Audio

THE AUTHORITATIVE MAGAZINE ABOUT HIGH FIDELITY • SEPTEMBER 1978 $1.25
47425

Mike Test Update

58 Cassette Types Tested

Performance of High-Energy Magnetic Materials for Cassettes

It's value.

For years, Nakamichi has enjoyed a reputation for building the world's finest cassette deck.

Now Pioneer is introducing something Nakamichi won't enjoy at all: the Pioneer CT-F1000. A cassette deck that offers all the features and performance of Nakamichi's best cassette deck, at less than half the price.

PIONEER VS. NAKAMICHI: THE HEAD TO HEAD COMPETITION.

The $1,650* Nakamichi 1000II and the $600* Pioneer CT-F1000 are both honest three headed cassette decks that let you monitor right off the tape as you record.

Both have separate Dolby systems for the playback and recording heads. So when you're making a recording with the Dolby on, you can monitor it exactly the same way.

Both have two motors to insure accurate tape speed.

Both feature solenoid logic controls that let you go from fast forward to reverse, or from play to record without punching the stop button, and without jamming the tape.

And both are filled with convenient items like automatic memories for going back to a selected spot on a tape, multiplex filters for making cleaner FM recordings, separate bias and equalization switches for getting the most out of different kinds of tape, and even a pitch control adjustment that lets you match the pitch of a cassette to the tuning of your guitar or piano.

A $1,000 GAP IN PRICE; NO GAP IN SOUND.

When we built the CT-F1000, however, we did more than match the Nakamichi's renowned features. We also matched its renowned performance.

Both machines boast totally inaudible total harmonic distortion levels of less than 1.5%.

Both have all but conquered the problem of wow and flutter. (An identical 0.05% for each machine.)

Both offer similarly impressive signal to noise ratios: 64 decibels Pioneer, 65 decibels Nakamichi. (At these levels we dare you to hear any noise at all, let alone any difference.)

And finally, where the CT-F1000 delivers a frequency response of 30 to 17,000 hertz, the Nakamichi deck goes from 35 to 20,000 hertz. (We offer a little more at the bottom; they offer a little more at the top. Either way, the specifications are close enough to be called virtually identical.)

A FEW PIONEER ADVANTAGES THAT AREN'T MONETARY.

To prevent you from making distorted tapes, the CT-F1000 has a peak limiter that the Nakamichi machine lacks.

Our tape heads are made out of a special single crystal ferrite material that's been proven to last longer than the Nakamichi's permalloy variety.

And our Dolby system can be calibrated by hand while the Nakamichi 1000II requires a screwdriver.

Admittedly, the Nakamichi 1000II *does* feature a fancy azimuth control for aligning your heads before every recording session. But we've developed a more accurate way to mount the heads in the first place. So you can spend your time recording, instead of aligning.

A FEW CONCESSIONS TO NAKAMICHI.

Obviously, at almost $1,000 more, the Nakamichi 1000II must offer some advantages over the CT-F1000.

And we'd be remiss if we didn't point out that their VU meters extend slightly higher than ours.

And that they have extra input for premixed program sources.

And although their signal to noise ratio is hardly different than ours, the Nakamichi 1000II does feature an extra Nakamichi-invented noise reduction system.

Considering the slimness of these advantages, the choice is clear-cut:

You can buy a Nakamichi 1000II and get an incredibly expensive cassette deck.

Or you can buy a CT-F1000. And get one that's simply incredible.

PIONEER®
We bring it back alive.

The Pioneer CT-F1000: $600*

The big difference between this cassette deck and Pioneer's new CT-F1000 isn't sound.

The Nakamichi 1000II: $1,650

Audio®

September 1978 Vol. 62, No. 9

"Successor to RADIO Est. 1917"

Feature Articles

Equipment Profiles

Record Reviews

Audio In General

About The Cover: Beginning on page 42, we present extensive tests of nearly every cassette tape now on the market, but seeing whether the tape has enough signal to light a bulb isn't part of our procedure. Photo by Photographic Illustrations, Philadelphia.

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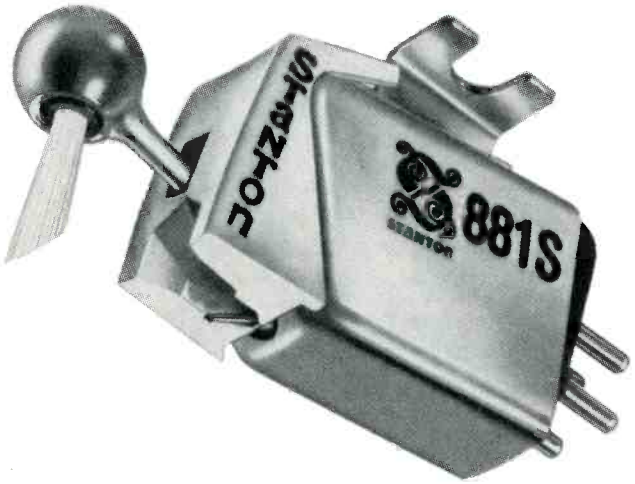
Let's set the record straight!

Stanton has had it all for more than 15 years.



The 881S has been acclaimed worldwide as the finest cartridge available. It embodies a unique combination of features developed by Stanton. After all, it was Stanton who pioneered the first Magnetic Stereo Cartridge — as well as the first CD-4 pickup produced in the United States.

1.

FEATURE

Record Static Elimination System

Every Stanton cartridge for the last 15 years has featured a patented stylus assembly which neutralizes the atmosphere surrounding the diamond stylus and discharges record static harmlessly into the grounded record playing system.

BENEFITS

A. Eliminates harmful static electricity at the record.
B. Eliminates static clicks and pops at the loudspeaker.
C. Enables the brush to do a *proper* cleaning job.
D. Permits the use of an Ungrounded Brush.
E. Eliminates electrostatic dust attraction to the stylus tip.

2.

FEATURE

"Longhair"® Brush

Its independently hinged action does not interfere with the tracking force of the stylus while its tapered nylon bristles clean the grooves in front of the stylus. Stanton developed it in 1966.

BENEFITS

A. Cleans records efficiently.
B. Damps tonearm resonance.
C. Improves low frequency tracking.
D. Dynamically stabilizes tonearm system.
E. Aids in playback of warped records.

3.

FEATURE

Stereohedron™ Stylus Tip

Patented in 1976, the Stereohedron stylus tip has a far greater bearing radius and more contact area with the groove.

BENEFITS

A. Exceptional frequency response.
B. Superior protection of high frequency signals in the groove.
C. Longer record life.
D. Longer stylus life.
E. Better tracing ability.

4.

FEATURE

High Energy Rare Earth Magnet

First introduced by Stanton in early 1977, this type of magnet enabled the complete miniaturization of the stylus assembly and tip mass. It is the beginning of a whole new generation of cartridges.

BENEFITS

A. Outstanding tracking ability.
B. Unequaled transient response.
C. Higher output with one tenth the mass of ordinary magnets.
D. Superior tracing ability.

Add it all up... and you see why Stanton is imitated... but unequaled!

Write today for further information to Stanton Magnetics, Inc., Terminal Drive, Plainview, N.Y. 11803.

... the choice of the professionals™

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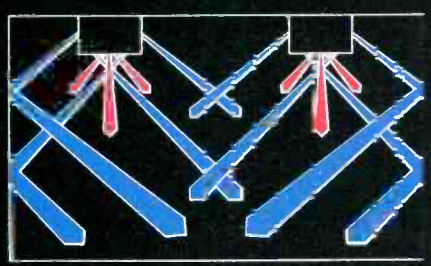
To understand why the Bose® Model 601 sounds so great you have to start at the top.

The Model 601 employs tweeters and woofers, as do conventional speaker systems. But there is where the similarity ends.

Notice how the high-performance Bose drivers are arranged. Each one of the four tweeters and two woofers is precisely positioned within the enclosure to radiate sound in a particular direction. Rearward. Sideways. Upward and forward. To give you the proper balance of reflected and direct sound. Much like you hear during a live performance.



Only a Bose Direct/Reflecting® speaker gives you the spatial realism of live-performance sound. No matter where you sit or stand in your listening room, you hear accurate stereo balance. Accurate location of each instrument, each note. With a clarity and precision that tells you you're listening to one of the finest speaker systems ever designed.

The Bose Model 601
Hear it at your Bose dealer.

BOSE®
Better sound through research.

How to improve

One of the most frequently-asked questions in high fidelity these days is how well a particular tonearm and cartridge work together. Because tonearm/cartridge compatibility is increasingly recognized as vital to accurate record reproduction.

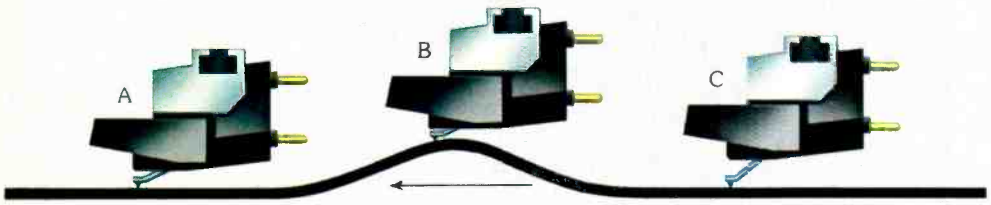


Figure 1. Record warp activates tonearm/cartridge resonance, undesirably reducing and increasing stylus force. (A) Normal position — normal tracking force. (B) Compressed position — increased tracking force. (C) Extended position — decreased tracking force. Record direction is right to left.

At Micro-Acoustics, we have a unique solution: *the first phono cartridge specifically designed to help any tonearm work at its best*— whether that tonearm is straight or S-shaped, low- or high-mass, with low to high cable capacity. We call it the 2002-e . . . and it offers significant advantages over conventional cartridge designs.

Tonearm/cartridge resonance: a critical problem

Record warp, present to some degree on nearly every disc you play, causes the cartridge to move up and down about the stylus (see Figure 1). This low-frequency up-and-down oscillation — called *tonearm/cartridge resonance* — can be considerable, since the amplitude of record warp can actually be *twelve to fifty times* that of the loudest musical program material.

During the upward motion of the tonearm/cartridge combination, the stylus tends to be pulled out of the groove, reducing tracking force to a fraction of the tonearm setting. When this lower tracking force coincides with a loud musical passage, the cartridge mistracks, causing audible distortion and sometimes, groove jumping.

There is a common misconception that tonearm/cartridge resonance can be "matched" out of existence. The fact is, it cannot: it must be *controlled* to allow the cartridge to function properly.

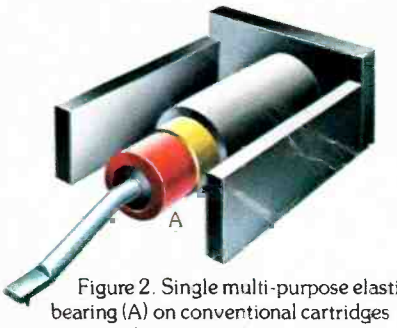
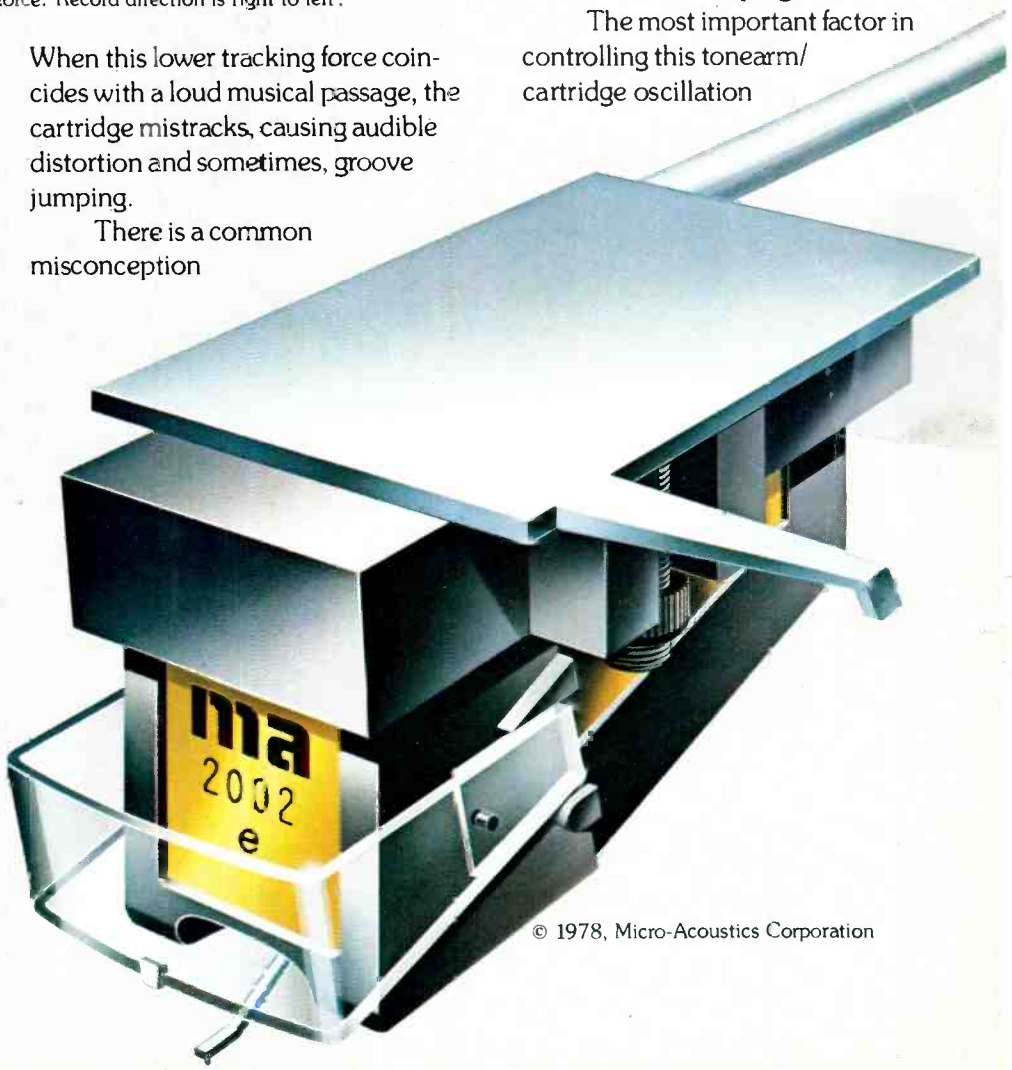


Figure 2. Single multi-purpose elastic bearing (A) on conventional cartridges compromises damping and compliance.

Compromised vs. optimized damping

The most important factor in controlling this tonearm/cartridge oscillation



your tonearm.

is *damping*—a mechanical counterforce precisely applied to suppress resonance. Because the tonearm must be absolutely free to move, virtually all tonearms are totally undamped devices. *So damping must be supplied by the cartridge.*

In conventional cartridges, damping of tonearm/cartridge resonance must be a compromise. Because it is provided by a *single*, multi-purpose elastic bearing (see Figure 2) which must trade off maximum compliance for tracking ability (less damping) with maximum suppression of high-frequency stylus resonance and tonearm/cartridge low-frequency resonance (more damping).

In contrast to this, Micro-Acoustics' 2002-*e* (Figure 3) has a sophisticated *multiple* damping system utilizing *eight* specialized dampers. One pair of these dampers are low-frequency warp stabilizers, *specifically designed* to control tonearm/cartridge resonance. This is the *first* effective warp-control system because it suppresses oscillation *at the cantilever pivot*, where it occurs

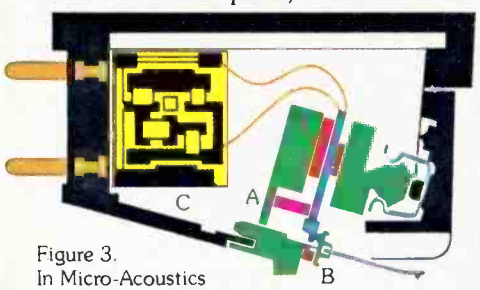


Figure 3. In Micro-Acoustics 2002-*e*, one pair of dampers—low-frequency warp stabilizers (A)—control tonearm/cartridge resonance. Other dampers optimize other characteristics. Dual bearings (B) provide maximum tracking ability. Microcircuit (C) optimizes cartridge output to any cable capacitance. (Only one channel shown.)

—rather than using an external device that rides ahead of the stylus. The remaining six dampers are optimized for stylus high-frequency damping and other factors, while our exclusive dual-bearing system *independently* optimizes tracking ability. By designing *separate* systems for damping and compliance within the 2002-*e*, we can precisely control tonearm/cartridge resonance *without compromising any other aspect of cartridge performance.*

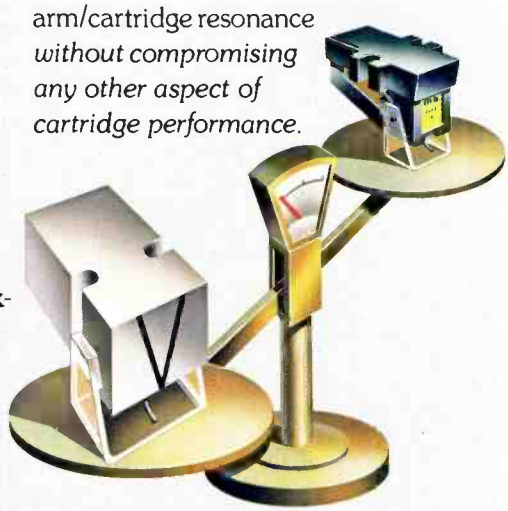


Figure 4. 2002-*e* is less than half the weight of many other quality cartridges.

High vs. low cartridge body weight

Regardless of the tonearm and damping system utilized, the lower the cartridge body weight, the greater the tonearm's ability to track warped records. This is because lower tonearm/cartridge weight allows damping to more effectively counteract tonearm/cartridge resonance.

At four grams, the Micro-Acoustics 2002-*e* is half the weight of many other high-quality cartridges, yielding *two or more times* the effective damping (see Figure 4).

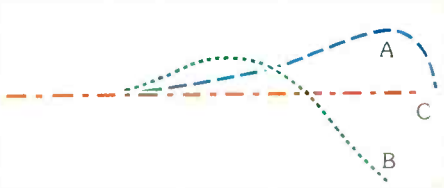


Figure 5. With conventional cartridges (A), low cable capacity causes response to peak; medium-to-high capacity (B) causes high-frequency response to roll off. Response of 2002-*e* (C) is unaffected.

Cable capacitance capability

Another important limitation of conventional cartridges is their interaction with cable capacity, which causes a deterioration in high-frequency response and transient ability (see Figure 5). In contrast to this, the 2002-*e* has a passive microcircuit which automatically matches the cartridge output to *any* tonearm's cable capacity, providing linear high-frequency response and transient accuracy.

Tonearm optimization made easy

If there were no such thing as tonearm/cartridge resonance or cable capacity, any cartridge would match any tonearm. But in the real world, where these problems exist, the only way to get optimum performance from your tonearm is the Micro-Acoustics 2002-*e*. Or our other direct-coupled cartridges: the moderately-priced 282-*e* and top-of-the-line 530-mp. All of them offer advantages you can hear today, at your Micro-Acoustics dealer.

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ma®
Micro-Acoustics
Because good tracking isn't enough.™

Audio etc.

Edward Tatnall Canby

Well, here it is September already, and summer is beginning to fail. So this month's column is going to have a lot of failings — including some that are of the double-negative sort that come out positive. If summer fails, can fall be far behind? And without fail, year after year, autumn is the time when hi fi falls into place again after the hot weather hiatus.

