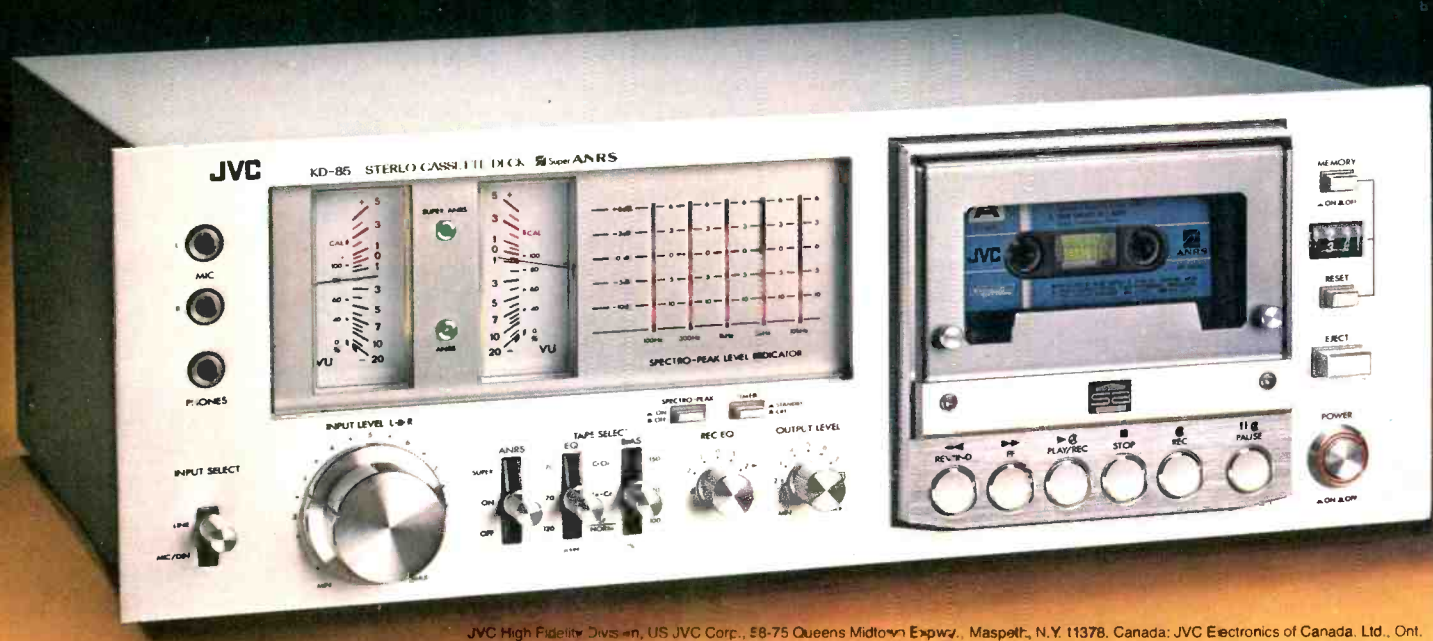
New Head Design.
Our refined Sen-Alloy head gives you the sensitive performance of permalloy head construction, combined with the extreme longevity of ferrite, for bright, full-sounding recordings.

Get the most out of any tape
Because whichever type you select, you'll extract the most from it with our special recording equalizer circuit that lets you "fine tune" the high frequency response of the deck to the exact requirements of the tape. These innovations alone set JVC cassette decks apart from all the others. Then when you consider our other refinements, like precision-ground capstans, gear/oil-damped cassette doors, multi-peak LED indicators, independent drive mechanisms, plus top performance specifications, you can understand why we say that JVC gives you more of what other decks wish they could. Visit your JVC dealer and you'll hear why.

JVC

Not all features in all decks.

Top: KD-65, KD-55, KD-25. Bottom: KD-10, KD-1770 II, KD-1636 II. Not shown: KD-2, KD-3030, KD-S2C1.



JVC High Fidelity Division, US JVC Corp., 58-75 Queens Midtown Expwy., Maspeth, N.Y. 11378. Canada: JVC Electronics of Canada, Ltd., Ont.

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Lux was showing two metal-particle tape compatible decks, interesting in that both units employ d.c. amplifiers in the record and playback circuits and have user adjustable azimuth control for the record head. Most unusual is that the entire head housing assembly is easily removable and could accept heads in a new configuration, should such items appear in the future . . . i.e. "half-track" cassette heads. The Eumig company showed its model FL1000 metal-particle tape compatible deck, and they also announced that the first Eumig cassette deck, their CCD model, can be updated with new erase and record head and bias and equalization circuitry to handle metal tape at a cost to the consumer of $200. In addition to the aforementioned metal compatible cassette decks, models of the same kind will be forthcoming from Hitachi, Fisher, Yamaha, Toshiba, Sony, Onkyo, Marantz, Sansui, Pioneer, and Sharp. With such overwhelming industry response to metal-particle tape, we are unquestionably entering a new era of high-quality cassette recording, which should come into full flower at the CES in Chicago, and have a most salutory effect on the market.

Before we leave cassette decks, it should be noted that other technological advances were in evidence besides metal-tape capability. Hitachi and Aiwa had decks in which tape formulation bias, equalization, and sensitivity were set via a microprocessor. The JVC KD-A8 deck is another of this breed, but gilds the lily by its ability to record metal-particle tapes as well.

Nor should we forget that open-reel decks still furnish the very highest quality in tape recording, along with their special capabilities of editing, overdubbing, etc. A number of new 10½-in. open-reel models appeared from such old pros as Teac and Technics, along with Akai, and relative newcomer, Philips. Many new performance and convenience features are on these new decks, including quartz-lock capstan drive.

Digital recording at the WCES is still on the back burner in contrast to the red-hot professional arena. Still, there were the PCM units from Sony, JVC, Mitsubishi, and Technics. At the Technics exhibit they were playing their VISC digital disc, using the Stravinsky *L'Histoire du Soldat* I had recorded for them on their PCM/VCR system last summer. It is worth noting that Dave Monoson, one of the most astute and knowledgable PR men in the audio business, who handles Yamaha and Maxell and imports the interesting

new Nagatronics ribbon phono cartridge (and a man with his ear close to the ground in Japan), feels that such tremendous advances are being made in LSI (large scale integrated) chip technology that PCM capabilities will be built into future VCR machines within 18 months to two years. The price range envisioned for these units would be around $2000, and of course this would make pre-recorded digital music cassettes a distinct possibility. One final note on the tape scene . . . don't forget that while metal-particle tape is causing a minor revolution in the world of cassette decks, the very same kind of metal tape has equal applicability to open-reel decks, to video cassette recorders, and even digital recorders. The super high packing density of the metal-particle tape will have an equally profound effect on the performance of these formats.

Audio Mainstay

It goes without saying that at the WCES, receivers were still the mainstay of the audio business. Models continue to proliferate, with every imaginable gizmo and technological advance being applied to them to gain some competitive advantage with each other and have greater appeal to the audio consumer. The horsepower race seems to have reached a plateau, with the 330-watt-per-channel Technics unit still the leader.

However, fast gaining ground on the receiver market is that of integrated amplifiers with associated tuners. Some of the integrated amplifiers are invading the "ultra-fi" quality once the exclusive province of high-end amplifiers and preamps. For example, Kenwood's KA-907 integrated amplifier is rated at 150 watts per channel, with a rise time of 0.8 microseconds and a slew rate of 230 volts per microsecond! This, along with many amenities in the preamp section, including an input for moving coil cartridges. Sansui has its 160-watt-per-channel AU-X1 integrated amplifier with rise time of only 0.5 microseconds and a 260 volts per microsecond. Let's face it, friends, those kinds of specs are better than many of the highly regarded "audiophile" of the separate amplifiers! Technics has a new waveform input/output distortion analysis system, which uses complex music signals for testing rather than the usual sine and square wave signals, and they state the use of music signals is a more accurate representation of an amplifier's true transient response and TIM distortion capabilities. One of the first fruits of this new analysis system is the Technics SU8099 integrated d.c. amplifier which puts out 115 watts per channel with THD claimed to be no more than 0.0007 percent. Yamaha and JVC, just to name two that come to mind, have equally sophisticated integrated amplifiers. The separate tuners, made to be companion pieces to these integrated amplifiers, are very advanced units. Perhaps the most sophisticated of the tuners was the Kenwood KT-917, which utilizes what is termed a "pulse count FM detector" that converts each cycle of an FM signal into a digital pulse. The detector's output is proportional to the count of density and is said to be theoretically and practically perfectly linear. The system is claimed to reduce FM distortion by a half, while improving signal-to-noise ratio 6 to 12 dB.

Quadraphonic Comeback?

As mentioned earlier, the Jockey Club in Las Vegas was the exclusive headquarters for the so-called "esoteric" audio manufacturers. With all those exotic audio goodies all in one place, needless to say, the audio press corps spent a lot of time there auditioning them. However, before we take on the Jockey Club, a slight diversion to the MGM-Grand hotel, to listen to some quadraphonic sound. HUH! You heard me correctly, friends. Regular readers of this column will know that for several years now I have been dealing with Mr. Wesley Ruggles, a charming fellow whose uncle is that fabulous comedian, Charley Ruggles. Wesley had acquired the rights to the Tate Directional Enhancement System, an ultra-sophisticated SQ four-channel decoder, featuring separation of 35 dB between channels. Wesley was trying to get this circuit reduced to integrated chips by the National Semiconductor Co. First results were promising, and I was supposed to receive one of the first SQ decoders built around the chips. Well, problems developed, promises were made, things got worse, quadraphonic sound became moribund . . . in any case, I never got the decoder and forgot about the whole thing. Well, I saw Wesley Ruggles in the convention hall, and he directed me to the suite of the

"Overall amplifier performance rating: excellent. Sound quality: superb." Len Feldman*

Len Feldman

The Sansui AU-717 DC integrated amplifier.

When Len Feldman tested the Sansui AU-717 for Radio-Electronics a year ago, he concentrated primarily on its traditional, steady-state performance measurements. Power output capability. Total harmonic distortion. RIAA phono equalization accuracy. Signal-to-noise ratio. Usual tests, though applied to an unusual amplifier. Here's some of what he said:

"One clear advantage of DC design is apparent. Even at the low 20Hz extreme, the amplifier delivers a full 92 watts – the same value obtained for mid-frequency power – compared with its 85-watt rating into 8 ohms...

"The equalization characteristic of the preamplifier was one of the most precise we have ever measured, with the deviation from the standard RIAA playback curve never exceeding more than 0.1dB... The 380-mV overload figure for phono is far greater than would ever be required using even the highest output magnetic cartridges available."

At the time, dynamic response measurements – such as slew rate, rise time, and Transient Inter-Modulation distortion (TIM) – were still in their infancy. Indeed, even now, engineers have not yet fully agreed on a standard method of measuring TIM, though its audible effects have been increasingly recognized. Mr. Feldman sensed this when he commented: "Sansui claims that this unit has reduced transient intermodulation distortion...and, indeed, the model AU-717 delivered sound as transparent and clean as any we have heard from an integrated amplifier..."

The fact is that while conventional amps are designed to reproduce sine-wave test signals – which have a smoothly-changing, endlessly repeating character – with negligible THD, they usually do so at the cost of increased TIM. The excessive negative feedback used to reduce steady-state distortion to the vanishing point can (and usually does) reduce the ability of the amplifier to respond fully to the dynamic, rapidly-changing, pulsive signals which are the music itself. Thus, you get the harsh, metallic sound of TIM.

That's why Sansui has not only led the way in DC amplifier design (circuits whose low-frequency response extends down to zero Hz), but has also concentrated on the high slew rate, fast rise time designs needed for the faithful reproduction of music, not just simple test signals. Slew rate is a high 60V/μSec; rise time a fast 1.4μSec. And the frequency response of the power amp of the AU-717 extends to a full 200,000Hz.

Visit your authorized Sansui dealer. You'll hear the difference Len Feldman heard, and you'll understand why the Sansui AU-717 is about the most popular integrated amplifier available today.

SANSUI ELECTRONICS CORP.
Lyndhurst, New Jersey 07071 • Gardena, Ca. 90247
Sansui Electric Co., Ltd., Tokyo, Japan
Sansui Audio Europe S.A., Antwerp, Belgium
In Canada: Electronic Distributors

*Reprinted in part from Len Feldman's test report in RADIO-ELECTRONICS, January, 1978.

Sansui

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Fosgate Company at the MGM-Grand hotel. Fosgate has heretofore been involved with high-quality auto-stereo components, but it seems the three chips of the Tate system finally had all the bugs ironed out, and Mr. Jim Fosgate had acquired a license to use them. His company has developed what he calls the Tetra One, a four-channel decoder, amplifier, and equalizer for cars, and the Tetra Two, a straight SQ decoder for home use. At the present time, only the car unit is in production, and this is what I heard through a very elaborate high-power four-channel system. In the SQ mode, playing various SQ recordings, the unit was as good as I had heard in the prototype some years ago. Separation was outstanding, with none of the annoying pumping that was the bane of some of the gain/adjust-logic decoders. However, it is in synthesizing four-channel effects from normal stereo records where the Tate system really shines. Depending upon the microphoning techniques used in the original recording, some extraordinary effects are produced. It is interesting to note that the Audionics Company of Oregon also has a license for the Tate chips and will be producing a decoder. And, of all things, Dr. Ray Dolby has acquired a Tate license for the four-channel decoding of his movie sound tracks! Does all this mean a return to four-channel sound? The FCC decisions are still pending, but the Fosgate people are quite enthusiastic about the prospects for the Tate system. There are a lot of old SQ recordings around, and it is true that all EMI classical recordings and some of those of German Electrola are recorded in SQ. We will watch this development very closely.

Let me preface my report on things at the Jockey Club by stating quite candidly that at that hotel, the bastion of the "high end," I heard a lot of appallingly bad sound . . . a good deal of indifferent sound, and , I'm afraid, a bare modicum of really good sound. I went into many rooms loaded with expensive equipment, and the poor balances, screechy distortion, boomy distortion, annoying buzzes, rattles, hums, undamped resonances, and crummy source material was beyond belief. The worst part of it was that there were people there smiling and saying, "Isn't that great?" In several instances, I tried to point out the distortions I was perceiving, but they just wouldn't acknowledge the fact. I assure them and you, dear reader, that I wasn't trying to be a "wise guy" or a "big deal." I was genuinely trying to be helpful. Most of the problems were in the phono playback setups, with a lot of mistracking, etc.

In a class by itself.

There are few stereophones of any kind that can match the full-bandwidth performance of the Koss Pro/4 AAA. That's because the Triple A's oversized voice coil and extra large diaphragm reproduce recorded material with a lifelike intensity and minimal distortion never before available in dynamic stereophones.

With a frequency response from 10 Hz to 22 kH_z, a highly efficient element and a perfect seal for low bass response to below audibility, the Triple A lets every note blossom to its fullest harmonic growth. You'll hear so much more of your favorite music, you'll think you're listening to a whole new recording.

Unlike other stereophones, the ear-cushions developed for the Pro/4 Triple A represent a breakthrough in both comfort and acoustical engineering. Through extensive studies on how stereophones are actually worn, Koss engineers were able to reduce lateral pressure with a direct contour Pneumalite® earcushion that not only offers soft pliable comfort, but also creates an ideal environment for minimizing the linear excusion of the driver. Thus, the driver is able to produce any volume level without distortion. So you'll hear all the fundamental and harmonic frequencies exactly as they were recorded.

In addition, Koss has designed a special Pneumalite® dual suspension headband that creates a feeling of almost weightlessness even over periods of extended listening. It makes wearing the Triple A's as pleasureable as listening to them.

Why not stop in at your audio specialist and see why the Koss Pro/4 Triple A belongs in a class by itself. Or write for our free, full-color catalog c/o Virginia Lamm. Better still, listen to a live demonstration of the incredible Sound of Koss with your favorite record or tape. We think you'll agree that when it comes to the Pro/4 AAA and other Koss Stereophones and CM loudspeakers: hearing is believing.

KOSS® stereophones/loudspeakers

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Superb Speaker Sound

In the area of exotic technology, the Plasmatronics loudspeaker is a *tour de force*. This was my third encounter with this system, and with an entirely revamped midrange and bass speaker, the sound was superb. Of course the major area of interest is in the "plasma" driver which operates from 700 Hz to beyond 20 kHz. Helium gas is bled into an "ionization" chamber and the output of a Class-A tube amplifier into the chamber ionizes the helium creating a "plasma" and subsequently modulates what is, in essence, a "massless diaphragm." As you might expect, the sound from 700 Hz up is seamless and silken smooth, with utterly astonishing transient response. Percussive sounds happen instantaneously with not the slightest smidgin of overshoot. It is big, expensive ($6500.00), complicated in its set-up, and with the helium costs about 25 cents an hour to play. And good though the new midrange and bass is, you wish that the plasma technology was also operative in this end of the frequency spectrum. It certainly isn't for everyone, but it is also incontestably one of the finest transducers extant.

Another sound that would be easy to live with was found in the Acoustat room. Their new electrostatic Monitor has been further refined and is now in full production. Though large, the styling is sleek, modern, and elegant. Here too, the sound is exceptional for its smoothness, especially on strings and voices, and transients are sharp and clean. Stereo imaging is exceptional, with good depth perspective and image stability.

Magnetic-Field Amp

Bob Carver brought some of the first products from his new Carver Corporation, which along with the metal-particle tape, represented some of the newest technology at the Show, and aroused great interest. As I'm sure you know, Bob founded Phase Linear some years ago, and his line of high-power amplifiers and an innovative preamp were the basis for a very successful company. Bob sold his interest in Phase Linear (which has subsequently been sold to U.S. Pioneer) and formed his present Carver Corp. His first products are a 250-watt-per-channel and a 350-watt-per-channel amplifier in what he terms "conventional" design. Decidedly unconventional is his innovative M-400 "Magnetic-Field Amplifier." The amplifier is a brushed-gold, 6¾-in. cube, which weighs in at only 12 pounds. There is a moving LED display with VU ballistics covering a 50-dB dynamic range. This tiny unit has an output of 200 watts per channel at 8 ohms from 1 Hz to beyond 20 kHz! Frequency response is listed as from 1 Hz to 250 kHz. THD is rated at 0.05 percent and TIM distortion is said to be unmeasurable. Hum and noise is rated below -100 dB at full output. Slew rate is said to be better than 80 volts per microsecond. Ok . . . very interesting, but what is a magnetic-field amplifier? Patents are still pending, but I was able to determine that one of the different things about the unit is that it has neither transformer nor big electrolytic storage capacitors. Voltage is stepped down, and energy stored in a small field coil. The amplifier has neither heat sinks nor cooling fans, as the efficiency of the amplifier is said to approach 94 percent! Consequently, the amplifier rarely gets warmer than room temperature. The M-400 employs fast-acting FETs, except for special silicon transistors in the output stage. An interesting point is that the M-400 maintains a constant output impedance so a number of speakers can be played in parallel without damage to the amplifier. The amplifier cannot be conventionally bridged, but merely using one output channel the unit gives a 400 watt output! The projected price of the M-400 is $349.95. In other words, a pair of these miniscule lightweight units will give you a 400 watts per channel for $700.00. I can see a lot of applications for such a unit. If the amplifier proves to be reliable, rock music road shows could really cut down on the weight of the huge amplifiers they now drag around, and their ability to accept multiple speakers without impedance changes would be equally useful. In consumer situations, a pair of them would furnish a 200-watt-per-channel bi-amp set up.

I listened to my latest London Philharmonic direct-disc recording of Morton Gould's *Spirituals for Orchestra*, with the M-400 amplifier driving a pair of KEF 105 speakers. These are not the most efficient speakers in general and, by coincidence, happen to be the monitor speakers I used on the London recording sessions. There are some very violent and heavy bass passages in this recording, and we played it back at a good high level. The sound was excellent . . . highly detailed, with good solid bass, and crisp clean transients. String sound was very smooth. After playing through the disc, the M-400 was slightly warm to the touch. Quite an amazing demonstration considering the size of the unit. Bob Carver has always had a special expertise in signal processing. Next month we will report on some of the unique new circuits in his new C-4000 preamp, along with many more audio goodies from the WCES.

A NEW PREAMP FOR THAT DISCERNING PERFECTIONIST WHO CAN APPRECIATE THE DIFFERENCE.

The new Phase 3000 Series Two was designed for that discerning music-lover who has a passion for accurate sound, an eye for elegant yet functional design, a feel for craftsmanship, and an unfailing determination to maximize return on investment.

The Phase 3000 incorporates the latest technological advancements in preamp design. Transient overloading that plagues preamps has been virtually eliminated, whether amplitude, frequency, or slew induced. Now you can enjoy the flexibility, performance and features that are priced substantially higher in other equipment.

CMOS LOGIC MEMORY SYSTEM

Most preamps use dated mechanical switching devices that force signals to travel long, noisy, circuitous routes from the inputs, to the front panel, then back to the outputs. *Ours doesn't.* The Phase 3000 uses CMOS-digital logic to energize switching relays located where they belong, at the input jacks. This shortens critical signal paths. Noise, hum, and the "crosstalk" that's characteristic of mechanical switching is virtually eliminated.

WANT MORE?

A listening session with a pair of headphones will convince you just how much of a difference a true headphone amp makes. Turn the 3000 around, and see how easy it is to patch in your noise reduction unit.

Two complete taping circuits allow you to copy between decks while listening to another source.

But we've done enough talking. If you're serious about state-of-the-art performance, it's time for you to do some listening. See your Phase dealer.

SPECIFICATIONS:

Distortion: less than 0.04% (20Hz-20kHz).
Typically 0.005% @ 1kHz.

Signal/Noise (IHF "A"):
Phono 1—Moving Magnet: greater than 90dB re: 10mV input
Phono 2—Moving Coil: greater than 78dB re: 1mV input

Frequency Response: Phono-1, Phono-2 deviation: ±0.3dB

Tone Controls: High & Low Frequency controls with switchable turnover points.

Volume Control: 22-position precision attenuator with plus or minus 0.5dB tracking.

Low Filter: 18dB/octave below 15Hz.

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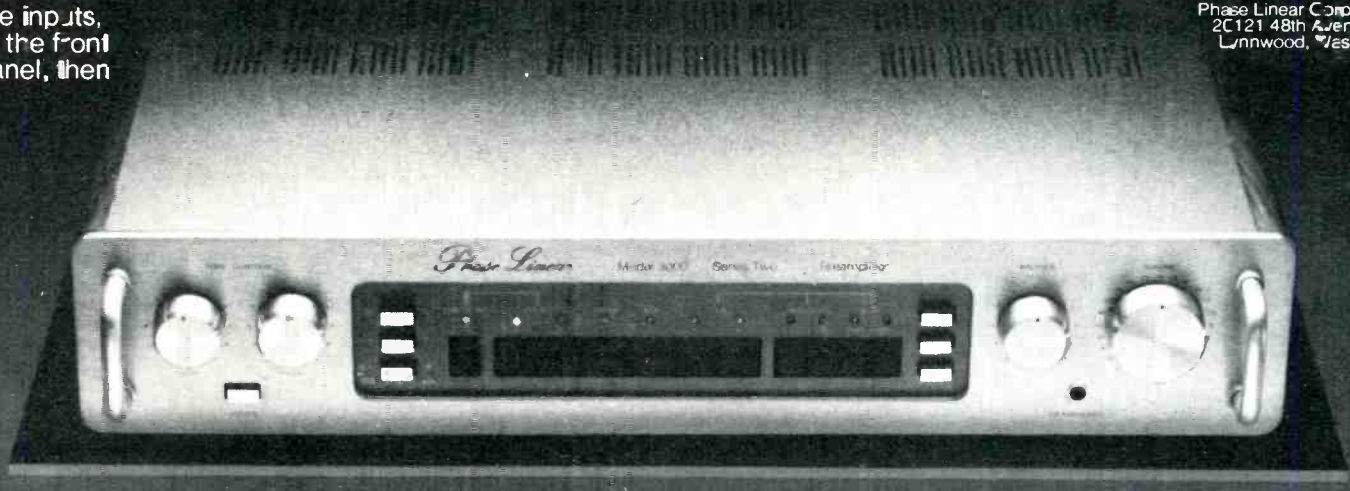

PHONO CARTRIDGE FLEXIBILITY

The two independent RIAA Phono Stages eliminate all low-level switching. As a result, noise is reduced to theoretical limits.
Phono 1 is designed for moving-magnet cartridges and has three selectable capacitance values.
Phono 2 is used with moving-coil cartridges and has three selectable resistance values. The expensive outboard headamp usually required for a moving-coil cartridge is already built into the 3000.

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Tape guide

Herman Burstein

Head Replacement

Q. How difficult is it to replace worn heads? — George Smith, Gainesville, Fla.

A. The degree of difficulty varies with the make and model of the tape deck. Alignment of the head with respect to vertical, azimuth, and lateral orientation can be a problem. An alignment tape is usually necessary. It is always best to have a competent service technician — preferably in an authorized service shop — perform the job.

Calibration Concern

Q. Using the calibration tape supplied with my external Dolby noise reduction unit, I get fluctuations on the meters. This is true when playing the tape on either of my two tape decks, also while calibrating in the record mode I get the same effect. Do you have any suggestions? —R.D. Mease, Hamden, O.

A. You did not indicate the magnitude of the fluctuations . . . if it is on the order of 1 to 2 dB, this is fairly normal. It is difficult to record and reproduce a perfectly steady tone, plus the ear is not likely to notice a fluctuation of this degree, especially on mixed tones.

Taping Primer

Q. I am a novice in the taping game and would like some pointers concerning open-reel taping of phono discs and FM programs. — O.L. Tracy, Overland Park, Kans.

A. Your question is so broad that it is difficult to answer. The best single statement I can make is to carefully read the instruction manual for your tape deck. In addition, it might be wise to visit your local audio store to see what books they have on tape recording for the amateur.

The following may be of help. The most difficult step for most tape enthusiasts is to set the recording level correctly — high enough to get maximum signal-to-noise ratio the deck is capable of, but low enough to avoid excessive distortion. Using a good-quality tape and phono disc as the source, experiment with different recording levels until you get a "feel" for the proper level. If you record too high, the sound may have a grainy, coarse, or even raspy quality. If you record at too low a level, the noise level (due to the tape and tape deck electronics) will be rather apparent. At too high a recording level, there may be a noticeable drop in the treble response due to tape saturation at the higher frequencies. For maximum quality, use the highest tape speed of your deck. After every eight hours of use, clean and demagnetize the heads, guides, and other components contacted by the tape.

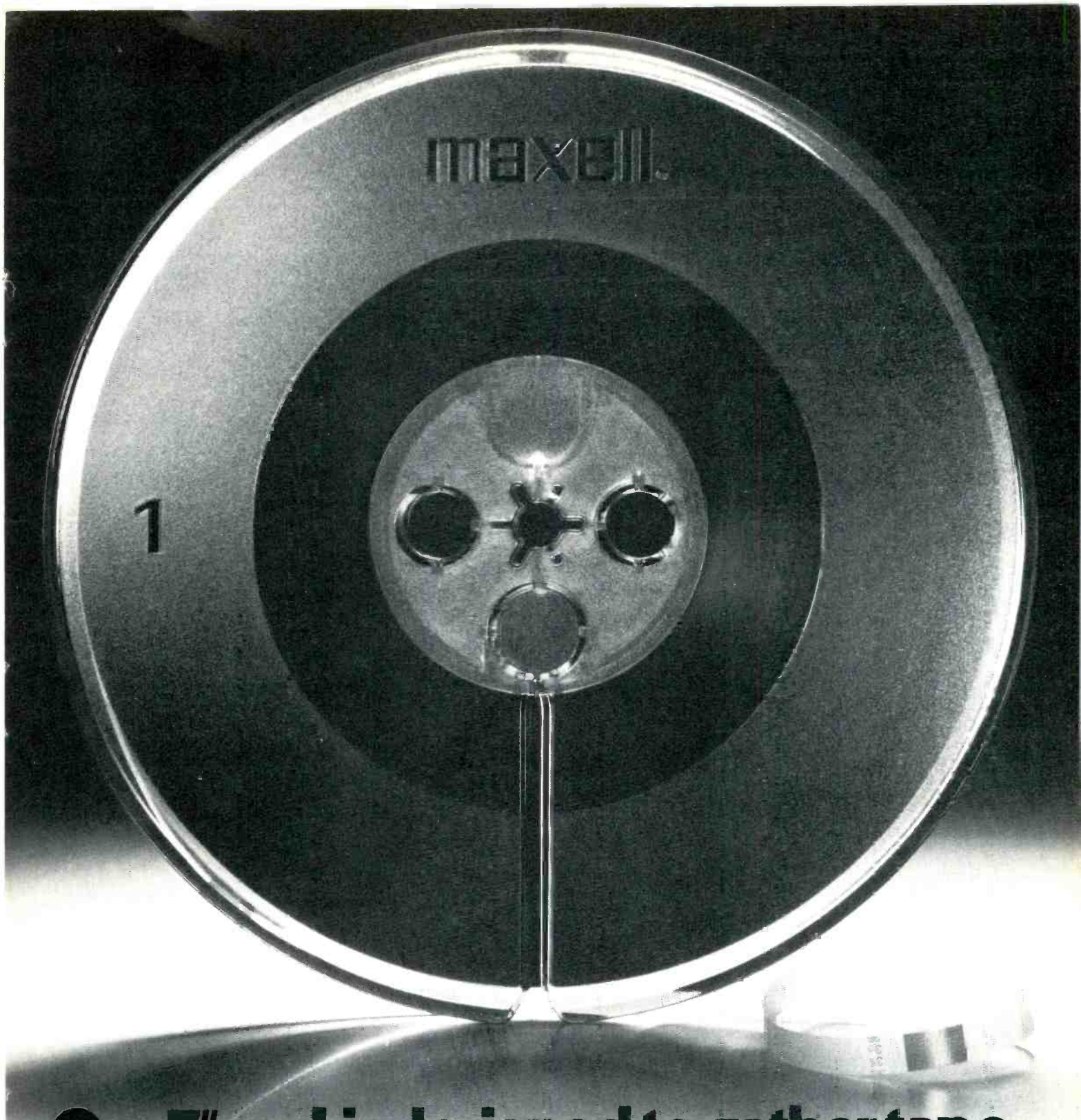
Quality Choice

Q. I am in the process of choosing between two tape decks for high-quality, semi-professional recording. One is a home-type deck costing around $900 and the other is a professional-grade deck costing nearly $3000. This large price difference has me somewhat confused. Your comments would be appreciated. — George Ciccone, Monmouth Beach, N.J.

A. Once you pay about $700 upwards for a home tape deck you are apt to get a very good quality in terms of performance — quality close to that of a "professional" machine. Much of the price difference is due to the sturdier construction of the professional machine, some is due to such additional features as ease of editing and ready adjustment of bias and equalization, while some is due to a slight superiority — not necessarily audible — in such respects as low noise, low distortion, wide and flat response, low wow and flutter, and accurate speed.

A professional machine is usually operated many hours a day, most days of the week, and most weeks of the year. It is important that the machine stand up under such hard usage with a minimum of costly down time. The home user doesn't need such a high degree of reliability, and therefore can benefit from the cost savings.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 401 N. Broad Street, Philadelphia, PA 19108. All letters are answered. Please enclose a stamped, self-addressed envelope.



Our 7" reel is designed to gather tape. Not dust.

Something as insignificant as a speck of dust can mess up a perfectly good recording.

So at Maxell, we've developed an ingenious device that keeps dust from collecting on our tape. Our take-up reel.

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You'll find it comes attached to something even more impressive.

Our tape.

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Audio etc.

Edward Tatnall Canby

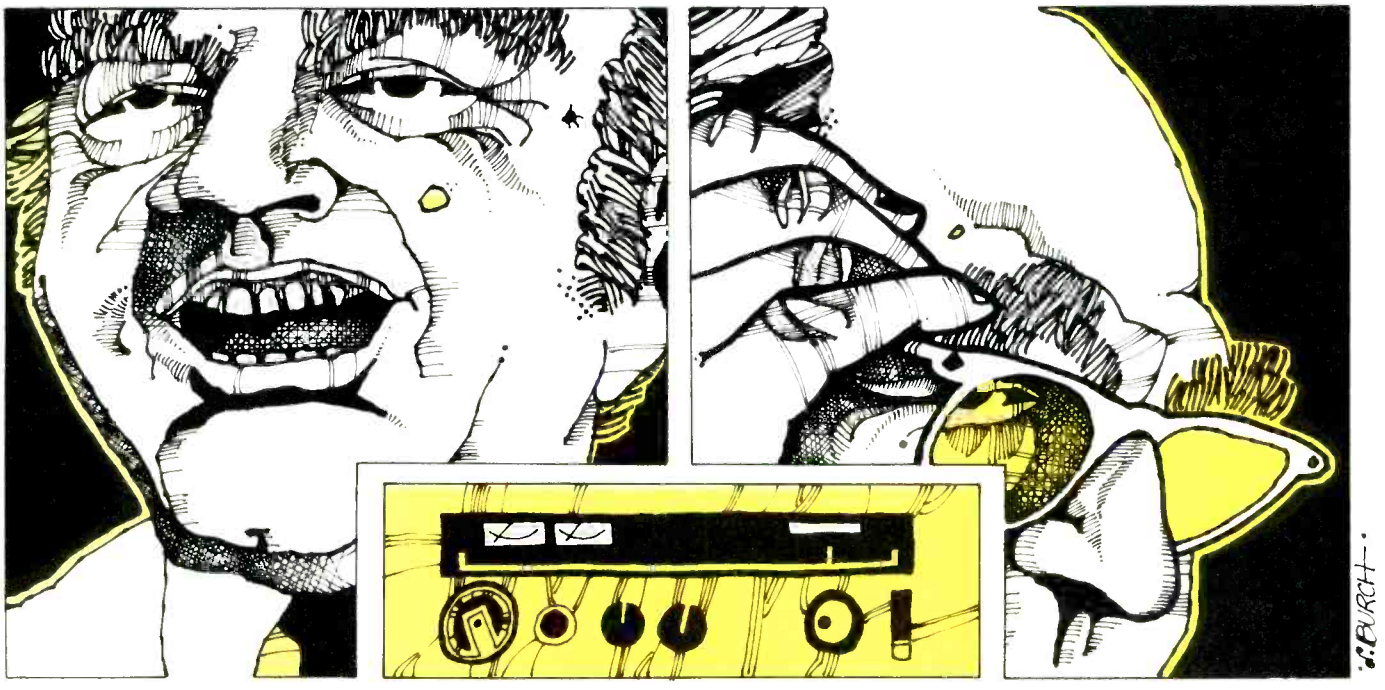
As I continue these days to listen intensively to stereo FM at a DX-ing distance of 100 miles — something I have not tried for a long, long time (see last month) — I am forcefully reminded that the very earliest stereo broadcasts were simulcasts at full strength, out of two separate stations, each offering its normal mono coverage. Like a pair of locomotives hitched to a double-length train. For if we were to send out two signals, should not each cover the same area in signal strength as one alone? Reasonable thought! But, alas, not now the case. Present stereo coverage, two channels via one carrier, is weaker than the equivalent mono broadcast and goes out a lesser distance in useable form. And yet — here I am 100 miles away and listening in stereo. Without pain. We do progress, in spite of necessary compromises.