We use that term "fail" too often, if you ask me. It's getting to be silly. Every single political opponent fails to do or say just about everything imaginable. I just got a snippy postcard concerning my musical broadcast in New York — I "failed to identify" some of the performers. I didn't *fail*. I did it deliberately, because my subject was the music and its composer, and the performers were performing very well on their own, thanks. So often, you see, we are doing something positive when we "fail." Yes, this evening I failed to drink my usual martini before dinner, I had a manhattan instead.

A year or so ago in this space you may well remember that I spoke of an honorable old AM-FM tuner, the Fisher Series 80, one of the first "miniaturized" hi-fi components using the then new miniature tubes and taking maximum advantage of their reduced space requirements. (My point, in case you forget, was that the enormously smaller transistor and its relatives plus the IC have led us not to smaller but to larger hi-fi units, a thought that failed to please me.) So shortly thereafter in a letter to *Audio* magazine (June, 1977) Burdick S. Trask of Sherman Oaks, Cal., wrote a fascinating account of his refurbished 1936 Spartan all-wave receiver, complete with bi-amped output into a 15-inch woofer and two tweeters via an electronic crossover . . . for more details see the letter itself. However, before he got into *that*, Mr. Trask took a good humored sideswipe at me and my Fisher. It seems I "failed to mention" — once again — the broad and narrow band width i.f. switch on the Fisher front panel, the main use of which was to allow reasonable hi fi when an AM station came in wide, clear and, maybe, clear-channel, yet in the narrow-band position reduce the hopeless AM interference, especially at night, when reception was weak and/or distant and the desired station overborne by its neighbors far and near. Selectivity.

Well, with reluctance, the truth must now out. Yes, I failed to mention this useful Fisher feature, out of tact. On my Fisher the FM worked beautifully as I indicated, but the AM was dead.

Well, not *quite*. It did produce several types of interesting hiss and the signal-strength needle moved perceptibly now and then as I wheeled along the AM band. But that wasn't enough for my local weather summary, which was what I was after at the moment. On mature reflection, and since the rest of the tuner worked just fine, I decided to fail to mention the dead AM. After all, it was probably my fault. And time had indeed been passing for many a year — so why not give Fisher the benefit of the advantage? And after all, too, Mr. Trask's Spartan was rebuilt by himself from the bottom upwards with new and revived parts and even some rather vital modernizations. My Fisher Series 80 was strictly on its own, never serviced in any way and still (mostly) operating. So there's one positive failure for you.

I'll betcha one of you hounds could fix that Fisher in an hour or two if you got your hands on it. Just call me up and I won't charge you a thing.

Historical Horrors

And speaking of that, our friend Bert Whyte last year in his history of hi-fi shows missed out on (i.e. failed to mention) one of the prime marvels of the first Audio Fairs in the Hotel New Yorker over on 8th Avenue and 34th Street in the Big Apple. That august hotel, vaguely out of the art deco era (1930s?) was indeed furnished with 120 volts of electric potential in each and every room, since it wasn't nearly old enough to boast gas light. But thanks to dear old Thomas A. Edison and his latter day namesake utility, now nicknamed Con Ed, the New Yorker was provided with the very best available electricity in the mid-town area — as we used to put it, 120 volts of d.c. current. And we picked *that* for a hi-fi show! Maybe nobody realized it until the last minute.

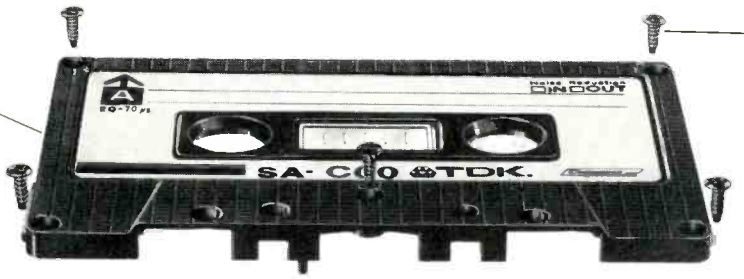
But the show must go on, and the Audio Fairs did indeed. Somebody with a proper electrical background had apparently foreseen the future and the lucrative possibilities in servicing Conventions at the hotel, electronic included. There was a modest local alternator, somewhere down in the basement, which fed a.c. to extra outlets (right among the d.c. outlets) in — well, in some of the rooms. Our earliest hi-fi exhibitors, therefore, had to choose the right socket, and if they did they were rewarded with that splendid cacophony which we now find so familiar in hi-fi shows the world over. It was a brand-new sound, then, and not

To get a superb performance, you need a precision machine.

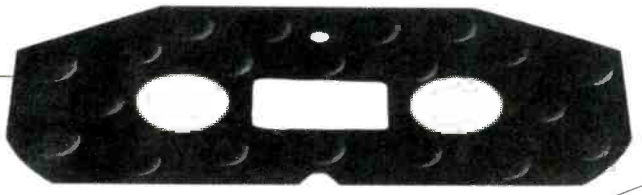
To command a great performance, a cassette shell and cassette tape must be engineered to the most rigorous standards. Which explains why we get so finicky about details. Consider:

Precision Molded Cassette Shells—are made by continuously monitored injection molding that virtually assures a mirror-image parallel match. That's insurance against signal overlap or channel loss in record or playback from A to B sides. Further insurance: high impact styrene that resists temperature extremes and sudden stress.

Five-Screw Assembly—for practically guaranteed warp-free mating of the cassette halves. Then nothing—no dust or tape snags—can come between the tape and a perfect performance.



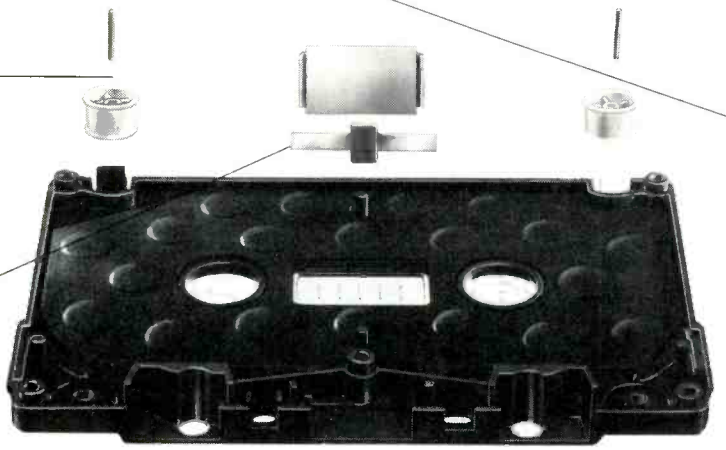
An Ingenious Bubble Surface Liner Sheet—commands the tape to follow a consistent running angle with gentle, fingertip-embossed cushions. Costly lubricants forestall drag, shedding, friction, edgewear, and annoying squeal. Checks channel loss and dropouts.



Perfectly Circular Hubs and Double Clamp System—insures there is no deviation from circularity that could result in tape tension variation producing wow and flutter and dropouts. The clamp weds the tape to the hub with a curvature impeccably matched to the hub's perimeter.

Head Cleaning Leader Tape—knocks off foreign matter that might interfere with superior tape performance, and prepares the heads for...

Tapered, Flanged Rollers—direct the tape from the hubs and program it against any up and down movement on its path towards the heads. Stainless steel pins minimize friction and avert wow and flutter, channel loss.



Our famous SA and AD Tape Performance—two of the finest tapes money can procure are securely housed inside our cassette shells. SA (Super Avilyn) is the tape most deck manufacturers use as their reference for the High (CrO_2) bias position. And the new Normal bias AD, the tape with a hot high end, is perfect for any type of music, in any deck. And that extra lift is perfect for noise reduction tracking.

Resilient Pressure Pad and Holding System—spring-mounted felt helps maintain tape contact at dead center on the head gap. Elegant interlocking pins moor the spring to the shell, and resist lateral slipping.

TDK Cassettes—despite all we put into them, we don't ask you to put out a lot for them. Visit your TDK dealer and discover how inexpensive it is to fight dropouts, level variation, channel loss, jamming, and other problems that interfere with musical enjoyment. Our full lifetime warranty* is your assurance that our machine is the machine for your machine. TDK Electronics Corp., Garden City, N.Y. 11530. Canada: Superior Electronics Ind., Ltd.

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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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nearly as well appreciated as now. If the wrong socket was chosen, in haste or by unfortunate accident, then there was smoke and damage and silence except for that ominous crackling hiss.

That alternator, if I remember correctly, was the handiest closing-time signal you can imagine. Right on the dot, six o'clock or whatever, the a.c. failed, whereupon the constant and excruciating blasts of nonintegrated fi from dozens of superior sources suddenly ceased penetrating every wall into four surrounding rooms and into corridors all over. And we were left in an instant with the loveliest silent d.c. illumination you can envision. The d.c. kept going — it was from Con Ed. Conversations, continued, in low, hushed tones, and I'd guess there were more hi-fi deals made in those late moments of silence than in all the day's noise.

All that goes back to one of T. Edison's greatest failures — in the midst of his greatest triumph, the integrated electric light system as pioneered right there in New York at the famed Pearl Street power station and distribution system. That system was built on direct current, two-conductor. Very soon after, Edison worked out the three-conductor system but again via d.c. When this idea

was applied to its ultimately right area, the a.c. distribution system, we had modern power — but old Thomas would not go along. He stuck to d.c. and there were horrid stories perpetrated about people being fried via high-voltage a.c. in those newfangled arrangements. This was made even more gory by virtue of the new electric chair, which fried but did not quite kill one of its earliest occupants. Result was that the older Eastern cities, notably Boston and New York (and I would suppose Philadelphia) became entrenched in the d.c. system and stayed that way an astonishing number of years, right on through the 1930s. Of all the vicious impediments to fi, that of d.c. in the home was surely — at that time — the worst. Very nearly insurmountable. I should know; I was there.

Yankee Ingenuity

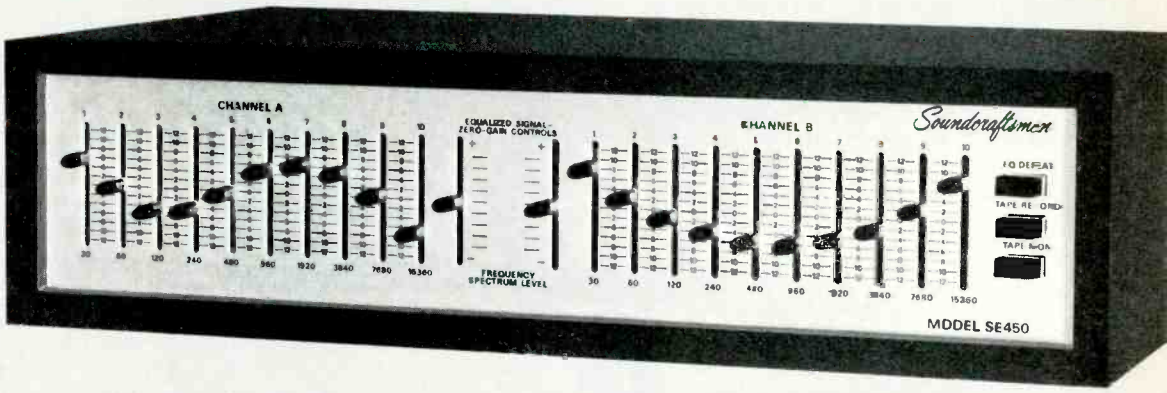
When I got out of college I moved to New York, right into a d.c. zone. There were plenty left, all over town. Ah, for today's ultra simple transverters, to make up a generic term! I could not exist without a record player, even then. I had a big collection of 78s, which travelled to New York from my college room with hardly more than 5 per cent breakage, a near miracle, thanks to enormous care in the packing of it into my family's Ford.

Naturally, I had rented my lodgings without a thought as to current — and now it was too late. So I went out and bought a perfectly enormous motor-generator thing, which I could just barely lift. Installed in my modest rooming-house corner, it went on with a wham, as the d.c. lights went momentarily dim, and produced a roar of "live" noise that rivalled the sound of the (a.c.) portable phono that it fed. So, heaven protect me, I put it in the back of a deep, deep, old-fashioned clothes closet and covered the entire thing with layers of old blankets and such. The brashness of youth! Somehow, there was no fire.

However, I failed to anticipate a failure to filter. There was a loud, insistent buzzing that came through my speaker whenever I played Beethoven. Was it square-wave or sawtooth? I tend to think the latter. And Beethoven would have rolled

Soundcraftsmen equalizers

the NEW SE450
$249.00
(Including cabinet)



the Best in EQ is now affordable—and GUARANTEED to enhance and improve any fine system!

SE450 SPECIFICATIONS

SIGNAL-TO-NOISE:
105dB below full output.

INDIVIDUAL CONTROLS:
32dB total adjustment range.
a. ±16dB each octave (all other octaves set at max.)
b. ±12dB each octave (all other octaves set at zero)

TOTAL GAIN/CUT:
+22DB, −28dB, all controls set at maximum.

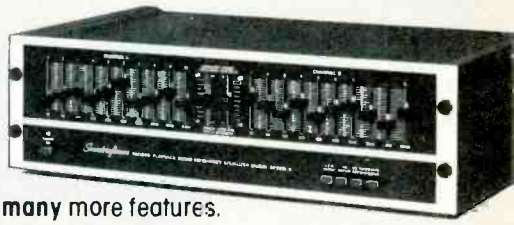
THD:
Less than 0.01% at 2V.

THE EQUALIZER YOU BUY SHOULD HAVE THESE FEATURES:

An environmental **do-it-yourself test record** edited and announced by Soundcraftsmen especially for use with the Soundcraftsmen equalizer... **Computone Charts** for making a record of, and resetting in seconds, any desired EQ curve... A full-channel **frequency spectrum level** control on each channel for instant "no distortion" in/out balancing... **Light-emitting-diodes** for precise visual signal level balancing... A **graphic display** for each EQ curve.

RP2201-R
$299.00
(including cabinet)
Same performance, more features.

RP2215-R
$370.00
(Including cabinet)
Spectacular performance, **many** more features.



Soundcraftsmen's PERFECT-PAIR MAKES A TERRIFIC-TRIO

$549.00

$799.00

1. A 20-band 2-channel GRAPHIC EQUALIZER
2. A PATCH-PANEL PUSHBUTTON PRE-AMP
3. A 250-WATT CLASS 'H' AMPLIFIER

1 PE2217-R EQ SECTION

A stereo ten-octave Graphic Equalizer complete with zero-gain level controls, visual level monitoring through L.E.D.'s, the ability to pre-equalize tape recordings, tape monitor facilities, front panel equalizer switching and our exclusive Instructional Test Record and Computone Charts. Signal-to-noise better than 106dB down, ±12dB per octave (typ. ±14dB), total gain/cut capability +30dB, −36dB.

2 PE2217-R PRE-AMP SECTION

Two independent discrete phono preamplifiers. Tape dubbing between two or three recorders with optional simultaneous equalizing and monitoring. Front panel tape input-output jacks. Double-dubbing into two recorders simultaneously. Two stereo headphone jacks. 84dB S/N and .01% distortion. Includes walnut-grained sculptured side panels, removable for 19" rack mounting.

3 MA5002 POWER AMP

The new Class "H" Analog logic Vari-Portional circuit with Auto-Crowbar protection circuit, input level controls, adjustable range meters, main and remote speaker selection, clipping indicators, Vari-Portional indicators and speaker protection. 250 watts RMS minimum p/c 20-20KHz @ 8 ohms, less than 0.1% THD. T.I.M. better than 0.02%. Slew rate better than 50V per micro-second.

Manufactured in California, U.S.A. by Soundcraftsmen, 1721 Newport Circle, Santa Ana, CA 92705

Enter No. 30 on Reader Service Card

over for good, because the pitch of everything, as you might guess if you are a Murphy's Law man, was about a half step too high.

Most radios and phonos in those days where a.c./d.c. and these faults, even in commercial manufactured equipment, were all too common. Nasty buzzing. Wrong pitch. The very idea of fixed and stable playback speed, of course, was then relatively recent. The old acoustic machines had a loosely adjustable friction playback speed control, marked Fast and Slow, or just F and S, and you pitched things to taste, with the spring fully wound. As most of us know, the early acoustic 78s were of many speed variants in the original cutting. Fixed pitch only became really practicable in the electrical area of the 1920s, but it took many long years before the home player could match the large professional cutting table in this extremely vital respect. So—I was brought up on variable pitch, alternating with unstable pitch, as commonly found on virtually all the standard home equipment of the pre-WW II period. That was a real failure, though nobody seemed to be bothered much except for a few of us musicians.

With all of that, you can understand why each time I hear of a new amplifier that is "flat to d.c." I give a cringe and fail to be properly impressed. In my book, d.c. is an element of hated memory. Is there any U.S. city still providing d.c. for public consumption? If there is, I don't want to hear about it, so please fail to tell me.

Booming Bass

One final item in the positive failure category. A few months back, I went to a fabulous "do" in a late-late New York disco-type place (it was mid-afternoon) to celebrate an ingenious new device for the disco trade (mostly) whereby a low-bass portion of the musical signal is electronically transposed *downwards* an octave (transpose is the proper musical term) and then fed to the giant woofers via giant power amps. When this thing was operating via the house system, the bench on which I had sat down actually jumped up and down under me on every beat. Overpowering. Fantastic!

The outfit behind this powerhouse bass is, of all people, dbx, a very imaginative firm if there ever was one. The only curious thing, as old readers may agree, is the title—*Boom Box !* Now, not too many years ago, that term was generally derogatory and unfunny, referring to a mistuned home speaker system that produced a resonant, broken-up, false bass, not so much a thump as a *thrrump*. The sound had its place in the old commercial jukeboxes, which often had no highs above 2.5 kHz and made up for it by the famous *basso, not so profundo*, that would go right through walls. In a crowded "joint" that was all you got to hear. But when a haphazardly matched home bass-reflex system (speaker and cabinet bought separately) produced a similar *thrrump*, we spoke disparagingly and with disdain of the boom-box sound. We disapproved. Ask Paul Klipsch.

Well, I suppose dbx really didn't know . . . or failed to remember. Because they are dealing with superpower public nitery and disco-type equipment where the enormously enhanced and improved Big Boom is very much in place and in taste. I liked it! However—dbx did put on a small publicity for their Boom Box as a home device, usable even with systems of very modest power. I'd take that with some d.c. salt, if I were you. The small system won't really get much whomp out of the transposing down an octave. Not enough power and probably not enough bass range in the speakers. But if you have the prevailing super-watt big system, you may find your floor hopping and ditto for the ceiling below. But have a care with the overall level of the system. For while you may well love the effect of the Boom Box, your downstairs neighbors may fail to appreciate the unit quite so much as you do. A

"The Sansui AU-717 is a superb amplifier. We like it with no ifs, ands, or buts." (Julian Hirsch) It offers "as much circuitry sophistication and control flexibility as any two-piece amplifying system."

Everyone says great things about the new Sansui AU-717, but the experts say it best.

The Sansui AU-717 DC integrated amplifier is "Sansui's finest .... It incorporates a fully direct-coupled power amplifier section whose frequency response varies less than +0, −3dB from 0Hz (D.C.) to 200 kHz. The amplifier's power rating is 85 watts per channel (min. RMS) from 20 to 20,000Hz into 8-ohm loads, with less than 0.025 per cent total harmonic distortion .... If any amplifier is free of Transient Intermodulation Distortion (TIM) or any other slew-rate induced distortion, it is this one .... The slew rate ... was the fastest we have measured on any amplifier, an impressive 60 V/μsec.

"The preamplifier section of the AU-717 .... has very impressive specifications for frequency response, equalization accuracy, and noise levels ... The AU-717 has dual power supplies, including separate power transformers, for its two channels ... [and] exceptionally comprehensive tape-recording and monitoring facilities .... Good human engineering ... separates this unit from some otherwise fine products....

"The Sansui AU-717 is a superb amplifier. We like it with no ifs, ands, or buts." (Reprinted, by permission, **Stereo Review** Magazine, Feb. 1978. Julian Hirsch Test Report. Copyright © 1978. Ziff-Davis Publishing Company. All rights reserved.)

"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....

"Sansui claims that this unit has reduced transient intermodulation distortion — a direct result of the DC design, and, indeed, the model AU-717 delivered sound as transparent and clean as any we have heard from an integrated amplifier....

"... worth serious consideration — even by those who prefer separate amplifiers and preamplifiers." (Reprinted in part from Len Feldman's test report in **Radio-Electronics,** January, 1978.)

Listen to the superb sound of the Sansui AU-717 at your Sansui dealer today. And be sure to ask him for a demonstration of the matching TU-717 super-tuner.

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Woodside, New York 11377 • Gardena, California 90247 • SANSUI ELECTRIC CO., LTD., Tokyo, Japan
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Sansui

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Tape guide

Herman Burstein

Six-Headed Advantages

Q. What are the advantages of a six-headed tape deck? — Larry Weissmann, Butler, N.J.

A. A six-headed machine would be one that records and plays in both directions of tape travel. One set of three heads is for erasing, recording, and playing in one direction, while the other set is for operation in the opposite direction. This eliminates the need to exchange reels when the tape has run out in one direction, and prevents the loss of valuable material in recording.

Retaping Query

Q. I have been doing my taping at 3¾ ips, but now I want to retape these reels at 7½ ips. What I want to know is whether by retaping at 7½ ips I will gain in dynamic range, and by using a Dolby unit at the same time, can I reduce noise on the tapes? — Anthony Mattina, Staten Island, N.Y.

A. Retaping your 3¾ ips tapes at 7½ ips, with or without Dolby, will not improve anything — the noise, frequency response, dynamic range, distortion, etc. Whatever is on the tape will remain there, including the undesirables as noise, etc.

Noise Reduction

Q. Is there any type of hiss filter I can add, or insert, between my amplifier and tape deck to reduce the hiss on my prerecorded tapes ? — Nelson Wong, Seattle, Wash.

A. Several noise reduction devices have appeared on the market to deal with noise already on tape (or contained in other program sources such as discs and radio broadcasts). I suggest that you visit your local audio dealers to find out what is available in this respect.

Purchase Preference

Q. I am thinking about purchasing a tape deck. There are two models, with and without Dolby, and I would like to know the advantages and disadvantages of each. Which is preferable? — P. Kramen, Brooklyn, N.Y.

A. In general, if two machines are fully equal in all respects, except for the inclusion of Dolby, I would prefer the one with Dolby, particularly if you are interested in recording at 3¾ ips, and even more so at 1⅞ ips. The Dolby accomplishes a worthwhile reduction in noise, particularly at speeds below 7½ ips. The only disadvantage I can think of is the substantial increase in price of the deck, owing to the inclusion of the Dolby unit.

Transferring to Tape

Q. I have several hundred long-play stereo records and I want to put them on tape. I would appreciate any information you could give me to insure that I get the very best results. — William Ure, Hanford, Cal.

A. Yours is a broad queston and I think that the best answer lies in the instruction manual for your tape machine. I would suggest that you be careful to avoid recording at too high a level as that will cause excessive distortion. Ordinarily you will obtain good results if you keep the VU meter from going above 0 VU. However, on some program sources, particularly those with sharp transients, it may be necessary to stay below 0 VU. Experience is the best guide. Since you will be taping from records, you can do a bit of experimenting to arrive at the best recording levels, and then erase and re-record those tapes which are unsatisfactory. Make sure that you choose a good quality tape, of a type recommended by the manufacturer of your deck.

Dirty Heads

Q. I have tape "dirt" in one of the gaps of the record head of my tape machine. I've tried alcohol and Q-tips, but cannot remove it. Would you know another way to clean the head since I'm getting a frequency loss in that channel. — Mark Briskie, Wantagh, N.Y.

A. It appears that your record head is seriously worn if you cannot easily remove the dirt on it. Replacement is indicated.

However, I'm not clear as to what you mean by "loss of frequency." Are you referring to treble loss? If so, such loss is usually due to a worn playback head or record-playback head.

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

The best tape decks in the world are only as good as this tape.

While there's a lot of controversy over who makes the world's best tape deck, there's very little over who makes the world's best tape.

Maxell.

Because Maxell gives you the widest frequency response, the highest signal-to-noise ratio and the lowest distortion of any tape you can buy. In fact, people who own the finest high-performance tape equipment use our tape more than any other brand.

So why buy one of the world's finest tape decks and get less than the world's best sound.

When you can use Maxell and get everything you paid for.

Maxell Corporation of America, 60 Oxford Drive, Moonachie, N.J. 07074.

maxell

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Dear editor

Conservation Connoisseur

Dear Sir:

I read with considerable interest your "Equipment Profile" on the Lirpa Vehicular Disk Reproduction System (VDRS) and look forward to its appearance on the market.

Living in the West as I do and being concerned with our electrical energy crisis, I feel that I will have to defer purchase until Prof. Lirpa introduces a diesel model, which I have no doubt is presently awaiting the EPA test certification.

Woodruff Ogden
Walnut Creek, Cal.

Distraught Discophile

Dear Sir:

The noise problem on records could have ended on May 10, 1977, the day that William K. Heine, of California, demonstrated his laser scanning phonograph record player (Laserphone). This device plays the standard LP record without any ticks or pops, plus it never wears out the record.

It would seem to me that with high-quality and high-priced electronics, there should be some way to play a record without the all too familiar snap, crackle, and pop we always seem to get. The audio industry has produced a few machines to eliminate these ticks and pops, but they only seem to work when the noise has been artificially induced by a knife across the surface of the disc. But the little ticks and pops you hear in the first two or three minutes of Beethoven's *Moonlight Sonata* are enough to drive you crazy.

I found out recently that TEAC has no present plans to release their digital laser disc player. I, for one, can understand their thinking since the lack of available software during the first two years would destroy their sales.

Let us hope that the audio industry is aware of the fact that the number of higher-priced turntable systems is beginning to drop slightly. The reason for this is the poor quality of the available software. If we can create digital time-delay units, digital PCM recorders, then we can certainly manufacture a patented, proven turntable such as the Laserphone.

Harry L. Foushee
Jacksonville, Fla.

Lamentable Lo Fi

Dear Sir:

I have read numerous letters in *Audio* magazine mentioning the poor quality of many of our popular records and FM radio broadcasts. I have also seen several letters discussing the potentials for better quality AM audio broadcasts. It is unquestionably true that the quality of much of our commercial recording and broadcasting is often far short of the state of the art, as it caters to a mass-market audience of which the audiophile

Errata

Dear Sir:

I have read with interest Mr. Michael Bucci's article on "VTRing" in your July issue of *Audio*.

There are one or two serious errors on the information chart on page 99. Opposite "manufacturer," the JVC Vidstar HR 3300 is listed as being manufactured by Matsushita. This is incorrect. Victor Company of Japan, Ltd. manufactures all of the VCRs marketed in the Vidstar format, as well as 100 percent of our "¾U VCRs." In fact, we also produce O.E.M. ½-in. VHS units for other brands marketing in Asia, North America, and Europe.

Although it is true that Victor is a subsidiary of Matsushita, all of JVC's VCRs are built in Victor's facilities, by Victor personnel and to our specifications.

In addition (although I am sure it is an oversight), JVC is not even listed in the "Companies Licensed" category. As Mr. Bucci accurately stated in his article, JVC did indeed develop VHS. Quite obviously we should be listed among the host of "licensees."

We are aware that such errors do inadvertently occur. We will appreciate it if you will kindly rectify the above mistakes in your next issue.

R. F. O'Brion
Vice President
U.S. JVC Corp.
Maspeth, N.Y.

THERE'S MORE TO FM THAN BEING ON THE RECEIVING END.

Over the past few years numerous hi-fi companies have introduced an array of sophisticated FM tuners. All claim to make a remarkable advancement in FM reception and the claims are justified. Strong reception is an important factor in the reproduction of an FM signal.

Unfortunately, the reception is only the beginning.

As a matter of necessity, most FM stations compress the dynamic range of the musical material prior to transmission in order to make it easier to broadcast. All other tuners regardless of their sophistication simply decode this compressed signal and pass it along to the amplifier. The reception may be excellent, but the dynamic range of the material is still greatly compressed. That's what your amplifier will reproduce. As a result, FM reproduction is generally regarded as mediocre in comparison to records and tapes.

Until now.

The Phase Linear 5000-Series Two FM Tuner represents a significant sonic improvement in the *reproduction* of an FM signal. By incorporating a linear signal expansion circuit, the Phase 5000-Series Two successfully compensates for problems associated with signal compression, and is able to restore up to 9 dB of dynamic range. With the Phase 5000-Series Two, FM reproduction exhibits a dynamic range and sonic quality that is audibly superior to other tuners. Regardless of price.

Interested in adding FM to your collection of recorded material? The Phase Linear 5000-Series Two belongs in your library.

SPECIFICATIONS

IHF SENSITIVITY: (mono) 10.8 dBf (1.9 uV)
(stereo) 20.8 dBf (6.0 uV)
USABLE SENSITIVITY:
50 dB Quieting: (mono) 14.8 dBf (3.0 uV)
(stereo) 34.8 dBf (30.0 uV)
SIGNAL: NOISE @ 65 dBf:
(mono) 74 dB
(stereo) 72 dB
TOTAL HARMONIC DISTORTION:
@ 65 dBf: (Narrow Band)
(mono) 0.1%
(stereo) 0.2%
FREQUENCY RESPONSE:
20 Hz-15 kHz ± .5 dB
CAPTURE RATIO: 1.2 dB (Narrow Band)
ALTERNATE CHANNEL SELECTIVITY:
75 dB (Narrow Band)
STEREO SEPARATION: 1k 42 dB,
10k 32 dB
SPURIOUS REJECTION: 120 dB
AM SUPPRESSION: 60 dB
IMAGE RESPONSE: 110 dB
DIMENSIONS: 19" × 7" × 10"
(48.3cm × 17.8cm × 25.4cm)
WEIGHT: 17 lbs. (7.7 kgs)
Optional accessories: Solid Oak or Walnut side panels.

- Convenient 300 ohm balanced and 75 ohm unbalanced FM Antenna Input connections, including standard lead coaxial connector.
- Fixed Outputs of a nominal 2 volt level can be used for direct taping.
- 75u-second/25u-second de-emphasis for the addition of an outboard Dolby unit, and for use when receiving Dolbyized FM signals.
- Variable Outputs allow precise adjustment of the 5000-Series Two to match that of the turntable.
- Phase Locked Loop (PLL) multiplex decoder.
- Variable Muting Controls lower interstation hiss when tuning.

Phase Linear®

THE POWERFUL DIFFERENCE

Phase Linear Corporation/20121-48th Avenue West/Lynnwood, Washington 98036
Made in U.S.A. Distributed in Canada by H. Roy Gray Ltd. and in Australia by Megasound Pty. Ltd.

makes up only a very small minority. Most of the general public has very little knowledge or interest in true sound reproduction, and many more are even mislead as to what hi fi really is.

Most department store consoles and compact music systems use a device known as "synthetic bass" (David Weems, "The Numbers Game," *Popular Electronics*, Nov., 1970). Since these units are incapable of reproducing frequencies below 100 Hz, or even 200 Hz, they are designed to peak their response by as much as 15 dB from about 250 Hz down to the cut-off point. While this produces an irritating drummy, boomy sound . . . this is the "hi-fi sound" to most people. Synthetic bass is often called "juke-box bass" since they also use this technique.

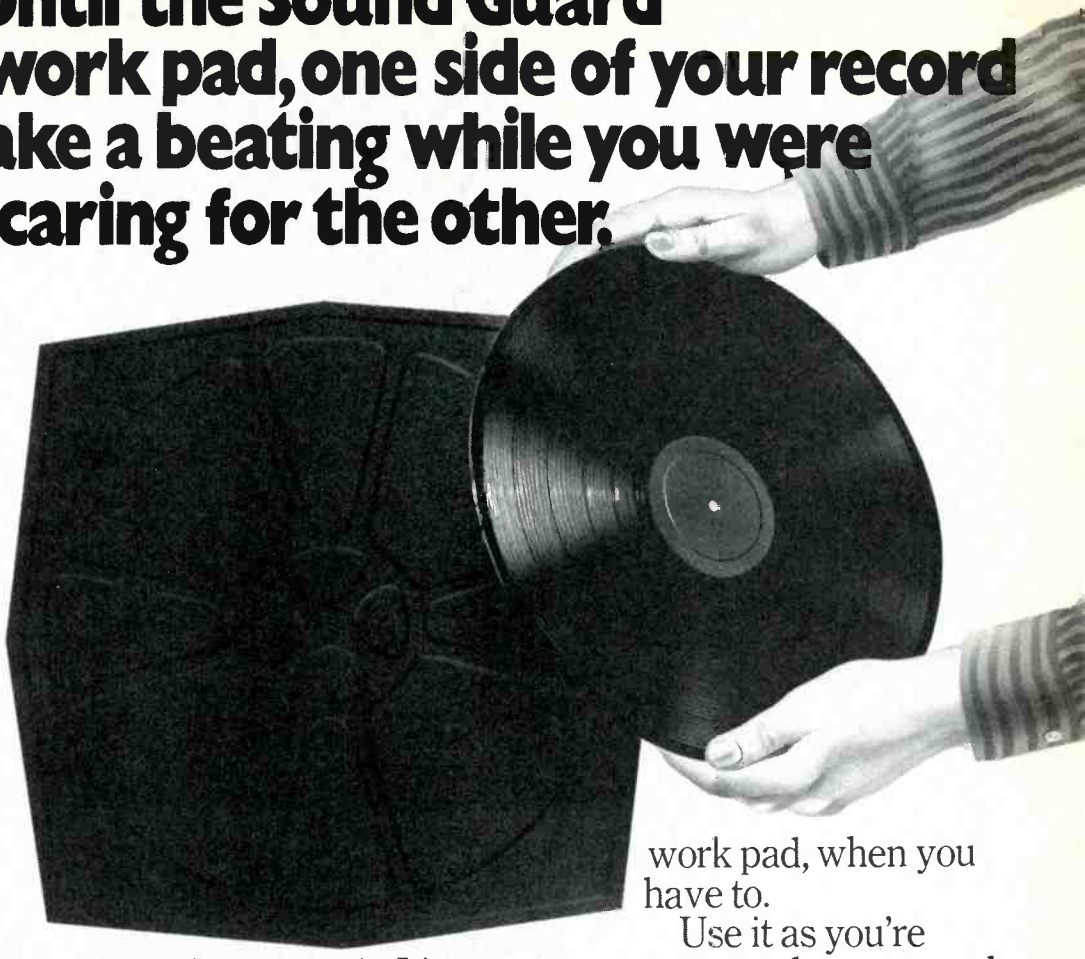
Secondly, I have walked into many a living room and found both speakers in the stereo system placed together off in one corner of the room well away from the general seating area. Worse yet, I have seen at least one "stereo" console unit in which both speakers are mounted right next to each other in the same cabinet. Obviously, many people have no concept of what stereo sound is or how to realize it, even though they are sold on having it. For this reason I suggest that the makers of low-cost, non-audiophile grade music systems revert back to monophonic reproduction, concentrating the cost of the unit into one decent channel of sound, rather than two mediocre ones. This is not to say that stereo is not useful, for under the right conditions it can do much for the sound of music. Nonetheless, in most living rooms visual aesthetics take precedence over proper speaker placement so that most "stereos" become redundant two-channel "monos."

Even our so-called live performances aren't really live, with very few exceptions. Today most contemporary music performers depend upon P.A. systems and other electronic equipment to convey their sounds to the audience. Worse yet, various forms of distortion are purposely introduced to "gimmick" the sound. Rock music does not even exist as a live acoustic sound, but is actually created through electronics.

Apparently, we live in an electronic jungle of unnatural, distorted, and gimmicked sound reproduction. Except for the audiophile who spends considerable amounts of time, energy, and money attempting to achieve perfection, the public, as a whole, is conditioned into accepting lo-fi reproduction. Unless some campaign can be waged to educate the public at large as to the virtues of hi-fi reproduction, the situation is unlikely to improve.

Michael Kiley
Palos Hghts, Ill.

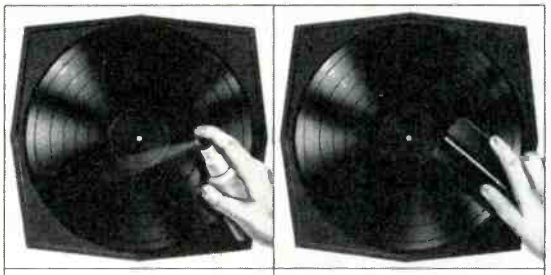
Until the Sound Guard™ record care work pad, one side of your record could take a beating while you were caring for the other.



A paper towel that could scratch. A piece of velvet that slips. A cloth of any kind that leaves telltale lint.

Until now, that's all you've had to lay your record on when you wiped, sprayed or buffed it.

Now you've got something that takes care of one side of your record while you're working on the other side. It's non-conductive to resist picking up particles from dirty records. It's not a fabric, so it has no lint to spread around. And it's non-abrasive to avoid scratching and slipping when you're buffing.



The pad protects one side of your record while you're working on the other.

The pad holds the record gently in place for buffing or wiping.

Its ingenious channels give you another advantage. They collect any excess fluid so it won't run over to the other side of your record—or onto your furniture.

Wash off your record care work pad, when you have to.

Use it as you're meant to, and your records will never take another beating.

Like all Sound Guard products, the Sound Guard record care work pad is sold in audio and record outlets.

Sound Guard® keeps your good sounds sounding good.

Ball

Sound Guard® preservative—Sound Guard™ cleaner—Sound Guard™ Total Record Care System—Sound Guard record care work pad

Record Rewrapping

Dear Sir:

To add to your recent discussions on the treatment of records before they reach the consumer, I have an interesting experience to relate.

At a local record store, I was told to go into the back room and ask a certain employe to help me find the record I was looking for. In the back room I was a bit shocked to see a plastic-wrapping machine which was obviously there for the purpose of rewrapping albums that had become unwrapped.

Unfortunately, the sealed plastic doesn't guarantee that the record hasn't been either used or abused.

Leslie Borean
Culver City, Cal.

Recording Blanks

Dear Sir:

I am in possession of a large number of early 1920's or 30's aluminum recording blanks. These are not acetate-coated blanks, but raw, plain aluminum. I would like to use these for recording, obviously not for serious high-fidelity recording, however I am unable to find anyone or any book with information about the recording styli specifications. I have also been unable to find anything as to the composition, size, or shape of the first recording styli that were used for the first so-called instantaneous recordings.

Are there any readers of *Audio* magazine who can either tell me where to obtain such a cutting stylus or what the parameters are so that I might be able to have one reproduced? I would be most grateful for your aid in solving this problem.

Michael Stosich
414 Assembly Drive
Bolingbrook, IL 60439

Quality Consciousness

Dear Sir:

A few months back I purchased a copy of the Crystal Clear Records direct-to-disc recording **San Francisco Ltd.** I had many problems with the record and four times brought it back to the store where it was purchased, trying to either get a refund or a new copy of this recording. Getting no satisfaction whatever from the retailer, I finally wrote directly to Crystal Clear Records asking them if there was something they could do to assist me in this matter. Shortly thereafter I received a brand-new copy of the recording in the mail.

This letter is just to let your readers know that there are still some companies around that respond quickly to complaints from purchasers of their products.

Thomas W. Smith
Franklin Square, N.Y.

Technics

Who needs the accuracy of Technics quartz-locked, direct-drive turntables? Professionals do. That's why radio stations use them and discos abuse them.