The early experiments didn't always work. Often one station was FM, the other AM, a matter of practicality. How could you listen, say, to an AM right channel, noisy and severely limited in frequency range, and an FM left channel, both noiseless and wide-range? The mix, as I well remember, was awful. A few FM-FM experiments were set up — in California, as I remember — and here the stereo was good and strong too. Perhaps better than we shall ever get now in respect to full coverage and noise-free reception, both channels. But this couldn't last. You could hardly expect a working FM outlet to operate on only half a signal, one-sided. There had to be a better way, two channels from a single station. And the pure engineering voice who told us how to do it via multiplex was Murray Crosby, a man who would not compromise short of the ideal merely to accommodate existing SCA subcarriers.

Well, Crosby lost out and SCA is still alive and occasionally with us. Our present stereo system is a somewhat elaborate compromise designed to take on, when necessary, more than the basic two channels, which leaves our stereo broadcast power somewhat under strength but basically pretty much OK, now that we have learned to live with it. But stereo coverage is apt to be weak in the outskirts and easily subject to noise interference, as plenty of us have discovered.

At 100 miles, I never earlier could listen to stereo on the air. Mono came through beautifully — stereo was mostly a roar of noise, a background sound so harsh and so cutting to the ears that I could not take it for long. It was a nasty and distressing choice — for a switch to mono brought instant peace, low noise, and inevitable boredom. Who wants to listen to mono? That's for portable transistors. I hated to miss something that I knew was right there, the full ambience and separation of two-channel broadcast sound. So near, and yet so far. Stereo, for me, at my distance, was a bust.

I say this because now for the first time, during these last months, I have at last been able to listen regularly in stereo and really enjoy it. Now, at last, in the current generation of FM stereo tuners, the noise is under control. Not counting, of course, passing interferences like planes, vast numbers of them and who knows how far away, bringing great pulses and gasps of the old familiar roaring, slow, then faster and faster as the reflection interference angles change . . . . But the planes are merely a nuisance factor. They come and they depart, and all is well. At my extreme range, my new tuner brings in numbers of very distant stereo stations with no more noise than many a disc and tape I play via the same equipment. But this isn't all in the way of improvement. There's something else that has me intrigued . . . the remaining noise *is no longer*



The standard bearers.

The high bias standard.

In the past few years, these fine deck manufacturers have helped to push the cassette medium ever closer to the ultimate boundaries of high fidelity. Today, their best decks can produce results that are virtually indistinguishable from those of the best reel-to-reel machines.

Through all of their technical breakthroughs, they've had one thing in common. They all use TDK SA as their reference tape for the high bias position. These manufacturers wanted a tape that could extract every last drop of performance from their decks and they chose SA.

And to make sure that kind of performance is duplicated by each and every deck that comes off the assembly line, these manufacturers use SA to align their decks before they leave the factory.

Which makes SA the logical choice for home use; the best way to be sure you get all the sound you've paid for.

But sound isn't the only reason SA is the high bias standard. Its super-precision mechanism is the most advanced and reliable TDK has ever made—and we've been backing our cassettes with a full lifetime warranty* longer than anyone else in hi fi—more than 10 years.

So if you would like to raise your own recording standards, simply switch to the tape that's become a recording legend—TDK SA. TDK Electronics Corp., Garden City, NY 11530.

TDK®

The machine for your machine.

*In the unlikely event that any TDK cassette ever fails to perform due to a defect in materials or workmanship, simply return it to your local dealer or to TDK for a free replacement.

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harsh. It has, somehow, been gentled — that's the best word.

Instead of the old barbed, sawtoothed FM-stereo roar, variously loud but always unpleasant at any level, there is now a smoother, more lubricated sound, altogether inoffensive when the signal strength is good — as it often is. Amazing! I mostly don't mind it a bit. Which makes real stereo listening quite possible, almost restful, via distant stations as well as those that are (relatively) nearby, say a mere 40 miles off. That's good news. I am unable to explain the lubrication, but it is there. Better a lubricated noise than sawtooth, any day, even if ideally there should be no background noise at all.

So let us forget the theoretical arguments, for we have our chosen system well in hand and we are improving its compromise by, literally, leaps and bounds . . . 100-mile leaps. Even Murray Crosby might be impressed at what we now can do with stereo.

Yes, I know. I will be assured, by those who know, that I am wrong. Under correct reception conditions there is no stereo noise. Well, I'll agree — for city or suburb listening. I have often heard it, so to speak. Especially when the music is background and the level turned down. But even with louder music there *seems* to be no noise — or is there? Do not forget that in the city there is a steady and subliminal background spectrum of "live" sound that can easily mask any slight residual noise in stereo reception. Even on a Sunday morning or in the wee small hours of the week. City FM listening is not an objective test. Very useful illusion, though, for city listeners.

Hi-Fi Coconut

Where I live, there is no masking, unless occasionally the wind sighs in the trees. Moreover, I like my music LOUD, just like any seasoned hi-fi coconut. If there's any residual noise at all, I'm going to hear it, and I do. It's there! Always. But I really don't mind much any more. Nor will you.

So put residual noise aside and look at stereo FM itself, in case you are newly interested, out there in your own country spot at a distance from the stations of your choice. With your brand-new hi-fi tuner — don't even *think* of trying an older one, however good it was in its time — you may perhaps get what you want via a rooftop directional TV antenna, which doesn't filter out the FM that is right between the two principal TV bands. A genuine FM directional is a better idea, space allowing, and the bigger the better, of course. I'm going to have to get me another rotator; you will need one if your stations are off in various directions. 'Nuff said. Just feed into your home hi-fi system and it will be happy and so will you, maybe even at 150 miles out. Possible, these days.

I've been fascinated at the current goings-on across the FM spectrum, as compared with some years back. Numberless new, loud, pop stations. As I tactfully suggested last month, I skip hastily over them, however worthy the listening from some people's viewpoint. (Not many of *these* people are hi-fi coconuts.) But I do find myself asking, how much of that hideous (?) distortion is artistically deliberate and a part of the musical effect? Quite a lot, and we must respect this even if we don't ourselves jive and bounce to the disco beat. If the station adds a deliberate bit more distortion — who's to complain? You can skip it . . . I skip it.

There are dozens of other stations, other types, to keep me perpetually busy — that's one great advantage of a distant country location, where you get a real overview, or underview, of the radio scene. I also mentioned muting circuitry, the usual way to cut out inter-station noise. Not much use in the country, it cuts out many stations too. This Pioneer's is in two fixed positions, and just for fun one day I put it into the extreme muting position, No. 2, just to see which stations would get through. Only the strongest can make it, normally the nearby locals. The rest are suppressed. Well, I have no nearby locals. But on this extreme muting I went down the dial and counted no less than 27 stations that made it past the mute, not one of them nearer than 40 or 50 miles. How's that for a choice? When I tried the milder No. 1 mute position, I picked up no less than 50, unmuted. Many more showed up on the signal-strength meter, though silent. Definitely, some of these, too, minus mute, are listenable, in mono if not in the noisier stereo, in case you really find something you want to hear. I often do. I suspect that with a rotator I could increase this vast station roster by a dozen or so useful outlets, if I ever had the time to listen to them. Thanks to narrow-band reception (alternative to the top-fi, wide-band circuit in Pioneer) and to extreme sensitivity, a large proportion of these many and closely packed sources are now at least marginally listenable, and there is very little of that disastrous overlapping of signals I used to experience.

Yamaha goes its separates way.

With unprecedented performance, features and price.

C-4 Our new C-4 stereo preamp has the most advanced circuitry imaginable to give you sound so real and true, you'll swear it's live. Distortion in the phono preamp section has been reduced to a miniscule 0.0035% at 2V output. Signal-to-noise ratio has been tamed to the virtually inaudible level of 97dB at 10mV. A special Current Noise Reduction Circuit maintains this high S/N ratio regardless of varying impedances caused by using different cartridges. But you really have to hear the sound of the C-4 to believe such pure musical tonality could pass through a piece of electronics.

The C-4's features put you in total command of its superb sound. Unheard of tone control is yours with the exclusive, continuously variable turnover frequencies for the bass and treble controls. You can select from five ranges for both capacitance and resistance to load your cartridge for optimum performance. The C-4's built-in head amp provides the boost necessary for you to indulge in the transparently beautiful sound of a moving coil cartridge. Without extra expense or noise.

And these are just a few of the fabulous features that make the sleekly styled C-4 a super-sophisticated device with possibilities limited only by your imagination.

M-4 Our passion for pure tonality reaches toward perfection in the M-4 stereo power amp. To deliver the cleanest, most musical sound possible, we built it with DC circuitry in a dual mono amp configuration. The dual mono amp configuration results in dramatically reduced crosstalk for dramatically enhanced listening pleasure.

The M-4's specs are nothing short of spectacular. THD takes a bow at an incredibly low 0.005% at rated output of 120W per channel into 8 ohms, 20Hz to 20kHz.

Signal-to-noise ratio is, (please hold the applause) an utterly silent 118dB.

Again though, specs can't do the sound of the M-4 justice. This boldly styled, superbly functional power amplifier is solidly in the super state-of-the-art category.

That's what both our new separates are all about. Unprecedented performance, features and styling. And the price? Well, you can benefit from what we learned in precedent-setting sound with our legendary cost-no-object B-1 and C-1 separates. Without paying the price. Audition our new, rack-mountable super separates, the C-4 and M-4 for yourself. It's an ear-opening experience you won't want to miss. For the name of your Yamaha Audio Specialty Dealer, check your Yellow Pages or write us.

From Yamaha, naturally

YAMAHA

Audio Division, P.O. Box 6600 Buena Park, CA 90622.

that matter, in the million $$ disco type of sound reproduction. This is entirely legitimate, I say, and the only question is, what should a stereo FM outlet do? Just play the things, and let the mono fall where it may. As we all know, mono sound in pop music can be pretty spectacular.

I note, by the way, that there are definitely different artistic techniques in the use or non-use of separation, from one pop disc to the next — interesting to watch, especially on a four-channel decode/enhance system like mine. The decoders are extremely sensitive to these differing techniques. The back-speaker meters react most strikingly and differently. There are, for instance, many pop discs which have a sort of two-way vertical mono, the right-channel meters moving in step, the left-channel pair also in step but differently. Oppositely, there are those which have horizontal mono, the top or front meters moving together, the bottom pair, the back channels, moving also together but differently. (Pure mono makes them all move alike.) You can get a load of some of this with your own eyes if you have a stereo tuner and available meters — use your tape recorder. Quite fascinating.

Interview-type Stereo

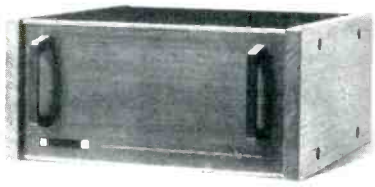
One thing that distresses and perplexes me is the lack of any useful stereo in the interview-type or round-table program of speech. There's the stereo light, on as usual. And both speaking voices, or all four or five, come vaguely out of dead center without the slightest trace of spatial location or separation. Why, Why?

It would seem to me that a multiple-voice speech program is the obvious place for good use of channel separation. Is it mere lack of imagination? Is it the technical need for compatibility with mono reception? (If so, then why bother with a stereo transmitter at all.) Is it, perhaps, partly a problem of transmission via the complex stereo broadcast circuitry, which (I am speculating) may not appreciate severe separation between channels? Some of you broadcast engineers might let us know your thoughts on this. I can only say that on occasion I have heard my own voice broadcast 90 percent in one channel — though in phase from a single mike — without problems, even against a full stereo spread of music. If there had been two of me, surely I would have put one in each channel for a right-left dialogue. But would I have been in trouble with the broadcast engineers? (Later, I shifted to 50-50 mono, into the two channels, but only because the center position was aesthetically better for the program.)

Collegiate FM

I could go on .... I haven't even started on my favorite sort of FM in this new round of listening, the student-operated university station. Such fun! Such knowledge and enthusiasm, such marvelous goofs and *gaffes!* Naive, but brilliant too. These stations mostly began 'way back as in-house affairs, carrying a city block or so, but today they often are full-power public outlets audible to millions. A real responsibility for young students. Some stations have gone stuffy, or conventional, but others retain a freshness that is wonderfully needed today in FM. At 100 miles I can pick up no less than three of these in the New York area. My favorite for its combination of solid and interesting programming with the most delightful *faux pas* — so many laughs — is Fordham University's WFUV (90.7), 24 hours a day — a lot for volunteer labor — and in stereo, too, with a beautiful clear signal and excellent presence. You're right in the studio as you listen. Or rather, these kids are right in your own living room with *you*. Enjoy! Even at 100 miles.

what's new



Infinity Amplifier

The Hybrid power amplifier features vacuum tubes in the input stage and transistors in the output stages for 150 W into 8 ohms. The tubes are 10,000 hour, high-transconductance pentodes operated as triodes. Claimed THD is 0.2 percent, 20 Hz to 20 kHz, in the fundamental output voltage. The internal logic circuitry automatically protects the amplifier and speakers, and a small information screen identifies the problem by displaying the appropriate warning. Price: $4050.00.

Enter No. 80 on Reader Service Card

AR Speaker System

The Model AR90 speaker system has a frequency response from 23 Hz to 30 kHz with five speaker elements: two 10-in. woofers, one 8-in. lower midrange, one 1½-in. upper midrange, and one ¾-in. dome tweeter. The crossover frequencies are 200 Hz, 1.2 and 7 kHz. The speaker has a nominal impedance of 4 ohms, produces an SPL of 87 dB per W/m on axis, and requires a minimum of 50 W power. Price: $550.00.

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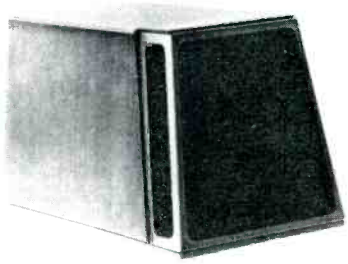

Pyramid Speaker

The Model T-1 is a ribbon tweeter with a frequency response from 3 to 40 kHz, ±3 dB, and an SPL of 93 dB per W/m pink noise. There is a built-in crossover of 12 dB per octave (-3 dB at 3 kHz), a vertical polar response of 90° at 10 kHz, and a horizontal polar response of 160° at 10 kHz. Measuring 4⅝-in. W x4¾-in. H x 7¾-in. D, the unit weighs 8½ lbs. Price: $990.00 per pair.

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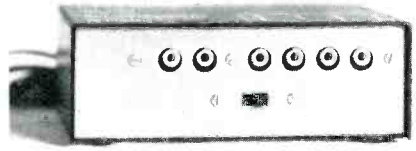


Ace Subwoofer Crossover

The Model 5000 subwoofer electronic crossover crosses over at 18 dB/octave at a frequency of 100 Hz. A level control allows precise adjustment of subwoofer output, and a defeat switch allows for accurate balancing to the rest of the system without instruments. Noise is listed at -90 dB and THD at less than 0.025 percent at 2 V output. Price: $99.50 factory wired, and $59.25 in kit form.

Enter No. 83 on Reader Service Card

BPI Analyzer

The Model 6000 Intermodulation Distortion analyzer makes available the measurement of IMD by the CCIF frequency difference or the SMPTE methods with residual distortion levels below 0.0008 percent. It has isolated internal oscillators which provide the standard SMPTE and CCIF frequencies for measurement of IMD of tape decks, FM tuners, and audio amplifiers. The unit features an rms digital voltmeter and a digital dB meter. An internal 1-kHz sine-wave oscillator is also included to allow setting sine wave equivalent power levels and to facilitate S/N measurements. Price: $1400.00.

Enter No. 84 on Reader Service Card

MLI Microphone

The Micro Mike is a wireless, battery-powered, condenser microphone with broad-band FM coverage. Tunable to any frequency between 88 and 108 MHz, the unit has a range of up to 100 ft. Price: $19.95.

Enter No. 85 on Reader Service Card

Pioneer Digital Timer

The Model DT-400 is a digital timer made for audio use. Having a quoted accuracy of +0.02 Sec. from set time, it automatically indicates a.m. and p.m. on the blue fluorescent indicator. The Auto-On Switch turns components on at a preset time for unattended recording, while the Auto-On/Off turns them on, then shuts them off after 59 minutes. Price: $100.00.

Enter No. 86 on Reader Service Card

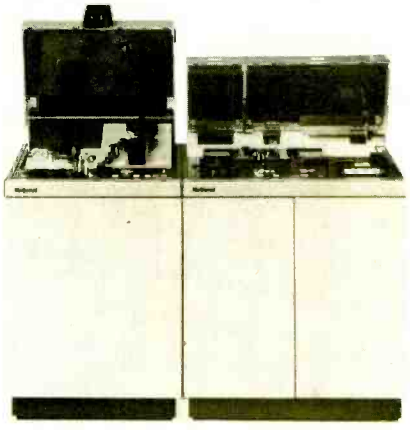
Video scenes

Bert Whyte

For a few years video, or TV if you will, took a back seat at both the CES and WCES. None of the big TV manufacturers had exhibits, and the whole scene was decidedly low key. What a difference at this 1979 WCES! Video was one of the hottest subjects at the show, and exhibits were everywhere. There are so many aspects of video now, that coverage has become almost as difficult as for audio.

Clearly the number one topic at the WCES was the long-awaited debut of the Magnavox/Philips video disc. Finally, there it was. The machine was fairly compact, not much larger than an average turntable. In spite of its laser complexity, it is simple to operate. The picture quality is clean, clear, and with excellent brightness and contrast ratios. Initially, there were about 200 discs available, with heavy emphasis on movies. The test marketing in both Atlanta and Minneapolis was a howling success, with lines of customers waiting outside the stores at an early hour to snap up all available players and discs. Everything seems rosy, and supposedly marketing is going full speed ahead. Well . . . of course there is the matter of competing, non-compatible systems, like the VISC stylus-and-groove system of Matsushita and the capacitance systems of JVC and RCA. But more than this, some people are skeptical about the long-term software situation. In other words, once the initial curiosity has diminished, the Jack Nicklaus golf lessons have been studied, you've whipped up a soufflé from the Julia Child disc, and you've seen the movie "Jaws" for the fifth time, what is left to entertain you? Of course, there should be an on-going supply of movies. But will this be enough to sustain interest? You certainly can't depend on selling TV reruns. What then? This has been an on-going situation for a long time and, more than the technological problems, has held up the introduction of the video disc. Time will tell, but some people are still banking on the VCR as the more viable medium.

The video cassette recorder was the victim of an over-ambitious sales projection in 1978, but nonetheless the units are selling well and, as newer models with still more conveniences are introduced and tape cassette prices come down a bit, the medium is going to flourish. At the WCES, a number of



Matsushita VHS video tape duplicator

companies were showing microprocessor controlled programmable VHS units. With these, up to a week's programs can be set up for recording. Hitachi joined the VHS ranks with their VT5000A unit, an attractively styled VCR with many convenience features.

Most of the blank tape manufacturers are now firmly in the videocassette business. Both Beta and VHS cassettes can be expected from Maxell, Memorex, Ampex, and BASF, as well as from 3M and TDK who are already well established. This activity is expected to bring cassette prices down somewhat, but not to the extent some people have in mind. Prerecorded video cassettes continue to proliferate, and in either format you can get everything from hard-core porno to the movie "Patton."

One of the hot video items at the WCES was projection TV. In addition to a new model from Advent, there are large screen units from Panasonic and two models from Sony. All of these are front-projection units, using various lens and mirror systems. The General Electric Wide Screen 1000 is a back-projection model, using a single-gun color tube. This unit takes up the least amount of space of any large projection unit. I have been checking out one of these units and can report that the color is excellent (and adjustable via intensity and hue controls), and the big screen has a bright image with good contrast. Highly satisfactory and I will have a full report on it before long.

There were many other interesting video items, but I would be most remiss if I didn't bring you a report on what was unquestionably the stellar video attraction at the WCES. I refer to the special Matsushita exhibit, where they gave us a tantalizing glimpse of some very advanced video products which may become available sooner than we think.

Those who live in an area with many tall buildings nearby, whose television reception is continually plagued by "ghost" images, would be delighted with Matsushita's "Mirage Free" TV system. Ghosts occur when a TV signal is bounced off a nearby object and reaches your TV set milliseconds after the main signal. This Matsushita sys-

Matsushita high-definition color TV system

BUILD YOUR OWN LOUDSPEAKER SYSTEM.

When we develop a loudspeaker system at KEF, we apply a "Total Design Concept," which integrates the design of the cabinet, drive units and the filter network, using computer aided techniques to get the best overall results.

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A 13 x 9 inch bass driver with a solid flat diaphragm.
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KEF B110 SP1003
A 5 inch drive unit, using the same diaphragm construction as the B200 with visco-elastic damping layers to ensure low colouration.
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55 to 3500 Hz.

KEF B200 SP1014
An 8 inch low frequency driver with a diaphragm of rubber modified polystyrene.
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KEF drive units and complete technical data are available from the following dealers.

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Arizona Audio Ltd Phoenix
Arizona Audio Ltd Sierra Vista
Arizona Audio Ltd Tuscon
California
Beverley Stereo Los Angeles
Blue Sky Stereo Tahoe City
Catania Sound San Rafael
Northridge Audio Centre Northridge
Paris Audio Los Angeles
Paris Audio West Los Angeles
Paris Audio Sherman Oaks
Sound Distinctions Concord
Sound Systems Palo Alto
Sound Systems San Francisco
Stereo Showcase Vallejo
Stereo Showcase Sacramento
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The Audio Gallery Temple Terrace
Dalton Audio Clear Water
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Stereo Sales Tallahassee
Georgia
Hi Fi Buys Atlanta
Hawaii
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Idaho
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Audio Ltd Champagne
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I/O Systems Chicago
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The Stereo Studio Arlington Heights
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Audio Specialist South Bend
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Advanced Audio Engineering Inc Iowa City
Ecologic Ear Des Moines
Louisiana
Alterman Audio New Orleans
Alterman Audio Metairie
Kadair's Baton Rouge
Maine
New England Music Co Portland
New England Music Co Bangor
New England Music Co Lewiston
New England Music Co Waterville
Maryland
Audio Associates Bethesda
Audio Associates Wheaton
House of Sound Baltimore
Soundscape Baltimore
Massachusetts
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Hearing Things Worcester
Natural Sound Framingham
S&L Sales Corp Watertown
The Audio Forum Watertown
Michigan
Audio Dimensions Birmingham
Mark One Audio Midland
The Gramophone Birmingham
Pointe Electronics Grosse Pointe Woods
Missouri
Audio Renaissance Kansas City
Flip's Stereo Ballwin
Flip's Stereo Place Florissant
Nebraska
Custom Electronics Omaha
Tobias Electronic Omaha
Nevada
The Tin Ear Sound Co Reno
New Jersey
Bernardsville Camera & Audio Mart Morristown
Sight & Sound Parsippany
Eastern Audio Burlington
Franklin Lakes Stereo Franklin Lakes
Bryn Mawr Stereo Cherry Hill
New Mexico
Hi Fi House Albuquerque
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Audio Den Stony Brook
Ear Drum of N.J. Inc Nanuet
Electronic Workshop Sales New York
Gordon Electronics Syracuse
Gordon Electronics Vestal
Harmony Sound New York
House of Hi Fi Glens Falls
Linear Sound New York
Lyric Hi Fi New York
Lyric Hi Fi White Plains
Music Masters New York
Park Avenue Audio New York
Stellar Stereo Ithaca
The Listening Room Scarsdale
The Sound Mill Mt. Kisco
The Speaker Shop Buffalo
North Carolina
Suber's Stereo Charlotte
Vicker's Audio Chapel Hill
Ohio
Audio Corner Canton
Audio Encore Cincinnati
Threshold Audio Emporium Heath
Oklahoma
Youngblood Sound Oklahoma City
Oregon
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Bryn Mawr Stereo Quakertown
D.S. Audio Inc Wyomissing
D.S. Audio Inc Lancaster
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tem starts with an automatically controlled antenna which seeks the signal with the least interference as each channel is tuned. Once "locked" on to this signal, special circuits wipe out the ghost image by producing an erasing circuit signal of exactly the same size and form as the interference. When such a system is marketed, it would be available as an integral part of new TV sets or as a separate "add-on" system for existing TV sets.

How about a TV set that is a color-facsimile machine as well? As you are watching a program, FM-FM modulation multiplexes a facsimile signal on the TV signal, using the extra carrier wave in a higher frequency than the normal audio frequency of TV. From a slot at the bottom of the TV, a letter-size, full-color sheet is delivered, printed by the built-in color ink printer, all in the span of two minutes! This system would furnish all sorts of matter . . . stock market quotes, recipes, weather reports . . . it could even deliver you a daily newspaper.

Imagine a VHS video-tape duplicator that does not have to function in real time? A new Matsushita unit will duplicate two- or four-hour tapes in five minutes. Duplication is accomplished by magnetic transfer and is independent of the condition of the recording head or electronic circuitry of the VCR. The two-unit system has a master tape recorder and a magnetic tape printer. The master unit records mirror image signals from the program to be duplicated. The master tape and slaves are wound together in the magnetic printer, and the image is transferred magnetically. A special alloy master tape is used, which does not deteriorate even after several thousand passes. This video duplicator could revolutionize the entire prerecorded video cassette business, making cassettes appreciably less expensive than at present.

Taking color TV pictures in the home would be much simplified with the new Matsushita single-tube color camera. The unit has an improved low-light Newvicon tube, so sensitive that it requires only 50 lux of illumination, roughly a 7.5 watt lightbulb!

By far the most fascinating of all the futuristic TV equipment shown by Matsushita at the WCES was their high-definition color TV system. Against a painted landscape reaching down to the sea is a model Spanish galleon, rocking fore and aft at anchor, the scene illuminated by intense lamps at the exact color temperature desired. A large professional color camera is photographing the scene. There are racks of associated electronic equipment. Over to the right of this scene is a special wide-screen projection system. The screen is somewhat reminiscent of the Cinemascope movie screen, with a 3:5 aspect ratio. The screen is showing the image of the galleon being photographed. The color is so bright, highly saturated, pure and clean, the image so sharp with such high definition that you want to gasp in awe. It's so good, it is almost real, a palpable, almost three-dimensional scene! The secret is new design concepts for TV using 1125 scanning lines compared to our present 525-line system. The resolution of the system is 800 lines at the red, green, and blue input. Believe it or not, for closed circuit use, this system can actually be ordered! For medical use and training, where very high resolution is desirable, as well as industrial monitoring of very detailed processes, this system is the obvious answer. Alas, use in the home on a broadcast basis would require establishment of a new standard for scanning. Well, maybe someday. Perhaps it's just as well it's not available. With a picture of this sensational quality, people would become bigger slaves of TV than they are already!

Realistic's System Seven . . . new size . . . new shape — compact without compromise

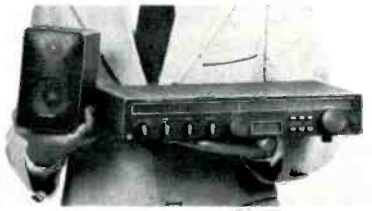
Cheers to "mini" styling! Realistic's fabulous System Seven combines beauty, elegant small size and a level of acoustical quality you've never heard, until now, in low-priced bookshelf stereo.

System Seven includes our STA-7 AM/FM receiver (10 watts per channel, minimum RMS into 8 ohms, 20-20,000 Hz, with no more than 0.5% total harmonic distortion) and a pair of our amazing Minimus®-7 speaker systems — featuring large-excursion woofers and soft-dome tweeters in diecast enclosures only 7 1/16" high.

At last — true hi-fi perfectly sized for a bookcase. The 4-1/3-lb. speakers can even be used for bookends!

Bass without bulk. Despite its small size, System Seven delivers rich, satisfying bass to 50 Hz and sound levels up to 90 dB for accurate reproduction of anything from classical to rock music. What's the secret? The receiver has a unique equalization network engineered especially for mini speakers . . . and it's switchable so you can use large speakers, if you wish.

Compact, but no compromises. You get "full-size" high-fidelity features with System Seven — magnetic and aux inputs, tape monitor, A/B speaker switching, even 75 and 300-ohm FM inputs. U.L. listed, of course, and housed in a stunning jet-black metal cabinet with blackout dial.



Receiver is briefcase-sized, a little taller than a credit card — just 3-1/2" high. Each speaker is about the size of two average books.

The price for all this may be the surprise of your audio life — only 239.95*, a savings of $39.90 off the "each" price!

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*Price may vary at individual stores and dealers.

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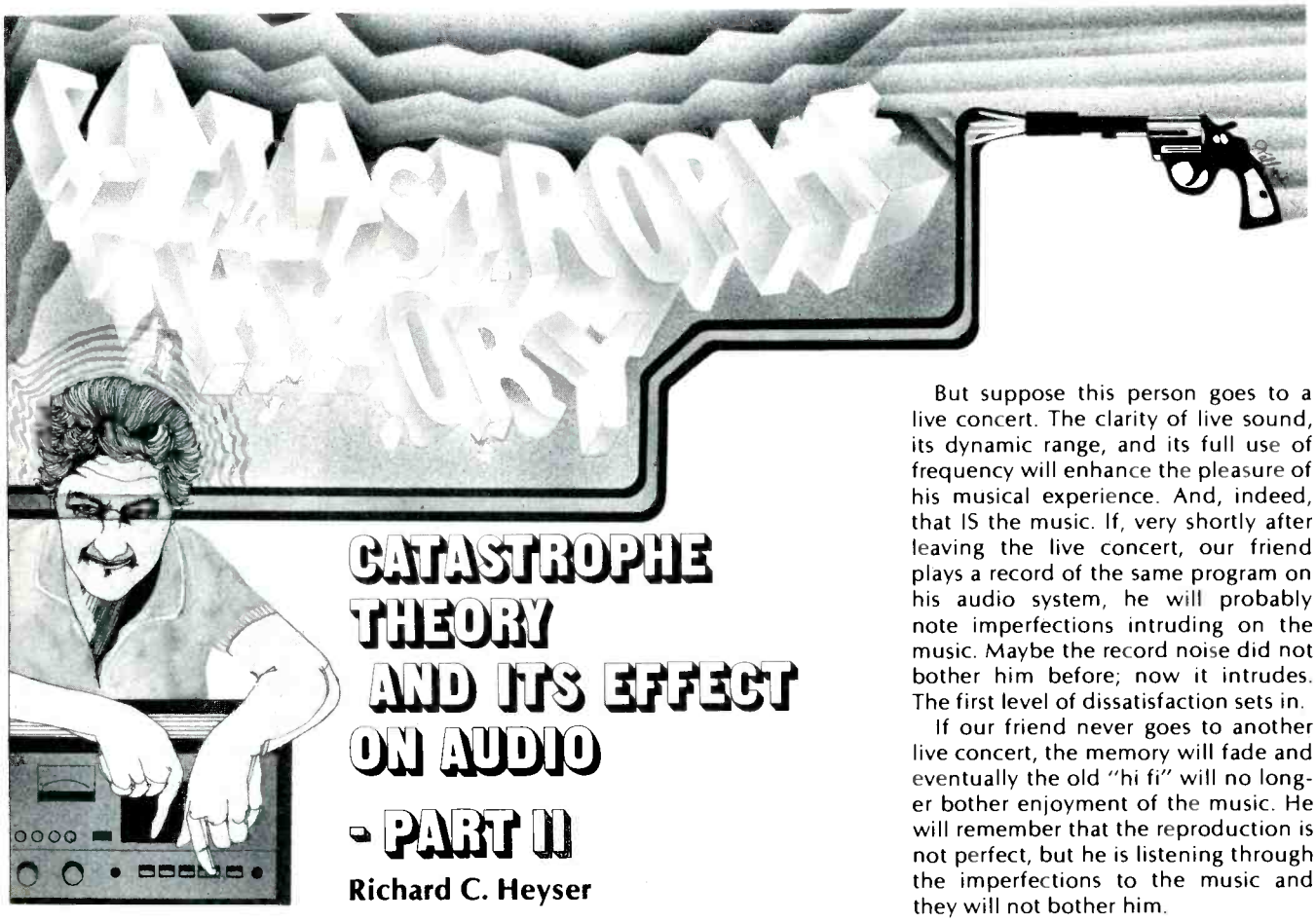

Richard C. Heyser

Away, you scullion! you rampallion! you fustilarian! I'll tickle your catastrophe.

King Henry IV, Part II, II, i.

In the previous article, we discussed the elementary basis of Catastrophe Theory and suggested that it may be applicable to problems in the perception of sound. In this discussion, I would like to present a simple example to show how this can be done.

Catastrophe theory, if you remember, is a mathematical basis for modelling certain simple patterns of response that can be expected under the influence of conflicting drives. This is a general nonlinear theory which can be applied to the analysis of equipment and to the study of human behavior.

The theory gets its name from the fact that sudden and dramatic alterations in behavior, response catastrophes, can be predicted within its framework. What makes this attractive, from the standpoint of our perception of sound quality, is the structured analysis which it brings to bear on problems involving the emotional reaction of the listener.

Suppose we now consider a very simple and straightforward problem in audio: How might one's opinion of the quality of sound reproduction from an existing audio system be modified under the influence of two factors, the amount of live music one hears and the amount of reproduced music one listens to from this system?

First, let us postulate a scenario that draws only on our observations of human nature. Presumably, if the owner of an audio system likes music, he will continue to indulge himself by acquiring new records and listening to reproduced sound. If there are no interfering factors which can reveal imperfections in quality, there is no drive to modify the opinion of the present audio system. If the listener never goes to a live concert, he is probably satisfied with the music heard at home. The listener probably never thinks about the audio system and would be perfectly satisfied with music heard from a table-model radio.

But suppose this person goes to a live concert. The clarity of live sound, its dynamic range, and its full use of frequency will enhance the pleasure of his musical experience. And, indeed, that IS the music. If, very shortly after leaving the live concert, our friend plays a record of the same program on his audio system, he will probably note imperfections intruding on the music. Maybe the record noise did not bother him before; now it intrudes. The first level of dissatisfaction sets in.

If our friend never goes to another live concert, the memory will fade and eventually the old "hi fi" will no longer bother enjoyment of the music. He will remember that the reproduction is not perfect, but he is listening through the imperfections to the music and they will not bother him.

If, on the other hand, there is a larger percentage of time spent on listening to live music, there is a good chance that one night, when he comes home and puts a record on the turntable, it will suddenly dawn on him how lousy the sound really is. He no longer likes the sound of music played on his system. From that point on, the degree of discontent will grow in proportion to the ratio of live vs. reproduced sound that is heard. If he mostly attends live concerts and only rarely plays records at home, his knowledge of what live music sounds like will increase the discontent he has with the quality of his reproduced sound.

If he drops off in the amount of live concert attendance, but maintains a small, steady diet of listening to reproduced music, his discontent will, at first, slowly diminish. But without his awareness, there will suddenly come a time when he is so caught up in the music that he never once thinks about the record scratch that bothered him so much just a few evenings before. His opinion switched from moderate dislike to moderate like. If the ratio of live to reproduced sound continues to diminish, he will again resort to a condition of satisfaction with reproduced music.

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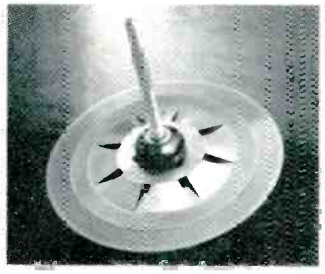

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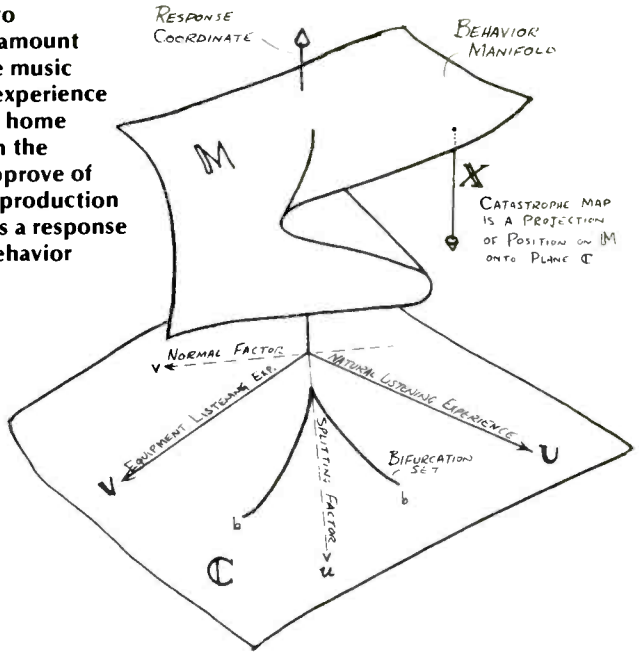

Fig. 1 — If there are two control factors, 1) the amount of experience with live music and 2) the amount of experience with listening to one's home audio equipment, then the degree to which we approve of the quality of audio reproduction from that equipment is a response that must lie on the behavior Manifold M.

Cusp Catastrophe

Admittedly this scenario is quite simplistic. But the behavior is not out of line with human reaction. Let us once again set up the same problem, but this time use catastrophe theory to anticipate behavior.

There are two control factors: Amount of experience with live music and amount of experience with reproduced sound. There is only one response we wish to consider, the degree to which the listener approves of the quality of audio reproduction.

Two factors and one response define a three-dimensional behavior space. This three-dimensional behavior space is sketched in Fig. 1. From our previous discussion we know that the behavior manifold, the location of all stable responses under unchanging factors, will be a subspace with the same number of dimensions as there are control factors. The manifold M, is a two-dimensional surface.

This surface, as we discussed last time, forms a folded shape of the type shown here. The horizontal plane, C, represents the given coordinates of live vs. reproduced listening. We use the letter C because this represents the Control subspace within the higher-dimensional behavior space. It is also referred to as the Parameter space in some mathematical literature. In this figure, I have dropped the position of plane C down below the behavior manifold for illustrative clarity. It makes no difference where the plane C is located relative to M because our interest lies in the projected "shadow" of M onto the control space. By separating M from C, we can readily observe what goes on.

The orientation of coordinate axes on the plane C depends upon the nature of the factors which they represent. The derivation which we presented in our prior discussion developed the concept from a behavior potential which would give coordinates u and v, shown dotted in Fig. 1. In contemporary literature, the axes u and v are referred to as the splitting factor and the normal factor, respectively. These coordinates would be used for situations in which the response under consideration is normally influenced by a single factor in a smooth, continuous manner, while, above a certain threshold, the action of the second factor is to set up a trigger condition where slight changes in the normal factor precipitates larger than normal changes in response. The start-up conditions in a free-running multivibrator are examples of this; a perfectly balanced circuit could not oscillate when voltage is applied, but offset symmetry — the splitting factor — can allow circuit noise above a certain level to start oscillations that build up to full-limit cycles.

When there are conflicting factors which pretty much compete in their contributions to response, then there is a little bit of control and a little bit of splitting in each of them. These axes are then rotated relative to u and v, as shown in Fig. 1 by the solid lines marked by the capital letters U and V. In the case of audio listening, I will assume that the conflicting factors of live music experience and reproduced music experience are of this latter type. This does not mean that they are rotated 45 degrees with respect to nor-

Your choice between these new LUX turntables depends on how you feel about bearing arms.

Although these two turntables are being introduced simultaneously, the PD-272 (with integrated tonearm) was actually designed and produced first. Its operation is purely manual—no automatic assist whatever. So if you believe that any amount of automation implies compromise, the PD-272 should appeal to you.

The performance will certainly appeal to purists. The servo-controlled direct-drive brushless DC motor with its gapless pole design is totally free of the cogging (pulsing) that plagues many other direct-drive motors.

The straight, statically-balanced tonearm has several important design features. For example, the vertical pivots extend through the arm rather than simply suspending it from the outside. This minimizes lateral play and assures that the stylus will always remain perpendicular to the record. Also, the arm's nested tube construction and internal damping deal very effectively with resonance.

Then for those audiophiles who like to go their separate ways, we produced the PD-270 (like the PD-272 but less tonearm) and the TA-1 (separate tonearm). With TA-1, you change cartridges by changing the entire tonearm tube. This system is much better than changing headshells since it minimizes mass at the critical point of the tonearm. The TA-1 also has a built-in stabilizer below the arm base which damps out vibration.

This additional flexibility has its price. The PD-270 drive system is $285; the TA-1 tonearm, $125. The complete PD-272 is $345. (And for either tonearm, the new 115-C moving coil cartridge, $195.)

As you can see, you do have to decide how likely you are to want interchangeable tonearms in the future. Think about it on your way to your LUX dealer. If it's still a problem when you get there, he'll help you bear up under it.

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PD-272. Effective tonearm length: 240mm. Tracking force calibrated 0-3 grams. Accepts cartridges from 4-11 grams. Anti-skating, viscous-damped cueing, adjustable height. Illuminated strobe, pitch variable ±4%. Wow and flutter less than 0.03% (WRMS); rumble more than 60 dB. Same drive system specifications apply to PD-270. Both include removable dust cover.

TA-1. Straight, tubular, static-balanced. Interchangeable tube. Stabilizer. Otherwise similar to tonearm of PD-272.

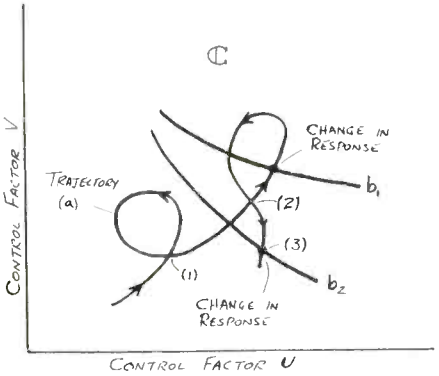

Fig. 2 — A flatlander, living on the control space C, will encounter mysterious, unmarked boundaries, b_1 and b_2 which will cause him to experience abrupt changes in behavior when passed in one direction, but not when passed in the opposite direction.

mal and splitting, but that they have some amount of rotation.

Flatland

The projection of the behavior fold in M onto the surface C is called the Bifurcation Set, and this curve is symbolized here by the letter b. It is called bifurcation, or two-pronged fork, because two different kinds of behavior occur when we move our location away from this line. This is the boundary of precipitous behavior in terms of the control factors. This curve has a sharp point which forms a cusp, and that is why the particular type of behavior pattern associated with this type of precipitous response is called a Cusp Catastrophe.

In order to understand how our listening emotions enter the picture, refer to Fig. 2. Imagine that we are flatlanders living on the surface C. We are moved about our flatworld under the influence of two factors, and our position within flatland is marked by the coordinates U and V. Our emotional feelings alter with our position in flatland. As we move along the trajectory marked (a), our feelings smoothly and continuously change with our coordinate location. When, in our wanderings, we cross back to the coordinate location shown here as (1), we duplicate the emotions we previously experienced when passing this same place. But when our trajectory crosses the magic boundary b_1 we suffer a dramatic and sudden change in emotion. Just before we got to this boundary we were content and liked our state. At the moment we touched this boundary, our state flipped to that of a strong dislike. Our emotions suffered a catastrophic change.

Seeking to restore our status we loop back to position (2) which we had just before encountering this magic boundary and which we knew was a position of content. But our emotions do not come back to what they were. Now, at position (2) we still have a feeling of strong discontent.

Baffled, we retrace our path until suddenly, at another magic boundary, b_2, we catastrophically jump back in emotion state to our previous condition. We had previously passed this second magic boundary going in another direction and nothing had happened; now, coming back across it, our emotions are dramatically altered.

Living life as a flatlander, unable to comprehend forces outside our world, we would probably attribute this mischief to divine influence and might develop some interesting theories to explain why these things should happen to us.

We might even devlop a *technocult* of flatland surveyors who, through ever finer instruments and more glorious linear mathematics, seek to quantify the measure of the geometry of flatland. Of course, these technocultists might be so burdened down with the weight of their precision apparatus that they cannot stray far from low-curvature regions where no catastrophic changes occur. Rumors of catastrophes might reach their ears, but no technocultist would ever accept the existence of such magic nonsense, since it was not only inconsistent with their linear mathematics, but could not be discerned by their survey instruments. In order to ease the fears of the *perceptofreaks*, who believe in such magic nonsense, the survey instruments are constantly being improved to measure imperfections to an ever finer resolution.

But a flatlander falling off a cliff takes little comfort from knowing that the science minds of flatland, who do not believe in the existence of cliffs, had developed a new flat measuring rod capable of resolving a nanometer.

It is not that the science minds are wrong; they just do not happen to be where the action is. They are under the wrong lamppost. If this situation sounds a little bit like our own problems in audio flatland, the resemblance is not coincidental.

What no one in flatland can realize is that his fate depends on higher dimensional influences. Let us go back to Fig. 1. The dramatic change called a catastrophe is a symbolic falling off a cliff in a higher dimensional space. The *catastrophe map*, shown here by the capital X, is the process of projecting the shadow of the actual position of response on the behavior surface M

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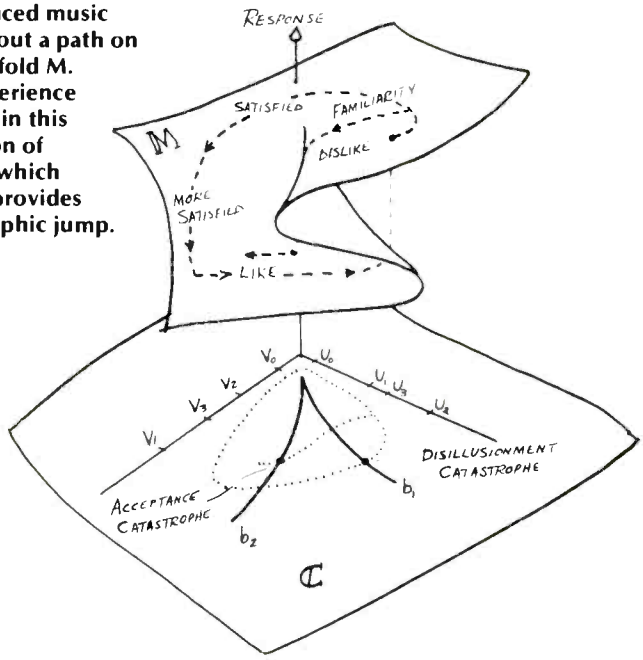

Fig. 3 — As our exposure to live music and reproduced music changes, we trace out a path on the behavior Manifold M. Whenever our experience takes us past folds in this surface, our opinion of the sound quality which our audio system provides will take a catastrophic jump.

onto an apparent position in terms of the control space C.

Journey on a Manifold

Let us take a journey on the manifold M. This journey is shown by the dashed line in Fig. 3 and starts out at the place marked "satisfied." Our *altitude* marks our *attitude*. Our height above the plane C (flatland) is a measure of response to the control parameters. The *higher* we are on M, the more we *dislike* the sound of the audio system. We are driven up and down this surface by the control parameters. We start this journey at "satisfied," the position of which is determined by control coordinates U_o and V_o.

At "satisfied" we have V_0 units of listening to our audio system and U_o units of listening to live music. Out of enjoyment of music, we begin to listen to more reproduced sound and begin our journey on the manifold M.

The more we listen to reproduced sound, the more that sound becomes our standard of performance. This drives our location on manifold M to a lower height, which means we become more satisfied with the sound of our audio system . . . or, looked at another way, the less we think about the quality of reproduced sound.

Then, around coordinates U_1 and V_1 we being to go to more like concerts. Our trajectory now takes a sharp change of direction back up the manifold. With increasing live music experience, our opinion of the old "hi fi" begins to drop, until somewhere around coordinates U_2 and V_2 we cross the magic boundary b_1. All of a sudden we experience a disillusionment catastrophe . . . our opinion changes from "like" to "dislike." The reason for this is that in order to remain on the surface of stable response, M, we had to jump from the lower sheet to the upper sheet where our trajectory took us past the fold. Under small changes in factors, we must take a big jump in response in order to stay on the manifold of stable response. When we approach a fold under smooth progressive drives, there is no way we can find ourselves on the inner sheet of M.

If we slack off on the ratio of live to reproduced listening, our opinion of reproduced sound quality will not snap back until we cross the boundary b_2 at position U_3 and V_3. Then, as we cross this boundary, our opinion will fall off the cliff, and we will suffer what I have referred to here as an acceptance catastrophe. We are back on the original trajectory and must accumulate a bit more live-listening experience before again experiencing a disillusionment catastrophe.

If, on the other hand, we simply slack off in both live and reproduced listening experience, we are passing along the path called here as "familiarity." The old habit patterns slowly take hold and we again will find ourselves at a "satisfied" status, back where we started.

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which is revealed by even this naive catastrophe model. Each of us, I am sure, would like to believe that he is master of his own behavior under conflicting factors. But the trend in behavior pattern which is disclosed by Thom's theory reveals the existence of an inexorable machine which we ought to be aware of. Knowledge of this machine introduces a new factor into the game and raises the dimensionality to a higher level. It is a case of forewarned being forearmed; once we know that participation in a situation with two factors and one response yields a cusp catastrophe, we can introduce that knowledge as a new control factor and avoid the cusp. But our cleverness could also be our undoing since we may have changed the situation to one of higher dimensionality.

One of the situations in which knowledge of this elementary catastrophe can be of value is in the purchase of audio equipment. If instead of a live listening versus reproduced listening, we were to label the control factors: Listening to Brand A versus listening to Brand B, we can sense how a clever salesperson could walk an unsuspecting customer up the manifold to sufficient strength of opinion to trigger purchase of a component.

Suppose you had decided Brand B sounded pretty good and was an excellent match to your bank account. About the time you show signs of being ready to purchase Brand B, the clever salesperson lets you hear just a brief bit of sound from a more expensive Brand A. By this time you had disclosed which kind of music you like and had expressed satisfaction with the way Brand B reproduced that sound. So, quite by "accident," Brand A is punched up on that music.

You are at point U_1 and V_1 and suddenly the introduction of a better sound stops your downward plunge on the opinion manifold and pulls you in a new direction of upward motion. You like the music and your curiosity makes you want to hear a bit more. The smallest dissatisfaction with Brand B starts to set in, and a clever salesperson knows that if you can be persuaded to listen long enough you will get "hooked" on the better sound of Brand A. A good salesperson will not force you to listen to Brand A; you said what your purchase limit was and Brand B was at that limit. So the trap is sprung to let you sell yourself.

A simple A-B comparison switch is all it takes, with you the unsuspecting driver of the machine when you are allowed to switch the music back and forth between the two competing systems. Any increase in relative exposure to the sound of A versus B will inexorably drive you upward on the manifold. If you trigger a disillusionment catastrophe, the deed is all but done. Once you are on the uppermost sheet of the manifold, it is likely that you will subconsciously place the switch in the A position for an increasingly longer time than in the B position. You are driving yourself higher on the manifold. By that time the salesperson is mentally computing his commission on the sale of Brand A.

Maybe you do not dig math. Maybe the idea of topological manifolds in a behavior space does nothing to you. But just knowing of the existence of such things can save your wallet from a needless onslaught the next time you go shopping for audio equipment. At the very least, you can be aware of emotional forces which can be set into motion to present you with tempting bait. Once you grab such bait, the hook is sunk, and it is your own struggle which sets the barb in deeper and pulls you into the purchase of a component you did not previously want to buy.

All Is Not Gold That Listens

Quite obviously, the more interesting situations arise when there are a multiplicity of factors, some conflicting and others of a splitting nature. We all recognize that emotional bias definitely plays a role in the reaction we have to conflicting circumstances.

Our individual perception of quality involves a delicate balance of conflicting factors, including our own involvement with one or more of those factors. The designer of a particular audio product may be a poor judge, from the standpoint of detached objectivity, of the relative merits of that product. And it must be admitted that the ratio of lead to gold in the ear of the listener is somehow related to the personal involvement which that listener has with the product being heard. This apparent rupture of objectivity, as perceived in the frame of reference of others, may occur without conscious awareness of the occurrence.

It is also possible that even in the presence of an emotional bias something can happen which will "change our mind" and alter the response we have to a given situation. Beauty, it is said, is in the eye of the beholder. But we all know that events can occur which catastrophically alter our perceptions even in the presence of prior strength of opinion.

In our next discussion we will consider another common audio situation which involves a higher dimensional catastrophe.

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the foil which will re-radiate the interference field."

Foil shielding material is optionally available with two-way, pressure-sensitive adhesive backing. This offers a simple way of attaching the material to the device to be shielded.

Decisions as to choice of sheet or foil, its thickness, and the number of layers depend in large part on the degree of attenuation sought. (Sheet material may also be chosen because of its rigidity, so as to preserve the shape of the shield, enable it to be secured in place, etc.) While formulas are available to assist in selection of the proper shielding material, gauge, and/or number of layers, these formulas yield only approximate results. A trial and error procedure is often necessary. Here an a.c. magnetic field evaluator probe, such as the one made by Perfection Mica, can be helpful to the engineer, technician, or hobbyist. In conjunction with an a.c. voltmeter or oscilloscope, the probe can measure the intensity of a magnetic field before and after shielding, thus indicating the degree of attenuation actually achieved. "With this necessary information," states Perfection Mica, "magnetic shielding material type and gauge can be intelligently selected and shield design optimized."

How Shielding Material Operates

A magnetic shield effective in the audio range performs its functions in two ways, depending on frequency of the interference field: (1) For a stationary field (zero frequency) produced by a permanent magnet, d.c. current, or the earth, the shield offers a path with low reluctance — that is, with low magnetic resistance. Thus the shield acts as a shunt, diverting the field from the sensitive device. At low audio frequencies, the shield behaves in much the same manner. At higher frequencies, however, the interference field produces eddy currents in the shield material. These currents in turn produce an electromagnetic field that opposes the interference field.

The specific shielding materials that we shall next discuss, namely those made by Perfection Mica, consist of an iron-nickel alloy. As previously stated, they are effective from d.c. to about 50,000 Hz; for higher frequencies, other shielding materials, such as copper, are required.

Perfection Mica's two basic types of shielding materials are:

1. *Co-Netic.* This has very high relative permeability, which is a measure of a material's ability to provide a path for magnetic lines of force. The higher the permeability, the greater is the shielding effect. Relative permeability is the permeability of a material relative to that of a vacuum. Air has a relative permeability of about 1. Co-Netic has a maximum relative permeability of about 500,000. For interference fields of weak to moderate strength, Co-Netic can prove an effective barrier when properly used, with a single layer typically providing about 40 dB attenuation of the field. Unfortunately, Co-Netic has a relatively low saturation level. That is, it cannot effectively serve as a barrier to strong magnetic fields. Beyond a point, it can no longer provide a path for magnetic lines of force.

2. *Netic.* This has much lower relative permeability than Co-Netic, but a much higher saturation level. While its permeability is only about 1/100th that of Co-Netic, it can accept more than 100 times as great a magnetizing force before reaching saturation. Hence, when dealing with strong magnetic fields, use of Netic is indicated; however, a single layer will provide only about 1/10th as much attenuation as does Co-Netic.

To achieve a desired degree of attenuation, several layers of shielding material may be needed. For an intense field, the most effective shielding tends to result from a combination of Netic and Co-Netic. The rule to be followed is to place the Netic material closest to the generating device, and the Co-Netic closest to the sensitive device. For example, if combination shielding were to be placed around a transformer, the Netic layer would be on the inside and the Co-Netic layer on the outside; if a combination shield were to be placed around a tape head, the Co-Netic would be on the inside and the Netic on the outside.

Both are available in sheet and foil form, each in a variety of gauges, widths, and lengths. For ease of handling (cutting, shaping, etc.), foil would probably be more advantageous to the audio hobbyist, although sheet has the advantages of rigidity and greater attenuation owing to its greater thickness.

Foil has another important advantage to the hobbyist: It eliminates the possible need for annealing in order to preserve the magnetic properties of the shielding material after it is worked into the desired shape. Annealing consists of heating the material to an appropriate temperature in an appropriate environment and cooling it at an appropriate rate — requiring facilities seldom available to the amateur.

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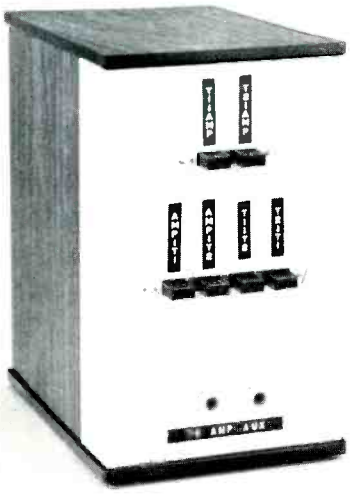
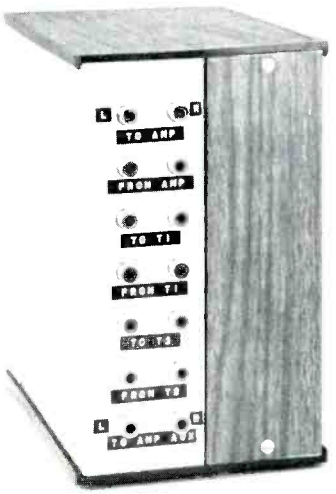
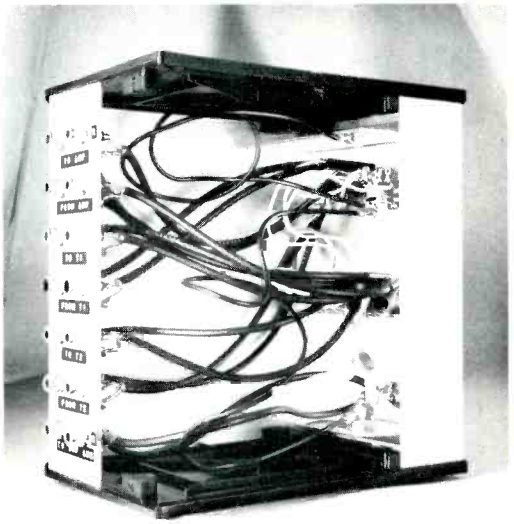






When I ran out of inputs on my Heath AR-1500A receiver, I decided to buy a tape deck switcher. However, when I saw their prices and found that they weren't the correct physical dimensions to fit into my system, I decided to build one.

The switches I used are all Switchcraft "Multi-Switches" which are interlocking so that when one switch is depressed, the others are automatically released. I used a four-station and a two-station DPDT switch arrangement to control the tape input, tape output, and copy functions.

The switcher is encased in a Bud MW-3222 Contempo Series III box, measuring $4\frac{3}{16}$ x $6\frac{3}{4}$ x $6\frac{5}{16}$ inches. Cutting the holes for the switches was first accomplished by marking the box for the size and location of the holes, and then drilling several holes smaller than the size of the final openings. I used a set of tool and die maker's files and a 6-in. flat mill file to change the round holes into the rectangular ones needed for the switches.

This system uses RCA connectors, and all jacks are mounted on the rear of the box, with the exception of the auxiliary input jacks which are on the front. On the inside of the box, I used shielded cable (Belden 8218 Sub Minax) to connect the jacks to the switches and 20-gauge hookup wire for all other switch connections.

When the construction was finished, all the switches and jacks were marked with labels made from an embossing label maker . . . and for less than $30.00, I had an operational tape deck switcher.

This switcher can be expanded to accomodate more inputs through the use of Multi Switches with more stations.

As can be seen from the schematic diagram, the switches function as follows:

$S1_A$ connects the amplifier output to the input of Tape 1.

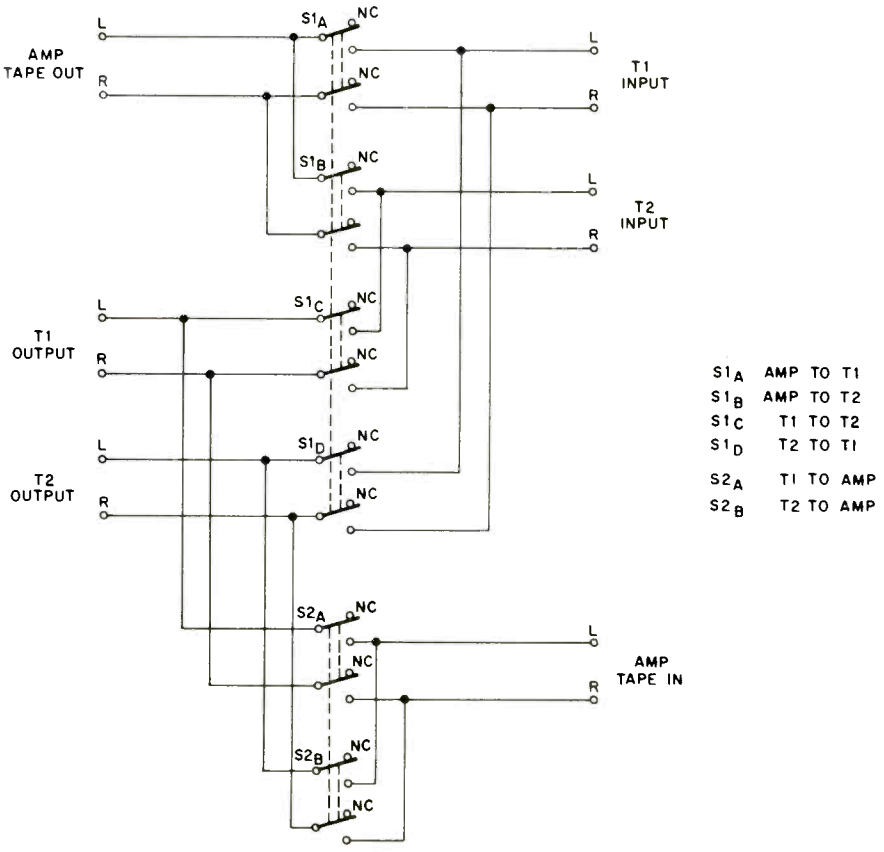
$S1_B$ connects the amplifier output to the input of Tape 2.

$S1_C$ connects the output of Tape 1 to the input of Tape 2.

$S1_D$ connects the output of Tape 2 to the input of Tape 1.

$S2_A$ connects the output of Tape 1 to the amplifier input.

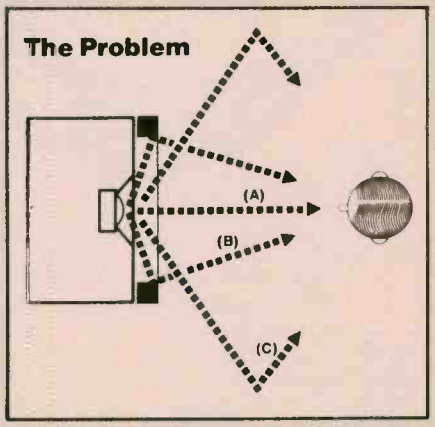
$S2_B$ connects the output of Tape 2 to the amplifier input.

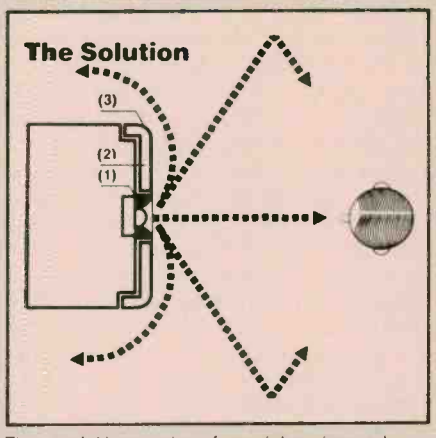


Unboxed Sound

Introducing minimum diffraction loudspeakers™ by Avid.

Unwanted cabinet/grille diffraction effects **(B)** give listener clue as to the size/shape of sound source – in this case a box. First arrival signals **(A)** locate source, while brain uses delayed room reflections **(C)** to identify listening environment.





The careful integration of special engineered Optimum Dispersion Couplers™ **(1)**, and solid front grille panels **(2)** with rolled edge design **(3)**, significantly reduces the unwanted cabinet diffraction effects – a principal contributor to "boxy" sound. These design principals are incorporated in all Avid Minimum Diffraction Loudspeakers™

In the quest for accuracy, cabinet loudspeakers, regardless of price, still generally suffer from a common failure – they still sound like loudspeakers, or more precisely their sound obviously comes from a box.

Your brain hears the box.

Without going too deeply into psycho-acoustics, cabinet speakers tell us their sound is emanating from a box because the brain has been conditioned to recognize the characteristics... size, shape, etc.... of any sound source.

What creates the boxy effect? Diffracted or reradiated sound waves, those that bounce off the sharp edges of the speaker and grille assembly, are the clues interpreted by the brain as "box-like."

No diffraction, no box.

The problem is graphically illustrated in the drawings. By eliminating sharp cabinet edges and grille panel obstructions, you reduce diffraction effects... which means you eliminate the boxiness of the sound. And that's exactly what we've done with our new line of Avid Minimum Diffraction Loudspeakers™

To open the box, we closed the cover.

The solution was deceivingly simple.

By engineering the drivers, cabinet enclosure and, importantly, the grille assembly to create a totally integrated acoustic system, we eliminated cabinet diffraction and the boxy sound quality inherent in typical cabinet loudspeakers.

Our new tweeter and midrange drivers have specially engineered coupling devices (we call them Optimum Dispersion Couplers™) which transmit sound waves with minimum diffraction.

"Solid front" grille panels perfectly mate with each coupler eliminating grille panel diffraction. And, the grille panels have rounded edges creating a smooth, gradual transition from the grille to the cabinet, significantly reducing cabinet edge diffraction – a major cause of boxy sound.