Now you can get all the accuracy of our professional turntables with the SL-1301 fully automatic and the SL-1401 semi-automatic, our new quartz-locked, direct-drive turntables. Accuracy like wow and flutter of only 0.025% WRMS, rumble of −78 dB (DIN B) and speed drift within 0.002%. That's professional accuracy.

How did our engineers achieve it? They started with a Technics hetero-pole, direct-drive motor. Next, they combined the functions of over 1,100 discrete circuit components into 3 IC chips, the same IC's found in our professional turntables. In one of these IC's you'll find the most reliable speed-reference device ever used in a turntable: A frequency generator quartz oscillator.

To dramatically reduce annoying acoustic feedback, both the SL-1301 and SL-1401 take advantage of Technics unique double isolated suspension system. One suspension damps out vibration from the base while the other absorbs vibrations from the platter and tonearm.

At the same time, Technics computer-analyzed, gimbal suspended S-shaped tonearm reduces friction to a mere 7 mg while it greatly increases tracking sensitivity.

The SL-1301 and the SL-1401. Both give you the accuracy of our professional turntables. With one big difference, the price.

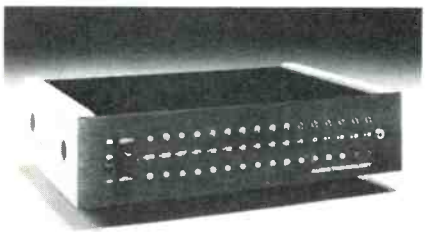
There are few differences between our professional turntables and these quartz-locked turntables. Accuracy isn't one of them.

Enter No. 34 on Reader Service Card

what's new

Audio Technology Peak Reading LED Display

The Model 510 two-channel peak reading LED display has a 45-dB dynamic range with 1-dB resolution either side of the 0 dB point and a display rise time of 50 μS. The 16 LEDs per channel, calibrated from −39 dB to +6 dB, display the peak value of complex audio waveforms to an accuracy of ±0.25 dB. It is designed to measure peak line-level signals (preamp output, tuner output, tape recorder input) or peak output from a power amplifier. In the power mode, it measures peak-power amplifier output from 0.00085 watts to 1600 watts, and rear panel switches are provided to set the 0-dB reference to 25, 50, or 100 watts and to select speaker impedances of 4, 8, or 16 ohms. In the line level



mode, each input is independently and continuously variable over a range of 50 m V to 5 V for a 0-dB indication; a calibration feature is included to balance channels and return the instrument to a 0-dBm reference. Price: $129.95.

Enter No. 95 on Reader Service Card

Harman Kardon Turntable

The Rabco Model ST-8 straight-line-tracking turntable with zero tracking error, zero skating force, and zero stylus overhang. Features include a 6-gram, low-mass tonearm; belt-drive; automatic speed control; illuminated strobe; automatic arm lift-off; damped cueing; a built-in bubble level; adjustable levelers; touch-sensitive resistance-type switch contacts, and a "Hall effect" d. c., fully servo-controlled motor, which brings the platter from stop to 33⅓ or 45 rpm in less than one revolution. Turntable speeds are adjustable to ±5.5 percent, rumble is -65 dB, wow and flutter 0.04 per cent, and turntable weight is 2.4 lbs. (1.1 kg). Price: $499.00.

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Nakamichi Audio Analyzer

The T-100 audio analyzer is a diagnostic instrument combining a number of testing functions in a compact format. Built in is a low distortion oscillator providing 21 frequencies, plus a pink noise generator, from 20 Hz to 20 kHz; a 400-Hz distortion meter for accurate THD readings down to 0.01 per cent; switched "A" weighted noise readings down to 10 μV; FET and d.c. logic controlled switching functions, and plasma-panel, bar-graph displays. The input impedance is 50 kilohms. Price: $800.00.

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Yamaha Pre-Preamp

The Model HA-1 pre-preamplifier, for use with moving-coil cartridges, incorporates two pairs of low-noise ICs for each stereo channel and uses metal-film resistors throughout its circuitry. It has an input-equivalent noise level of -157 dBV (RIAA, IHF A Network, inputs shorted), distortion of 0.005 percent for an input of 5 mV, with an overload capacity to 30 mV. Featured is a cartridge output-level switch, which in the low position has an impedance of 10 ohms and a gain of 34 dB, in the high position an input impedance of 100 ohms and a gain of 14 dB, and in the pass position the input and output are directly connected. Price: $270.00.

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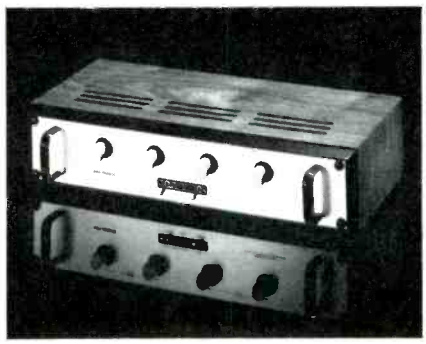

Audio Research Electronic Crossover

The EC-5 is a two-way, fixed-frequency electronic crossover, featuring two switch-selectable crossover slopes, a changeable crossover frequency with optional network parts cards, and variable channel gain. Crossover slopes or rolloff (transfer) characteristics are front-panel switch selectable 6 dB or 18 dB (1st and 3rd order) Butterworth for minimum "summed" channel gain error within the frequency cutoff region. The basic active filter is a multiple-feedback, infinite-gain configuration with relay-selected odd-order feedback network cards which may be changed for various crossover frequency requirements. Frequency response is ±1 dB, 5 Hz to 30 kHz, -3 dB points 1 Hz and 100 kHz, and harmonic and IM distortion are less than 0.005 per cent at 2 volts rms output (IHF load). Price: $895.00.

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BGW Amplifier

The BGW Model 410 amplifier features a 10-segment LED light-metering display; a gain control which allows the amplifier's sensitivity to be lowered from its maximum of 2 volts; a four-position, heavy-duty switch for selecting one or both sets of speakers; a headphone jack for driving medium impedance phones (600 ohms); d. c.-coupled, fully complementary output circuitry; high-speed (15 mHz), high slew rate (50V/ μS) input circuitry, and relay output protection circuitry. The power output is 200 watts continuous per channel, both channels driven into 8 ohms; frequency response is 20 Hz to 20 kHz, +0, -0.2 dB; slew rate is 40 volts/microsecond; THD is less than 0.07 percent from 20 Hz to 20 kHz; intermodulation distortion and TIM are less than 0.02 percent from 250 milliwatts to 200 watts, and hum and noise (residual) 110 dB below 200 watts.

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Burwen Remote Equalizer

The remote variable field equalizer has a hand-held unit with six bands per channel over a frequency range of 15-25,000 Hz, which is joined by a 20-ft. cord to a base power unit. It has a combination of peaking and shelving slide controls operating at 15, 120, 500, 2000, 5000, and 25,000 Hz which offer equalization of ±32 dB at 15 Hz, ±7 dB at both 500 and 2000 Hz, and ±22 dB at 25,000 Hz. Shelving controls provide additional equalization of ±12 dB at 120 Hz and ±11 dB at 5000 Hz, giving a maximum equalization of ±44 dB at 15 Hz and ±33 dB at 25,000 Hz. Frequency response is flat within 1 dB when controls are set at 0, and THD is 0.03 per cent at 1 kHz, 7.8 V. Price: $299.00.

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Robins Headphones

The Model 47-921 headphones have a frequency response of 20-20 kHz, and an 8 ohm impedance. They feature imprinted left/right positioning with individual continuous volume controls, a stereo/mono switch, 3-in. dynamic speakers, and a 9-ft. cord with ¼-in. phone plus. Price $20.00.

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Audio Research Preamplifier

The Audio Research SP-6 preamplifier has a power supply capable of providing isolated and regulated voltages to each circuit section by utilizing an all solid-state regulator with massive "filtering" at the output to each section, making it possible to increase the bandwidth of the a.c.-coupled vacuum tube design without compromising the circuit stability. The preamp features a close tolerance, segmented gain control with 2-dB steps (guaranteed 1½ dB tracking, ½ dB typical) and rear panel provision to disconnect "common" from the chassis so that rack-mount installations with power amplifiers, etc. may be accomplished without ground-loop induced hum. Frequency response in the high-level section is ±0.25 dB, 10 Hz to 30 kHz, with −3 dB wider than 5 Hz and 100 kHz; magnetic phono response is ±1 dB of RIAA from 30 Hz to 15 kHz; harmonic distortion is less than 0.003 percent at 5 V rms output, 20 Hz to 20 kHz; IM distortion is less than 0.008 percent at 5 V rms output; noise in high level is more than 90 dB below 1 V rms input (less than 20 μV equivalent noise). Price $1075.00.

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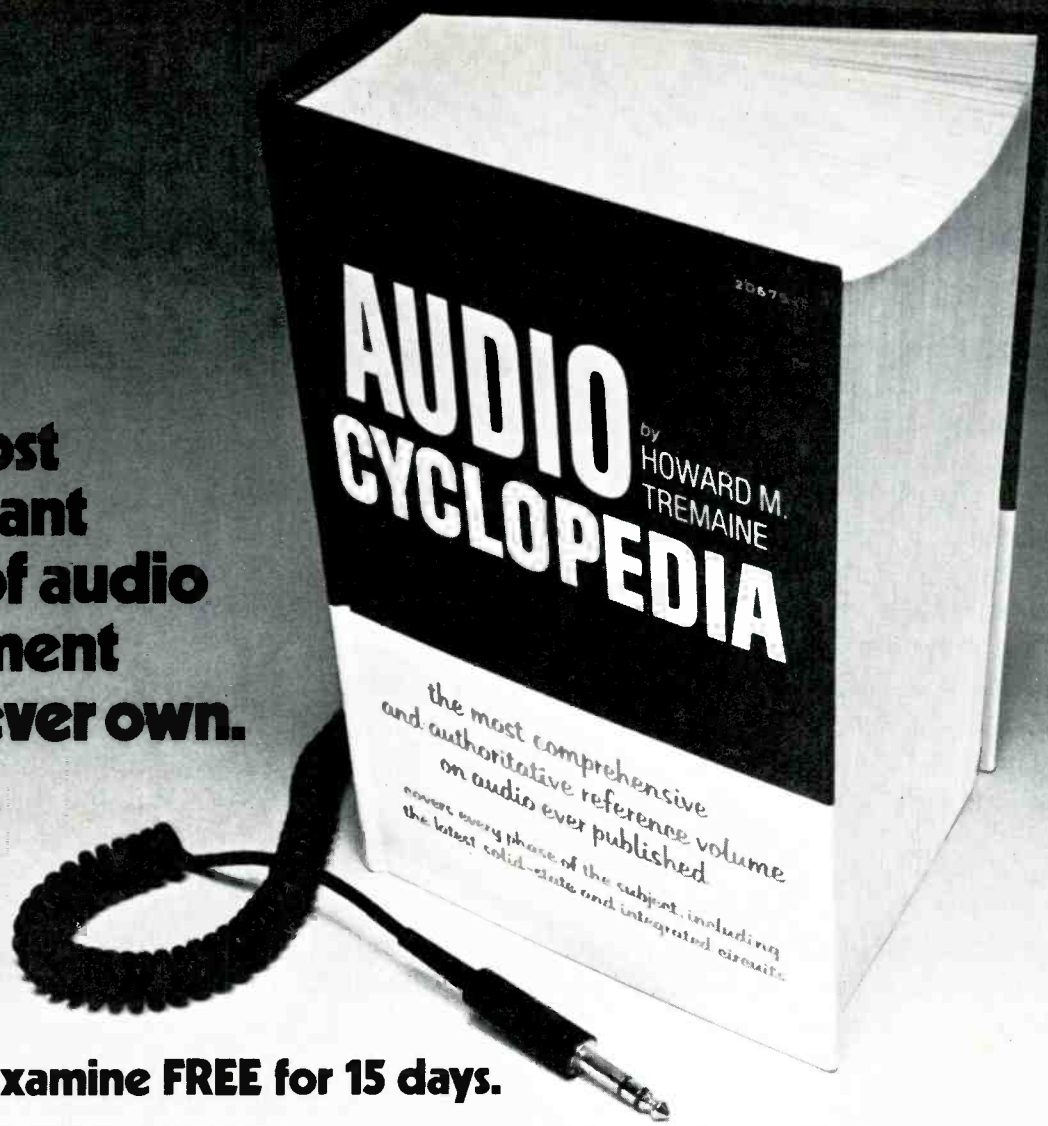

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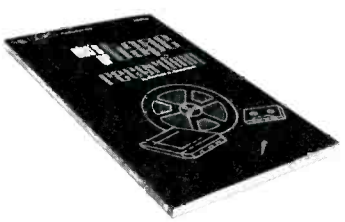

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Audioclinic

Joseph Giovanelli

Neighbors & Sound Systems

Q. I am a tenant in a multi-dwelling apartment complex. I purchased a high-performance stereo system which cannot be used at an adequate listening level without disturbing my neighbors. Are we owners of stereo systems forced to give up the use of our speakers and listen to high fidelity through a pair of headphones? — Michael Tudos, Brooklyn, N.Y.

A. Where an individual's high fidelity listening interferes with his neighbor's rest, peace, right to quiet, etc., the person with the high fidelity system must keep the volume down. Each of us is free to do whatever we like, just as long as this freedom does not, in some manner, interfere with the rights of others.

You would not want to be awakened by a TV set blasting away at 3 a.m., but this is a possibility if one of your neighbors works until midnight. The same holds true for your neighbor if you blast your sound system, or even play it at moderate levels in today's houses. Bass carries, and it is generally the bass which is the disturbing factor in these cases.

It is fortunate that we do have rather good, lightweight stereo headphones available. With the poor acoustic construction of modern apartment buildings, loudspeakers blasting away simply have no place in such apartment buildings.

High Listening Levels

Q. After having read in magazines about people having hearing problems after prolonged exposure to loud music, I've come to you with a question. In the future I would like to be a recording engineer in a studio. I know that I should take good care of my ears and I would like to know what average dB level do you think is a safe listening level? — James Tate, Sharon, Pa.

A. You raise a serious point in terms of hearing problems associated with high level listening, and you are *right* to be concerned about it. Where the sound level is really excessive, it may be a matter of just a year or two before all highs above, perhaps, 5 kHz are lost. I've received some rather sad letters from teenagers who've said that this has already happened to them, and the damage is irreversible.

Today's music places a greater emphasis than before on "feeling" the music as well as hearing it. Apparently, the near painful elements of this experience are very important to both performers and listeners alike. But with hearing loss, the feathery edge that makes for real immediacy and transparency of sound is gone forever.

It is interesting that you wish to enter the recording field as a studio engineer. If you visit the average recording studio and watch a mixing session, you will hear sound at incredibly high levels, considerably above the conservathve 85 dE sound level. I believe that listening at levels above 85 dB is asking for hearing problems, even though there are people who argue that 90 to 95 dB sound level is more realistic.

Given the facts that the ears must last a lifetime and that the ears can and do sustain damage when exposed to high listening levels, you must decide whether work as a studio engineer is really what you wish to do, or if there are other aspects of sound recording work which would be equally satisfying to you. True, the work as a studio engineer is the most well known, but there are other fields such as disc mastering, equipment maintenance, field recording, etc. that are equally challenging and rewarding.

Volume Control

Q. How do you tape a program so that the volume level will be fairly constant, and you don't have to readjust for each selection or station? — Mike Harkey, Lorain, O.

A. Some inexpensive tape machines have an automatic volume control (AVC) so that the recording level doesn't have to be adjusted. However, high-quality machines keep away from this due to distortion and other problems introduced with it. If you want good quality, you have to change recording level when the level of your program source changes. An alternative would be to set the recording gain control on your deck to accommodate the program source with the highest level, e.g. a radio station which comes in strongest. However, weaker incoming signals would then be under-recorded resulting in a drop in the signal-to-noise ratio. If you are using a very fine tape deck with a high S/N ratio (60 dB or better), you may be able to afford the loss of 5 or 6 dB as a result of not turning up the recording gain for the weaker program sources.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 401 North Broad Street, Philadelphia, Pa. 19106. All letters are answered. Please enclose a stamped, self-addressed envelope.

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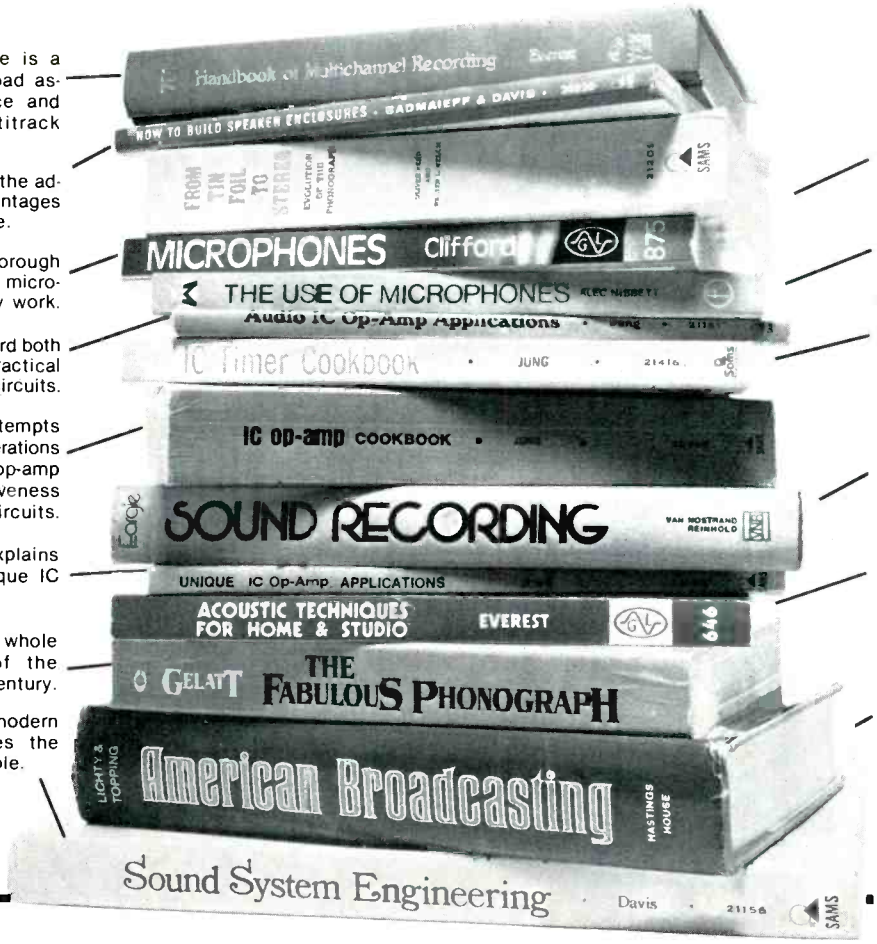