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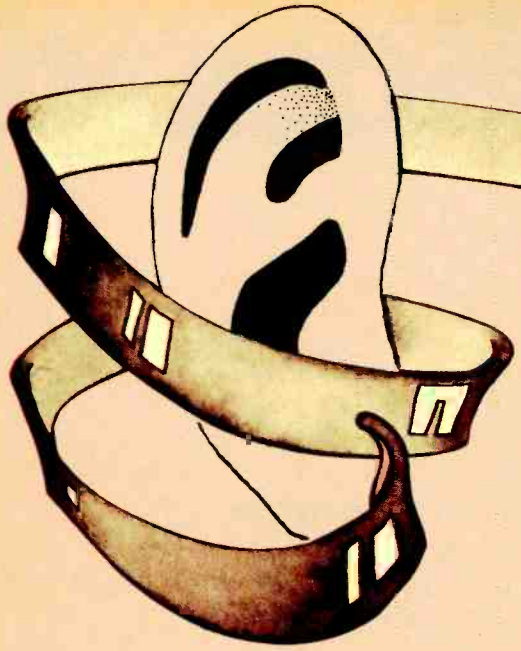


PHASE, TIME, EARS & TAPE

William A. Manly

During nearly 20 years of association with audio and tape recording, I have noticed that technical development tends to be quite faddish. The "in" thing recently has certainly been phase and phase distortion. It really doesn't matter which transducer holds one's interest: Articles and ads can be found in profusion, extolling the virtues of some new technique, or imploring the purchase of some new and expensive piece of equipment. "Transducer" is the key word here — the only electronics which possess any measure of phase shift or distortion are those designed to correct for the non- linearities of some transducer (speaker, phono cartridge, tape head, etc.) in the audio system.

But what is the point? Didn't Herr Doktor Professor Hermann Ludwig Ferdinand Baron von Helmholtz himself say that tone quality did not depend upon the relative phase of its components?[1] Yes, indeed . . . but the statement was very carefully qualified, and Helmholtz tabulated some exceptions. Even those who say that individual system phase distortion is not audible[2,3] will agree that phase differences between stereo channels will displace the stereo image, but the situation is worse than that. I don't intend to take a lot of space here to defend my point of view, but for the purposes of this article I will take the position that certain types of phase distortion are important to audio. The conditions and qualifications will be carefully stated. If you need to be persuaded, I can only recommend Schroeder's marvelous paper,[4] which convinced me beyond a doubt.

Phase

Few readers of this magazine are totally ignorant of what is meant by the terms *phase* and *phase shift*, but there is so much confusion in the literature that it's best to start off with some "basic basics" that we all know. I'll define terms as I go, so that nobody (including me!) gets lost as things get more complicated.

A single frequency can be represented as a constantly rotating vector of constant length, called a *phasor*. To see how this can represent the thing we generally call a *sine wave*, see Fig. 1a. The phasor rotates with one end fixed at "P," and the other end describes a circle. The phasor starts with its moving end at "O." At the end of a certain amount of time, the moving end is at "a," and the phasor has rotated through an angle "A." At the end of twice the first interval of time, the end of the phasor is at point "b," and the rotation has been through an angle "B," which is exactly twice angle "A." This is continued around the circle.

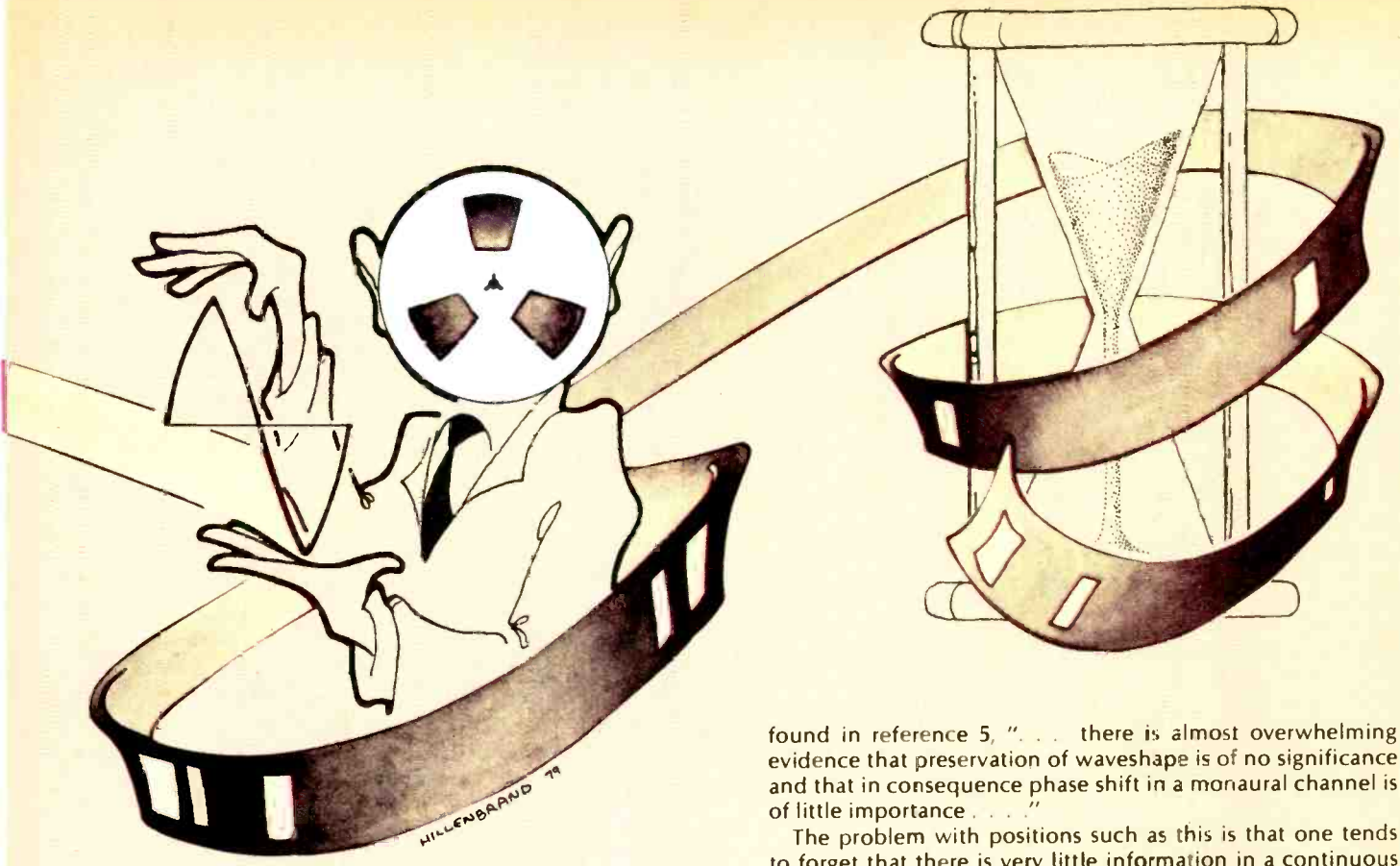
A Cartesian graph is now constructed, with the abscissa extended from the line through the center of the circle and point "O." The abscissa is marked off into equal intervals, and ordinates are erected at each point, labeled to correspond with the points around the circle. Horizontal extensions are made from point "a" to ordinate "a'," from "b," to "b'," etc. A continuous curve (solid line) is drawn through the points where extensions cross their corresponding ordinates. This curve is known as a sine wave. It is a plot of amplitude vs. time of a single frequency. Points along the wave can either be measured by time or by the angle of the phasor. This measurement is known as the *phase* or the *phase angle*. Phase is measured either in degrees (360° for a complete circle) or radians ($2\pi = 6.283\ldots$ for the circle). The points on this particular graph are 20° or $\pi/6$ radians apart. The *frequency* of the signal is just the number of times per second that the phasor makes a complete circle. The *angular frequency* is the number of radians per second through which the phasor rotates or just twice the frequency. *Phase shift* of one sine wave with respect to another can be thought of as if there were a horizontal relative movement of the wave along the abscissa (time axis). In Fig. 1A, the wave shown by the dashed line lags the one shown by the solid line by 90°.

Complex Waveforms

More complicated waveforms can be constructed by adding together sine waves of different frequencies. These frequencies are *harmonically related*, which means that if the *fundamental frequency* is denoted by f_1, the only other frequencies present are the harmonics of f_1, that is f_2 (= $2f_1$), f_3 (= $3f_1$), etc. A square wave, for instance, can be constructed with the fundamental (at the same frequency as the square wave) and its odd harmonics, as follows:

Frequency	*Amplitude*	*Phase Shift*
f_1	1	0°
f_3	1/3	0°
f_5	1/5	0°
f_7	1/7	0°
—	—	—
f_i	1_i	0°

with the additions continuing indefinitely. Actually, the frequencies do not go upward without limit in any real system, but the amplitudes of the highest harmonics are so small that they don't contribute very much. If the proper harmonics



with proper amplitudes are added, but the phase relationships are different than shown, the result is not a square wave at all. It may not even be recognizable as a distorted square wave if it is viewed on an oscilloscope screen.[5,6] Nevertheless, what Helmholtz said, is that the ear is sensitive only to the frequencies and the amplitudes, and not in any way to the phase relationships of the various harmonic frequencies. This has been shown many times since by many experimenters, giving rise to such absolute statements as that found in reference 5, ". . . there is almost overwhelming evidence that preservation of waveshape is of no significance and that in consequence phase shift in a monaural channel is of little importance . . . ."

The problem with positions such as this is that one tends to forget that there is very little information in a continuous wave, no matter how exotic its shape. Not many people settle down in their living room chairs for a few hours of easy listening to their favorite square wave! Almost all the information found in speech and music is in the changes found therein, changes in frequency and amplitude, including starts and stops. It also seems obvious that fundamentals and har-

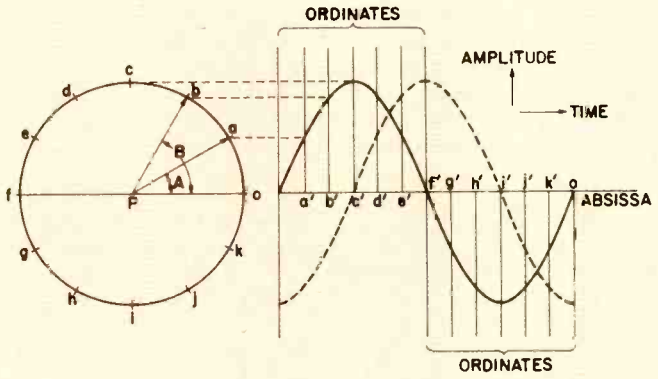


Figure 1A — Construction of a sine wave from a phasor. The phasor is of constant length and has one point fixed at "P." It revolves around "P" with a constant angular velocity. At the end of each unit of angular rotation, the point at the end of the phasor is projected to the proper ordinate representing a unit of time. The height of the ordinate at a' (for instance) is given by h(a') = L sin A where h(a') is the height at a', L is the length of the phasor, and A is the angle of rotation at a. Because of this relationship, the locus of the points is called a "sine wave." The dashed sine wave is of the same amplitude, but it has been phase shifted by 90 degrees.

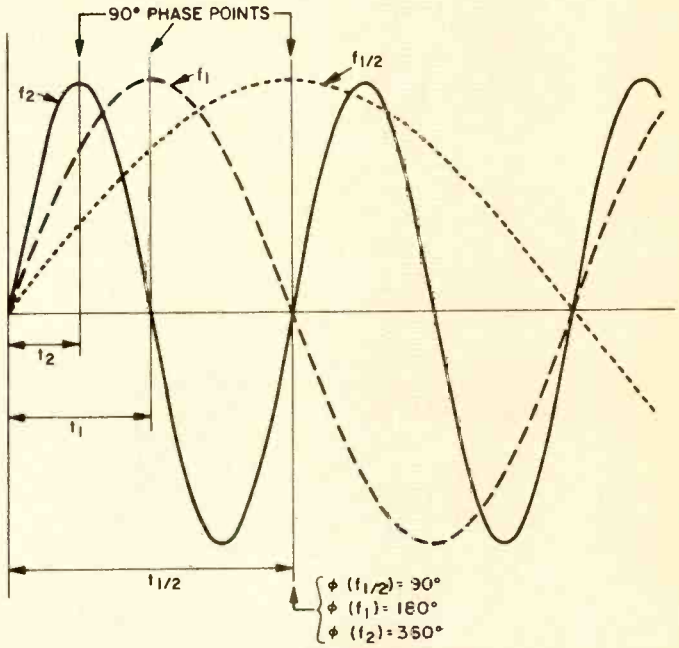


Figure 1B — Three sine waves of different frequency with the same initial phase; f_1 is the fundamental, f_2 is the second harmonic ($f_2 = 2f_1$), and $f_{\frac{1}{2}}$ is at half the frequency of the fundamental. The 90° phase points $\Phi_{90}(f_1)$, $\Phi_{90}(f_2)$, and $\Phi_{90}(f_{\frac{1}{2}})$ occur at different times, t_1, t_2, and $t_{\frac{1}{2}}$ respectively. For a fixed time delay $t_{\frac{1}{2}}$, the phases are different: $\Phi(f_{\frac{1}{2}}) = 90°$, $\Phi(f_1) = 180°$, and $\Phi(f_2) = 360°$.

monics must not arrive at audibly different times from each other, so the timing of the changes is important. What all this means, is that the *transient response* (response to changes in the signal) of the system is of great importance — and it is possible for certain types of phase distortions to give rise to audible transient effects.[6]

Time

The phase shift shown between the solid and dashed curves in Fig. 1A can be regarded as a time shift as well. This particular one has a time lag of three units of time. If the frequency was twice that shown, a time lag of three units would give twice as much phase shift, or 180°. For half the frequency, the three units of time shift would give half the phase shift, or 45°. Thus, a constant time delay creates a phase shift proportional to frequency (Fig. 1B). A constant time shift causes no problems, or recordings could not be made now, stored, and replayed later.[5]

Neither is the ear sensitive to a phase shift which is a constant number of degrees for all frequencies. The time delay for a given amount of phase lag is greatest at the low frequencies, and smallest for the high frequencies (Fig. 1B, see how the 90° phase points as a function of frequency affect the time delays in Fig. 1A). This sort of phase change does change the waveshape, as has been previously noted, but the ear ignores it. Of course, if there are two stereo channels with different amounts of phase change, the stereo image will shift its location[7].

Except for minor effects which are caused mostly by nonlinearities in the inner ear, the important effects reduce to two categories, each with two subcategories: 1) Relative time delay, comprised of a) channel-to-channel time delay in a stereo presentation,[8] and b) frequency dependent time delay[8] (this is the same as saying that the phase shift is not a linear function of frequency,[6] and 2) any phase changes in a system when the signal has a positive/negative asymmetry in its waveform, comprised of a) transients,[9] and b) steady state.[4] So far, all of the design effort has been concentrated in dealing with category number 1. Compensating for category no. 2 would require the setting of a phase standard (i.e., if the live music had a positive pressure wave at a certain point, the reproduction should also exhibit a positive pressure wave at that point). Such compensation would also open up a large Pandora's Box; for example, since the phase relations are different at every point in a concert hall, which point is to be chosen for the standard? Nevertheless, category 2 exists, and it can be demonstrated by any well-equipped audio lab, but there has been so little work done on it that we are here forced to concentrate most of our attention on number 1.

Table I — Some time constants of human hearing.

Acoustic Reflex (Gain Control) — middle ear[4]	10 mS
Gain Control — acoustic neurons (Brain)[4]	20 mS
Time for wave to travel the length of the basilar membrane (inner ear)[4]	5 mS
Time for a sound wave coming directly into one ear to diffract to the other ear (calculated)	0.7 mS
Refractory Period (dead time) of an acoustic nerve after firing[4]	1 mS
Electrical pulse (spike) length — acoustic nerve[4]	0.5 mS
Pulse repetition time of acoustic nerve — during onset of strong stimulation[4]	1 mS
Limits of Precedence Effect[10]:	
Lower Limit	1 mS
Upper limit (limit of fusion) — clicks	5 mS
Upper limit (limit of fusion) — complex sounds	40 mS

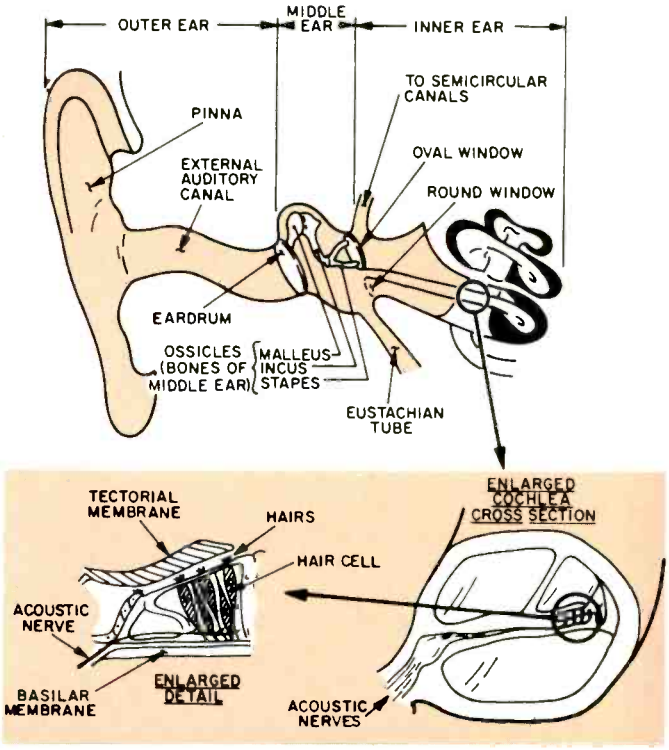


Fig. 2 — The human ear, semi-schematic diagram.[4, 22, 23] The ear consists of three parts, an outer ear, a middle ear, and an inner ear. The outer ear (along with the rotation of the head) assists in the perception of directionality of the sounds. The external auditory canal is a Helmholtz resonator with a resonant frequency of about 4 kHz. Due to the convolutions, the resonance is strongly damped. The ossicles are an impedance matching system to couple the air vibrations to the fluid in the inner ear. The impedance drops by a factor of 22. The resonant frequency of the ossicles is about 1.7 kHz, and it is highly damped. The inner ear is an acoustic transmission line with a low-pass characteristic and a cutoff frequency of about 8 kHz. The cochlea cross-section shows how the acoustic nerves connect to the hair cells. Relative movement between the tectorial membrane and the basilar membrane disturbs the hairs, which sends a signal via the acoustic nerves to the acoustic neurons in the brain.

What we will do now is to place some limits on time delay or phase nonlinearity, then see what restrictions these limits indicate for tape recorder design.

Ears

Table I gives some time constants found in human hearing, and it is well to keep these constants in mind, since one would expect that any time constants of importance would be in the same range as these time constants of hearing. If time effects are described which are not in this range, one should suspect the reality of such effects unless they are satisfactorily explained.

Some description of these effects is in order. The ear consists of three parts (Fig. 2), an outer ear, open to the air and concluded with the membrane called the eardrum; a middle ear, consisting of three small bones (ossicles) suspended in muscle, which transmit the vibrations of the eardrum to another membrane, and the inner ear, which consists of a spiral fluid-filled chamber (cochlea) with a central (basilar) mem-

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Table IV—Sources of amplitude and phase errors in magnetic recording.

Name of Error	Type of Error	Location of Error
Gap loss	A (5)	Playback head
Spacing loss	A (5)	Head/tape interface, on playback
Thickness loss	A (5)	Tape, on playback
Head resonance	A (1,4); P (1,4)	Playback head
Head core loss	A (1,4); P (1,4)	Playback and record heads
Azimuth error	A (1,5); P (2,5)	Between playback and record heads
Gap scatter	P (2,5)	Record or playback heads
Faraday's emf Law	A (4)	Playback head
Recording losses	A (1,3,5)	Tape, on record
Signal demagnetization	A (1,5)	Tape, after record
Gap length/coating thickness geometry	A (1,5); P (1,5)	Record head, in conjunction with the tape
Contour effect	A (1,5); P (1,5)	Playback head contour/tape path geometry
Equalization	A (1,4); P (1,4)	Record and playback electronics

Notes: A=amplitude, P=phase.
(1) Single-channel effect. Any single-channel effect can be a between-channel effect if the channels are different with respect to the effect.
(2) Between-channels effect.
(3) Sensitive to bias setting.
(4) As a function of frequency.
(5) As a function of wavelength, sensitive to head/tape speed.

ments of the transport and heads are very critical, and misadjustments cause several kinds of losses and distortions. Tape magnetization is sensitive to temperature and mechanical stresses on the tape. The list goes on and on, and it's a wonder the process works at all — but work it does and oftentimes very well.

There are a number of things in magnetic recording which cause amplitude losses. Some cause losses of only the amplitude of the signals, while others also cause phase changes. Amplitude losses are very apparent to the listener, so *Equalization* in the playback and record electronics is utilized to compensate for the amplitutde losses, and thus create a system which has a flat amplitude characteristic. The simplest type of equalization unfortunately creates additional phase changes in the system. These additional phase changes in many cases add to the phase changes already in the magnetic recording process, producing systems which are well-known for their inability to reproduce waveforms. [11] A list of the various losses is given in Table IV. [14, 15, 16] We'll take a closer look at these, and see how the phase distortion might be decreased by improved design.

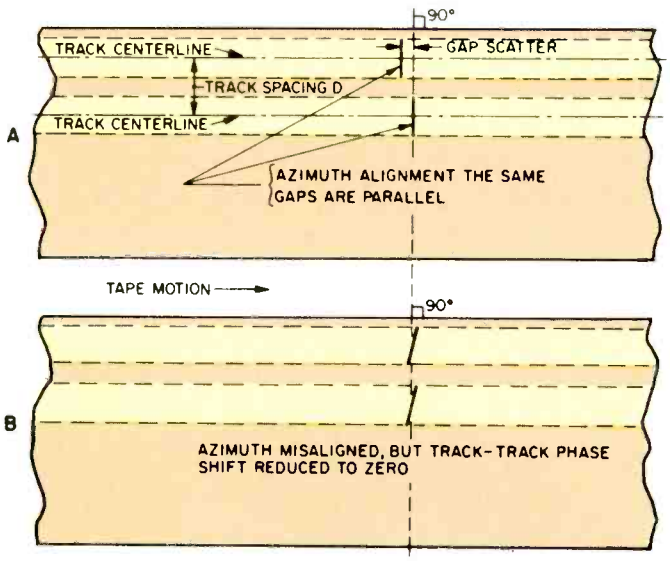

Fig. 4 — Schematic diagram of tapes with two signal tracks, passing playback heads with gap scatter. A) Gaps parallel and aligned, but with between-track phase or timing error. B) Same head, but misaligned so as to remove the between-track phase or timing error.

Playback Losses (Mostly)

The first three sources of loss *(Gap Loss, Spacing Loss,* and *Thickness Loss)* are all amplitude-only loss sources on playback only and do not themselves have any associated phase changes. Gap loss is caused by the finite length of the playback head gap ("length" of a head gap is in the direction of tape travel, though the "width" of the head gap/track may be a much greater dimension). When the recorded wavelength is so small that the gap length is approximately equal to the wavelength, a null occurs in the output (see Fig. 8). There is a sharp drop from about the point where the gap is a half wavelength long to the first null (which occurs where the wavelength is about equal to one gap length). Spacing loss is due to the separation of the head from the tape and is 54.6 dB per wavelength of separation. Thickness loss is similar to a demagnetization loss. The signal on a tape may be viewed as a number of bar magnets laid end to end. When the length of the bar magnets is long compared to their thickness (the tape coating thickness), all the flux lines from the magnets can enter the playback head. When the magnets are short compared to their thickness, some of the flux lines from the parts farthest from the head may not be able to enter the head and thus will be lost to the playback process. These losses may be kept to reasonable values by (respectively): (a) Using short-gap playback heads; (b) keeping the heads and tape surfaces very smooth and the head/tape spacing small, and (c) designing tapes with thin coatings. These three dimensions are measured using the shortest wavelength to be recorded as the measuring unit. Modern systems, especially cassette systems, are designed with these three things in mind.

The next two, *Head Resonance* and *Core Loss,* are losses which are present in all heads, both playback and record. Head resonance is caused by the inductance of the head winding in parallel with the distributed and stray capacitance. Core loss is caused by the fact that the magnetic permeability of the head material is a complex quantity which changes with frequency. With proper design and choice of magnetic material, these can be kept quite small, especially in the record head, which has to work with the high frequency bias signal. Resonance of the playback head has sometimes been used as part of the equalization, but modern practice is to locate the resonance above the audio pass band and utilize all-electronic equalization. This eliminates a large part of the phase shift problem before it ever gets started.

Azimuth Error and *Gap Scatter* are associated with the adjustment and precision of the head's manufacture. When more than one track is in use, it is impossible to adjust the head to eliminate these problems unless the head is perfectly made. Since nothing made by man is perfect, it is always possible to detect errors, even with the best heads available.

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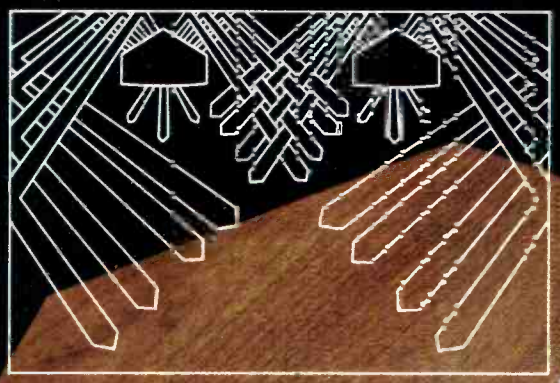

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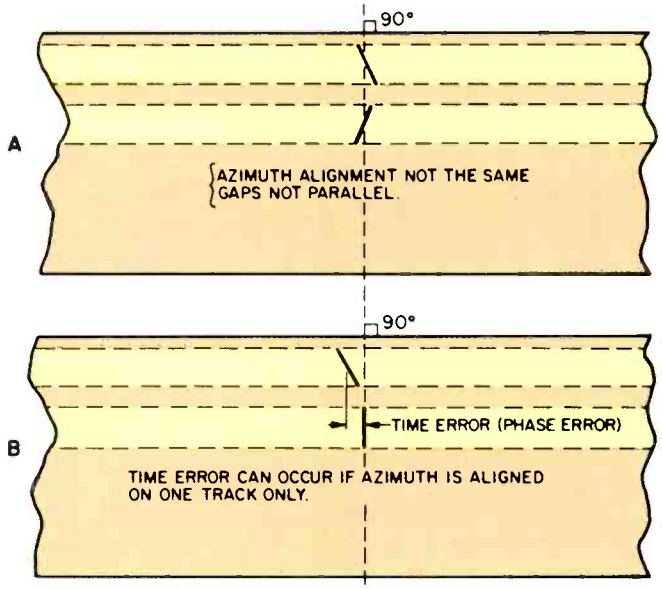

Fig. 5 — Schematic diagrams of tapes with two signal tracks, passing playback heads with gaps which are not parallel. A) Gaps aligned to give zero time error between tracks. B) Azimuth aligned on one gap. Azimuth is misaligned for the other gap, and a time error exists between the two tracks.

Of course, the best heads have acceptably small defects. Let's look at what is meant by these two terms.

Figure 3 shows a schematic of part of a tape passing a perfect two-channel playback head. We assume that the signal tracks have been laid down by perfect record heads, perfectly adjusted. By this, we mean that the record head gaps are perfectly straight and on the same straight line with each other, and that the angle between the gaps and the tape motion (called the *azimuth*) has been adjusted to be exactly 90°. Events which occur at the same time on both channels at record will play back on both channels simultaneously. Also note that the playback head is adjusted so that the gaps are exactly on top of the signal tracks. If the PB (playback) head overhangs the signal track, there will be loss of signal amplitude, but record heads are normally a little wider than PB heads to prevent this, so this particular error is not listed in Table IV.

Figure 4 shows the same situation, except that the PB head has gaps which do not lie on the same straight line, though they are parallel. Figure 4A shows the playback head aligned so that both gaps have their azimuth adjusted properly. The gap scatter is clearly seen. With the tape moving as shown, the gap on top will receive simultaneously recorded signals a little bit before the bottom gap will, thus introducing a time shift between channels. To stay within the first and second limits given in Table II, allowable gap scatter (which depends on head/tape speed) must stay within the limits given in Table III.

The limits in the third column, especially for the 1.875 ips tape speed (used for cassettes), are very demanding of the head-maker's art. The length of the cassette head gap (in the direction of tape movement, remember) is probably about 50 microinches or a bit less. To put this in perspective, green light has a wavelength of about 20 microinches. If you don't want to add to both stereo channels together to make one mono channel, the tolerance for time shift gives dimensions 10 times those shown for stereo channel addition.

Now we are talking about tolerances which any good head should meet, so that stereo image shift due to gap scatter should be relatively rare. Figure 4B shows a condition where the between-tracks time error has been adjusted away, but at the expense of misaligning the azimuth for both gaps (azimuth misadjustment causes an amplitude loss which increases for decreasing wavelength). Methods are in use for making either type of head azimuth adjustment. Both require the use of standard playback alignment tapes, available (at considerable cost) from several sources.

Figure 5 shows a similar situation, but the PB head has gaps which are not parallel. Figure 5A shows alignment such that there is no between-track time error. Figure 5B shows one gap with perfect azimuth alignment, which throws the other gap out of alignment by a serious amount. Proper adjustment for such a head is with the head aligned so that the loss due to misalignment of the azimuth is the same for both channels. There may be some residual between-track time error left after this type of adjustment, but it should not be serious. Most real heads are of this type, but a good one will not require more than about ½ to 1 dB of output drop in each channel at 15 kHz to make the compromise. Figure 5 is greatly exaggerated — the actual angles are very small. Table VA shows just how small — the angles were calculated to give a 1-dB loss in the 15-kHz signal due to azimuth misadjustment. The angles are given in minutes and seconds (for those who have forgotten their geometry, 60 minutes = 1 degree and 60 seconds = 1 minute). If perfect heads have the azimuth deliberately misadjusted to give 1 dB of 15-kHz loss, this will cause an amount of "gap scatter" which is listed in Table VB. Comparing these figures with those given in Table III, we can see that these amounts of "gap scatter" will cause problems with adding stereo channels to form one mono channel, but are too small to cause audible stereo image shift. The track dimensions used in these calculations were taken from a convenient listing published by Nortronics,[17] and the azimuth alignment loss calculations were made using the formula given by Begun: [18]

$$\text{Alignment Loss (dB)} = 20 \log_{10} \left[\frac{\sin\left(\frac{\pi W \tan \alpha}{\lambda}\right)}{\left(\frac{\pi W \tan \alpha}{\lambda}\right)} \right]$$

Where W is the track width, α is the azimuth angle (α=0 for perfect alignment), and λ is the wavelength of the signal (λ=head/tape speed divided by the signal frequency).

Faraday's emf Law says that the usual inductive PB head has an output proportional to the rate of change of the magnetic flux from the tape flowing in the head. The head output is not proportional to the level itself. The output from

Table V A — Angle for 1-dB loss of signal at 15 kHz.

Tape Speed, ips	Track Width, in.	Wavelength, in.	Angle
1.875	0.021 (1)	0.000125	5m, 21.1s
3.75	0.043 (2)	0.00025	5m, 13.6s
3.75	0.021 (3)	0.00025	10m, 42.1s
7.5	0.043 (2)	0.005	10m, 27.2s
15	0.08 (4)	0.001	11m, 14.2s

Table V B — "Gap scatter" caused by 1 dB of azimuth misadjustment at 15 kHz.

Tape Speed, ips	Azimuth Angle	Track/Track Spacing, in.	Implied Gap Scatter, microinches
1.875	5m, 21.1s	0.035 (1)	54.4
3.75	5m, 13.6s	0.136 (2)	206.8
3.75	10m, 42.1s	0.127 (3)	395.3
7.5	10m, 27.2s	0.136 (2)	413.5
15	11m, 14.2s	0.156 (4)	509.9

Notes:
(1) Cassette.
(2) ¼ inch, 2 channel, 4 track.
(3) ¼ inch, 2 channel, 8 track.
(4) ¼ inch, 2 channel, 2 track.

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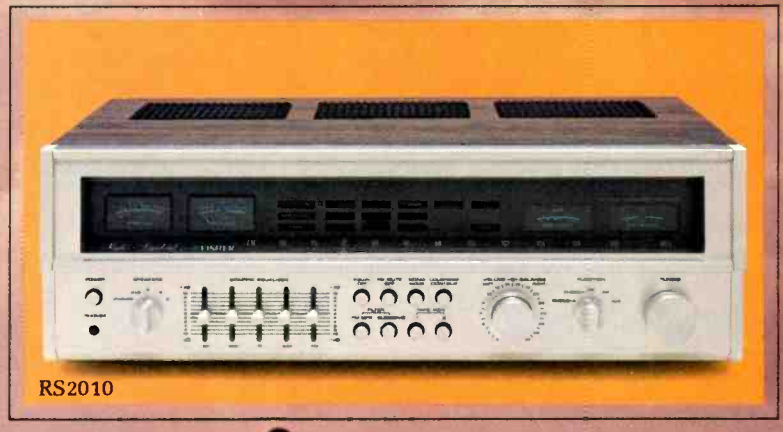


RS2010

such a head has a constant (+ 90°) phase shift — the same at all frequencies — associated with it. The frequency sensitive amplitude loss (greatest at low frequencies) is normally compensated by an *integrator* in the playback electronics, which has an equal phase shift of the opposite sense (90°). The phase shifts cancel out, except at the ends of the compensation range. We'll come back to this when we cover equalization later.

Recording Losses

The category called "Recording Losses" is actually a collection of several kinds of signal losses which occur during the record process. These are due to [16] *Bias Erasure,* geometry of the record head field, recording field not aligned with the particles, *Switching field* not the same for all the particles, and recording not *anhysteretic* at high frequencies. All of these require some explanation.