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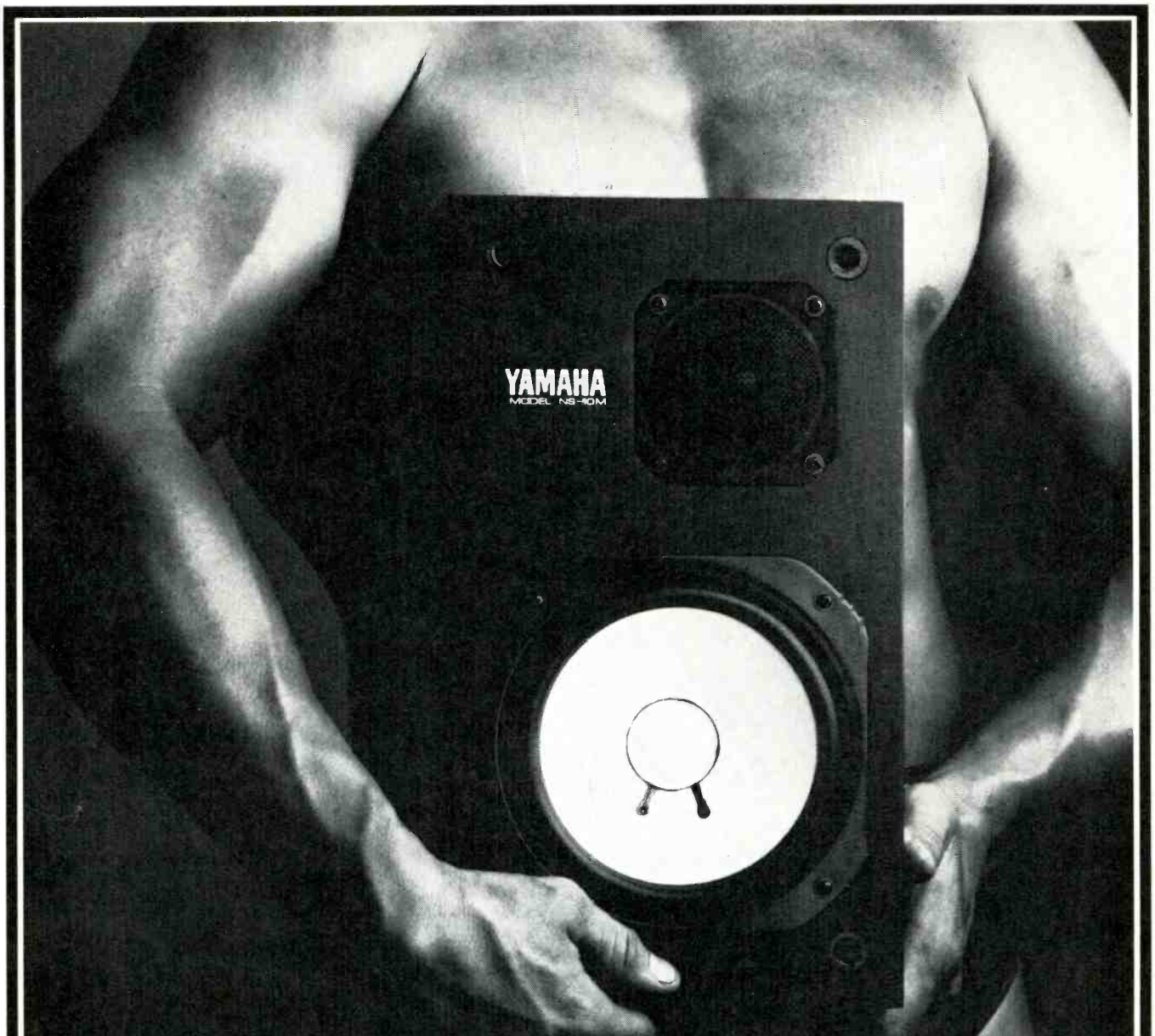

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The Mini-Monitor was made in the image of the NS-1000. It has an identical finish, and like its bigger brother, is sold in mirror-image matched pairs. At low volume levels the sound is virtually the same. It's a primary monitor with the NS-1000 look and sound, for places the NS-1000 won't fit.

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The Compleat Microphone Evaluation

AN UPDATE

Jon Sank

Our previous article on microphone testing described methods that we anticipated using for microphone reviews. When we wrote that article we may have had a stereotyped image of a moderately priced dynamic microphone for audiophile use with a cassette recorder.

Instead, we have been privileged to review a number of excellent microphones including ribbon, dynamic, electret and air-condenser types and have been pleasantly surprised to find that these high quality mikes are priced within the reach of audiophiles.

Our goal remains unchanged; we intend to acquire data as complete as time and budget allow, and follow applicable standards as closely as possible. To meet our goal, we are constantly improving our techniques to keep up with advancing technology in microphones.

This update will describe some of our "new wrinkles" in testing. Aspects of two new tests will be described, noise and frequency response testing under plane-wave conditions outdoors, and the setup and procedures that we're using for listening tests.

A recent review (2) showed results of an experimental noise test on an air-condenser microphone. The ⅓-octave noise levels of this high quality mike provide good baseline data. The overall measured levels were higher than specs, which inspired us to refine our methods. Our set up was similar to Fig. 1 but employed the same wide-band, solid-state RCA BA-31 preamp used for frequency response testing [Fig. 1]. For noise testing only, we switched to our "standard of quiet," the RCA OP-5 portable amplifier, an old vacuum-tube, remote-broadcast amplifier of high quality, with a step attenuator and classic Weston 4-in. VU meter. The overall noise levels are -129.5 dBm (unweighted) and -131 dBm ("A" weighted) referred to the input. The dBV numbers are the same because the rated input source impedance is 250 ohms [1]. The ⅓-octave spectrum of the OP-6 noise is shown in Fig. 3, and the SPL scale is to be disregarded for the present. The 250-ohm impedance rating does not conform to the recent broadcast standard which is 150 ohms, but is ideal for testing today's low impedance microphones which vary from 150 to 600 ohms.

A little mathematics will show why a restricted frequency response amplifier is less noisy than a wide band unit. Random noise is generated by thermal agitation in a resistor or in the resistive component of a complex impedance. The total rms open-circuit voltage e in the frequency band (f_2-f_1) is [4]:

$$e_n = \sqrt{4kTR(f_2-f_1)}$$

Where k is Boltzmann's Constant, T the absolute temperature (°K), and R is the resistance value in ohms. If we reduce bandwidth from 150 kHz to 15 kHz, e will be reduced by 10 dB. Failing to band-limit the amplifier can result in a high noise reading that is not related to what you hear. Alternately, we could chill our device to near absolute zero and the noise will be very low, but this is only practical for specialized radio receivers.

If we assume a temperature of 20 degrees C and a bandwidth of 15 kHz, the noise voltage E_n in dB re 1 volt (dBV) is:

$$E_n = \sqrt{-156.2 + 10\,\mathrm{Log}_{10}\,R}$$

The 250-ohm resistor termination for our OP-6 produces −132.2 dBV of noise according to the equation. Thus the OP-6 adds -129.5 - (-132.2) = 2.7 dB to the noise and is said to have a noise figure of 2.7 dB.

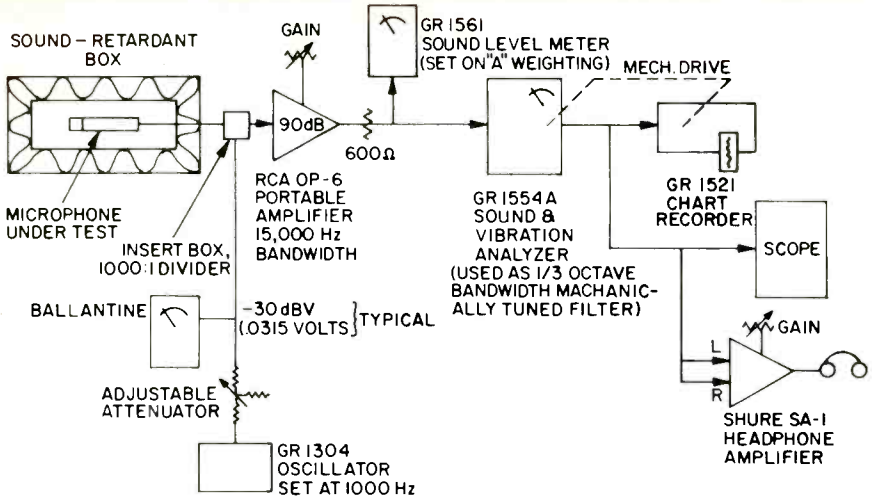


Fig. 1—Test setup for noise measurement.

This is a low N.F. for an audio amplifier, and a limited review of IC Op Amp specifications plus calculations have shown a higher N.F., particularly with unloaded input conditions where the input impedance is five to ten times nominal mike impedance. We would be pleased to receive test data on quiet ICs.

We've only considered the fundamental case of noise generated by a resistance. References 3 and 4 discuss other sources of noise in microphones and amplifiers.

A precision sound level meter (less microphone) is included in our noise test setup to indicate overall levels unweighted (flat respone) and "A" weighted (bass rolloff). The "A" weighting is appropriate because microphone noise would be perceived by the ear at a very low sound level where "hiss" is more easily heard than "hum."

European manufacturers specify DIN weighting, but "A" weighting is commonly used in the U.S. for acoustic noise measurements and ratings and is specified by NAB for tape equipment testing. Our noise test equipment conforms to the standards listed in Table I, and these may be consulted for more detailed information.

Our sound-retardant box is made of ¾-in. plywood, double thickness, braced by 2 x 3 in. boards and lined with several layers of 1-in. acoustical foam. It is purposely non-metallic and non-magnetic because microphone noise properly includes components resulting from ambient magnetic or electric fields We position the box to minimize hum if it is encountered, because in practice one may so orient a mike. The sound transmission loss (TL) of the box has been measured by exposing it to a high level, calibrated, reverberant sound field. The results are shown in Fig. 2. The loss at low frequencies is remarkably high for an inexpensive box. Room ambient noise generally peaks in the 63 and 125 Hz region due to motors and lamp ballasts, then falls to a low SPL at 1000 Hz and above. This complements the TL curve, and the resulting ambient sound inside the box tends toward a flat spectrum, which minimizes interference to microphone tests. Nevertheless, we only make tests when the room is very quiet, and continuously listen for ambient noise from the mike.

We have shown that a simple resistor makes noise, and thus condenser mikes having integral amplifiers are not singular in their ability to generate noise. In fact, all types of mikes make noise. Figure 3 shows some "baseline" data on our lab reference BK-5B ribbon mike. Below 1000 Hz, hum and harmonics predominate above the OP-6 amplifier noise even though the box was oriented to minimize hum. Incidentally, our sound room does not have strong fields, and the BK-5B has low hum sensitivity. Above 1000 Hz, the mike generates no more noise than a resistor. The result is that the noise does not exceed 25 dB unweighted and 19 dB "A" weighted *equivalent sound pressure level in dB re 20 microPascals*. How is this rating determined? We calibrate our chart paper scale as well as the sound level meter scale in dBV by the insert voltage technique described in Ref. 1. Then we remove this calibrating voltage and measure overall noise levels with the SLM, and record the spectrum on the chart. In order to compare with manufacturer's specifications, the dBV numbers must be converted to equivalent SPL (L_{pn}) as follows:

$$L_{pn} = E_n - R_f + 94.$$

R_f is the microphone acoustic sensitivity (previously measured) expressed in dBV/Pascal, as described in Ref. 1. Obviously, if E_n is "A" weighted, L_{pn} will be an "A" weighted sound level.

The L_{pn} number may be easily utilized in a practical recording situation. Let's assume we have a rather noisy mike with an "A" weighted L_{pn} of 35 dB and a Nagra IV SD recorder with an ("A" weighted?) S/N of 72 dB (6). In order that the mike noise will be below tape noise, the sound level at the mike must exceed L_{pn} by 72 dB (plus a safety margin). Thus our *minimum* SPL must be an astounding 107 dB! With this mike we can record high-level rock music or pavement breakers but preferably not classical music or normal speech. If we use our BK-5B and OP-6 combination (which is a very quiet system), our minimum SPL is

Fig. 2—Sound transmissions loss of microphone noise testing box.

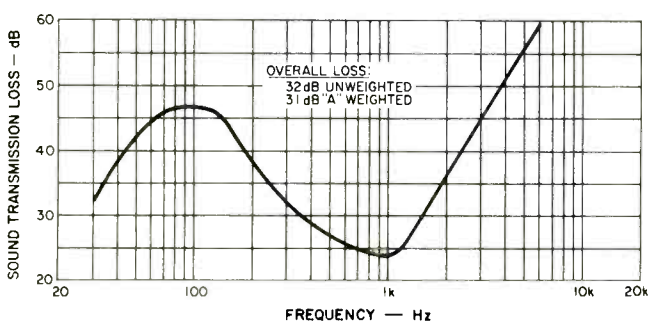
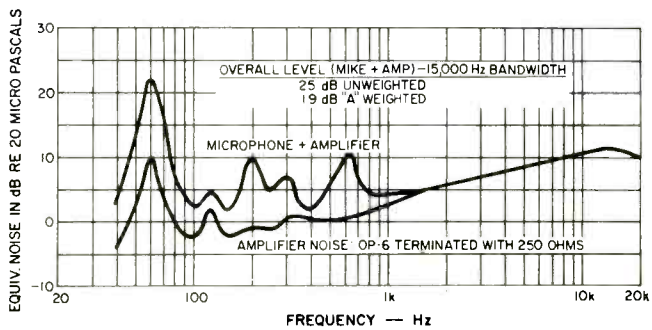


Fig. 3—One-third-octave band noise spectrum of BK-5B (reference) microphone plus OP-6 amplifier.



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LSS components as shown, top to bottom: T-12 FM tuner with 10.7 dBf (1.8 μV) usable sensitivity, 14.1 dBf (2.8 μV) for 50dB quieting (IHF), 0.8 dB capture ratio, and 90 dB selectivity. G-11 ten-octave graphic equalizer provides ±6 or ±12 dB boost or cut at each octave, ≦ 0.005% THD. The C-12 preamplifier, ≦ 0.005% THD and 0.002% IM distortion, signal-to-noise ≦ 96dB, 1D mV input (IHF-A weighted). 300 mV phono overload. M-12 stereo power amplifier, 80 watts per channel, both channels driven, into 8 ohms from 20 to 20,000 Hz, ≦ 0.006% THD.

The LRS line of nine separates includes: ST50 frequency-synthesized FM tuner with digital readout and 7-station memory; SC50 preamplifier, DC and fully direct-coupled, THD 0.005%; SG12 12-octave graphic equalizer; SF70 tone control unit; SE24 LED level indicator; SM21 DC direct-coupled power amplifier with meters. Also: SL15 integrated amplifier; ST70 FM tuner with Accutouch; SM20 power amplifier without meters.

Table I — ANSI (American National Standards Institute) and NAB (National Association of Broadcasters) standards related to audio noise measurement.

ANSI 51.11-1966 (R1976) octave, half-octave, and third-octave filter sets, specifications.
ANSI 51.4-1971 (R1976) sound level meters, specifications.
NAB Standard, April 1965 magnetic tape recording and reproducing (reel-to-reel).

19+72 = 91 dB. We can record classical music successfully because the recorder gain will be adjusted for 0 VU on the loud passages, which should exceed 91 dB. *A high quality, high S/N tape recorder requires a low noise, high sensitivity microphone.* The mike preamp in your recorder or mixer can degrade S/N if a low sensitivity or mismatched impedance mike is used or the preamp can be just plain noisy.

Now that we've attracted your attention to microphone noise, we think it only fair to mention a saving grace in realistic audiophile recording sessions and that is ambient acoustical noise. The church in which we record has an ambient noise level of 25 dB "A" weighted, with no people. During a concert, the background sound must obviously be higher. Thus, any mike having a noise rating of less than 25 dB "A" is adequate.

What is the least noisy mike we've measured? It is (surprise!) a condenser. Our RCA MI-10006A varidirectional condenser microphone (7) measures approximately 7 dB unweighted and 0 dB "A" weighted! The MI-10006A was designed for motion picture applications on very quiet sound stages, but surprisingly was not favored because of infrequent "pop" noises which could spoil a long scene. This mike has a lower "threshold of hearing" at low frequencies, than the human ear, and listening to ambient sound with this mike reveals otherwise inaudible noises that sound like distant thunderstorms.

Listening Tests

In our 1977 article in *Audio*, we described the principles of A-B comparisons. We did not show specific methods because of space limitations, but think it a good idea to describe the details, both for the record and for audiophiles who are interested in making more productive listening tests.

Figure 4 shows our test setup. It may appear complicated, but the audiophile could construct a rough equivalent with a pair of mike mixers, a switch, and a headset.

We always use the same reference mike as "A," our BK-5B that we built with T.L.C. about 10 years ago. Periodic checks on the frequency response have shown it to be a stable mike. Since it is a cardioid, it can properly serve only for comparison with cardioid microphones, but these comprise about 80 per cent of mikes reviewed to date.

Each mike is connected to the same load, a balanced, 150-ohm unloaded input. The step attenuators in each channel are adjusted for equal audio levels as indicated on the VU meter. The difference in attenuator settings in decibels should equal the measured difference in microphone sensitivities. The master attenuator is adjusted so that the overall gain (in the reference "A" channel, at least) is unity, so a ribbon microphone level signal is present at the OP-6 input. The A-B switch is a console-type key switch. It is followed by the matching transformer which presents a balanced circuit to the OP-6 amplifier which functions to boost the signal to a normal program level of +8 VU and provides a large VU meter for indicating levels.

It is important to use headphones which reproduce the entire audio frequency range with low distortion. We have tried a number of high quality phones, but in general, changing phones does not change the conclusions of an A-B comparison of microphones.

We try to follow an orderly and consistent test procedure. First, we position the two mikes close together, make a talk test, balance the levels, and check for correlation of attenuator settings and known differences in sensitivities. This is followed by several comparative tests, some of which are more objective than subjective:

1. Evaluate sound quality of voice.
2. Shake the mike and listen for noises; check operation of on-off or voice-music switches.
3. Tap the stands and mikes and observe outputs.
4. Check sensitivities to breath "pops," with and without accessory windscreens.
5. Orient each mike for maximum output at a specific distance from a coil carrying 60 Hz current, with a field of approximately one gauss, and note relative hum levels.
6. Check clipping level on calibrated scope with loud speech. The voltage value is converted to SPL by calculation using the measured R_t value.

Pending results from these tests, we set up the microphones in our rectangular listening room which is approximately 400 sq. ft. in volume, with 15-in. studio monitor speakers on one end and 15-in. thick sound absorbing material at the other. Real time analysis at selected locations throughout the room reveals a uniform acoustic response with no need for "room" equalization. The monitor speakers have uniform response from 40 to 15,000 Hz, so that a full range of musical instrument sounds can be reproduced from master tapes of concerts, and this is satisfactory source material for most A-B comparisons of microphones. Then we usually make a quick test using available live instruments, to see if the results correlate.

Further listening tests may be made as circumstances dictate, including stereo taping of live concerts, which necessitates obtaining a second mike. Products for review are submitted in unit quantity, which is usually one microphone. We have not yet attempted A-B comparisons between pairs of microphones.