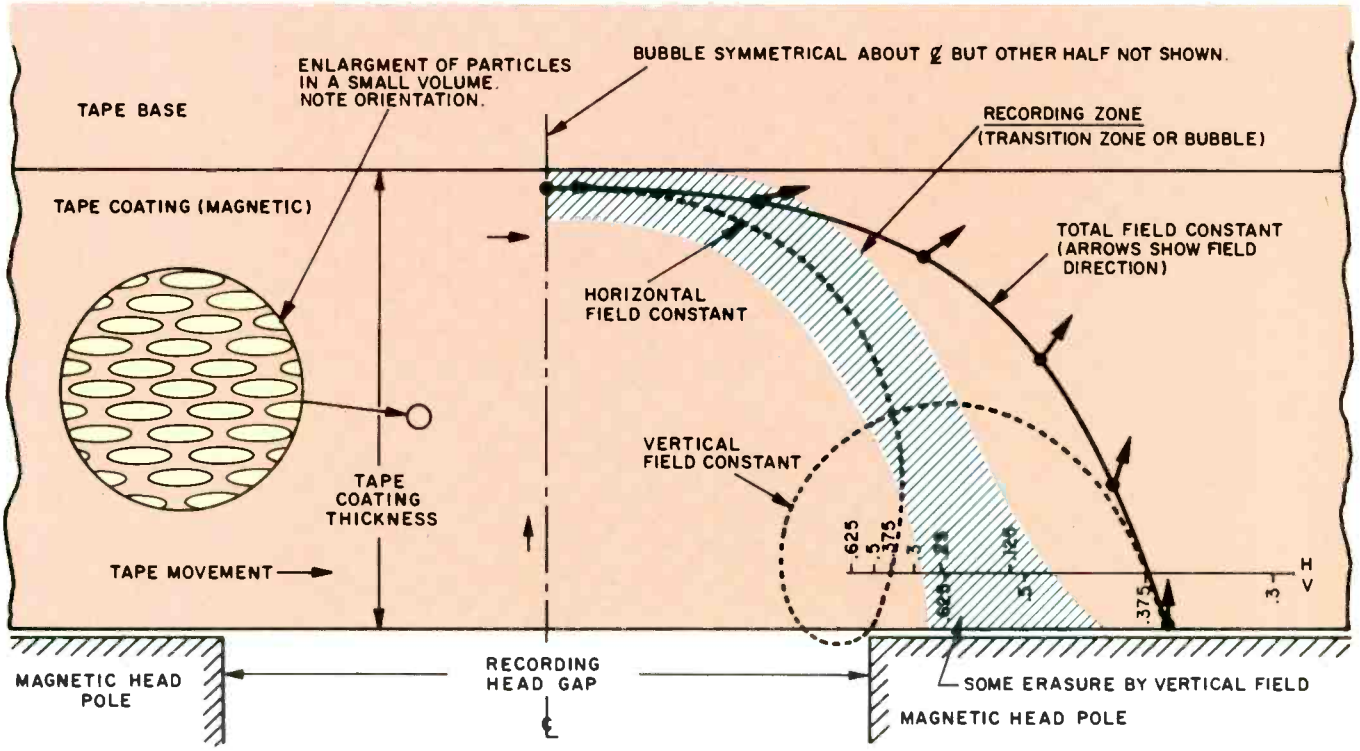
Bias erasure is a description of the appearance of these losses. The bias for maximum sensitivity is not the same for short wavelength signals as for long. The bias is usually adjusted to optimize something such as sensitivity or linearity at long wavelengths, which means that the short wavelengths are overbiased and thus partially "erased." Actually, this "erasure" can be explained in terms of the next four loss sources.

Fig. 6 — Section of the recording head and the tape showing the shape of the recording field "bubble," [16] the shape of the transition zone, and the orientation of the magnetic particles in the tape. In this figure, the record head gap length is of the same order of magnitude as the coating thickness. The scale at the lower right shows the horizontal (above line) and vertical (below line) field values at the points indicated. Note how the vertical field falls off more slowly than the horizontal field as the tape moves away from the record head gap.

The geometry of the record head field is shown in Fig. 6, which is a section through the record head and the tape. Inside of a half-cylindrical "bubble," which lies along the width of the record head gap, the particles in the tape coating are being magnetically switched (having their magnetization change direction) by the high-frequency bias. Outside the bubble, the bias field is too small to switch them. Recording thus takes place at the trailing edge of the bubble, in a transition zone. The reason that this zone is not infinitesimally thin is that all the particles do not have the same switching field, since they are not exactly identical.

Because of the influence of the larger vertical field near the head, the longitudinal extent of the transition zone is greater near the surface of the tape than it is half-way through the coating. The particles in the tape are normally *oriented* in the direction of head/tape movement and are thus easier to magnetize in that direction. Since the field at the surface is only partially longitudinal, it doesn't record on the surface particles as well as it does on the particles in the inner part of the coating. These things don't make much difference at long wavelengths, but at short wavelengths the strongest recorded signal is half way through the coating and not at the surface of the tape, so it suffers from spacing loss at playback. Note that the vertical component of the bias field cannot record upon horizontally oriented particles, but it can erase recording already done by the horizontal component of the field.

One might logically wonder why the *acicular* (needle-like) particles are used and why they are horizontally oriented. Acicular particles have a higher *coercive force,* which means that they are more resistant to demagnetization by external forces and internal fields. Orienting them lowers the distortion and increases the output and sensitivity at long wavelengths. It helps a bit at short wavelengths too, but not as much. Some tapes have a vertically oriented layer at the surface, which allows short wavelengths to be recorded right to the surface of the tape. This gets rid of the problem dis-



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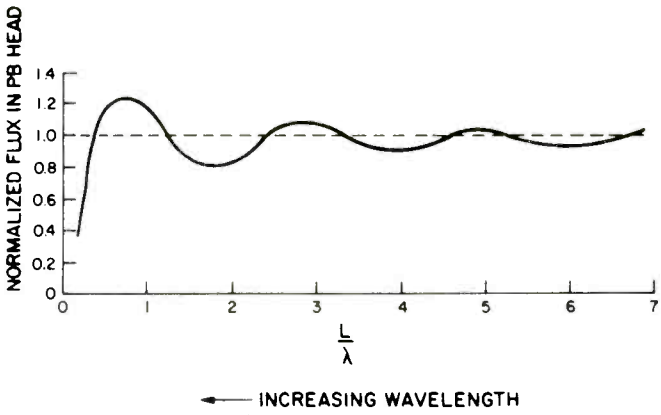
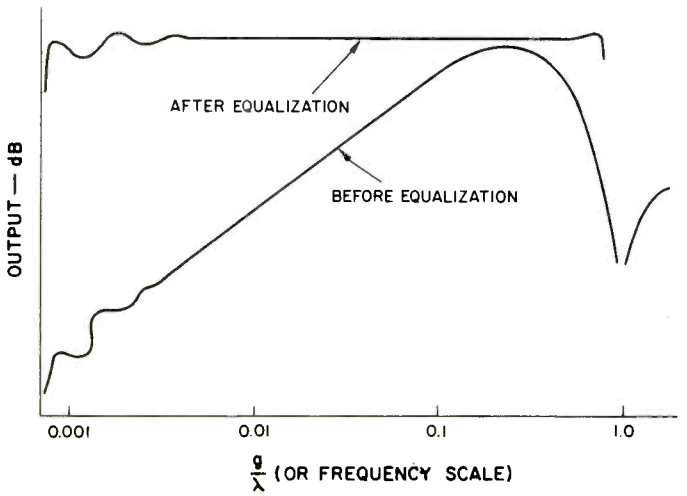


Fig. 7 — Tape flux amplitude circuiting the playback head at very long wavelengths, such that the wavelengths are of the same order of magnitude as the overall length of the head (not the head gap).[19] The interference effect is clearly seen, as is the long wavelength cutoff.

cussed in the previous paragraph, but brings up another: The vertical component of the field does not have a high gradient (drop of the field intensity as the tape leaves the gap) as does the horizontal component. This makes for a wide transition zone, unless a very short gap recording head is used. If the record head gap is too short, there will be difficulty in obtaining good long wavelength recording. The gradient of the horizontal field component is virtually unaffected by change of the record head gap length.

It has already been mentioned that the particles do not all have the same switching field. This means that the particles will "switch" or have their north- and south-seeking poles to exchange places at different applied fields. This causes the transition zone to be wider than it would be if all the switching fields were the same. This wider transition zone causes a smearing of the recorded signal, which blurs the short wavelengths more than it does the long, and results in further short wavelength loss.

Fig. 8 — The total record/playback frequency characteristic before and after the application of equalization to the record and playback circuits. The numbers on the abscissa actually apply to the parameter g/λ, where g is the playback gap length and λ is the wavelength. The frequency is given by f = s/λ, where f is the frequency and s is the head/tape speed, so the numbers on the abscissa differ from the frequency only by a multiplying constant.



To see why the loss of the anhysteretic quality of the recording (at high frequencies) is important, we must first see how anhysteretic recording works. The bias is a strong alternating field which carries the magnetization of almost all the particles through their major (magnetically saturated) hysteresis loop in a cyclic manner, i.e., the particles are magnetized to saturation first in one direction, then in the opposite one. The signal field is much smaller, a tenth of the bias field or less, and it is added to the bias field. When the tape moves out of the head field, the bias field dies out, and the particles stop switching, with some magnetized with their north poles in one direction, and some in the other. The number of left-pointing particles is equal to the number of right-pointing particles with a no-signal condition, but the numbers become unequal as the signal strength rises, almost in perfect proportion to the signal strength. All this requires that the signal change very little as a section of tape moves through the transition zone. This is nearly true for low frequency (or long wavelength) signals, but becomes less true as the signal frequency gets higher (and the wavelength gets shorter). Thus, recording which is nearly anhysteretic at low frequencies becomes less so at high frequencies. Anhysteretic recording is the most efficient type of recording (i.e, it has the highest sensitivity), hence high frequency recording is less efficient than low frequency recording.

After the tape leaves the vicinity of the record gap, it still lies on the high permeability head for a while (permeability can be regarded as a measure of the affinity of a magnetic material for absorbing magnetic field lines). Recorded signals on the tape can be regarded as a series of small permanent magnets, which put out field lines. The head absorbs the field lines from these little magnets almost completely. This absorption of the field actually helps the magnets to retain their magnetization, as there is no field left to demagnetize them (any field from a permanent magnet always has the effect of demagnetizing the magnet to some extent). When the tape leaves the vicinity of the record head, the signals are demagnetized, with the shortest wave-length signals suffering the most. When the tape comes into contact with the playback head (which is also high permeability), some of the demagnetization is reversed, but some of it is not reversible and is permanent. Again, the short wavelength signals suffer in respect to the long wavelengths. Also, the tape with the highest permeability of its own suffers more from irreversible demagnetization than tapes with lower permeability.

Figure 6 shows a record gap which is of the same order of dimension as the coating thickness of the tape. If the record head gap is about twice as long as the coating thickness, this is a balanced situation, with neither the short wavelengths nor the long wavelengths being emphasized. If the record gap length is a lot smaller than the coating thickness, it is difficult for the head field to reach all the way through the coating. Recording tends to be near the surface, and short wavelengths are emphasized with respect to long. If the record head gap is quite long compared to the coating thickness, the field easily reaches all the way through the coating, but the field near the surface tends to be more vertical than horizontal at normal bias levels, the transition zone is correspondingly longer at the surface, and short wavelengths suffer more recording losses than long.

There is only a finite length of the playback head in contact with the tape. As the wavelengths begin to approach this dimension, an *interference effect* occurs. Some wavelengths cause more flux to go into the head than would go into an infinitely long head, while some wavelengths cause less. At wavelengths longer than about twice the length of the head, very little flux gets into the head, and the head is not responsive to longer wavelengths. The flux going into a head of

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finite length L is shown in Fig. 7 as a function of L/λ where λ is the wavelength (reference 19, page 181). The undulations are known in the trade as "head bumps." They can be minimized by contouring the head (thus, some writers call this "The Contour Effect") so that the tape approaches and leaves the head in a gradual manner. Any head, despite contouring, will have no useful output above some cutoff wavelength. This effect holds even for heads which are flux sensitive and suffer no losses from Faraday's emf Law. A flux sensitive head will read the tape flux at zero head/tape speed, and thus zero frequency, but it will not read tape flux at infinite wavelength.

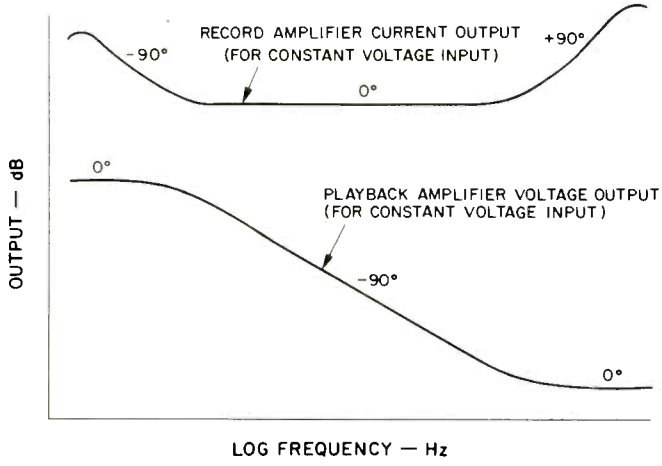
Equalization

The total record/playback frequency characteristic before the application of any equalization is shown in Fig. 8. Also shown is the desired flat frequency characteristic after equalization. Some of the correction is done during recording, and some is done during playback. A considerable amount of literature has been written on just how much to apply in each case. The playback characteristics, being easiest to measure, are usually standardized to be less than the total amount needed for any tape. Only enough record equalization is applied to make the frequency characteristic flat with a particular tape; thus we say that a recorder is "optimized for a certain tape." With any other type of tape (which always has somewhat different characteristics), the overall frequency characteristic will not be flat.

The general type of equalization characteristics applied to the record and playback channels are shown in Fig. 9. A particular machine will sometimes leave out one or both of the shapes at the extreme ends of the record curve. Electronic circuits which have these frequency characteristics generally have an associated phase shift. When the curves change shape (as at the ends), the phase shift is especially pronounced. Because of the very complicated situation shown in Table IV, the phase shifts generated by the equalization never cancel the phase shifts arising from other sources. In fact, they sometimes add to them or create phase shifts where none were before.

In Fig. 9, one can estimate the phase shift caused by the two amplitude characteristics this way. If there is no slope to the amplitude characteristic, the phase shift is zero; if the line slopes to the right by 6 dB per octave, the phase shift is -90°, and if the line slopes to the left by 6 dB per octave, the slope is +90°. These relationships apply to a whole class of electrical networks called *minimum phase networks*. Most ordinary amplifier circuits and simple equalizer circuits fall into this category. With some effort, the designer can construct circuits which have phase shift different from the rules given above. He can then (theoretically) tailor in a phase shift characteristic which exactly compensates for the total of the phase shifts from all other sources, and get a tape recorder with a flat phase shift characteristic. Such a recorder would not suffer from waveform distortion, group delay, or any of the other ills previously outlined. For several reasons, this is not what is presently being done.

Fig. 9 — The general frequency characteristic of the playback and the record equalization for audio machines. The numbers above the curves give the amount of phase shift at those points, if the equalization is produced by minimum phase networks.



Phase Compensation

An excellent example of the current practice is the Ampex ATR-100, a mastering recorder with phase equalization as well as amplitude equalization.[14,20] For all of the errors listed in Table IV except "Faraday's emf Law" and "Equalization," the designers used only a careful and thoughtful engineering design to keep the phase errors suitably low. This design ensured that the major part of the phase shift error would be in the equalization. A standard playback equalization was used to compensate for the Faraday's emf Law. This introduced an extra phase error in the manner which has been described. Then, in the record electronics, an extra phase shift was introduced in the opposite direction which compensated for the phase shift errors in *all* of the equalization.The phase shift adjusts along with the amplitude adjustment, so that compensation is obtained for any tape to which the machine is adjusted. Thus, tapes made on this machine will play back on any other machine with small phase errors, since the compensation is recorded onto the tape itself. A square wave recorded on this machine comes back looking very much like a square wave — something many other machines will not accomplish.

Another example, the Sony 880-2, utilized a different design philosophy. Again, careful engineering design and some carefully made heads keep the introduced phase shift down to a low level. Contrary to the Ampex practice they chose to put their phase equalization in the playback circuit. So long as both recording and playback is done on the same machine, it makes little difference where the phase equalization is, provided the recordings are at a suitably low level. When the recordings are at levels near saturation, phase shift can cause higher than usual *peak factors* (the ratio of the peak value of a waveform to its rms value) to occur. If these peaks are high enough to be clipped by tape saturation or by the electronics, audible distortion will occur. Clearly, it would be much better to correct some of the phase distortion in playback and some in record,[21] to keep the peak factors down to a suitably low level. Sony's engineers probably chose to do it all in playback since any machine sold to the general public will presumably be used to play quite a few tapes made on other machines. The Sony machine will perform phase correction on "prerecorded" tapes.

Now let's take this to its ultimate conclusion. Suppose that all the recorded tape producers use machines with complete phase compensation on all their record circuits. These tapes will play back on all the old machines free of phase distortions. On your brand-new machine with phase compensation in the playback circuits (Sony isn't the only one!), the tape will be overcompensated and will be phase distorted in the opposite sense. Plainly, someone out there ought to be doing some work on standardization of phase correction techniques. Since there still is an argument raging on whether phase compensation is necessary or not, there's not much chance of standardization right now.

None of the foregoing should be construed as a criticism of the engineering decisions which have been made so far. In

the absence of standards, all the decisions have been about as good as could be made.

Conclusions

This discussion has looked at a number of different aspects of the audio phase problem. I think that a good case has been made that phase distortions are audible and that phase corrections will result in cleaner sound. We have looked at the sources of phase distortions in magnetic recording, and some of the means now being used to correct for those phase distortions. Lastly, we have seen that there is a great need for standardization in phase correction (phase equalization) techniques right now! Standardization people, what are you doing for us?

References

1. H. L. F. Helmholtz, *On the Sensations of Tone*, translated by A. J. Ellis in 1885 (from the third German edition, 1870), Dover, N.Y. 1954, p. 127.
2. Thomas A. Saponas, Randolph C. Matson, and J. Robert Ashley, "Plain and Fancy Test Signals for Music Reproduction Systems," *J. Audio Eng. Soc.*, Vol. 19, No. 4, April, 1971, pp. 294-305.
3. Benjamin B. Bauer, "Audibility of Phase Distortion," *Wireless World*, Vol. 80, No. 1459, March, 1974, pp. 27-28.
4. Manfred R. Schroeder, "Models of Hearing," *Proc. IEEE*, Vol. 63, No. 9, September, 1975, pp. 1332-1350.
5. James Moir, "Phase and Sound Quality," *Wireless World*, Vol. 82, No.1483, March, 1976, pp. 80-84.
6. D. Preis, "Linear Distortion," *J. Audio Eng. Soc.*, Vol. 24, No. 5, June, 1976, pp. 346-367.
7. Takeshi K. Matsudaira and Takeshi Fukami, "Phase Difference and Sound Image Location," *J. Audio Eng. Soc.*, Vol. 21, No. 10, December, 1973, pp. 792-797. Also correction, ibid, Vol. 22, No. 2, April, 1974, p. 186.
8. D. E. L. Shorter, H. D. Harwood, and W. I. Manson, "Stereophony: The Effect of Interchannel Differences in the Phase/Frequency and Amplitude/Frequency Characteristics," *BBC Engineering Monograph No. 56*, December, 1964, 27 pages.
9. Villy Hansen and Erik Rorbaek Madsen, "On Aural Phase Detection," *J. Audio Eng. Soc.*, Vol. 22, No. 1, January-February, 1974, pp. 10-14.
10. Hans Wallach, Edwin B. Newman and Mark R. Rosenzweig, "The Precedence Effect in Sound Localization," *American J. Psychology LXIII*, pp. 315-336. Reprinted in *J. Audio Eng. Soc.*, Vol. 21, No. 10, Dec. 1973, pp. 817-826.
11. John K. Hilliard, "Notes on How Phase and Delay Distortions Affect the Quality of Speech, Music and Sound Effects," *IEEE Trans Audio*, Vol. AU12, No. 2, March-April, 1964, pp. 23-25.
12. Benjamin B. Bauer, "Some Techniques Toward Better Stereophonic Perspective," *J. Audio Eng. Soc.*, Vol. 17, No. 4, August, 1969, pp. 410-415. Reprinted from *IEEE Trans. Audio*, Vol. AU-11, May-June, 1963, p. 88.
13. Duane H. Cooper and Takeo Shiga, "Discrete-Matrix Multichannel Stereo," *J. Audio Eng. Soc.*, Vol. 20, No. 5, June, 1972, pp. 346-360.
14. Alastair M. Heaslett, "Phase Distortion in Audio Magnetic Recording," paper presented at the Audio Eng. Society 55th Convention, Oct. 29-Nov. 1, 1976. AES Preprint No. 1178 (P-3), 14 pages.
15. Jim Grimshaw, "Multi-Track Phasing Errors," *db Magazine*, Vol. 9, No. 11, Nov., 1975, pp. 40-42.
16. C. D. Mee, *The Physics of Magnetic Recording*, North-Holland Pub. Co., Amsterdam (1968). Distributed in the U.S. and Canada by Interscience Publishers.
17. Design Data, Nortronics Audio Heads; Nortronics Track Configurations; from "*Nortronics Audio Magnetic Heads — Application Notes and Design Data*," Nortronics, 1975 (Form 9223).
18. S. J. Begun, *Magnetic Recording*, Rinehart & Co., Inc., New York, 1949.
19. W. K. Westmijze, "Studies on Magnetic Recording," *Philips Res. Repts. 8*; April, 1953, pp. 148-157; June, 1953, pp. 161-183; August, 1953, pp. 244-269; October, 1953, pp. 344-346.
20. Larry Zide, "The Making of the Ampex ATR-100," *db Magazine*, Vol. 10, No. 12, Dec., 1976, pp. 32-35; and Part II, ibid, Vol. 11, No. 2, Feb., 1977, pp. 36-38.
21. Finn Jorgensen, "Phase Equalization is Important," *Electronic Industries*, Oct., 1961.
22. Arthur C. Guyton, M.D., *Textbook of Medical Physiology*, second ed., W. B. Saunders, Philadelphia, 1961.
23. William D. Zoethout and W. W. Tuttle, *Textbook of Physiology*, eleventh ed., C. V. Mosby, St. Louis, 1952.

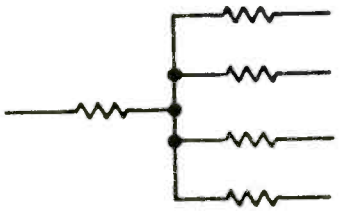
Dear editor

Lirpavention

Dear Sir:

It is my custom to pore over electronic journals from all over the world. As good luck and fickle fate would provide, I had someone deliver a copy of *Transylvania Elektronik* which had been smuggled out of Bucharest in the bottom of a canary cage.

In it was an article by your prolific pedant, Prof I. Lirpa, who has invented the "Warsaw Box," a 4-1-4 system for making quadraphonic sound out of mono. The good professor figures that this will revolutionize the history of sound, once someone in Bucharest figures out how to obtain four speakers all at once. Even with two speakers they would be able to get dual-mono sound, another great Lirpa invention.



Enclosed is a rare schematic of this new and highly sophisticated circuit.

John Woram
Rockville Centre, N.Y.

Origins Explained

Dear Sir:

I believe the following will be of interest to Bert Whyte as he professed ignorance about the origin of the term "green room" in the December, 1978, "Behind the Scenes" column.

In 1816 the limelight (sometimes referred to as the Drummond light after its inventor, Thomas Drummond) was developed. A piece of lime or calcium was heated via a gas flame until it glowed. The resulting point source of light was directed by an optical system (comprised of a reflector and lens) onto a specific object.

Introduced to the theatrical world in 1837, the device gained widespread acceptance in the 1850s and '60s. Though it was far from perfect — the burning lime required constant attention to keep the super-heated area aligned with the optics — the first practical "spotlight" had been born.

Unfortunately, the actors and actresses who had to work literally "in the limelight" found themselves prone to severe headaches. After some experimentation, however, it was discovered that if the cast spent its off-stage time — both during and for a short period following a play — in a room painted a light green, they were much less subject to the discomforting headaches. That room, quite obviously, became known as the "green room." The nomenclature, to this day, has remained the same even though the green walls have long since been redone in other colors.

David Greep
Raymond, Maine

Phono Frustration

Dear Sir:

I recently purchased a reel-to-reel tape deck, a noise reduction unit, and a dynamic range expander in hopes of avoiding the nicks, scratches, and pops which eventually find their way onto any LP. To accomplish this, I had intended to buy new records, tape them, and then put them away. In my ignorance I assumed that a new record would be free from flaws. However, this is not the case as even new LPs have these flaws.

I was very disappointed at first, but two things gave me hope that there might be a solution: 1) I noticed that many sections of a disc were very good and this told me that records could be made better with a little more attention paid to quality control and consistency. 2) An article in the Sept. 7, 1978, issue of *Rolling Stone* entitled, "Record Quality: A Pressing Problem" made some interesting observations: a) There is a definite lack of quality control in the record pressing process, b) European and Japanese record quality is far superior to U.S. quality, c) a person within the record industry stated that for the cost of $1.00 more to the consumer, a far superior product could be made available, and d) the record industry is aware of the flaws in its product.

Armed with this information, I decided to do something about it. I wrote letters to the manufacturers of all components I own, in addition to several record companies.

I recently received a reply from Mr. Murray Rosenberg of United Audio (Dual). He said that he and the rest of the high fidelity component business were concerned with the quality of the phonograph record, and he intended to bring this matter before the Institute of High Fidelity in hopes of organizing a campaign to reverse this trend.

I have stated my problem and my attempt to correct it. I would ask the industry and readers of *Audio* Magazine to render any kind of assistance they can . . . write to the record companies and let them know how you feel.

Martin J. Barrow
Cape Elizabeth, Maine

Crashworthy Components

Dear Sir:

After reading the "Dear Editor" letter by David B. Adams in your January, 1979, issue of *Audio*, I felt motivated to salute two manufacturers.

I play music professionally and travel more than 50,000 miles a year. In September, 1978, my van was rear-ended by an auto travelling at 55 mph while we were stopped off the side of the highway. Miraculously, little injury was incurred to the occupants in my van.

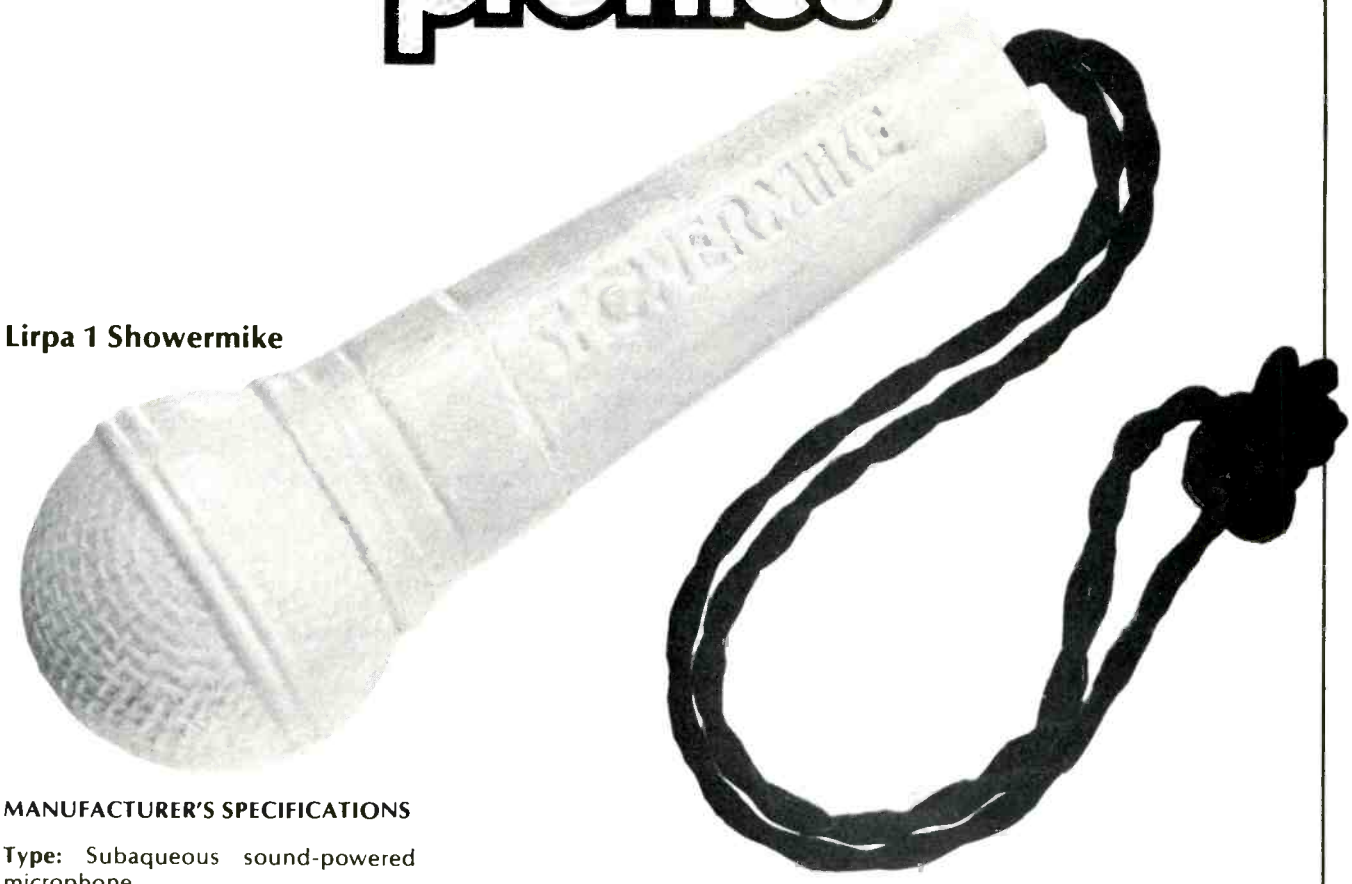
In the back of the van were two Cerwin-Vega speakers and a Phase Linear 400 amplifier. They took the full force of the impact, and although the van was totalled, they escaped with only dents and a torn covering. I still travel with that PA system and would like to extend my praises to those manufacturers, particularly since those speakers may have saved my life.

Those are really tough components. In this day and age it's still nice to know that some things can still "keep on truckin'."

Carter Wilson
Boise, Idaho

Equipment profiles

Lirpa 1 Showermike



MANUFACTURER'S SPECIFICATIONS

Type: Subaqueous sound-powered microphone.
Application: Vocal pickup in shower.
Frequency Response: Irregular response curve, becoming smoother with use.
Output Level at 1000 Hz: — 99.44 dB (0 dB = IV/Ivory).
Open-Circuit Voltage: 10^{-8} volts per microbar of soap.
Operating Principle: Lirpa-effect bubble transducer.
Impedance: 1 Gigaohm.
Construction: One piece molded from a soluble compound of fats, oils, and alkali.
Dimensions: 5 x 15 cm, decreasing with use.
Output Cord: Non-conductive textile, twisted pair loop, 30-cm developed length.
Mounting Provisions: Cord fastens directly to ½-inch pipe fittings usually present near sound source. Lavalier mounting possible.
Maximum Input SPL: 120 dB re: 1 microbubble.
Distortion: Normally has clean sound, but becomes soft and distorted with prolonged subaqueous use.
Average Life: 2 weeks (clean people) to 14 weeks (dirty people).
S.I. *(Systeme Idiotique)* units used exclusively.

After years of painstaking research and experimentation, Professor I. Lirpa has succeeded in developing a microphone of sufficiently high quality to bear the Lirpa name. It is the first microphone to join the line of Lirpa audio products which are well known to readers of *Audio*.

This microphone is unique in construction. Readers will note from previous reviews that Lirpa products are, generally speaking, of hybrid design. They incorporate semiconductors, tubes, light bulbs, and miscellaneous recycled materials gathered by the Professor on his weekly resource recovery expeditions. The Lirpa I microphone, in contrast, represents the first of a new generation of audio products. It is more advanced than equipment incorporating semi-conductor technology, being constructed from non-conductors. These non-conductors are assembled into a three-dimensional matrix which is not unlike Large-Scale Integration (LSI). Semiconductor LSI chips are largely two-dimensional, but the non-conductor matrix is entirely flexible in the third dimension and may be readily formed into the shape of the finished product at very low cost, using conventional molding equipment.

The Lirpa I Showermike is, therefore, the first truly solid-state microphone (at least in the dry state where it is not in use). How then, you may ask, does it function as a transducer? When in use under subaqueous, or more precisely, semi-subaqueous conditions, a thin layer of bubbles are formed on the surface (Fig. 1). Professor Lirpa discovered, that often on accidental exposure to sigma rays, a bar of soap gave an electric shock when he slipped on it in the bath tub. Further research revealed the operating mechanism of this "Lirpa

Fig. 1 — Cross section showing thin layer of bubbles.

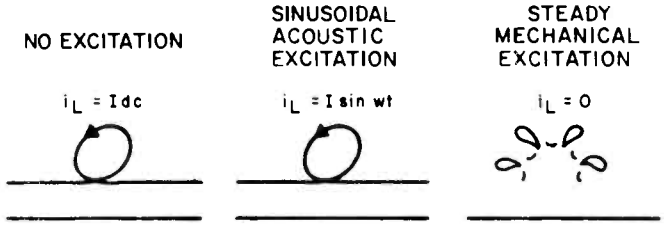


Fig. 2—Details of bubble transducer showing the Lirpa effect current.

effect" which is shown in Fig. 2. The surface irradiation causes circulating currents (i_L) in each bubble. Upon application of alternating sound pressure, the bubble air volume is modulated, and the Lirpa effect current bears a linear relation to the acoustic input as shown. When steady force (or atmospheric pressure) of sufficient intensity is applied, the bubble bursts and $i_L = 0$. A similar breakdown of the Lirpa effect occurs for very high sound pressures. This automatically forces the vocalist not to sing too loudly or to "swallow" the mike. The unpleasant flavor also discourages this incorrect usage.

Laboratory Tests

We anticipated that working with audio equipment in the bath might be risky, and we had no idea how to test a Lirpa-effect bubble transducer. So, following the editorial policy established last year for the Lirpa "VDRS" review, we called upon Lirpa Labs to provide certified Lirpagraphs pertinent to the sample unit supplied to *Audio*.

The impedance varies over a wide range under dry to wet conditions (Fig. 3). Measurement of the very high impedance Lirpa-effect transducer requires a high voltage, and the Labs thought it wise to calculate the "wet" curve, rather than test it under actual use. Users of recorders with low impedance inputs need not be concerned, because as long as the non-conductive textile card remains an unbroken loop, the Lirpa bubble current will recirculate, and perfect isolation will be maintained between mike and recorder.

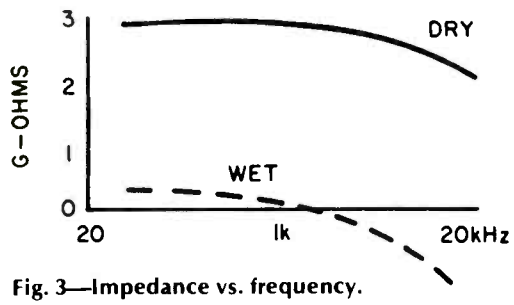
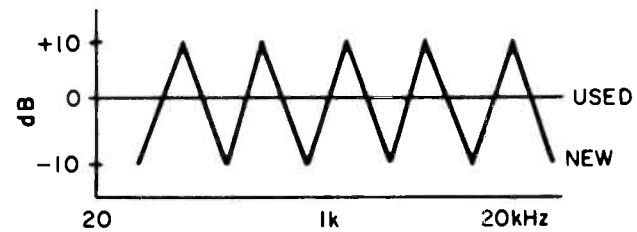


Fig. 3—Impedance vs. frequency.

Fig. 4—Frequency response.



The Lirpa engineers ignored ANSI Standards and measured frequency response in a reverberant, rather than anechoic test room (Fig. 4). This measurement is said to be more relevant to actual usage. Observe that the frequency response is irregular when the mike is new, but becomes very smooth with use. This variation need not concern the tape recordist because the output level (see the specifications) will be less than the equivalent input noise level of all recorders, including those with Dolby noise reduction circuits.

Figures 5 and 6 indicate how the Lirpa effect varies with time. Obviously, the Lirpa effect is active only under subaqueous conditons. Thus, the output level is zero except for the wet period which typically varies from 10 minutes per day for clean people to 10 minutes per week for dirty people. Peak output level occurs around the seventh usage because the Lirpa effect varies with the aqueous ablution of the microphone housing. Again, the variation of output is of no concern because, in all instances, a negative S/N is maintained at the recorder. Also, note the tradeoff that is possible between microphone life and the user's state of cleanliness.

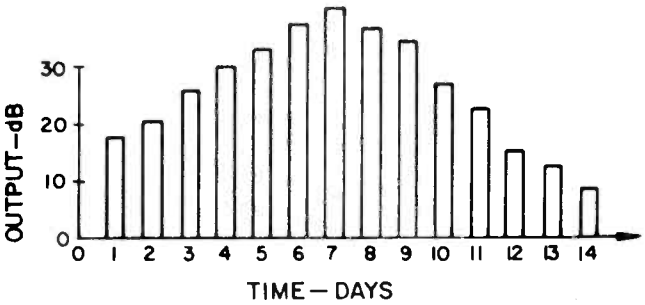
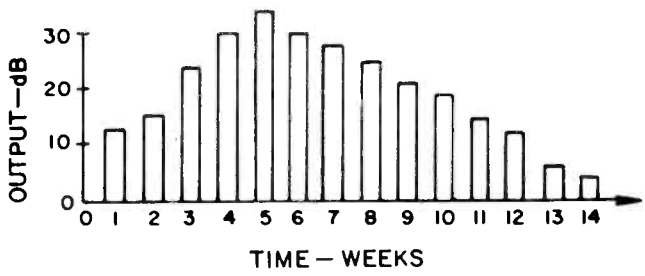


Fig. 5—Output level vs. time (when used by "clean" people).

Fig. 6—Output level vs. time (when used by "dirty" people).



Listening and Use Tests

In order to do a proper evaluation of the Lirpa I Shower-mike we had to obtain a vocalist who was in need of a bath. Our thoughts immediately turned to pop singers, and a suitable subject was obtained (under protest) from a local rock group. He rendered several contemporary songs, using the microphone in the hand-held mode, being careful to maintain a semi-subaqueous state by periodically holding it under the shower. We used a Donamichi 10001I cassette recorder, placed just outside the bathroom.

We assembled a blue-ribbon listening panel (composed entirely of opera lovers) to audition the tape. They were unanimous in their opinion that it was the finest recording of pop music they had ever heard, being white noise only.

Our vocalist was pleased to have a mike to use, even in such a foreign place as the shower.

We can enthusiastically recommend the Lirpa 1 Shower-mike to all audio enthusiasts because our findings indicate it brings great pleasure to both the user and the listener.

Noj Knas

Professional Systems Engineering (PSE) Studio One Preamplifier and Studio Two Power Amplifier

MANUFACTURER'S SPECIFICATIONS

Studio One Preamplifier/Control Unit

THD: Less than 0.01 percent from 20 Hz to 20 kHz at 2.0 V output.
S/N Ratio: Phono, 88 dB re: 10 mV input "A" weighted; Line, 98 dB re: 2.0 V out "A" weighted.
Frequency Response: Phono, RIAA ±0.25 dB; Line, 20 Hz to 20 kHz, ±0.25 dB.
Gain: Phono preamp, 45 dB at 1 kHz; Line, 20 dB.
Slew Rate: Greater than 50 V/ μS, all stages.
Clipping Level: 15 V.
Low Filter: 12 dB/octave at 40 Hz.
High Filter: 12 dB/octave at 10 kHz.
Equalization: +3 dB at 100, 200, 400, or 800 Hz; Treble, +3 dB at 1.5, 3, 6, or 12 kHz.
Max Cut or Boost: 15 dB.
Dimensions: 3½ in (8.9 cm) H x 18 in. (45.7 cm) W x 10 in. (25.4 cm) D.
Power Consumption: 20 watts.
Weight: 16 lbs. (9.26 kg).
Price: $610.00.

Studio Two Power Amplifier

Power Output: 80 W per channel from 20 Hz to 20 kHz, 8-ohm loads (140 W with 4-ohm loads).
THD: 0.02 percent at 8 ohms, 0.04 percent at 4 ohms.
Clipping Level: 100 watts at 8 ohms, 180 watts at 4 ohms.
Input Sensitivity: 1.2 V for 100 watts, 8 ohms.
Slew Rate: 100 V/ μS.
Damping Factor: 200 at all audio frequencies.
S/N Ratio: Better than 100 dB below rated output, 20 Hz to 20 kHz band width.
Dimensions: 3½ in. (8.9 cm) H x 18 in. (45.7 cm) W x 10½ in. (26.7 cm) D.
Power Consumption: From 35 to 450 watts.
Weight: 30 lbs. (13.6 kg).
Price: $630.00.

These two components from Professional Systems Engineering are so obviously made fo reach other that we decided to evaluate them as a pair. The Studio One "input control amplifier" (preamplifier/control unit in more usual language) can be classified as a control unit which is between the "straight wire with gain" and the "no control holds barred" design philosophies. That is, it sports a fair number of useful controls on its front panel while omitting such useless frills as "loudness control" switches and seldom-if-ever used mode switches. Large-sized rotary knobs at the left and right ends of the all-black front panel handle program source switching (only one phono position, but three AUX positions plus a tuner input pair) and master gain. The gain control is calibrated from +20 dB to "minus infinity," and 0 dB (unity gain for the line level inputs) is nicely positioned at around "12 o'clock" on the rotary control. The bass and treble control knobs, continuously variable from +15 dB of boost to -15 dB of cut, are each associated with a four-position switch which selects turnover frequencies over a range of four octaves, affording a degree of tone-control flexibility rarely found in two-control equalizer systems. A fifth small rotary control serves as a channel balancer.

Pushbutton switches along the bottom edge of the front panel handle two tape-monitoring circuits, tape transferring (which connects tape circuits to each other while disconnecting them from program sources being listened to), *Left/Right Mono* or *Stereo Switching, Tone Defeat, Low- and High-Cut Filters, Power On/Off,* and a *-20 dB Audio Muting circuit.*

The rear panel is neatly equipped with the usual pairs of input jacks, tape out and in jacks, twin pairs of output jacks, a ground terminal, and four switched plus two unswitched a.c. receptacles.

Studio One Circuit Description

The Studio One preamp/control unit employs discrete Class-A circuitry from input to output. The phono section uses 10 transistors divided into two stages in each channel. The first stage isolates the cartridge to insure proper loading and also incorporates the subsonic filtering. In the second

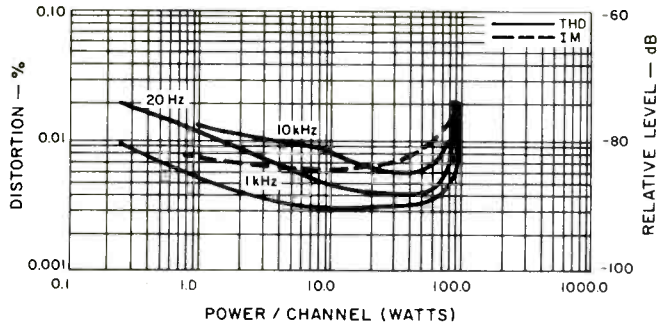


Fig. 1 — Power output vs. distortion on the Studio Two amplifer with an 8-ohm load.

stage, the RIAA response characteristics are accurately reproduced.

The line amplifier consists of a discrete operational amplifier using selected and matched transistors. A buffer amplifier drives the line outputs when using the high- and low-filter circuits. Five selected transistors are used in a feedback-type equalizer, which employs shelving characteristics with switched, selectable turnover frequencies.

The power supply provides regulated ±30 volts of d.c., and all a.c. wiring is well isolated from any low- or high-level signal stages. The power switch is in the d.c. voltage circuits, and the switched a.c. outlets are controlled by a 20-ampere relay.

The Studio Two Amplifier

The matching Studio Two power amplifier is physically very much like the Studio One, having a low profile appearance and similar width to its companion unit. Both units can be rack mounted. The front of the Studio Two is entirely covered by the vertical fins of the heat sink, which internally is physically coupled, via heavy brackets, to the actual output transistors which are actually mounted directly to the amplifier circuit boards for each channel. This seemed to us a rather indirect way to transfer heat from the output devices to the expansive, exposed heat sink and, as our tests later disclosed, the amplifier, under *static* testing, was subject to frequent thermal cutout. (Not so under music listening conditions, we hasten to add.) The rear surface of the amplifier is equipped with a pair of input jacks and, just below, are five-way, color-coded, binding posts on standard ¾-in. centers for speaker cable connection. A line fuse is accessible via the rear panel fuseholder, while a toggle switch allows the amp to be used in a bridged mode. While the end caps of *two* power transformers are clearly visible protruding from the rear panel, these two power transformers are wired together to provide a common supply source for both channels of the amplifier and are not dual supplies. The use of two smaller transformers, rather than a single larger one, may have been dictated by the desire to maintain the low-profile look for this amplifier.

Studio Two Circuit Description

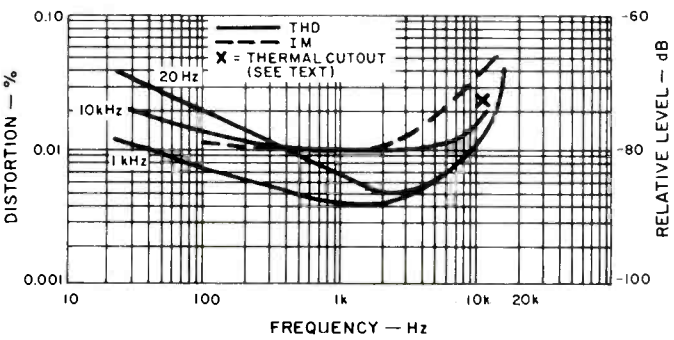
The two channels of the Studio Two are totally separate insofar as signal handling is concerned and are mounted on two separate circuit board modules. Common supply voltage is ±50 V d.c. filtered by dual 16,000-μF capacitors. Each amplifier is an all-discrete, direct-coupled, balanced design. A paralleled complementary Darlington output stage is used, along with matched differential amplifiers for the low level stages. True differential to single-ended conversion is used without bootstrapping. An active bias circuit exhibits a slightly negative temperature characteristic to help keep distortion independent of varying bias current and changing operating temperatures. A common input and output ground point at the rear of the chassis is used to help eliminate ground loop problems and to reduce r.f. interference. An output coupling network helps to prevent r.f. from entering via speaker lines.

In addition to primary fusing, the Studio Two had dual supply fusing on each channel. A high-gain, fast-recovery volt/amp protection circuit is also included, as is a thermal-cutout protection circuit.

Studio Two Laboratory Measurements

We measured the Studio Two power amplifier first. The amp delivered 91.8 watts at 1 kHz into 8-ohm loads for the rated THD of 0.02 percent. At the same test frequency, using 4-ohm loads, output for rated THD equalled 150 watts per channel. At the frequency extremes of 20 Hz and 10 kHz, using 8-ohm loads, power output reached 85.1 and 87 watts per channel respectively for 0.02 percent THD. Attempting to determine power output for rated THD at 20 Hz and 20 kHz with 4-ohm loads connected resulted in thermal cutout be-

Fig. 2 — Power output vs. distortion on the Studio Two with a 4-ohm load.



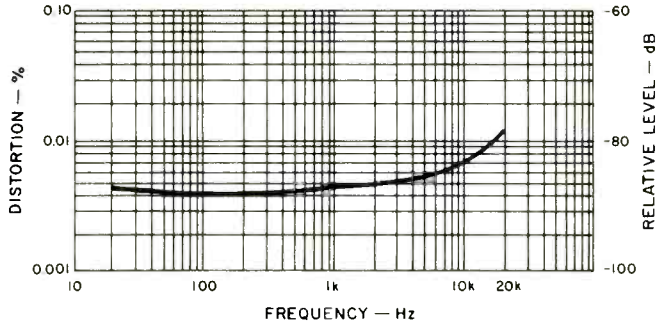


Fig. 3 — Distortion vs. frequency on the Studio Two with an 8-ohm load at the rated output (80 W per channel).

fore we were able to make a definitive reading. This, of course, would be frowned upon by the Federal Trade Commission whose amplifier power rule requires that an amplifier be able to deliver rated power at all frequencies within its power band for five minutes but frankly the action of the thermal cutout during these tests didn't disturb us too much, since such extreme testing is almost totally unrelated to what the amplifier will be called upon to do when reproducing music signals, even at quite high power output levels. Still, in terms of published claims, PSE might be better off omitting the 4-ohm power rating (as do so many other amplifier receiver and amplifier manufacturers these days) or perhaps they might prefer to de-rate the power output figure for 4-ohm operation to 120 watts or so. Power vs. distortion curves at the three test frequencies we used are plotted in Fig. 1 (for 8-ohm operation) and Fig. 2 (4-ohm loads), as are the measured IM distortion readings. With 8-ohm loads, at 80 watts per channel output, THD measured a very low 0.005 percent at 1 kHz, 0.0047 percent at 20 Hz, and 0.007 percent at 10 kHz, while IM distortion measured 0.016 percent. Power bandwidth (for rated THD of 0.02 percent) extended from 11 Hz to 30 kHz using 8-ohm loads. Frequency response was flat within 1 dB from 3.5 Hz to 80 kHz, within 3 dB from 3 Hz to 190 kHz, and damping factor (measured at 50 Hz) exceeded 100. Input sensitivity for rated output measured 1.1 volts, while signal-to-noise ratio measured 107 dB below rated output. Since there is no input level control on this unit, readers who wish to translate the S/N and input sensitivity numbers to the new IHF standards may do so by direct mathematical ratios. IHF Dynamic Headroom was 1.02 dB. A curve showing harmonic distortion vs. frequency at 80 watts rated output per channel using 8-ohm loads is plotted in Fig. 3.

Studio One Preamplifier Measurements

The Studio One preamp/control unit was measured next. RIAA equalization was found to be accurate within 0.1 dB from 30 Hz to 15 kHz. A sub-sonic filter is permanently introduced in the phono circuitry to roll-off frequencies beginning at around 20 Hz. Phono input sensitivity, per the IHF standards, was 0.55 millivolts, while phono overload occurred at 160 millivolts (at 1 kHz). High level input sensitivity (for 0.5 volts out, per IHF standards) measured 47.5 mV, while IHF S/N for the high level inputs was 88 dB. Phono S/N using the new IHF reference input level of 5 mV and output level of 0.5 V was 83 dB, an extremely good figure. Residual hum and noise with gain control set to minimum was 88 dB below 0.5 volts output. In accordance with recommended practice and the new IHF standards, phono overload was also measured at other test frequencies and was 31 mV at 100 Hz and 770 mV at 10 kHz. Harmonic distortion at 2.0 volts output via the high-level inputs measured below 0.005 percent from 20 Hz to 10 kHz, increasing slightly to 0.006 percent at 20 kHz. SMPTE IM distortion measured 0.025 percent for the same output, while using the so-called CCIR twin-frequency IM measurement method (with a 1-kHz difference between the test frequencies having equal amplitudes), IM measured almost the same value, at 0.03 percent. Clipping or maximum output level measured 15 volts.

A complete graphic plot of the bass and treble control range at the various turnover frequencies provided is shown in the spectrum analyzer 'scope photo of Fig. 4. Figure 5 is a plot of the response of the low- and high-cut filters which exhibited 3-dB corner frequencies of 47 Hz and 11.2 kHz respectively.

Listening and Use Tests

During the past year or so we have become particularly aware of (and able to detect) the effect of slew-limiting and transient distortion effects in auditioning amplifier equipment. The subtle differences between amplifers and preamplifiers when subjected to listening tests which had previously been ignored by many critics and equipment testers have now been recognized, as least in part, for what they are.

I am, therefore, particularly happy to report that the combination of the Studio One and Studio Two provided extremely accurate reproduction of music signals which, through run-of-the-mill equipment, have often caused clearly audible sonic deficiencies of these more subtle types. Even when the system was driven into clipping levels, recovery was extremely fast and almost undetectable, and as far as transient handling ability, these components rank with some of the finest (and most expensive) we have recently auditioned. As mentioned earlier, we ran into no thermal cycling during our long, high-level listening tests despite the fact that such cycling had taken place during static testing (FTC take note!). We believe that if you subject these components, either singly or taken together, to as critical a series of listening tests as we did, you will find that both units offer extremely good sound reproduction value for their suggested retail prices. Together they can form the basis of a top-quality music reproduction system in your listening room.

Leonard Feldman

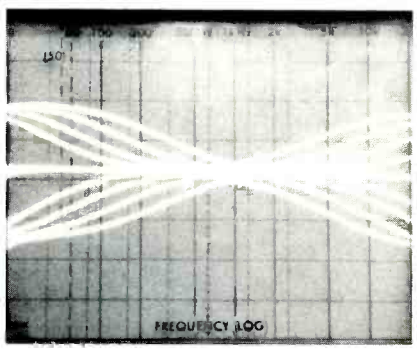


Fig. 4 — Range of response for the variable turnover bass and treble controls on the Studio One preamplifier.

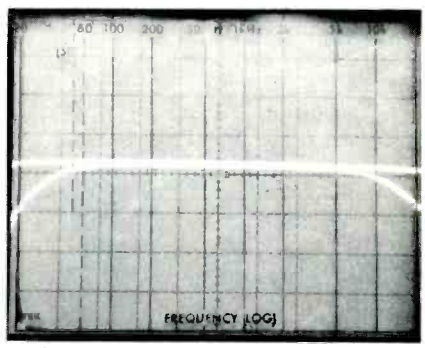


Fig. 5 — High- and low-cut filter response on the Studio One preamplifier.

Empire Disco Film Record Cleaner

Price: $29.95.

At one time, not too many years ago, records — if they were cleaned at all — were polished with a cloth, any old cloth that wasn't too lint laden. I'm sure that many readers will remember the ads that showed a gorgeous blonde, or perhaps a brunette, sitting seductively on a plush carpet with records strewn all around. But that was before the days of the LP and the vast improvements in phono cartridges and sound reproduction in general. Today all of that has changed and record cleaners are big business.

Most record cleaners on the market today use weak detergent solutions or distilled water with neatly designed brushes, all neatly packaged. But recently Empire Scientific came up with a new idea — Disco Film, a plastic film that peels off the record taking the dirt with it. It comes in a black cylindrical container about 8½-in. high by 2¼-in. wide.

Taking off the large top cap reveals a sponge. The record to be cleaned is then placed in the small projecting spindle on top of the cap and the sponge applicator is used to spread the viscous solution all over the disc, being careful to avoid getting it on the label. The record is then flipped over so the other side can be treated. When the disc is completely dry, in about 60 to 90 minutes, a piece of tape laid across the plastic film allows it to be pulled off.

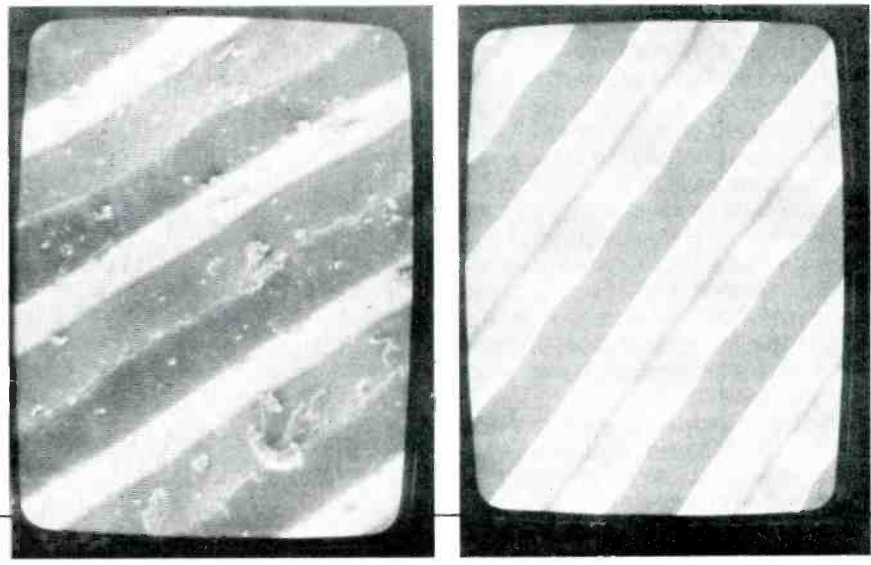
Well, I tried the Disco Film cleaner on several records, and there's no doubt about it, the film really does what it's supposed to, and the microphotographs (see Fig. 1) supplied by Empire are certainly not exaggerated. I could detect no sign of damage to the records (some solvents dissolve the record plasticizers), and the water-soluble solution is harmless to vinyl records. The instructions state however that the cleaner is *not* to be used on the old shellac records.

The container holds enough to clean 70 sides, or 35 records, and with the list price of $29.95 this comes out to be about 85¢ per disc. However, when you consider that the cost of a direct-to-disc record is about $15.00, and a good phono cartridge can cost up to $300.00, then the price of properly and completely cleaning a record doesn't seem all that expensive, relative to more conventional cleaners.

George W. Tillett

Enter No. 91 on Reader Service Card

Fig. 1 — Photos through an electron microscope at 500 times magnification showing a new, unplayed disc (left) and one that has been cleaned with Disco Film.



Sencore Model PR 50 Audio Prescaler

Price: $125.00.

The Sencore PR50 is designed to be used with a frequency counter to measure lower frequencies with greatly improved resolution. The prescaler input is from 10 Hz to 20 kHz, with a sensitivity of about 100 mV, and a square wave output of 400 mV p-p. Switch selection is made for inputs between 10 Hz and 500 Hz to be multiplied by 100, or between 500 Hz and 20 kHz to be multiplied by 10. The unit requires 7 to 12 V d.c. at 12 mA, and it has a standard coax power jack. An accessory a.c. power adapter is available for $9.95.

In tests the PLL-based circuit of the PR50 performed very well. The input frequency range actually extended down to 8 Hz with an 800-Hz output. The threshold for output was well defined, jumping from no signal to a stable square wave with minimal phase jitter over its frequency range. Rounding of the waveform appeared at the highest output frequencies, but the peak voltage remained the same.

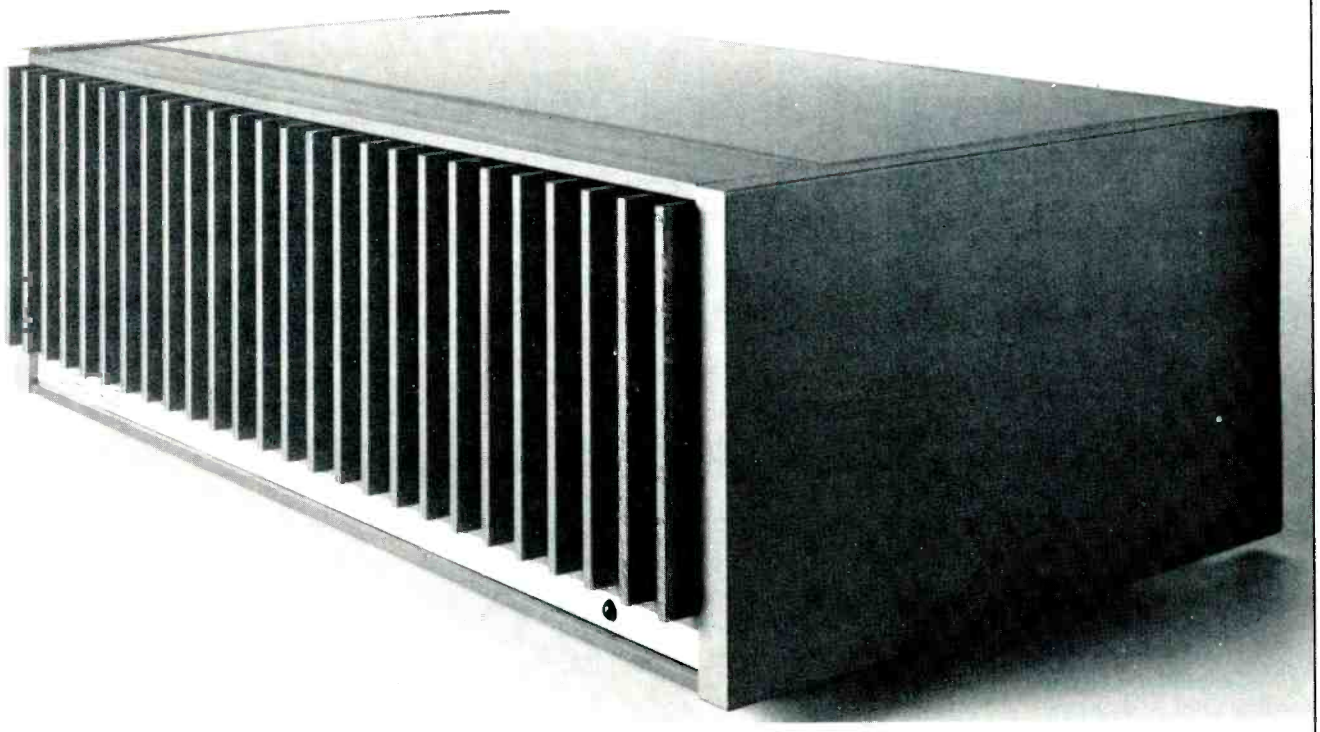
The Sencore unit is not just another gadget, but can provide essential information in the low-frequency region where many counters have low resolution and poor accuracy (actually the PR50 will improve things up to 20 kHz). If the counter has a one-second gate time, the errors around 10 Hz can be over 10 percent. If the gate time is 0.1 second, the situation is much worse.

The $125.00 price tag for the PR50 is well justified if you need to measure these lower frequencies accurately and your present counter has a gate time of one second or less. Applications include keyboard instrument tuning, VTR head-speed checks, and frequency responses. The PLL scheme used in the PR50 is more convenient and not subject to the errors possible with Schmitt-trigger period counters.

Howard A. Roberson

Enter No. 92 on Reader Service Card

Quad (Acoustical Mfg. Co., Ltd.) Model 405 Power Amplifier



MANUFACTURER'S SPECIFICATIONS

Power Output: 100 watts per channel, 8 ohm loads.

Rated THD: Less than 0.01 percent at 1 kHz and 100 Hz, and less than 0.05 percent at 10 kHz.

Frequency Response: -1 dB at 20 Hz, -0.5 dB at 20 kHz, and -3.0 dB at 50 kHz.

Signal Input Level: 0.5 V, ±0.5 dB for rated output into 8-ohm loads.

Signal Input Slew Rate Limit: 0.1 V/ μS.

Signal Input Overload: Instantaneous recovery up to +20 dB overload.

Hum & Noise: 95 dB below rated output "A" weighted, 90 dB below rated power output unweighted, 15.7 kHz measured bandwidth.

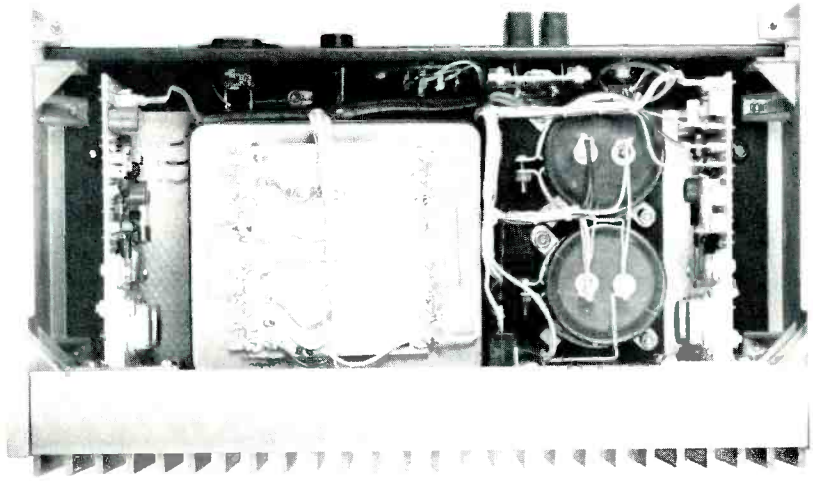
Stability: Unconditionally stable with any load under any signal.

Power Requirements: 110, 120, 130, 220, 230, 240 V, 50/60 Hz, 30 to 350 watts (depending upon signal level).

Dimensions: 13.4 in. (34 cm) W x 4.5 in. (11.4 cm) H x 7.7 in. (19.6 cm) D.

Weight: 20 lbs. (9 kg).

Price: $480.00.



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Leave it to our British friends to stubbornly continue to publish performance specifications for audio products that do not conform to other internationally recognized standards. Mind you, I happen to like the sound produced by the Quad 405, and I think it is a very worthwhile and well-designed product, having innovative and meaningful circuit approaches, but I'm not altogether certain that our Federal Trade Commission would be happy about that rating of power output which appears at the beginning of this report. The makers of the Quad 405 have *not* specified power bandwidth in terms acceptable to the FTC. Clearly, however, what they are telling us is that the amplifier will *not* deliver 100 watts at the 20 kHz extreme, and in fact it does not. Rather than derate the amplifier in its most useful frequency range, they simply tell us what it *will* deliver at three frequencies (100 Hz, 1 kHz, and 10 kHz) and at what THD levels. For that matter, it won't quite deliver a full 100 watts per channel at the low-frequency 20 Hz extreme either, but more about that later. I know that the British audiophiles (and equipment testers) believe that we Americans and our colleagues in Japan are a bit daft with all our emphasis on wide-band design and our love affair with distortion figures approaching "absolute zero," and perhaps in this regard, they are quite correct.The slew rate spec is also one to look at closely, since it is for the *input signal,* rather than the amplifier's output as is usual. However, the amp's slew rate can be calculated from the figure given, 0.1 V per miscrosecond, since the unit's gain is 35 dB, and thus the 405's slew rate spec turns out to be 5.62 V/ μS, a moderate figure these days.

In any case, the Quad 405, pictured here, carries no controls of any kind and may therefore be mounted out of sight, providing adequate ventilation is provided. Speaker output

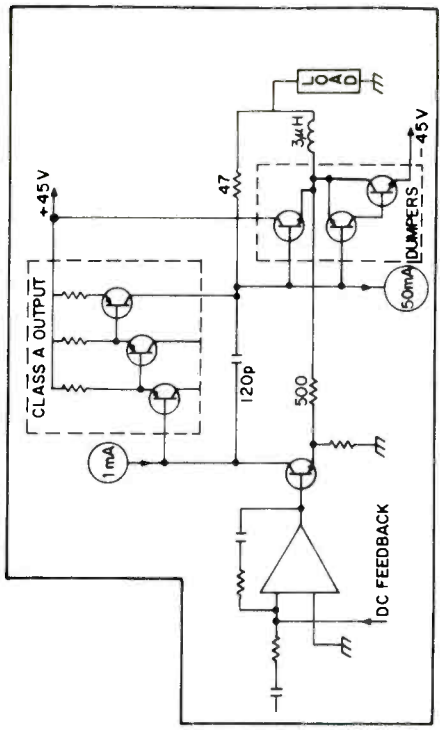

Fig 1—Simplified schematic showing Class A, dumpers, and bridge components.