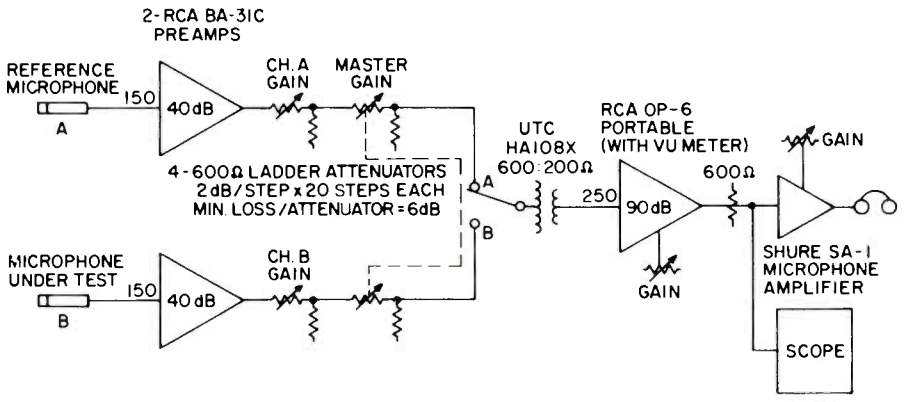
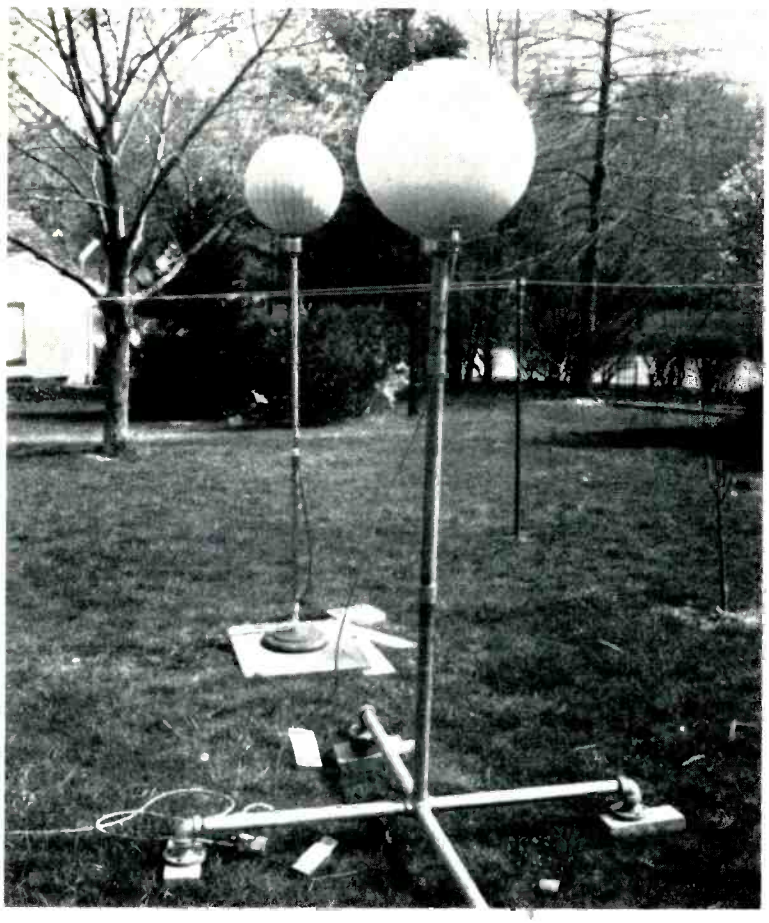


Fig. 4—Equipment setup for comparative listening tests.

Response and Directivity Tests Outdoors

The relevant ANSI and EIA standards (see April, 1977, *Audio* article) require that a plane wave be used for testing frequency response and directional characteristics of microphones. This requirement is essentially met at high frequencies where the microphone is one or more wavelengths from the source. At lower frequencies where the distance is less than about ⅓ wavelength from the source, pressure-gradient microphones, such as cardioid or figure-eight pattern, exhibit a bass boost or proximity effect as illustrated in Fig. 8 of our 1977 article. A cardioid will exhibit a varying effect depending upon angle of incidence. The 0-degree response follows the curves of the graph, the 90-degree response is not boosted, and the 180-degree response is boosted more than the 0 degree.

Fig. 5—The large spherical sound source in the foreground with the SPX ribbon microphone enclosed in a large windscreen.



Normally, we measure microphones indoors on the small spherical sound source [1] at distances from 6 in. to 2 ft. These data are published along with the plane wave response which is usually calculated from the 6 and 12 in. curves, using the proximity effect graph. This is fine when you are using a source whose dimension is small compared to the microphone distance, in other words, the mike is in the *far field* of the source. When the mike is closer than twice the source dimension (for this purpose use the diaphragm diameter), the distance to the (effective) point source is undefined, probably varies with frequency, and plane wave response cannot be calculated.

We have discovered that few, if any, manufacturers actually publish low frequency response curves for plane wave conditions. Frequently, the distance to the source is not mentioned, and the source dimension is rarely stated. Most overseas manufacturers use a 1-meter distance. We discovered one overseas company testing at 50 cm, and one domestic company testing at 12 in. (30.5 cm). The latter was using a 12-in. speaker. The 50-cm distance is all right if the source is less than 25 cm in diameter and the data appropriately corrected to plane wave conditions. Testing at 12 in. from a 12-in. speaker is improper unless, of course, you only test omnidirectional (pressure) microphones.

L. J. Anderson (for whom we worked at RCA) is quoted by Ref. 5, stating that essentially plane wave conditions are obtained at a distance d from a (point) source, above a lower limiting frequency f according to $f = 350 \div d$, where d is in ft. and f in Hz.

We have calculated f for the distances mentioned in this article:

d meters	d feet	f Hz
0.15	0.5	700
0.31	1.0	350
0.50	1.6	219
0.61	2.0	175
1.00	3.3	106
1.22	4.0	88
1.82	6.0	58

Strictly speaking, data corrections should be made when the microphone is closer than six ft. from the source.

Our indoor test setup with a small spherical source is satisfactory for omni, cardioid, and figure-8 microphones. The 180-degree response of cardioids at two ft. is a little in doubt below 175 Hz because of uncertain correction factors, but this is a minor difficulty.

Our test procedures had been routine until the Editor (in his infinite wisdom) submitted a shotgun type of ultradirectional microphone. Our extensive experience with this kind of mike has shown that plane wave test conditions are definitely required. It is intuitively evident that a microphone with sound entrances distributed along 40 cm of length should not be tested at, for example, 40 cm from a source, because the SPL at the rear of the mike will be 6 dB less than the SPL at the front. Generally, these mikes are intended to reject reverberant sound that would measure the same SPL at any point in space to be occupied by the mike.

In response to this challenge, we produced our large spherical sound source (Fig. 5), which like the Son of Godzilla, is not smaller than its father, the small spherical sound source! We are sorry to disappoint you with a description of this device, which is in no way as magnificent as its predecessor. The large source consists of a fiberglass sphere, about 18 in. in diameter, ¼-in. thick, coated on the inside with ¼ in. of vibration damping compound, and filled with absorbing material. The transducer is a selected ALTEC 755C (8 in.) speaker. Our principal use for this source is for reverberation, response, and sound transmission tests in buildings. Devotees of plumbing will note the stand which is made of 1¼-in. pipe and contains an esoteric fitting known as a "side arm cross." This is actually a railing fitting — it's hard to find but is the key ingredient of this very useful portable stand.

Figure 5 may lead you to believe that our beloved SPX laboratory ribbon microphone has had a monstrous offspring, but alas, this is not so. The microphone shown with the source is the SPX enclosed in a large windscreen. This screen is sufficiently good that wind noise from trees is generally heard before the velocity becomes great enough to generate noise in the SPX. The screen is a silver-solderer's masterpiece, made of thin brass rod covered with open-weave fabric. It was made to permit outdoor tests of large horn-type loudspeakers.

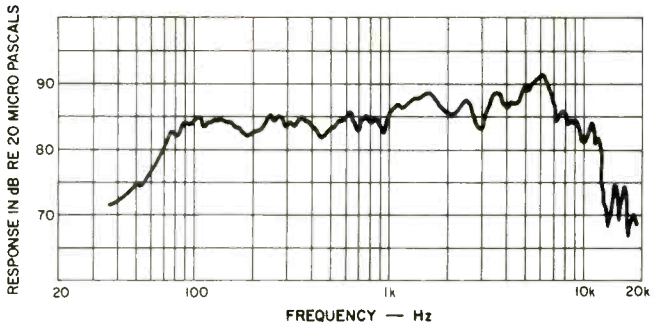


Fig. 6—Calibration of the large spherical sound source.

Those of you who have tried to test loudspeakers outdoors using conventional condenser pressure microphones know that you must either bury the speaker flush with the ground or position it and the mike very high above the ground to avoid wiggles from ground reflections. The ribbon velocity microphone produces accurate, smooth calibration curves of our source with the more practical setup of Fig. 5 where the source is six ft. from the mike, six ft. above grade. The figure-eight directional pattern of the velocity microphone rejects ground reflections, and of course at a six-ft. distance the mike has negligible bass boost due to the proximity effect [8].

It follows that our outdoor setup is best suited to frequency response tests of microphones having a null or at least some significant rejection of sound from the 90-degree direction. These microphones include figure-eight, ultradirectional shotguns, and super cardioids. Of course, most types of mikes, other than the shotgun, can be tested indoors. On high quality cardioids, the outdoor test will show a greater front-to-back ratio, particularly below 200 Hz, than the indoor test.

Figure 6 shows the calibration of the source. The large source is not ideally suited to frequency response tests of microphones having very smooth response, as the reduced date contain wiggles that are not present on curves from indoor tests. Presumably this is because the response of the small sound source is much smoother [1, Fig. 5].

The various schemes of source flattening we described enable more precise tests of microphones using commercial loudspeakers as sources, but it is doubtful that an artificially smoothed cone speaker can even equal the naturally smooth small source in making accurate microphone measurements.

We hope that this explanation of our "new wrinkles" in microphone testing has given you food for thought, both natural and artificial, of course. A

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7. Tremaine, *Audio Cyclopedia*, pp. 209-210, Howard W. Sams & Co., 1977.
8. Yes, we realize that your test equipment store is fresh out of SPXs. If you have an application (and a budget), we'd like to hear about it.

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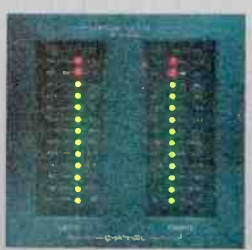
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58 CASSETTES TESTED

Howard A. Roberson

The goal of this tape survey was to evaluate all cassette formulations currently available, including the bargain-priced ones. Contact was made with all known manufacturers or their representatives. Three samples each were requested of C-90s, the length to receive the greatest attention, and C-60s, plus any other lengths the manufacturer wanted to go through the test process. Three samples were considered the minimum number to make any determination of cassette consistency. Information was requested on each formulation's magnetic properties, features worthy of note, and prices. Unfortunately, technical information was not obtained on the majority of samples, and much of the data actually received was incomplete in one way or another. It was not possible, therefore, to correlate the test results with magnetic properties. Prices were obtained for most of the cassettes, but they were most confusing, what with list price, dealer price, audiophile net, maximum retail price, direct mail order, etc.

The requested samples were received from most of the makers, although fewer than three samples were provided in some cases. A few of the brands were obtained by direct purchase, including the bargain store labels, K-Mart and Zayre. All sources were contacted shortly before the testing started to ensure that the samples being used were representative of current production. The bargain-priced tapes were included so that their actual limitations would be defined and to supply additional information on how improvements in formulations benefit the purchaser.

Manufacturers' Specifications

A total of 58 formulations were tested, and technical data was secured on less than half of these. The table lists the majority of the C-90 magnetic specifications given, but some characteristics of lesser interest are not shown. The *Tape Type* entries were limited to "Fe" for many varieties of ferrics, "FeCr" for ferrichrome, "FeCo" for ferricobalt, and CrO_2. As most of the manufacturers say very little about the exact make-up of the formulations, the listing is undetailed, and there could be some error.

The magnetization curve figure has points of interest labeled for reference. The coercivity, H_{ci}, is the demagnetizing force needed to bring the induced flux to zero, and is expressed in oersteds. The retentivity, B_r, is the number of flux lines per cm^2 (gauss) of the tape coating cross-section, the width of the tape, and the coating thickness. It is indicative of high-frequency sensitivity. Remanence, is the actual magnetic signal retention in lines of flux (Maxwells) applied to the specific tape. It is the *total* flux, *not* the flux density (gauss). Most manufacturers give values for the 0.150-inch width of the cassettes tapes. Some, however, give values for ¼-inch widths, and their figures must be multiplied by 0.6 for the smaller width. Remanence affects distortion, sensitivity, and output at the lower frequencies. Squareness ratio is the decimal fraction of the flux remaining relative to the maximum possible at saturation. It is a measure of the "efficiency" of the magnetization process.

Although DIN standards are not true international standards, some of them are used throughout the world. Test tapes made by BASF include a blank section of tape which is used to establish reference levels for sensitivity at 333 Hz and for bias. The manufacturer's figures for sensitivity and bias give his values in dB relative to the reference tape levels. Sometimes confusion may arise because the bias for CrO_2 tape may be referred to either the standard ferric tape or to the standard CrO_2 tape. If the values are close to zero, the reference is to the standard CrO_2 tape.

Tests Performed

A basic guideline for the testing of each tape type was that each one would be presented at its best, with bias and EQ adjusted for best results. There was no "standard" fixed bias used to match one particular tape, causing other tapes to appear less satisfactory. An important part of the evaluation gear was a Technics RS-9900US 3-head cassette deck. This unit has front-panel continually variable bias and EQ pots, greatly facilitating the test process.

The first step for each tape was examination of the C-90 record playback response with the ⅓-octave RTA with pink noise being recorded at a low level. (A few tapes were available only in C-60.) The record head was adjusted for alignment with the play head, for the skew of the cassette in use. EQ was always started in detent (zero reference), and bias was adjusted for the best response between 1 and 10 kHz, with limits of +1.5/-0.0 dB. EQ was used, if needed, to meet these amplitude limits. Bias was measured on the dB scale of a Heath SM-5238, referenced to standard bias, with a scope monitor. The EQ change was measured by noting the shift in dB at 10 kHz.

The reference record level was established at 400 Hz for Dolby-level indication (200 nWb/m) in playback. Playback of the internal 400-Hz tone gave the data on tape sensitivity. Record/playback responses were run at the reference record level and 20 dB below that. The maximum record level was measured at 100 and 400 Hz, and 3 kHz with an HDL_3 = 3 per cent guideline and at 10 kHz for tape saturation. The signal-to-noise ratio used IEC "A" weighting

Manufacturer's Specifications

BRAND OR MANUFACTURER	TAPE DESIGNATION	TAPE TYPE	COER Oer	RET Gau	REM Max	SQU RAT	SENS dB	BIAS dB	PRICE C-90
Ampex	Plus	Fe	310	1300			0	-0.5	$2.49
Ampex	20 - 20+	Fe	300	1400			+2.4	-0.5	3.49
Ampex	Grand Master	Fe	325	1700			+1.5	+2.0	4.29
AudioMagnetics	High Performance	Fe					+0.5		2.99
BASF	Performance	Fe	320	1250	0.23	0.79	+1.8	+0.5	3.59
BASF	Studio	Fe	290	1450	0.20	0.85	+4.0	-1.4	4.49
BASF	CrO_2	CrO_2							4.49
BASF	Professional I	Fe							4.79
BASF	Professional II	CrO_2							4.99
BASF	Professional III	FeCr							4.99
Capitol	1	Fe	310	1300	0.25		+1.5	-1.0	1.49
Capitol	Music	Fe	310	1300	0.25		+1.5	-1.0	3.69
Capitol	Music	CrO_2	510	1600		0.9		+6.0	4.09
Certron	HE	Fe	310	1300		0.82	+0.5	+0.4	2.39
Columbia	Low Noise	Fe							
Comsette	Low Noise	Fe	310	1550		0.88			1.80
DAK	HEC	Fe							1.91
DAK	HEC-SL	Fe							1.78
Fuji	FL	Fe	320	1210			0.0	-0.2	3.60
Fuji	FX-I	Fe	345	1520		0.84	+1.5	0.0	5.10
Fuji	FX-II	Fe	550	1400		0.88	+2.0	+3.8	5.10
K-Mart		Fe							0.73
Lafayette	LN	Fe							1.69
Lafayette	Criterion	Fe							2.19
Lafayette	XHE	Fe							3.29
Maxell	LN	Fe							
Maxell	UD	Fe							
Maxell	UDXLI	FeCo	333	1640		0.92	+2.5	0.0	
Maxell	UDXLII	FeCo	548	1542		0.91	+2.0	+0.8	
Memorex	MRX_3	Fe	350	1525		0.90	+1.7	+1.0	3.99
Memorex	CrO_2	CrO_2							
Nakamichi	EX	Fe							5.80
Nakamichi	EXII	FeCo							7.00
Nakamichi	SX	FeCo							7.20
Realistic	Concertape	Fe							2.99
Realistic	LN	Fe							
Realistic	Supertape Gold	Fe							
Realistic	CrO_2	CrO_2							
Royal	APC/LN	Fe							3.00
Royal	Ultra Linear	Fe							5.00
Royal	CrO_2	CrO_2							4.50
Scotch	Highlander	Fe							2.39
Scotch	Dynarange	Fe	360	1500	0.26		+1.0	-0.5	3.69
Scotch	Master I	Fe	330	1700	0.33		+2.5	-1.5	4.29
Scotch	Master II	FeCo	550	1500	0.33		+4.5	+1.3	4.99
Scotch	Master III	FeCr	370	1500	0.30		+2.5	+1.5	4.99
Sony	LN	Fe							
Sony	UHF	Fe							
Sony	FeCr	FeCr	320	1500		0.87	+2.0	+0.7	
Sony	CrO_2	CrO_2							
Superscope	HF	Fe							1.65
Superscope	SHF	Fe							2.25
Superscope	CrO_2	CrO_2							3.50
TDK	Maverick	Fe	330	1200		0.75	0.0		2.39
TDK	D	Fe	330	1200		0.75	0.0		2.59
TDK	AD	Fe	390	1500		0.8	0.8		3.99
TDK	SA	FeCo	540	1500		0.83	+1.5		4.99
Zayre	Pro Range	Fe							0.70

Notes on Headings:

"COER" and "Oer" are "coercivity" and "oersteds" respectively.

"RET" and "Gau" are "retentivity" and "Gauss" respectively.

"REM" and "Max" are "remanence" and "Maxwells" respectively.

"SQU" and "RAT" are "squareness ratio."

"SENS" is sensitivity, at 333 Hz.

Prices for C-90s are given as supplied and include all varieties of list, suggested net, direct mail order, suggested retail, etc.

with the 400-Hz 3 per cent distortion point as the signal reference level. The Nakamichi T-100 audio analyzer was used to measure levels, signal and noise, and the distortion at 400 Hz. A Tektronix 5L4N spectrum analyzer was used for the 100 Hz and 3 kHz tests. Swept responses utilized an Exact 128 generator with an 80-second sweep, a Gen Rad 1933 SLM as the a.c./d.c. log converter and an MFE 715 X-Y recorder. A Morrey-modified Heath IG-18 generator was the low-distortion source.

Modulation noise was measured with a 1-kHz tone recorded at 0 dB. The 500-to-1500 Hz bandpass was set with a Gen Rad 1952 filter, and the tone was notched out on playback with a UREI 560, with all supressor filters at 1 kHz. Flutter data was gathered with the Nakamichi T-100. Earlier data had also been taken with a Tandberg TCD-330 feeding a Ferrograph RTS-1. Amplitude stability and drop-outs were measured, to some extent, with the slow swept-frequency responses. Additional data was gained with a 3-kHz tone feeding the SLM on playback with *Fast* response, with its output feeding a storage scope.

Consistency of bias and EQ requirements, frequency response, sensitivity, and skew were checked for all samples of each length. Variations in C-60s or C-120s compared to C-90s were also determined, and their record/playback response plotted.

Test Results

The 58 formulations were distributed in five categories as follows: 8 low-bias ferric tapes, 34 normal-bias ferric tapes, 3 ferrichrome tapes, 8 CrO_2 tapes, and 5 high-bias non-CrO_2 tapes. The need for the first category was revealed in the testing as these tapes exhibited common properties. The table shows the results with all of the C-90 tapes, grouped in the categories mentioned. (C-60 results are shown when that was the only length available.) Listed are the high-frequency 3-dB down points at 0 and -20 dB, the MRL at four frequencies, the S/N ratio in dBA, the modulation noise in (-) dB, and the relative 400-Hz sensitivity and bias, both in dB. The EQ is given in dB change introduced at 10 kHz. The flutter is weighted peak in per cent. Frequency response plots are shown for each of the cassettes, including C-60 and C-120 lengths. Additional comments on each formulation appear with the discussion of the plots below. Cassettes were screw-assembled with regular hard-plastic boxes, unless noted otherwise.