Fig. 2—Schematic diagram of the Quad 405 amp.

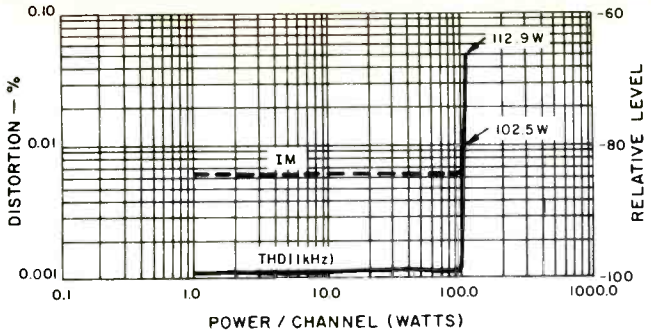

Fig. 3—Distortion vs. power output.

connections are made in the usual manner, by means of spring-loaded speaker terminals. As for the inputs, a special cable is provided which is terminated at one end in a 4-pin DIN plug and at the other with a pair of standard phono-tip plugs which can be directly connected to the output of one's associated preamplifier-control unit. If a matching Quad 33 control unit is used, that product comes equipped with a DIN-to-DIN cable, in which case the adaptor cable supplied with the Quad 405 can be put aside. A 5-ampere fuse (for 120 volt supplies) is accessible from the outside of the unit, while four additional fuses (one in each leg of the positive and negative power supply lines of each channel of the amplifier) are wired internally.

Internally, the amplifier consists of two identical circuit boards, one for each channel of amplification. Each of these boards has a pair of spring-loaded wiring terminals into which may be inserted a pair of supplied 1.8 kilohm resistors which will limit the output of the amplifier to a maximum of 20 volts rms per channel (50 watts across an 8-ohm load). The manufacturers tell the user that this "power limiting" scheme should be used if the amplifier is to be used with their well-known Quad electrostatic speakers or with any other speakers that are rated at less than 100 watts for maximum power input.

The chief circuit innovation in the Quad 405 is called a current-dumping output circuit; a simplified schematic diagram of this output circuit is shown in Fig. 1. In a current dumping amplifier there is both a low-powered, high quality amplifier which essentially operates at all times in Class A, plus a high-powered, heavy duty amplifier. The low-powered amplifier controls the loudspeakers at all times, calling upon the high powered section to provide high-power signals when required. The small amplifier is so arranged (it carries an error signal) so that when the larger power transistors (the current dumpers) get within the target area of the required output current, it will fill in the remainder of the signal current accurately and completely. According to the makers of the Quad amp, the reproduced sound quality is solely dependent upon the smaller powered amplifier which can be made very good indeed. In addition, this circuit arrangement is said to solve problems of crossover, crossover distortion, quiescent current adjustment, thermal tracking, and transistor matching. There are, in fact, no internal adjustments or alignment points within the amplifier and, once again according to the manufacturer, the choice of power transistors becomes less restrictive than in conventional Class B amplifier designs. A complete schematic diagram of the Quad 405 is reproduced in Fig. 2.

Laboratory Measurements

Harmonic distortion of the Quad 405, when measured with a 1-kHz input signal, remained extremely low at all levels up to rated output. In fact, it was necessary to calculate the actual harmonic distortion using our spectrum analyzer, since, at low levels, the THD was buried well below the noise floor. The most accurate reading we could come up with was 0.0012 percent, which is essentially the distortion of our signal source. The rated THD level of 0.01 percent (for 1 kHz) was reached at an output of 102.5 watts per channel, increasing to 0.05 percent at an output of 112.9 watts per channel, for 8 ohm loads. SMPTE IM Distortion measured approximately 0.0065 percent for all power output levels below rated output. These results are shown graphically in Fig. 3.

We decided to use the new IHF IM measurement techniques which involve analysis of difference-frequency components generated when the amplifier is subjected to signals which are 1 kHz apart. Using 14- and 15- kHz input signals adjusted to provide the equivalent of rated output from the amplifier, only two significant IM components were generated (at 13 and 16 kHz) as shown in the spectrum analysis photo of Fig. 4. These were some 68 dB below the input signal level, which represents an IM percentage of 0.04 percent. When the two signal frequencies were shifted up to 19 and 20 kHz, a great many more "sideband" or IM products were generated, as illustrated in Fig. 5. Calculating the rated IHF IM distortion by formula for this "worst case" condition yields a figure of approximately 0.09 percent.

Figure 6 is a plot of distortion versus frequency, with the amplifier delivering 100 watts per channel into 8-ohm loads. At 10 kHz, we reduced input signal very slightly to find the power output that could be delivered with 0.01 percent harmonic distortion. The value of power determined was 97.3 watts. The ideal load for the Quad 405 (in terms of maximum power output attainable) seemed to be 8 ohms, unlike that of most conventional amplifiers which deliver somewhat greater power output with 4-ohm loads. With a 4-ohm load connected, maximum power output for a distortion level of 0.01 percent (harmonic) for the Quad 405 was reduced to approximately 75 watts per channel, using a 1-kHz test signal.

Damping factor at 50 Hz (referred to an 8-ohm load) measured 91.5. Dynamic headroom for short-term signal bursts measured 1.34 dB above rated continuous power output. Frequency response was flat within ±1.0 dB from 19 Hz to 26 kHz, while the -3 dB roll-off points were observed at 13.5 Hz and 48 kHz. The amplifier has a built-in, sub-sonic filter rolling off low frequencies in accordance with the curve shown in Fig. 7. Maximum power consumption of the amplifier (when delivering 100 watts per channel, both channels driven) was 450 watts.

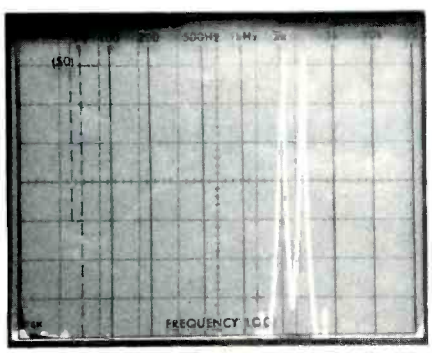

Fig. 4—IHF IM products (low level peaks) generated when 14 and 15 kHz signal mix is applied at rated output level. (Linear sweep from 0 to 20 kHz is employed, rather than a log sweep.)

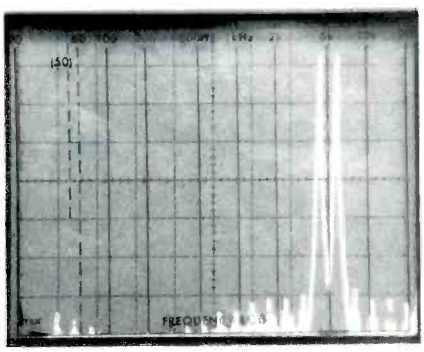

Fig. 5—IHF IM products generated when 19 and 20 kHz signal mix is applied at rated output level.

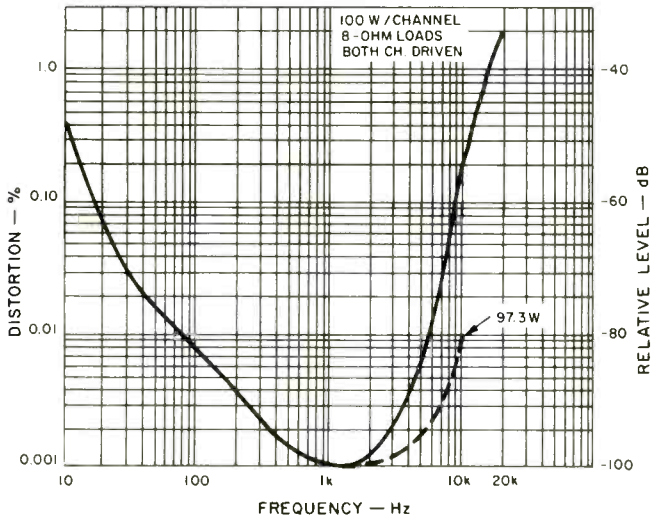

Fig. 6—Distortion vs. frequency.

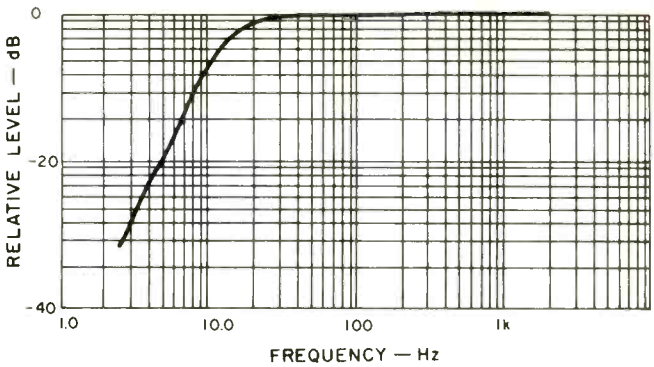

Fig. 7—Low frequency filter response.

In summary, if one needs around 50 watts per channel of maximum power (and that should be no problem with many of today's higher-efficiency speakers), the Quad 405 amplifier does very well indeed. Based upon American measurement techniques and design philosophy, however, we would be reluctant to recommend the Quad 405 for those applications where a "strong" 100 watts per channel of amplification is required. *Leonard Feldman*

Listening and Use Tests

At low and medium power output levels, the sound reproduced using the Quad 405 could not be faulted and, in fact, was so good that it made us wonder about the need for ultra-wideband response in power amplifiers so frequently endorsed by many American and Japanese amplifier manufacturers. When we attempted to push amplifier output towards rated output, but still well below the clipping point, we did begin to notice some deterioration in sound quality, specifically in the extreme treble region and when the amplifier was subjected to program sources containing sharp musical transients.

Editor's Note: Acoustical Mfg. commissioned an independent laboratory to conduct a series of blind A/B listening tests based on their belief "that it is perfectly possible to design amplifiers that do not degrade the quality of the program (and introduce) no detectable change in quality." The tests generally appear to be well designed and had, as listeners, well-known experts in this field. Both a 50 percent probability test and a Chi^2 test showed that the preferences expressed by the panel "were no more than would be achieved by sheer chance." Further discussion of such testing will be found in the review of the AGI 511A preamp published in June, 1978. — E.P.

John Wright European records

Since 1970 Alfred Brendel has been intermittently engaged in the recording of the complete Beethoven *Sonatas*. These are now available in a 13-record set at a favorable price (Philips 6768 004). It would be mis-directed to consider these just as reissues, for each is as fresh as the day it was performed, and such has been the consistently superior standards of interpretation, performance, and recording that it is difficult to believe that they are not the result of a single, continuous, concentrated effort. In fact I am given to understand that two producers were involved at a greater number of locations. Thus the consistency between the sonatas in all matters both musical and technical is truly remarkable. The general recording subjectively suggests a simple, but slightly spaced microphone technique with the minimum requirement for noise reduction apparatus. I choose to start this quarterly column by recommending this mammoth exercise since it is so unspeakably fine and is, in my opinion, the most authoritative and best recorded collection of these sonatas available.

Also on the Philips label I note that they have now released as a box set the series of Haydn *Symphonies* performed by the Academy of St. Martin-in-the-Fields conducted by Neville Marriner 6768 003 (6 LPs). Entitled *Twelve Named Symphonies*, the series starts with Haydn *Symphonies No. 92 in G the Oxford* and *104 in D the London*, (9500 304). The smooth and ambient sound is as before with the somewhat pompous opening of the *London* contrasting the *Oxfords* more vigorous attributes, both revealing their inner delicacy.

In my last column I gave mention to a new series of recordings to comprise the complete organ works of Bach from EMI (SLS 5087). Performed by Lionel Rogg on a variety of organs, I found it difficult to generalize about tonal qualities except upon their overall lightness of texture. On the Argo label, Peter Hurford now begins his recordings of the complete organ works. Volume One (D12 OD, 3 discs) is also performed on more than one instrument, in this case The Church of our Lady of Sorrows in Canada and the organ of Knox Grammar School, Sydney, Australia. Equally, these do not have distinctively thunderous low frequencies. Both organs are recorded very cleanly and distinctly, if with rather more weight and breathlessness captured in the ambience from the Australian organ. Surfaces are impeccable apart from some grumbling noises in scrolls between works. There are none of the exaggerated tonal contrasts or flamboyancy as one might expect from, perhaps, Karl Richter. In fact Hurford's technique makes these performances sound easy and effortless, rather in a manner that Alicia De Larrocha can achieve in complex piano works. With no declared intention of

retrospective authenticity, the results are, as the advertising promises, "both invigorating and immensely rewarding." As a Bach freak I look forward to Volume Two.

Also, partly as a result of my personal dedication to that composer, I could barely fault the new recording of the *St. John Passion*. On STU 71151 these three records are typical of the uncluttered presentation which we have come to expect of the Erato label. It consists of a mixture of closeness and cleanliness with some blended reverberation. Felicity Palmer, Birgit Finnila, Kurt Equiluz, Werner Krenn, Ruud van der Meer, and Philippe Huttenlocher are soloists with the Lausanne Vocal Ensemble & Chamber Orchestra conducted by Michael Corboz. Other critics have expressed their appreciation of the inspiration contained within this recorded performance, and I can certainly find no grounds upon which to contradict. Also on the Erato label we have a soloist's eye view of the popular Rodrigo *Guitar Concerto*, coupled to his *Fantasia Para un Gentilhombre*, on STU 71128. As intimated, this artificial balance makes the guitar larger than life. Nevertheless, the receded orchestra is clean and suitably submissive. Crystalline as it is, maybe the performance justifies a less spectacular format. Having no right or wrong volume, for its minor technical inaccuracies the album is endowed with exceptionally low surface noise.

Even more universally popular than the Rodrigo must rate the Greig and Schumann *Piano Concertos*, so often coupled on one disc, in this case on EMI ASD 3521. Although the review pressing had a poor surface in places accompanied by an occasional high frequency trickling noise, the whole performance is a sheer delight. That is not to say that certain inexactitudes do not exhibit themselves from soloist Horacio Gutierrez, but this makes for spontaneity. With the piano recorded to the left this tasteful arrangement is light and airy, containing great delicacy. Being a multi-microphone presentation, it nevertheless bears the hallmark of a reconstructed jigsaw puzzle, although with very little raggedness around the joins.

The Paul Tortelier Masterclasses transmitted by BBC television in July of last year has motivated performances of the Brahms *Cello Sonatas in E minor Op. 38* and in *F, Op. 99*, performed by the maestro and accompanied by his daughter Maria de la Pau. On EMI ASD 3612 the recording is rather close, but not overtly so and when played at a realistic level it is not difficult to believe that the performers are in one's presence. Naturally, there is something special about a family performance where sympathies must coincide not only on an emotional but also on a blood-relationship level. The much felt depth, while probably more appreciated by those who watched the series, will nevertheless not be lost by the listener previously unaware of Tortelier's visual inflections.

Also on the EMI label, I would bring to the readers attention a new recording of Haydn's *The Creation* (SLS 5125). Not being a block-busting spectacular and containing only very minor technical aggravations, due to its overall neutrality I suddenly found I was enjoying the music! As Robert Tear is featured among soloists Helen Donath and Jose van Dam (with the Philharmonia Chorus and Orchestra), this is probably not surprising. Since this music formed an intricate part of my formal education, an element of nostalgia must be declared . . . .

Part of almost everyone's musical background must, however, be Handel's *Water Music*. Unusual is a new release on the L'oiseau-Lyre label (DSLO 543) as it is being proclaimed as

"authentic." Somewhat scrawny sounds of early instruments closely recorded are far from the warm presentations to which we have generally become accustomed. As remarked before, without direct reference, it is impossible to authoritatively vouch for the recording quality but I was surprised at its intimacy, especially in consideration of its originally intended venue. Perhaps it would sound different in the open air? Performed by Christopher Hogwood and The Academy of Ancient Music, I would somehow doubt that they would overlook the obvious.

From interest value, it is not a record I would like to be without, and it is interesting to compare this version with the latest lush, modern interpretation by the Prague Chamber Orchestra complimentarily balanced by Stanislav Sykora. Recorded in co-production with Supraphon, it is issued under the EMI label (ASD 3597).

The tremendous attack of a modern symphony orchestra is maintained in the latest recording of Elgar's *Pomp & Circumstance Marches*, coupled to the *Cockaigne Overture* on RCA RL 25158. This is another example of the Scottish National Orchestra conducted by Sir Alexander Gibson and recorded by Brian Cousens. As is now becoming expected from this combination, the rendition is both spectacular and natural at the same time. A low cutting level allows vast dynamic and frequency range which, although it compromises the signal-to-noise ratio, cannot be rated as anything less than superb. Decca recordings featuring conductor Sir George Solti often, to my ears, have had a tendency towards hardness — especially when he is conducting the Chicago Symphony Orchestra. However, his new direction on Verdi's thrilling opera *Otello* largely avoids this (D 102D 3). The Vienna Philharmonic Orchestra is accompanied by a star-studded cast, and although up to their usual (and largely justifiable) electronic subterfuges, the three-record box set well suits the home entertainment media on both musical and technical grounds. I cannot however still resist a yearning for the 1962 recording by Herbert von Karajan and the Vienna State Opera Chorus, complete with impressive opening of cannon shot. Decca must think so too, as it is still listed (D 55 P3) with a highlights selection on SXL 2314.

Coincidentally it was only recently that I expressed surprise at the number of available recordings of Stravinsky's *The Rite of Spring*. Although awarding unreserved praise to Colin Davis' new version (9500 323), I expressed the opinion that I thought *Petrochka* offered more musical (without the visual) enjoyment of all Stravinsky's ballets. And low and behold Decca has released a brand-new disc, also with the Vienna Philharmonic Orchestra, this time conducted by Christoph von Dohnanyi (SXL 6883). Possessing impressive and well-differentiated bass complemented by a clinical top, the disc also contains more than usual front-to-back perspective. In all, thoroughly recommended!

Concluding rather where I came in, with Brendel and Philips' box sets, readers may remember that precisely a year ago I recommended his recording with the London Philharmonic conducted by Bernard Haitink of the Beethoven *Piano Concertos* (6767 022) as "One of this most important . . . to be released . . . by Alfred Brendel." I am pleased to see that they are becoming available separately, now pressed in England rather than Holland. The initial record is of *Concerto No. 5 The Emperor* (950 243), and it seems to have suffered little from the voyage.

top of the pile

Gould Conducts Gould: Spirituals for Orchestra, Foster Gallery, London Philharmonic Orchestra.
Crystal Clear CCS-7005, direct-to-disc, stereo, $14.95.
Music of Prokofiev, Ravel, and Falla, London Philharmonic Orchestra, Walter Susskind, cond.
Crystal Clear CCS-7006, direct-to-disc, stereo, $14.95.

One of the golden ages of stereo comprised a large number of recordings made by Everest Records during the fifties. They were first available on two-track stereo tapes and later on stereo discs. Those of us who grew up with the Everest catalog have wished many times during these 20 years that the particular recording approach favored by Everest could be restated in terms of today's finest technology, free from the noise and granularity characteristics of even the best recording systems of that earlier time. The approach was always basically "hands off," once the players were set in an array which emphasized natural balances between orchestral sections and, just as important, the balance between orchestra and acoustical environment.

One of the guiding minds behind the Everest venture was *Audio* Magazine's Bert Whyte. When I heard last fall that Crystal Clear Records was planning a pair of discs with the London Philharmonic Orchestra—and with Bert Whyte as recording engineer — I felt that we were close to a realization in modern technical terms of the musical integrity of the Everest years. The review copies have arrived and been played many times, and it is my pleasure to tell you that the wish has essentially been fulfilled.

As in his other work, Whyte has chosen a spaced-apart, left-center-right omni-directional microphone array *sans* accent microphones or gain manipulation. The recording venue is not the favored Walthamstow Town Hall of the older Everest catalog but rather Watford Town Hall, a site used for many of the Mercury recordings with Antal Dorati and the London Symphony Orchestra in the early sixties. Watford doesn't have the expansive sound of Walthamstow, but there is warmth aplenty along with a solid low end and lots of sheen to the strings.

The first of these records, CCS-7005, presents Morton Gould conducting two of his works, *Spirituals for Orchestra* and the *Foster Gallery*. *Spirituals* is a finely wrought work, perhaps Gould's best, and demands a dynamic range as great as any orchestral piece I know of. The anvil strokes at the start of the third movement are reproduced with no sign of clipping or overload anywhere in the chain, and throughout the work the bass drum sound has as solid a 30 to 35 Hz impact as you could wish for.

All of this means that the disc was cut at a sensible level, perhaps some four or five dB lower than is the norm for a non-audiophile classical product. Lower levels often mean more noise (and this is, of course, why compression and rolled-off low ends are endemic to the industry), but these German-pressed discs are certainly quiet enough. For those interested in comparative listening, the Gould version on RCA with the Chicago Symphony (mid-'60s) and the Susskind version on Everest (from the golden age) are recommended.

The *Foster Gallery* is, according to the liner notes, an abbreviated set from an earlier collection of 13 settings of Stephen Foster songs. These run the gamut of orchestral textures and make excellent demo material; however, they are apt to pall quickly in comparison to the *Spirituals*.

The second record, CCS-7006, presents Walter Susskind conducting the Prokofiev Suite from the *Love of Three Oranges*, Ravel's *Bolero*, and Falla's dance from *La Vida Breve*. While we presume that the same basic microphone array was used in the Susskind recording, there is somehow less sense of space, rather as though the center microphone had been emphasized more than in the Gould disc, resulting in a more pronounced monophonic cast to the recording. This appears to be less so on the Ravel/Falla side. In any event, the difference is a subtle one, and we are, as with the first disc, treated to gorgeous timbres and wide dynamic range.

While one could wish for a more Gallic reading of *La Valse*, the Prokofiev is given its due. It is appropriately supercharged with all the acerbic edge its brass and percussion writing calls for. For those interested in comparative listening, there is a Dorati recording on Mercury with the London Symphony Orchestra made in the same hall during the early sixties.

Without question, these discs are the best to date of classical orchestral recording in the direct-to-disc genre. What is most impressive is the total lack of stridency in the tutti passages and the projection of a natural lambency and warmth to the massed strings. In this regard, these discs are far ahead of the earlier Boston Pops recordings on Crystal Clear.

In order to receive the full impact of what has been put into these discs, they must be played back at a level which is close to that of the sound field existing at the microphones. This is generally the case with most straight forward, hands-off recordings, and it will call for more horsepower than many audiophile systems may be capable of. *John Eargle*

Vivaldi/Koffman, The Jazz/Rock Seasons: Moe Koffman, Flute
Sonic Technology Corp. STC-100, direct-pressed disc, $15.00.

What's a direct-pressed disc? Well . . . that requires some explaining, so please be patient if it takes me a little time to get around to talking about the music.

Most records are manufactured using what is known as a three-step process. This means that after the master lacquer is cut, the grooved surface is covered with a layer of metal by first coating the lacquer with silver and then electro-plating a layer of nickel over that. Then, the metal is carefully separated from the lacquer, resulting in a metal negative — or master. This negative is now plated, the two metal parts separated to give us a metal positive, which is sometimes called a mother. This positive is then plated, and the new metal part separated from this process becomes the stamper. The advantage of this three-step process is that many stampers can be made from each mother, and many mothers can be made from each master.

What STC does, however, is to use the metal master as a stamper, thus eliminating two plating processes. STC claims that each plating process can add three to five dB of noise as well as adding some amount of transient distortion. Further, by pressing directly from the metal master, the signal to

noise of the pressing will improve by six to 10 dB. While there is nothing basically wrong with these statements, the amount of noise generated by the plating process depends, in my experience, on who is doing the plating, as one manufacturer could very easily generate more noise in one plating step than another manufacturer in three steps. As for any improvement in transient response, keep in mind that the transient response of an audio recording is still primarily limited by the tranducers used during the recording process, i.e. the microphones, tape recorders, and cutting lathes.

With all that out of the way, how does this record sound? Well, it is quiet, as far as any plating-related surface noises are concerned, but my review copy did have an annoying number of pops and ticks, noises usually due to the pressing process. As for the music, I found Moe Koffman's arrangement of Vivaldi's *Seasons* to be only moderately successful. For me, many sections sound awkward, not really suitable for Vivaldi, but not fitting into a jazz/rock idiom either. The level of playing by Mr. Koffman and his unidentified group of studio musicians is not up to the level of someone like the Jacques Loussier Trio nor does it have the imagination or excitement of the arrangements by Emerson, Lake and Palmer.

My overall impression of this record is that STC is trying to cash in on the sudden development of the market for expensive, high-quality audiophile recordings. What STC appears to have done here is to put a high price and some technical jargon on a rather ordinary studio recording. Not recommended. *Charles P. Repka*

Sound: B Pressing: B Performance: C

Bach: Concerto for Violin, String Orch. and Continuo in E, BWV 102; Chorale Prelude "O Mench bewein;" Prelude from Partita in E (arr. orch.). Steven Staryk; Toronto Chamber Orch., Boyd Neel. **Umbrella DD9,** direct-to-disc stereo, $14.95.

This Bach recording by Boyd Neel (see my "Audio ETC" articles of some time back) has some of the virtues and faults of "d-to-d" and even more of those we now associate with Baroque playing of the pre-War period, when Neel was indeed a pioneer in this music in early recordings on 78. There are more discs in the series from Umbrella.

The sound is as it should be, technically excellent. That's what you are paying for. Nobody questions the potential for better quality inherent in the tapeless direct-to-lathe technique, and that potential is usually realized in fact or the record doesn't get released.

First, I hear immediately that slight extra tension which says, we have to play for around 16 minutes without making ONE slip of any sort. Both good and bad — at least the music is not lax. More important, this is a big, bouncing, typically 1930's performance, bumpy and unphrased, out of the era of Stokowski though played with a proper small orchestra. Most listeners, even so, will like it. We still hear Bach this way often enough. But for those who are accustomed to Bach in the 1970s the sound is just plain wrong, abysmally so. Matter of choice! Take yours. After all, the day after tomorrow it'll be something else again, no doubt.

The Reger-arranged *Chorale Prelude* on Side 2 is Stokowsky but twice as thick and juicy. I could not bear it. The well-known *E Major Prelude* is fine — it tears along in the violins as it should, and sounds as effective as ever. It "transcribes" from the original solo violin most beautifully.

Ah, the Achilles heel of direct-to-disc! The pressing . . . it has ticks. *E.T.C.*

Sound: A- Recording: B Surfaces: B-

Jon Tiven

Michael Tearson

The column

Comes a Time: Neil Young
Reprise MSK 2266, stereo, $7.98.

Comes a Time is easily the most satisfying and consistent album Neil Young has made at least since the very successful **Harvest.** Like **Harvest,** the overall tone is light and acoustic; unlike **Harvest,** no track is blatantly excessive.

Neil's songs here are the least tortured he has released in ages. His wounds, open and raw on albums like **Zuma** and **American Stars 'n Bars,** are now no worse than scar tissue. Acceptance and wisdom earned are themes running through the album. They show particularly strong in the title track and the lovely ballads *Already One* ("Now only time can come between us") and *Goin' Back.* The only jarring lyric clunker is *Field of Opportunity* which has the awful forced image "In the field of opportunity, it's plowing time again."

The album's production values are remarkably consistent for something recorded in six different places. The arrangements are thoughtfully spare, especially the string arrangements. On *Goin' Back* the strings are held back for superb impact when they are brought in. Sound is clean and occasionally very imaginative. On *Look Out for My Love,* one of two tracks recorded with Young's band Crazy Horse, in one verse electric guitar sounds are used as sound effects for hydraulic motors and walkie-talkie babble to great advantage.

I would be crazy not to specially mention the contribution of Nicolette Larson. Nicolette has been a studio harmony singer with Young, Emmylou Harris, and Commander Cody among others. Her work here is the best she has done yet. From reports Young told her simply to sing what she felt in the studio. From this freedom developed some of the best duo singing since Gram Parsons and Emmylou Harris on Gram's **Grievous Angel.** She becomes the force that actually propels **Comes a Time.**

Ever since he left Buffalo Springfield, Neil Young has played the eccentric to the hilt. Indeed he often performed with his back to the audience even back then. Some of his work is unabashedly brilliant, some of it absolutely awful. **Comes a Time** is one of his best. It vindicates those who have believed in Young despite himself, and it vindicates the man as well. With this album, there appears a sense of control and focus and interest which too often were all too obviously absent.

M. T.

Sound: B Performance: A

Sgt. Pepper's Lonely Hearts Club Band: The Beatles
Capitol SMAS-2653, stereo, $7.98.

Not a movie soundtrack! Not a new recording! This is the legendary original recording by the Beatles whom you might remember from the 60s.

Recently, with minimal fanfare, George Martin went back to Pepper's original four-track (yes, four tracks only) master tape and applied a decade's improved technology to them. In so doing, he has taken a record often used as a stereo test and improved it. Fear not, for the music is fully intact. The stereo is as brilliant as

ever. Actually the changes are virtually subliminal. The sound is just a notch brighter and cleaner. The presence is textbook close. And that's about all.

Well, not quite all. The yellow strip across the top of the front cover which says "STEREO" is gone, mute testimony to the death of mono in 1968. Also on the back cover John Lennon's thumbs' position no longer coincides with the word "love" in the lyrics of *Within You Without You* as it has always done before. This last item once and for all disproves the "Great Sgt. Pepper Conspiracy Theory" which stated that if you decoded this and other Beatle albums you'd automatically receive a ticket (one way) to Pepper's Island, the magic place where nothing is bad.

In any case I needed an excuse to cop a new copy. My old one was beat to hell. *M.T.*

Sound: A+ Performance: Need you ask?

Crystal Rainbows : William Penn
Sounds Reasonable Records SR 7801, stereo, $8.98.
The Glass Orchestra: The Glass Orchestra
Music Gallery Editions 10, stereo, $7.98.

The Glass Orchestra and **Crystal Rainbows** are recordings that employ very unusual and exotic instruments to create some enticing music. As its name implies, The Glass Orchestra plays glass instruments. Some are glass variations on conventional instruments, like a glass marimba, sopranino, soprano sax, flute, and clarinet. Others are more bizarre. There are bow bowls, glass icicles, glass loudspeaker, pookaphone, and silica shakers. These are all rubbed, bowed, blowed, beaten, shaken, or have water poured into them to create an ethereal music of clear resonance. The ensemble confines itself to environmental spaces of shifting textures, meditative drones, and crystaline glissandos that seem to materialize in the midst of a void.

Crystal Rainbows takes its instruments from a display at the Smithsonian Institute. They include traditional oddities like cloud chamber bowls (first used by Harry Partch) and a glass harmonica. Then there are the such favorites as the single-string, stainless-steel cello which is a 10-foot long sheet of metal, the electronic jawbone, and the rubber piano. These are combined with more common instruments like piano, synthesizer, dulcimer, and various percussion devices. William Penn uses these and other instruments in much the same way as the Glass Orchestra and creates living spaces of music. But Penn has a greater concern for form and, with his more varied instrumentation, is able to extract a much wider range of colors and dynamics. Even though there is rarely a discernible melody or rhythm, he uses studio techniques to imply cohesion and movement in his works and also evokes images of other music cultures. On *Gossamer Looms* he manages to combine a Scottish traditional feel with a Tibetan orchestra without using any Tibetan instruments. And just to show us he can do it, he does one finger-popping tune called *Moonshine*.

Both these records go beyond the freakishness of their sound sources to create music that is both exciting and provoking . . . each are sonic delights in their own ways. The Glass Orchestra sounds like a straight-forward recording with little studio manipulation used to extract the pure tones of the glass instruments. William Penn, on the other hand, uses the studio as part of his composing technique, with reverb and echo giving his instruments an added resonace for their overtones to play on. He's also highly conscious of sound placement along the stereo stage to give his music an all-surrounding depth whether heard on headphones or speakers.

Music Gallery Editions, 30 St. Patrick St., Toronto, Ontario, Canada M5T 1V1. Sounds Reasonble Records, 2000 "P" St. Northwest, Washington, DC 20036. *John Diliberto*

Sound: A Performance: A

Back to Earth: Cat Stevens
A&M SP-4735, Stereo, $7.98.

With **Back to Earth** Cat Stevens returns to the musical forms in which he is strongest, an acoustic-oriented sound as on **Tea for the Tillerman** and **Teaser and the Firecat.** At its best — the song Cat wrote for UNICEF's Year of the Child, *Daybreak*, the wistful *Randy* and the jaunty rocker *Bad Brakes* — it is vintage Stevens. The only vestige of the recent, modern Cat Stevens of **Izitso** is the instrumental *Nascimento*. Like the cover photo, the album's sound and production are vibrant and pristine clear.

For the last several years Cat Stevens has had a string of albums that have felt like less than **Tea, Teaser,** and **Catch Bull at Four.** They have included the portentious, if pretty, *Foreigner Suite*, the cozmic fluff of **Buddha and the Chocolate Box** and **Numbers,** and the experimental and spotty **Izitso. Back to Earth** reminds me of what attracted me to Cat Stevens in the first place. *M.T.*

Sound: A- Performance: B

Vital: Van Der Graaf Generator
PVC Records 9901, stereo, $9.98.

Vital is a double-disc, live recording that marks the 10-year recorded existence of Van Der Graaf Generator. For that time it's been the extension of lyricist, vocalist and supplementary guitarist Peter Hammill, who uses the group to give dynamic life and murky depths to his dark visions into the human psyche. Though lumped loosely in with the British art rock scene, Van Der Graaf has rarely had any of the prettiness or classical leanings that mark that genre. Rather, they have gone in the opposite direction, using coarse horn and guitar arrangements to flesh out Hammill's often schizophrenic constructions.

For **Vital** the group brings together some old and new members of the relatively stable VDGG personnel for a set of live tunes spanning from their third album, **Pioneers Over C,** through their most recent, **Ship of Fools.** It's hard to tell just how coherent a performance this is because the recording is definitely fifth rate. Hammill's voice and Nic Potter's chunky bass dominate the mix, while the rest of the group churns in a sluggish mire, with all the dynamics compacted in the middle.

But Hammill's impassioned delivery and his songs' kinetic power lift the session. It's only when he gives the songs over to instrumental sections that they flounder. With violinist Graham Smith and sax player David Jackson sticking to ornamental outlines, the group lacks a strong frontline soloist.

This album is vital to those loyal followers of VDGG. For those who want to become addicted, pick up a copy of **Pawn Hearts** in your local cut-out bin.

John Diliberto

Sound: C- Performance: B-

Dire Straits
Warner Brothers BSK 3266, stereo, $7.98.

In an era of ready-made music, Dire Straits' debut album is something special. Coming out of postpunk, post New Wave England, they have a sound and thrust all their own.

They are a totally self-contained unit. Singer/guitarist Mark Knopfler writes the songs. The rest of the band is Mark's brother David on guitar, John Illsley on bass, and Pick Withers on drums. And that's all. No extra session guys, no string or horn frills. A no-nonsense band. They ain't real pretty or even very unusual looking. The music does the speaking.

Sultans of Swing is *the* killer cut, a song about some old-timers who can

still play hot despite never "making it" and despite the rock & roll crowd that couldn't care less. But those cats can blow some sounds.

In the Gallery is about a painter who has to die to get his recognition. *Down on the Waterline* is a tough/tender tableau of love and poverty. *Wild West End* captures the ambience of a rough part of London.

So you can see that Dire Straits' very name fits their music. Their songs chronicle the poor and the desperate, the beaten and the not-yet-beaten. Muff Winwood's production is just right, spare and stark, nothing extra. On bare bones stuff like this, prettifying it with grand production and arranging would only be a distracting contradiction. It would only water down one of the most intriguing bands I've heard in a while. Dire Straits says all it needs to. *M. T.*

Sound: B Performance: B+

Tormato: Yes
Atlantic SD 19202, stereo, $7.98.

This album shows the most song consciousness of any Yes has done in a long while. It has nine cuts, all under eight minutes. Working more within song-sized ideas, instead of murals, forces Yes to be more economical in arranging than they have been recently. Their production values remain exemplary, with excellent sound quality that is not nearly as dense as usual for them.

On **Tormato** Yes even comes down from the clouds to rock out convincingly. *Don't Kill the Whale* is very impressive, both for the power the music achieves and for being a message song without being heavy-handed. Also *Release, Release* and *Future Times/Rejoice* have progressive thrusts with solid beats.

At other turns, Yes charms. *Circus of Heaven* is lovely and wistful. It's a benevolent Dr. Lao idea for a father and son outing that ends with Damion Anderson, vocalist Jon's son, complaining, "Oh, it was OK!! But there were no clowns, no tigers, lions or bears, candy floss, toffee apples, no clowns." The kid may be cute, but he may be his father's equal in pretense. The soft *Madrigal* has a lovely Rick Wakeman string arrangement.

I've always liked Yes best when they don't try so hard to be ponderous and ramble on as if they had nothing else to do. When they play with economy and authority combined, as they do on **Tormato,** they are superb. *M. T.*

Sound: A Performance: A-

jazz & blues

The Mastery of John Coltrane/Vol. 3 "Jupiter Variation" : John Coltrane
ABC IA-9360, stereo, $7.98.

This is the third in what I hope is a never-ending series of recordings from the vaults of John Coltrane. **Jupiter Variations** contains three new performances plus an attempt to rectify a past blasphemy. The most striking aspect of this set is the side of duets with Rashied Ali, Coltrane's drummer in his final phase of music. *Juptier (Variation)* is an alternate take from the performance on **Interstellar Space** while *Leo* is a duet rendition which has previously been presented with a group. Both tunes exhibit an empathy between musicians that goes beyond telepathy. When they played together, Ali and Coltrane were one unified force. After brief statements of the theme, they would take off in a tumultuous course. Coltrane dissected the melody, breaking it down into cyclic figures and putting it through every possible permutation. Ali would swing right along with him on a roll of drum and cymbal flurries. Coltrane's affinity for the hypnotic feel of Indian ragas is especially evident on *Leo*, where they emerge from the flow with a series of fast exchanges like those between a sitar and tabla.

The other side features a completely new tune, with the arbitrary title *Number One*. It features the quartet of Ali, Jimmy Garrison on bass, and Alice Coltrane on piano. When he was with Coltrane, Jimmy Garrison played bass like a navigator plotting a course through a sea of meteors and asteroids. He picks his way carefully but with complete command and authority. Ali is a controlled chaos of polyrhythms and cymbal washes. Alice, who never really maintains a pace with Coltrane and his sidemen, is content to drift little sprays of piano into the mix. Coltrane is in ecstatic form. He creates the legendary "sheets of sound" with wildly oscillating patterns and a rapid fire delivery.

Finally, there's *Peace On Earth*, a piece that originally appeared on **Infinity,** here with Alice recutting her piano part, excision of Jimmy Garrison's bass for replacement by Charlie Haden's, and a dub in of a string section. While the power of the Coltrane performance comes through, it is obscured and also trivialized by this "sweetening," It appears here, less the strings, as a statement of hope and muted anguish. Coltrane plays with reined-in force on top of Ali's swirling brush work.

We should all be thankful that the work of Coltrane's timeless genius and vision has been so well documented under excelent studio conditions.

John Diliberto

Sound: B Performance: A+

Spiral: Muhal Richard Abrams
Arista/Novus AN3007, stereo, $7.98.

It's pretty easy to become blasé when a new record of solo piano music is released. Particularly after the originator of that trend, Keith Jarrett, has just put out a 10-volume set of solo piano improvisations. Don't act blasé when you see this new album of Muhal, however . . . hear it and be awed. As the founder of The Association for the Advancement of Creative Musicians of Chicago (AACM) Muhal brings a historical and philosophical perspective that enriches his deeply personal explorations.

Without playing standards or favorite riffs, Muhal invokes the history of jazz. His improvisations move from crystaline contemplations to pounding bass runs that hint at boogie-woogie. Even in his wildest forays, Muhal maintains a warm lyricism that reassures you of his humanity. There is always a sensation of resolve in his kaleidoscopic ramblings to ease you into his next shift of patterns.

Spiral is also one of the finer technical recordings I've heard recently, done live at Montreux last year. Even in the midst of Abrams' sonic clusters, each note is heard clearly and not just lost in a rumble of overtones. When Muhal goes inside the piano to play the strings, his softest ministrations are clear in the dynamic shuffle. **Spiral** is a perfect expression from the soul of Muhal Richard Abrams.

John Diliberto

Sound: A- Performance: A+

Pat Metheny Group
ECM1-1114, stereo, $7.98.

This one's been a favorite for some months that I intended to write about sooner. With this his second album, Pat Metheny has fully emerged as a major artist. His work in Gary Burton's group was impressive, but only hinted at the extensive musical vocabulary of Metheny's own work. He plays a whale of a guitar and has a dandy band in Lyle Mays, Mark Egan, and Dan Gottlieb.

Most impressive is Metheny's sense of melody. Side One, with *San Lorenzo* and *Phase Dance,* is nigh on perfect. The flip, while not quite so boggling, is far from a disappointment.

The electric nature of Metheny's band doesn't receive ECM's most perfect sound. It is good, but not the brilliant sound of the label's acoustic recording. Still **Pat Metheny Group** is clearly one of the year's real class acts.

Michael Tearson

Sound: B- Performance: A-

Embraced: Cecil Taylor and Mary Lou Williams
Pablo 2620 108, stereo, $13.98.

Embraced is a term used to signify warmth and affection for an object, idea, or person. In the context of a piano duet performance between *avant-gardist* Cecil Taylor and traditionalist Mary Lou Williams, the object would be the piano; the idea jazz and improvisation, and the persons, of course, each other. That they embrace the first two is obvious from every action they've undertaken in their careers. But their embrace of each other seems to be one of conflict rather than affection.

Mary Lou has built a reputation in recent years for her reactionary views of jazz history. To quote her own liner notes, "After the bop era, creation in jazz stopped." Mary Lou has withstood the "perverted force" of the *avant-garde* and played in a style which encompasses jazz history up to the bop period. In fact, she has been in the forefront of all jazz periods since the mid-twenties when she played with John Williams Syncopators and Andy Kirk's Twelve Clouds of Joy. Her strong chops, lyrical improvisations, and harmonic freedom have brought her intact through the years. Though her viewpoint is dated, her music still thrives.

Cecil Taylor stands as a dazzling refutation of Mary Lou's reactionism while still maintaining her high regard for jazz history and tradition. In the past 20 years he has staked out an area of abstract freedom which evokes all the styles of jazz in molten and turbulent improvisations. They hint at its roots but yield much more in their ecstatic revelations. Cecil is used as a measurement of the *avant-garde.* With the broad scope of his playing, he will always be considered so.

Yet these two diverse talents do not enter the same stage with swords drawn. Rather there is an air of accommodation that initially pervades the performance, until it becomes apparent that the two styles are incompatible. Cecil is simply too enormous a virtuoso and visionary to be constrained, and Mary Lou, for all her chops and feeling, is earthbound.

The set opens with an extended composition by Mary Lou that spans from the spirituals of early jazz influence, through Swing and ragtime and finally ending on bop. While Mary Lou runs her chords and stylistically accurate improvisations in the left channel, Cecil is straining at the leash in the right. His piano washes are a pulsating wave to which Mary Lou attempts to give form and rhythm. Occasionally they arrive together at the same spot, and the audience bursts approval in sudden recognition. The addition of Mickey Roker on drums and Bob Cranshaw on bass only muddies both the mix and clarity of the performance. Neither of these workmanlike players has the ability to follow the flow of Cecil, but they do help Mary Lou hold up her end of things.

The best moment of the album comes on a Cecil composition, *Ayizan*. Rather than force Mary Lou's style into a mold or to play with him, Cecil leaves Mary Lou holes into which she drops well-timed bursts and rhythmic thrusts. The piece has a natural flow from its restrained romantic opening through its passionate, cascading peaks.

As a one-time performance, this concert was certainly more successful than I would have expected. When they listened to each other as on *Ayizan*, it became apparent that all the music was one and categorization was meaningless. But there were also many times when they could've been playing on different planets rather than the same stage.

The tension of the performance seems to have caught the producers and engineers a bit off guard also. The two pianos lack resonance and presence. The rhythm section is under-recorded and appears more as an annoying background buzz than a precise rhythmic force. But the album is a two piano recording which does not pretend to some classical perfection. Its flaws come from a lack of cohesion between the two performers. Its brilliance is derived from their love of the music and approaches that, even if they are different, will not be compromised. *John Diliberto*

Sound: C+ Performance: B

Classical reviews

Edward Tatnall Canby

Beethoven: The 5 Piano Concertos; Choral Fantasy. Alfred Brendel; London Philharmonic Orch. and Chorus, Haitink. **Philips 6767.002** (5 discs), stereo, $44.75.

Philips will have to pardon me for not reviewing all of their Alfred Brendel recordings — we would fill up every issue for months. This omnibus job, though, is typical and it is superb.

Brendel, out of the Viennese tradition, is an ideal recording pianist not merely because he makes good recordings and does them with musical conviction . . . he is one of those people who play better than they look — he is no stage Romeo! That face, very expressive and hugely intelligent, now appears on so many record covers that you can watch it in your sleep, but the pudgy body and growing double chin are more and more difficult to conceal. (Mostly, now, he is looking eagerly upward, for inspiration from above? I suspect that this helps iron out the double chin.)

What could be better for records, where we do not have to watch! The man is a towering pianist, a bundle of dynamic energy, chin or no, and he inspires his orchestras and his conductors to be towering too. In native surroundings Bernard Haitink, of the Concertgebouw in Amsterdam, tends to be prolific and a wee bit dull on the whole. But here in London with Brendel at work he seems full of life — or is Brendel indirectly doing the conducting? Doesn't matter — this is a superbly dynamic cooperation, without ever being frenetic and over-tense, and always in impeccable style. You will not find better Beethoven, both the early and the late works. Nor more beautiful recording, direct-to-tape.

An interesting "extra" is the *Choral Fantasy*, one of numerous "trial balloons" that Beethoven sent forth as (eventually) sketches for the well-known last movement of the *Choral* or *Ninth Symphony* and its great song of joy for solo voices and chorus. A nutty piece, this one, of a sort only possible in that very early 19th century period, a three-way potpourri, first piano solo, then piano concerto, and finally grand semi-symphony with solos, chorus, and orchestra. But the tunes are so extraordinarily *Ninth-Symphony*-like that (if you know that work) you will be astonished. The *Ninth* is better of course. So what.

Sound: A- Recording: A- Surfaces: B+

American Portraits: Eastman-Rochester Symphony, Howard Hanson, cond. **Eastman Rochester Archives,** stereo, $7.98.

I confess I didn't exactly look forward to this album of symphonic music based (with one exception) on folk themes.

There has always seemed to be an elitist attitude (not necessarily intended by individual composers) accompanying the use of folk music by the "American school" of composition.

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This anti-traditional folk bias, propagated by educators and "music appreciation" writers (who, fortunately, seem to have fallen out of favor in recent years), holds that folk songs have little intrinsic value. In order to "legitimize" them, they must be taken out of their natural environment, dressed up in garish orchestral duds, and bounced around in outlandish permutations. To make matters worse, the elitist's idea of "great folk music" generally runs to children's songs, such as *Skip To My Lou* and *Shoo Fly, Don't Bother Me.* (Thank goodness for Aaron Copland, who had the taste and sensitivity to choose tunes with substance, e.g. *Simple Gifts* and *Bonaparte's Retreat.*)

Perhaps I've mellowed of late, but I must say I not only found **American Portraits** (a reissue of an old Mercury album) less objectionable than I'd expected, I actually found three of the four pieces richly entertaining. Robert McBride's *Mexican Rhapsody* is especially enjoyable, a witty, jaunty, intelligently handled assemblage of ultra-familiar Mexican dance tunes. McBride subjects these old melodies to clever manipulations and orchestral colorations so ingratiating, it's hard not to be won over by them.

Ron Nelson's *Savannah River Holiday* doesn't quote any folk tunes, but it has an indisputable Nationalist atmosphere nonetheless. Nelson's outdoorsy light-classical themes and muscular orchestration rather resemble the score of a travel-documentary film. This isn't to say the piece is nothing more than a perfunctory throwaway, however. It certainly has the potential to become a perennial pops-concert crowd pleaser.

Charles Vardell's *Joe Clark Steps Out* is, as you'd expect, a variation on *Old Joe Clark.* It's a very friendly little piece, with a graceful charm that encourages the listener to re-examine the familiar fiddle tune from a new melodic perspective.

The one piece which lives up to my original apprehensions is Lyndol Mitchell's *Kentucky Mountain Portraits.* The first and third movements are virtually a textbook on how to bloat up poor, unsuspecting folk songs (including, you guessed it, *Skip To My Lou*) out of all reasonable proportions.

Howard Hanson is, of course, in his element here. The performances are about as ideal as the composers could ever hope for. The recording sounds somewhat dated (no year is given), though aside from some deadened crescendoes and muffled tympani, it's certainly acceptable. *Tom Bingham*

Sound: B- Performance: A

Folk bag

Lines on the Paper: Kate Wolf
Owl OL 003, stereo, $7.98.

Kate Wolf's last album, the highly-regraded **Back Roads,** was squarely in the contemporary folk category. **Lines On the Paper** adds the flavor of California country music of the immediate post-WW II period to several cuts.

The most obvious (though untypical) example is the title song, with Jim Nails' frisky, rugged accordion, an instrument rarely heard in country music these days (which may be all for the good, since it never did fit in very well). *Picture Puzzle* and *Everybody's Looking For the Same Thing* seem to betray the influence of the Maddox Bros. and Rose, with their near-bluegrass melodies and quick-stepping "jump" rhythms. Even the more folk-oriented songs permit similar outside influences. Note Gary Roda's classic pedal steel lines on *I Never Knew My Father* (a song which has a special personal meaning for this reviewer), the fiddle (Paul Ellis)/harmonica (Don Coffin) duet break on *Amazed to Find,* and John Croizat's thick Cajun-waltz fiddling on *Midnight on the Water.*

Wolf is a very convincing singer, with a smooth, mellow, slightly dusky voice on the lower side of middle register. Though not overtly emotional, her singing conveys an underlying poignancy which adds a stamp of authenticity to her often sad (though more reflective than defeatist) lyrics.

The production is fuller, the arrangements more intricate than on **Back Roads,** without sacrificing the living-room intimacy which characterized the earlier album. The multiple-guitar textures of *You're Not Standing Like You Used To* and *The Heart* are warm, beautifully executed, and highly complementary to both Wolf's songs and singing. The accompaniment — by various combinations of Wolf's regular band (the Wildwood Flower), the Cache Valley Drifters, and other guests — is totally sympathetic.

Although the recording was done at a guest ranch rather than in a professional studio, the list of equipment used indicates this wasn't a quickie amateur job by any means. The immaculate, soft-focused acoustic string sounds and the sensitive, dark-tinted clarity of Wolf's voice are worth the extra time and expense involved. Certainly money is tight and small labels are forced to cut wherever they can, but Kate Wolf and co-producer/engineer Dan Dugan prove that artist-run record companies need not be limited to murky sound. Available from Owl Records, P.O. Box 711, Sebastopol, CA 95472. *Tom Bingham*

Sound: A- Performance: B+

Selected Jigs Reels & Songs: De Danann
Shanachie 79001, stereo, $7.98.

Many devotees of traditional Irish music will tell you that De Danann has long since surpassed the Chieftains as *the* Irish ensemble of our time. Their music is a close-knit blend of traditional material and instrumental styles with contemporary innovations (the most visionary of which is Alec Finn's supple, spellbinding bouzouki work). Indeed, it's often difficult to separate the new from the time-honored — take Frankie Gavin's fiddling, which sounds thoroughly traditional until you attempt to trace his antecedents. De Danann has an exceptional flair for choosing tunes and an equally remarkable ability to arrange them in fresh, arresting settings. Johnny Moynihan's singing (on four cuts) is thoughtful

and distinctive, particularly on the two *a cappella* tracks. (Moynihan has since been replaced by Tim Lyons.) A most auspicious American debut. Shanachie Records, 1375 Crosby Ave., Bronx, NY 10461. *Tom Bingham*

Sound: B+ Performance: A

The New Pennywhistle Album: Billy Novick & Guy Van Duser
Green Linnet/Innisfree SIF 1013, stereo, $7.98.

The last thing I expected was an album of pennywhistle music, much less one as entertaining as this is, but here it is with Billy Novick as Mr. Pennywhistle in residence.

Mercifully the program is not all jigs, reels, and hornpipes, although some are present. Novick and Van Duser extend the instrument's range with a medley of Gershwin tunes and Charlie Parker's *Scrapple in the Apple* with an original or three as well. Without these departures **The New Pennywhistle Album** could have been deadly, but as it turns out it is anything but.

Recording a sound as thin and piercing as the pennywhistle no doubt presents special problems, but it works fine here, probably as much a testament to Novick as to the engineers. Supporting Novick are Van Duser on guitars electric and acoustic, piano, bass and mandolin with Michael Avery on drums. Fine playing.

All told, it's an unlikely treat.
Michael Tearson

Sound: B Performance: B

He Rows Me Over the Tide: Singing Cookes
QCA 382, stereo, $7.98.

The country music of the '50s and '60s isn't dead; the lyrics have changed, that's all. Instead of bewailing about honky-tonks, cheaters, and broken hearts, the Singing Cookes (a Virginia family group) are more interested in one-way flights to Gloryland, the home up yonder, healing, hope, and faith in Jesus — subjects that have been part of country music since its very beginnings. The Cookes' singing is strong and fervent, the instrumental backgrounds (featuring vintage-style pedal steel, a Pig Robbins-flavored pianist, and a top-notch rhythm section) are first-rate, while the clean, carefully balanced engineering is up to QCA's admirably high standards (by far the best in gospel). Should be easy to find, but if not, write to QCA Records, 2832 Spring Grove Ave., Cincinnati, OH 45225. *Tom Bingham*

Sound: A- Performance: A-

The Noah's Ark Trap: Nic Jones
Shanachie 79003, stereo, $7.98.

Nic Jones is yet another excellent English singer of traditional balladry. His album emphasizes story songs with an instrumental *Jackie Tar* for pacing.

Nic's selection of songs is excellent. *The Wanton Seed, Crockery Ware* and *The Golden Glove* are all good, spirited songs in the best sense. Especially ingratiating are his choices to close the sides. Both are achingly lovely. *The Indian Lass* adds harmonium and second voice while *Annachie Gordon* is a solo performance as most of the album is. Either melody could stick with you for long after you hear it.

Bill Leader has recorded enough superb albums of English folk music to know how to stay out of a singer's way when recording him, and also how to encourage the best out of him. Here he does both functions admirably. Occasional flashes of studio technique, such as multi-tracking of voices (not overdubbing so much as overlapping) or of guitars make the album a more vibrant listening experience.

The Noah's Ark Trap is simply a very fine record of traditional English folk songs by an assured and talented artist. *Michael Tearson*

Sound: B+ Performance: A-

Steel Wool: Winnie Winston
Philo 1058, stereo, $7.98.

Winnie Winston is a steel guitar master who lives nowhere near Nashville . . . he is also one hell of a banjo player.

This album showcases his playing in a variety of musical forms that range from hot country and western swing to cool C&W ballads, from a hymn medley to some Wes Montgomery inspired cool jazz, from dance tunes to traditional airs played on steel guitar and Northumbrian small pipes. The cast of support players varies to match the selection and occasion.

Steel Wool has the distinctive clean sound of Philo's Earth Audio Techniques Studio in Vermont. The acoustic instruments come through especially crisp and clear. With the pedal steel, the mix, like the cast, varies to match material and circumstance.

Winnie Winston has been playing great stuff obscurely for years and years. **Steel Wool** gives him the overdue opportunity to showcase his skills in the framework of his own music. Consider it an opportunity well-taken. *Michael Tearson*

Sound: B+ Performance: B+

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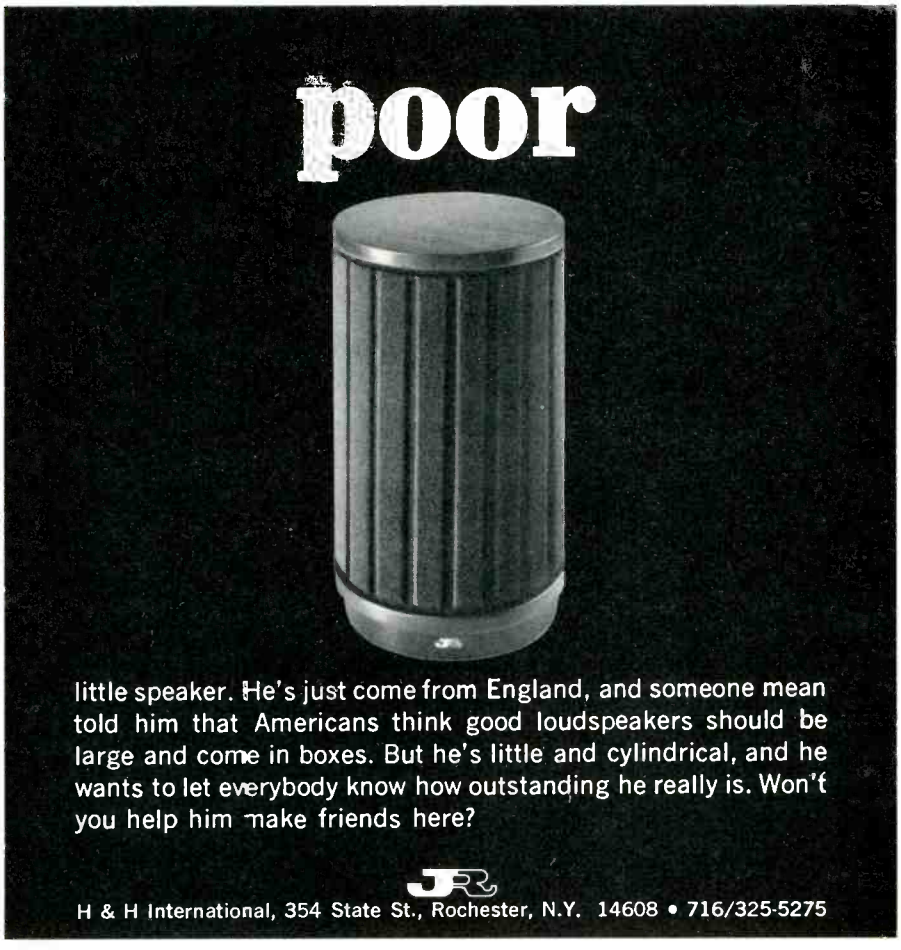

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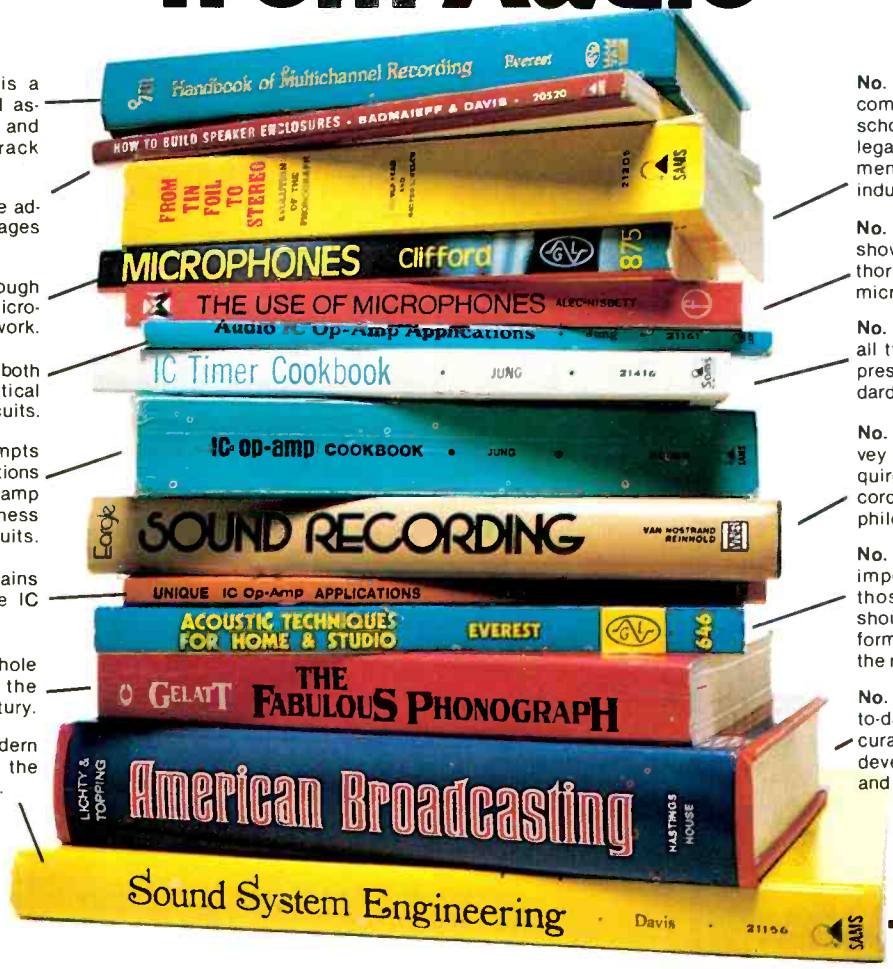

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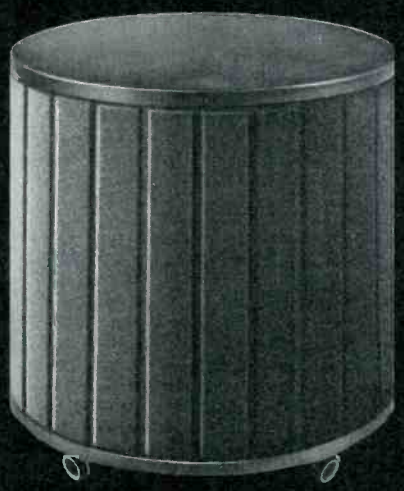

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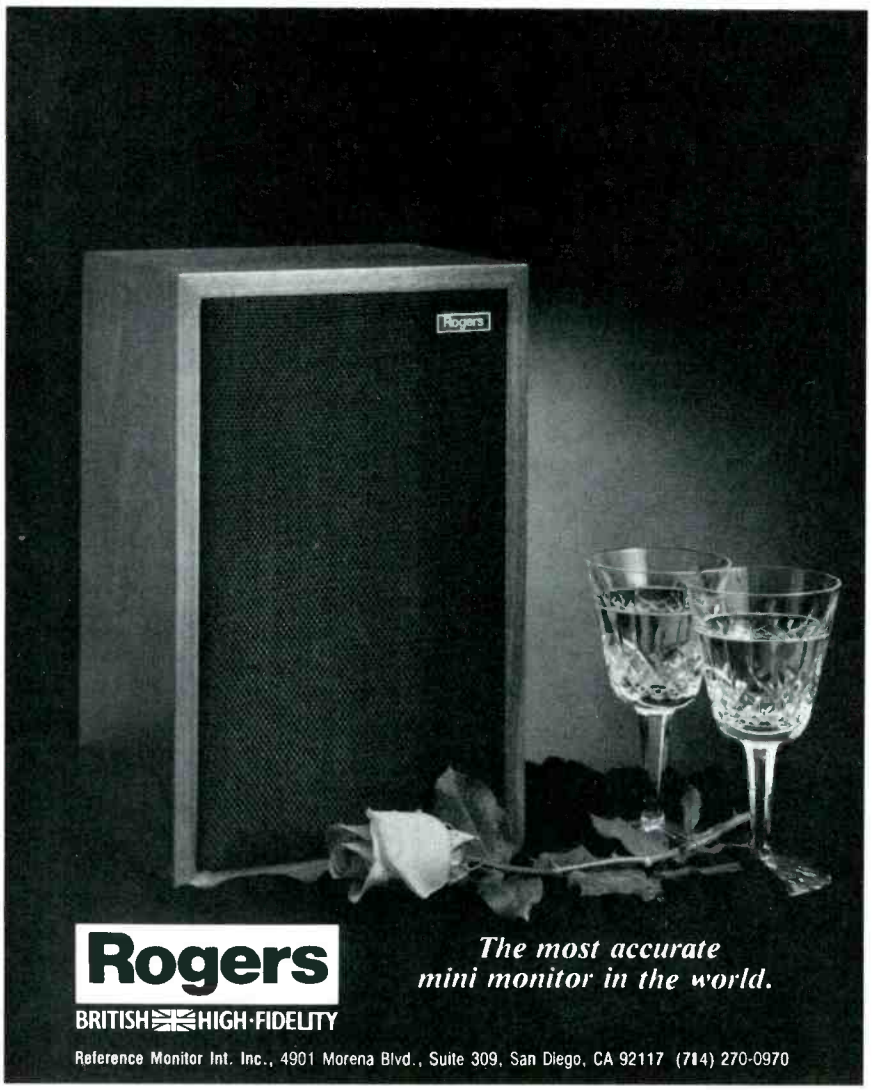

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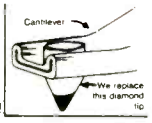

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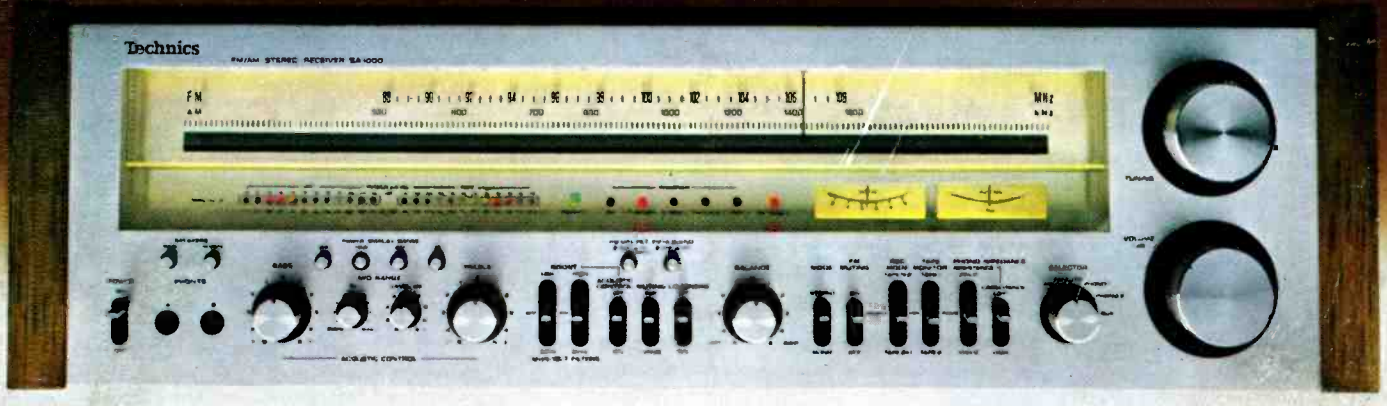

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