As mentioned earlier, the bias and EQ were adjusted for the best response with each tape, with particular attention to the region between 1 and 10 kHz. Data taken on many tapes showed that a rough guideline could be drawn that for every dB change in bias with a particular tape, there would be a 2-dB change in re-

Table 1: Test Results

BRAND OR MANUFACTURER	DESIGNATION	RESP. @ 0 dB Level	-3 dB kHz -20 dB Level	MRL (dB re 0 dB) AT 4 FREQS.(Hz) HDL$_3$=3% 100	400	3k	Sat. 10k	S/N RATIO dBA	MOD. NOISE -dB	400-Hz SENS. dB	BIAS dB	EQ dB	W&F WTD PK %
DAK	HEC	4.4	14.1	-7.5	-7.0	-4.5	-15.7	48.0	43.7	-2.3	-3.3	0	0.045
K-Mart		4.7	14.0	-3.2	-3.4	-1.7	-14.0	49.2	44.0	+0.2	-3.1	+1	0.10
Lafayette	LN	5.5	15.0	-3.8	-3.4	-1.0	-12.5	48.8	40.3	-0.5	-3.3	+½	0.05
Lafayette	Criterion	5.8	15.4	-4.1	-2.8	-2.6	-11.0	48.9	45.6	0.0	-3.2	0	0.07
Realistic	Concertape	4.2	11.2	-6.1	-8.4	-3.7	-17.5	46.0	43.6	-2.0	-3.2	+2	0.07
Realistic	LN	4.5	13.7	-8.2	-9.0	-7.2	-15.8	46.0	42.3	-2.0	-3.0	-½	0.07
Royal	APC/LN	3.3	8.6	-9.3	-11.1	-7.2	-23.0	46.5	39.3	-2.0	-3.4	+3	0.07
Zayre	Pro Range	4.8	13.6	-9.0	-9.3	-6.8	-16.3	48.8	44.5	-1.8	-3.1	0	0.11
Average values for low-bias ferric tapes		4.6	13.2	-6.4	-6.8	-4.3	-15.7	47.8	42.9	-1.3	-3.2	+¼	0.073
Ampex	Plus	6.0	15.8	+1.0	+2.5	+0.9	-11.2	54.6	48.0	+1.0	+0.1	0	0.055
Ampex	20-20+	5.9	16.0	+2.6	+4.0	+1.4	-10.7	55.3	47.3	+1.6	-0.5	0	0.06
Ampex	Grand Master	7.4	16.9	+5.0	+5.4	+2.7	-8.5	55.8	46.7	+2.8	-0.1	-½	0.075
AudioMagnetics	High Performance	6.8	16.4	+2.5	+3.0	+1.5	-9.8	54.0	43.0	+1.2	-0.1	0	0.075
BASF	Performance	5.8	16.0	-1.2	-1.3	-0.7	-11.3	52.1	42.5	+0.3	-1.6	0	0.065
BASF	Studio	6.4	15.6	+0.9	+1.4	+1.4	-11.7	53.8	47.2	+1.2	-0.1	0	0.06
BASF	Professional I	7.6	15.9	+4.0	+4.8	+2.3	-8.8	56.3	46.7	+1.0	+0.3	-½	0.065
Capitol	1	5.4	14.7	-0.5	+2.1	-0.5	-13.2	55.2	44.8	+1.0	-0.9	0	0.075
Capitol	Music	5.8	15.7	-1.7	-1.0	+0.5	-11.3	51.8	42.9	0.0	-0.6	0	0.055
Certron	HE	6.3	16.2	-0.8	-0.4	-0.3	-10.8	51.2	43.3	+1.5	-1.6	0	0.07
Columbia	Low Noise	5.5	15.6	-0.2	-1.4	-3.4	-11.0	51.4	44.3	+0.7	-1.1	-½	0.07
Comsette	Low Noise	6.6	16.3	+1.0	-1.5	+3.0	-10.6	53.7	41.1	+1.0	-1.0	-½	0.07
DAK	HEC-SL	5.8	15.4	-2.7	-3.5	-2.3	-13.4	48.8	46.2	-1.7	-0.7	-1	0.08
Fuji	FL	6.4	15.7	+0.4	+0.2	-0.8	-10.7	52.5	48.7	-0.8	-1.5	-1	0.065
Fuji	FX-I	7.2	16.4	+1.3	+2.2	-0.3	-8.8	54.5	48.1	+1.0	0.0	-1	0.07
Lafayette	XHE	6.0	15.3	-0.5	+1.0	-0.8	-11.5	52.1	46.5	+0.7	-1.0	0	0.07
Maxell	LN	6.2	15.6	-0.8	-0.6	-2.7	-11.7	52.0	47.7	-0.1	-0.8	-1	0.055
Maxell	UD	7.6	16.5	+3.3	+3.3	-0.5	-8.6	54.8	47.7	+1.7	+0.1	-1	0.042
Maxell	UDXLI	7.1	16.4	+5.4	+5.1	+0.8	-9.7	55.8	47.8	+2.5	+0.1	-½	0.07
Memorex	MRX$_3$	6.8	16.0	+4.4	+4.3	+2.2	-9.8	56.2	46.7	+2.0	+0.3	0	0.08
Nakamichi	EX	7.3	16.7	+1.9	+2.6	+0.6	-8.1	53.9	49.8	+0.8	+0.7	-½	0.065
Nakamichi	EXII	7.3	16.3	+4.2	+4.5	+2.8	-9.7	56.4	47.8	+2.7	-0.2	-½	0.065
Realistic	Supertape Gold	7.2	17.2	+6.5	+6.4	+2.7	-7.8	57.5	44.5	+2.0	+0.3	-½	0.075
Royal	Ultra Linear	7.1	16.1	+1.2	+0.7	+0.8	-9.5	52.3	44.0	-1.0	+0.1	-1	0.07

sponse at 10 kHz. Increasing the bias would cause a drop in response, and decreasing it would have the reverse effect. With a particular *recorder*, changing to a tape requiring less bias could cause an unacceptable loss in highs, or perhaps reduce excessive highs in another case. A tape calling for more bias, of course, would add more response at the high end. From the bias listing in the table, you can tell what to expect in this regard if you do mage a change.

Consistency of bias requirements from one length to the other is reported for each formulation so that you will know what to expect. Perhaps you will want to choose a tape which shows the same bias for all lengths. Consistency of sensitivity for the various lengths of one tape, and differences in sensitivity from one tape to the other, is important for best Dolby tracking, particularly if your deck does not have provision for adjusting the record sensitivity. Variations in tape skew as shown by the need to adjust the record head of the Technics RS-9900US are indicative of changing mechanical alignment of the tape itself. If the tape were made and guided perfectly, the skew problem would disappear. The relative skew from sample to sample for a tape, expressed in dB loss at 10 kHz, is indicative of the mechanical consistency resulting from design, manufacture, and assembly.

Low-Bias Ferric Tapes

The eight tapes in this category all had the best responses with bias 3.0 dB or more below the ferric bias reference. Some of the responses at -20 dB did not seem bad, but most were somewhat poorer at 0 dB. At the bottom of each column for the eight tapes are the average values. Note that the MRLs are below zero at all frequencies; measurable compression had taken place by the time these tapes had been driven hard enough to get to the reference playback level. All S/N ratios are less than 50 dBA, and the average modulation noise is less than 43 dB down. Most of the tapes had typical flutter figures, but the K-Mart and Zayre tapes were 50 percent higher than most. It had been expected that these two tapes would not be particularly great, but more had been expected from some of the others. No tapes in this category can be recommended for true high fidelity recording, though they can prove adequate for other purposes.

Normal-Bias Ferric Tapes

This category includes 34 tapes, more than half the total. Bias requirements ranged from -1.8 to +0.9 dB, with most figures between -1.0 and +0.4. Discrepancies between the bias specifications and the test settings kept appearing, but these differences were small in many cases. The average results for this large group were markedly

BRAND OR MANUFACTURER	DESIGNATION	RESP. @ 0 dB Level	−3 dB kHz −20 dB Level	MRL (dB re 0 dB) AT 4 FREQS.(Hz) HDL$_3$=3% 100	400	3k	Sat. 10k	S/N RATIO dBA	MOD. NOISE -dB	400-Hz SENS. dB	BIAS dB	EQ dB	W&F WTD PK %
Scotch	Highlander	5.7	15.2	−1.8	−2.0	−2.8	−11.8	50.8	47.0	0.0	−1.8	−1	0.075
Scotch	Dynarange	8.1	16.3	+1.4	+1.8	+0.8	−6.9	54.2	48.5	+0.9	+0.3	−1	0.07
Scotch	Master I	7.8	17.0	+6.2	+6.4	+4.7	−7.0	57.4	46.9	+2.7	0.0	−1	0.08
Sony	LN	6.5	16.0	−1.5	+0.6	−1.4	−10.8	52.9	47.5	−0.9	−1.5	−½	0.08
Sony	UHF	6.2	15.7	−1.0	+0.7	−0.3	−11.4	53.6	47.4	+0.1	−0.1	0	0.045
Superscope	HF	5.3	15.4	−1.8	−0.5	−1.4	−12.9	53.0	45.6	−1.4	−1.2	0	0.08
Superscope	SHF	5.9	15.3	−0.6	−0.8	+0.5	−10.0	53.9	47.8	+0.3	−0.5	−½	0.08
TDK	Maverick	6.4	15.9	−1.7	−1.4	−1.0	−11.0	51.4	47.2	+0.2	−1.1	−½	0.08
TDK	D	6.0	15.5	−2.3	−1.6	−1.0	−11.4	51.0	46.3	−0.1	−1.0	−1	0.07
TDK	AD	7.8	17.1	+2.8	+3.7	+1.6	−7.3	55.7	47.9	+0.7	+0.9	−1	0.07
Average values for normal bias ferric tapes:		6.5	16.0	+1.1	+1.6	+0.3	−10.3	53.7	46.3	+0.8	−0.5	−½	0.069
BASF	Professional III	5.2	22.6	+6.2	+6.0	−4.0	−8.0	61.5	44.4	+1.1	+0.9	−1	0.065
Scotch	Master III	6.1	22.2	+5.0	+5.8	−4.5	−7.4	60.0	47.3	+2.2	−0.5	−2	0.065
Sony	FeCr	4.9	23.0	+4.1	+5.5	−4.8	−7.7	60.4	45.9	+0.5	+0.6	−½	0.085
Average values for ferrichrome tapes:		5.4	22.6	+5.1	+5.8	−4.4	−7.7	60.6	45.9	+1.3	+0.3	−1	0.072
BASF	CrO_2	5.5	17.2	−4.2	−3.8	−4.6	−10.5	53.8	46.3	−2.3	+0.5	0	0.06
BASF	Professional II	5.6	18.8	+4.2	+3.8	+1.2	−8.5	58.1	48.8	+1.0	+1.2	+½	0.08
Capitol	Music	5.8	17.3	−0.4	+0.4	+2.3	−10.0	55.8	47.4	−2.0	0.0	0	0.07
Memorex	CrO_2	6.6	18.5	+0.8	0.0	−3.0	−8.8	55.8	48.8	−1.6	+0.1	−½	0.062
Realistic	CrO_2	6.6	19.0	+0.4	+1.1	−1.0	−7.9	56.7	45.2	0.0	−0.7	0	0.10
Royal	CrO_2	6.5	18.2	+1.1	−0.4	−3.2	−6.5	56.5	48.8	−0.3	−0.2	−1	0.09
Sony	CrO_2	6.7	18.1	−0.9	+0.5	−3.1	−8.6	55.9	50.3	−1.2	+0.2	0	0.075
Superscope	CrO_2	6.1	18.7	0.0	−1.0	−4.2	−9.8	54.5	47.2	−0.7	−0.5	0	0.07
Avg. values for CrO_2 tapes:		6.2	18.2	+0.1	+0.1	−2.0	−8.8	55.9	47.9	−0.9	+0.1	--	0.067
Fuji	FX-II	6.9	18.6	+1.1	+1.9	−1.4	−7.9	57.3	47.7	+2.8	−0.4	0	0.065
Maxell	UDXLII	8.4	19.3	+3.6	+3.3	−0.2	−6.5	57.6	50.7	+2.1	−1.0	−¼	0.07
Nakamichi	SX	7.3	19.1	+0.9	−0.1	−2.0	−8.0	55.0	49.0	+1.0	−0.4	0	0.085
Scotch	Master II	7.0	20.2	+1.6	+3.5	−0.7	−5.0	58.8	46.2	+2.6	−0.2	+½	0.085
TDK	SA	7.9	18.9	+1.6	+2.4	−0.5	−6.5	56.8	49.6	+1.6	+0.1	−1	0.10
Avg. values for high-bias non-CrO_2 tapes:		7.5	19.2	+1.8	+2.2	−1.0	−6.8	57.1	48.6	+2.0	−0.4	--	0.081

better than those for the low-bias tapes — high fidelity had been reached. It should be noted, however, that those formulations with bias values from -1.8 to -0.7 were *generally* not the equal of tapes with higher bias requirements. Once again, keep in mind that a lower-bias tape (say -1.5 dB) would have a high-frequency loss (2 dB at 10 kHz) for more normal bias (say -0.5 dB). There are improvements in every single area over the low-bias (-3 dB) tapes, but some formulations in this category are little better. DAK HEC-SL, for example, has MRLs all below 0 dB and a S/N ratio of less than 50 dBA. There are other tapes with all MRLs below zero dB, and all of these have bias values on the minus side.

On the other hand, Ampex 20-20+ and Grand Master, BASF Professional I, Maxell UD and UDXLI, Memorex MRX$_3$, Realistic Supertape Gold, Nakamichi EXII, Scotch Master I, and TDK AD all deliver very good frequency response, excellent MRLs, very good S/N ratios, and low modulation noise. The average bias for these tapes was +0.1 dB. Review of the table will allow comparing a tape with any other, and with the averages for the category. Do not put too much weight on minor differences in frequency response. The difference in sound between roll-off at 15.5 and 16.5 kHz is very subtle, and such a difference can be caused by a small change in the bias. More important is the smoothness from 1 to 10 kHz shown in the plots.

Ferrichrome Tapes

This group of just three tapes showed the best performance in response at -20 dB, MRLs at 100 and 400 Hz, and S/N ratio. Modulation noise was very close to that for the ferric tapes. The MRL at 10 kHz was somewhat better than the average of the better ferric tapes. The responses at 0 dB and the MRLs at 3 kHz were not quite as good, however, and the cause is unclear.

CrO_2 Tapes

The eight tapes in this group showed response limitations similar to the FeCr cassettes at 0 dB, but the rolloff was at a higher frequency. At -20 dB, the high-end limit averaged 18.2 kHz, better than any of the ferrics, although not equal to any of the FeCr tapes. The high-end -3-dB point could have been shifted out very easily with a reduction in bias, but with an increase in a broad peak around 10 kHz, putting it above the +1.5 dB test limit. The S/N ratios were very good, although not up to those of the FeCr cassettes. The average modulation noise was lower than the ferric or FeCr tape averages. With the exception of BASF Professional II and Realistic CrO_2, the test bias range was +0.5 dB, a small change in requirements from one tape to the other.

High-Bias Non-CrO_2 Tapes

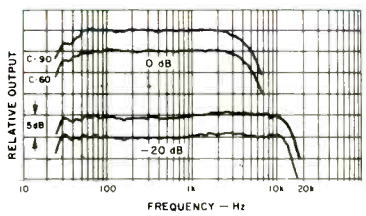
The five tapes in this group had performance that, on the average, was superior in each area compared to the CrO_2 samples. There was some variation within each group, however, and any prospective choice should be compared to the other 12 tapes in the two categories, to say nothing about the FeCr formulations or one of the better ferrics. The flutter was very slightly higher than in any of the other categories.

Low-Bias Ferric Tapes

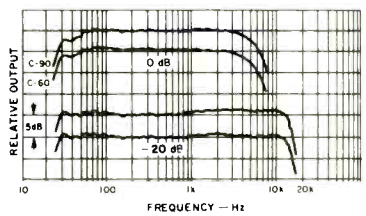
DAK HE: Generally smooth responses, but limited in extent. Compression across frequency range at zero dB level with roll-off of lows. Continual, rapid variations in sensitivity of 0.5 dB. Skew consistent within 1.5 dB at 10 kHz for C-90s. Skew and bias of C-60s consistent with C-90s. Many medium drop-outs. Sonic-weld cassette, a bit rough.

K-Mart: Generally smooth responses, but limited in extent. Compression across frequency range at 0 dB level. Continual, rapid variations in sensitivity of 0.5 dB or so. Consistent skew and bias. Three medium and nine minor

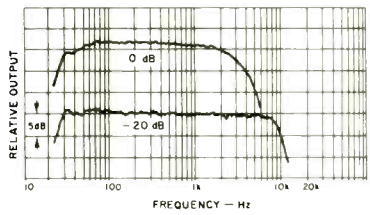
Low-Bias Ferric Tapes



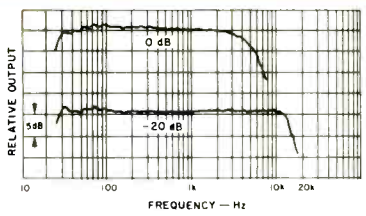
DAK HE



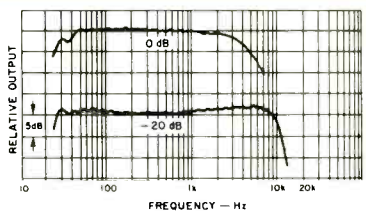
Lafayette Criterion



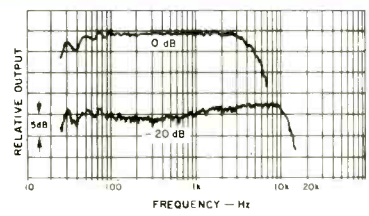
Royal Low Noise (APC), C-90 Only



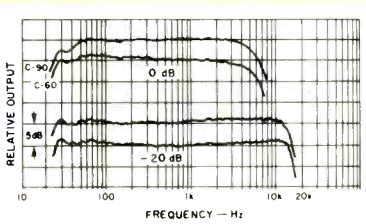
K-Mart, C-60 Only



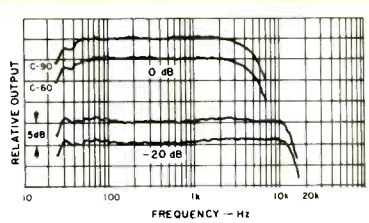
Realistic Concertape, C-60 Only



Zayre ProRange, C-60 Only



Lafayette LN



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dropouts. Sonic-weld cassette, a bit rough, one of which jammed. Plastic bag.

Lafayette LN: Generally smooth response, but limited in extent, particularly at 0 dB where compression occurred. Continual variations in sensitivity of 0.5 dB or more. Spread in sensitivity of 2 dB from cassette to cassette. Consistent skew and bias within C-90s. Bias 2.4 dB higher (-0.9 dB) for C-60s. Skew change caused 1.5 dB drop at 10 kHz re C-90s. One C-60 jammed. Five medium drop-outs. Sonic-weld cassette. Soft plastic box.

Lafayette Criterion: Generally smooth response. Overall the best performer in this category. Sensitivity spread of 1 dB. Consistent bias, but one C-90 had change in skew causing 3.5 dB drop at 10 kHz (on the three-head test deck). The C-60s had skew resulting in more than 10 dB drop with C-90 setting. C-60s showed compression at 0 dB. Nine major drop-outs.

Realistic Concertape: Limited frequency response. Compression at 0 dB. Continual, small variations in sensitivity. Consistent bias and skew. Eleven minor drop-outs. Sonic-weld cassette. Plastic bag.

Realistic LN: Limited frequency response. Compression at 0 dB. Amplitude variations generally less than ¼ dB. One C-90 much different in skew. Skew effects for C-60s showed 3 dB spread at 10 kHz. Three medium and nine minor drop-outs. Sonic-weld cassette.

Royal APC/LN: Very limited frequency response. Heavy compression at 0 dB. Continual, rapid sensitivity variations up to 1 dB. Many major drop-outs. Excessive drag tripped end-of-tape sensor, preventing some tests. Sonic-weld cassette.

Zayre Pro Range: Mediocre response with continual, rapid sensitivity variations up to 1 dB and heavy compression at 0 dB. Sensitivity variations prevented getting data on bias and skew consistency. Seven minor drop-outs. Sonic-weld cassette. Plastic bag.

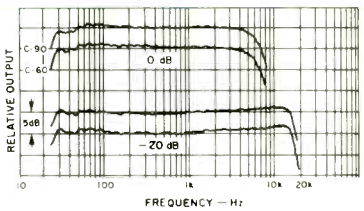
Normal-Bias Ferric Tapes

Ampex Plus: Good frequency responses, average for this category. One sample showed periodic sensitivity variations of 0.5 dB. Consistent bias and skew for C-90s, and for C-60s, but C-60s 0.7 dB less bias (-0.6 dB) and had different skew. Six minor drop-outs.

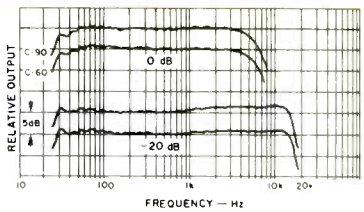
Ampex 20-20+: Good, smooth frequency response. Periodic sensitivity variations of 0.3 dB. Bias requirements consistent for both lengths. C-60s skewed slightly relative to C-90s. Four very minor drop-outs.

Ampex Grand Master: Very good, smooth frequency response with excellent headroom across the band. Excellent consistency in sensitivity, skew and bias requirements for all samples of both

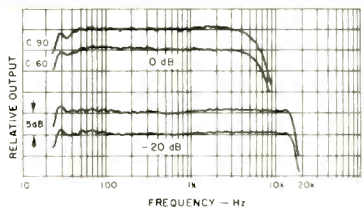
Normal-Bias Ferric Tapes



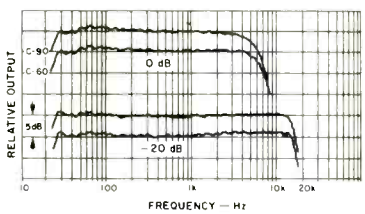
Ampex Plus



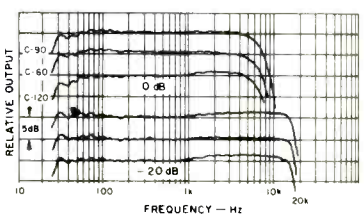
BASF Performance



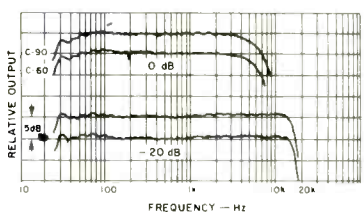
Capitol Music



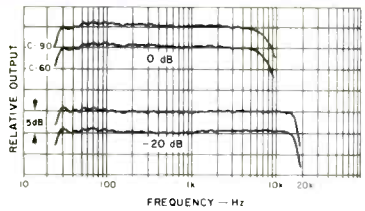
Ampex 20-20+



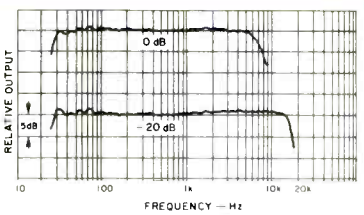
BASF Studio



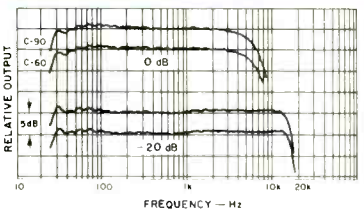
Certron HE



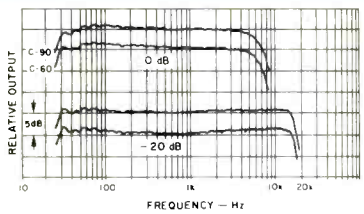
Ampex Grand Master



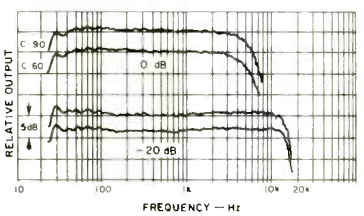
BASF Professional I, C-90 Only



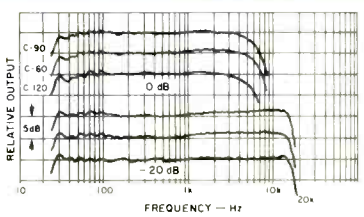
Columbia Low-Noise



AudioMagnetics High Performance



Capitol I



Comsette Low-Noise

lengths. Two medium drop-outs. One of the best ferric tapes.

AudioMagnetics High Performance: Above average frequency responses with good headroom across the band. Sensitivity spread over 1.5 dB plus continual small variations. Skew quite consistent from cassette to cassette, but varied some with time. Ten minor drop-outs.

BASF Performance: About average frequency responses with lower than average headroom across the band. Sensitivity spread 1.2 dB with very minor variations with time. Skew very consistent for all samples. C-60s required 0.3 dB more bias (to -1.3 dB). One medium drop-out.

BASF Studio: Frequency responses, headroom, etc. generally average for this category. Excellent consistency in bias and skew for all samples and all three lengths. Sensitivity consistent for all C-90s and C-60s, but 2.6 dB lower for C-120s. One major drop-out.

BASF Professional I: Very smooth frequency responses, although not particularly extended at -20 dB. Excellent headroom and S/N ratio. Sensitivity spread 1.6 dB, with very little variation with time. Bias requirement consistent, although shift in skew with one sample was evidenced with 1.5 dB drop at 10 kHz. One medium drop-out.

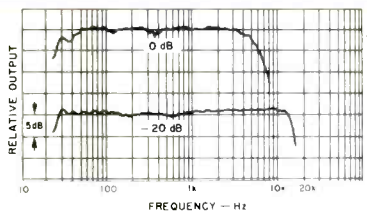
Capitol 1: Frequency responses generally smooth, but below average, as was the MRL at most points. Sensitivity, bias, and skew were consistent most of the time and for most samples, but a slow amplitude "breathing" in the higher frequencies made assessment difficult. C-60s required 1.8 dB lower bias (to -2.7 dB). One major drop-out. Sonic-welded. Cardboard box.

Capitol Music: Smooth frequency responses, but below average, as was the MRL at most points. Consistent sensitivity, bias, and skew among C-90s and among C-60s, but C-60s were 1-dB more sensitive, required 0.4dB less bias (-1.0 dB) and showed 2-dB droop before correcting the record head. Three very minor drop-outs.

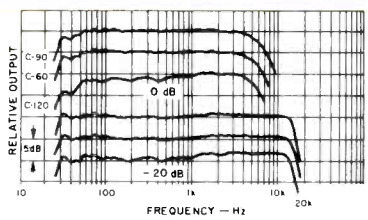
Certron HE: Average frequency responses. Below average for MRLs and other entries in table. Generally consistent sensitivity, skew, and bias requirements. Periodic small sensitivity variations. Five minor drop-outs.

Columbia Low Noise: Below average in frequency response and other respects. Sensitivity spread of 1.6 dB with minor variations with time. Skew inconsistency, with some samples down 6 dB at 10 kHz compared to most. C-60s required 0.9 dB less bias (-2.0 dB). Five very minor drop-outs. Sonic-welded.

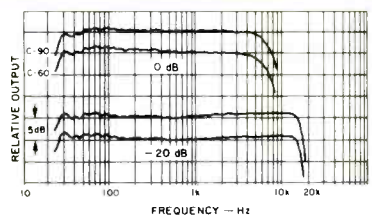
Comsette Low Noise: This formulation provides average performance in all respects, with the exception of higher modulation noise, for a lower-than-average price. Variations in sensitivity of up



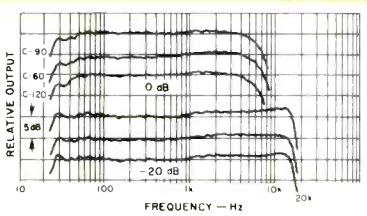
DAK HEC-SL, C-90 Only



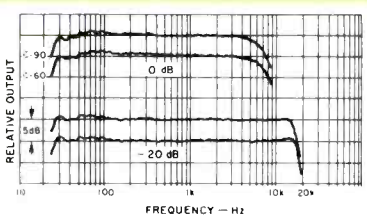
Maxell LN



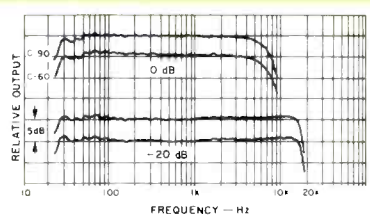
Nakamichi EX



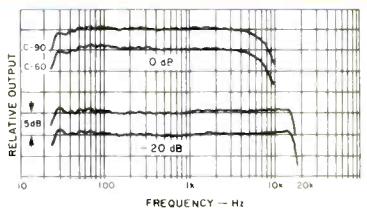
Fuji FL



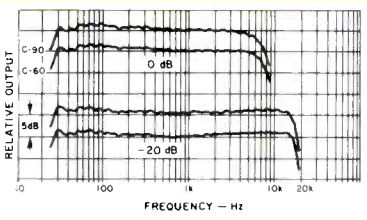
Maxell UD



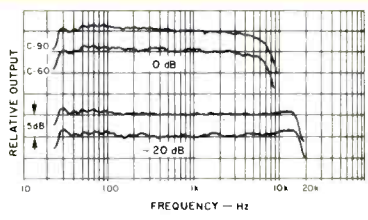
Nakamichi EX-II



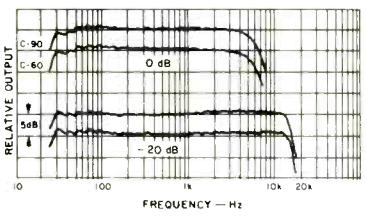
Fuji FX-I



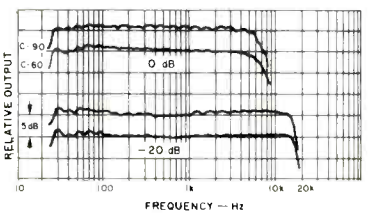
Maxell UD-XL I



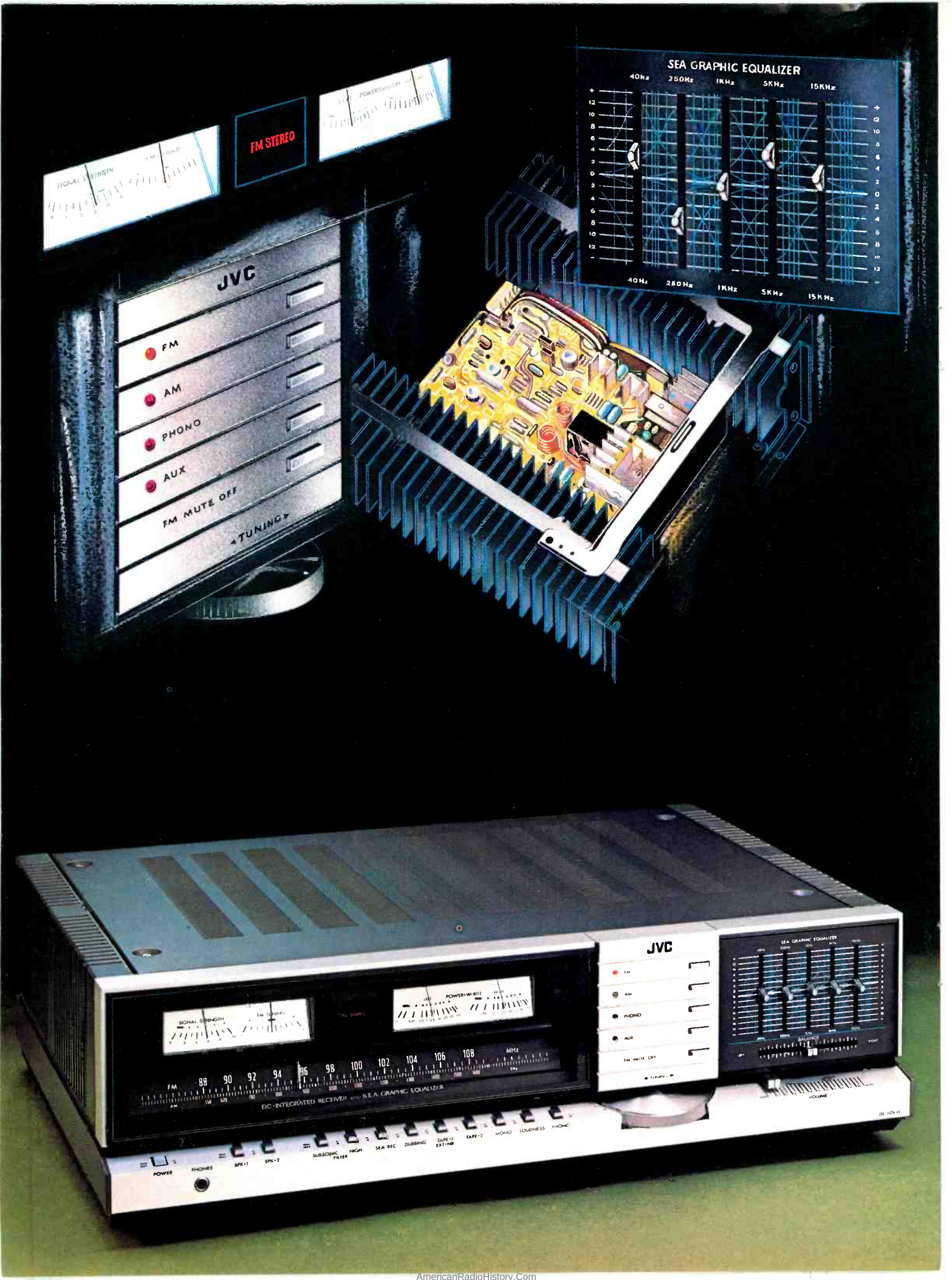
Realistic Supertape Gold



Lafayette XHE



Memorex MRX$_3$



THE JVC RECEIVER.

Every bit as revolutionary as they look, and then some.

In our case, looks are never deceiving. Because all our new DC integrated stereo receivers combine unprecedentedly revolutionary styling with electronic design features that reflect JVC's more than 50 years' experience in audio development and innovation.

DC POWER AMPLIFIER DESIGN

Usually found only in costlier separates, JVC offers DC amplifier circuitry in *all* four of our new receivers. By eliminating distortion-causing capacitors in our interconnecting circuit sections, JVC designers have created an amplifier that offers virtually distortion-free performance (0.03% THD) not only over the entire audio spectrum, but above and below it. As a result, all the sounds you hear are clearer, cleaner and crisper. Moreover, our DC design improves square wave performance and eliminates phase-shift—both factors being of paramount importance in distortion-free music reproduction. In addition, Triple Power Protection circuits and dual power meters give you safety and full indication of receiver operation. There are four new JVC DC integrated receivers, offering your choice of 120, 85, 60 and 35 watts/channel* respectively.

S.E.A.—ALL THE WAY

JVC was the first receiver manufacturer to offer a built-in S.E.A. Graphic Equalizer in a quality receiver, and we continue this tradition by incorporating this convenient feature in our entire new receiver line. Far superior to even triple tone controls, this JVC exclusive gives you complete control over the entire musical spectrum. You can attenuate or accentuate any of five separate bands, covering the entire audible range of music. And as an added feature, we've incorporated a special button so that the S.E.A. equalizer circuit can also be switched to your tape deck, so you record exactly what you hear.

PUSHBUTTON SOURCE SELECTORS

Unlike conventional receivers, ours incorporate an advanced pushbutton source selection panel. Color-keyed LEDs indicate the program source, and a full-function horizontal pushbutton panel provides total control over all receiver operations. Professional-type slider controls set volume and balance.

SUPERIOR TUNER SECTION

High sensitivity and tuning precision are featured in all four new JVC receivers. Multi-gang FM tuning capacitors, PLL MPX demodulators and other circuit refinements provide optimum frequency response and stereo separation for FM, with maximum sensitivity for AM reception—a feature often neglected in receiver designs. A thumb-control tuning wheel and accurate metering make station location and fine-tuning easy.

Other features include Mode/Loudness/Subsonic Filter switches and provision for connecting two sets of speakers.

Features, styling, innovation and performance: the four main things to look for in a DC integrated stereo receiver. And you'll find them all in a JVC. JVC America Company, Division of US JVC Corp., Maspeth, N.Y. 11378. In Canada, JVC Electronics of Canada, Ltd., Ont.

JVC

We build in what the others leave out.

JR-S501 (featured at left). Below. JR-S401 (top). JR-S201 (bottom left) & JR-S301 (bottom right).

*@ 8 Ohms, both channels driven from 20Hz-20 KHz, with no more than 0.03% THD.

Enter No. 12 on Reader Service Card

to 2.5 dB at a 2 Hz rate appeared at one point. Some samples had noticeably different skew than others. Bias requirements for C-120s matched the C-90s, but the C-60s required 0.7 dB more (-0.3 dB). Seven minor drop-outs. Sonic-welded.

DAK HEC-SL: Low-priced, direct-mail-order cassette was one of the poorest performers in this category, as examination of the table entries will show. Sensitivity was fairly consistent from cassette to cassette, but varied with time. Relative skew reached 1.5 dB at 10 kHz. Six minor drop-outs.

Fuji FL: Frequency responses and other characteristics were average. Sensitivity was very consistent and did not vary with time. Too few samples were received to check C-60 and C-120 consistency. Four very minor drop-outs.

Fuji FX-I: Frequency responses and other results were, in general, above average. This cassette tape was outstanding in its consistency of sensitivity, skew, and bias requirements for all samples of both lengths. There were minor wiggles in amplitude in the plotting, but there were zero drop-outs.

Lafayette XHE: Average performances were obtained with this tape. Sensitivity, skew, and bias requirements were consistent among all samples of both lengths, with the exception of minor sensitivity differences. Variations with time were very small, and there were six minor drop-outs.

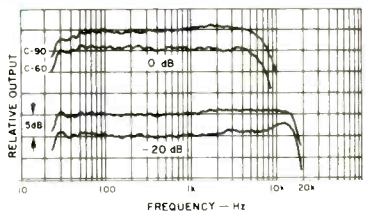
Maxell LN: Frequency responses and other results with this tape were average. Skew was consistent among all of the samples, and bias and sensitivity were consistent for each length. C-60s required 0.9 dB more bias (+0.1 dB) and had the same sensitivity as the C-90s. C-120s required 0.3 dB more bias (-0.5 dB) and were 1.4 dB less sensitive than C-90s. Sensitivity variations with time were very small except for the C-120s, which had a slow, periodic shifting. Two medium drop-outs.

Maxell UD: Very smooth, above average frequency responses with other areas of high performance to match. Excellent consistency of sensitivity, skew, and bias requirements among all samples of both lengths. Small sensitivity variations with 3-second period. Zero drop-outs. Lowest flutter of all tapes.

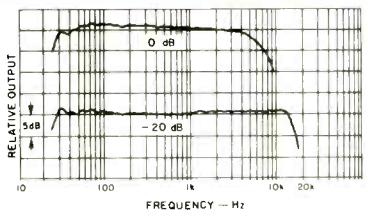
Maxell UDXLI: Generally smooth, above average frequency responses, but showing periodic sensitivity variations, of perhaps 0.5 dB. A high-performance tape in other areas, listed in the table, and with one exception, all samples consistent in sensitivity, skew, and bias requirements. Zero drop-outs.

Memorex MRX3: This tape formulation can provide performance that is above average in all areas. Bias and skew consistency could not be pinpointed as frequent, random level variations with most samples prevented ascertaining the best settings of the bias pot and the record head. With the best C-90 sample, used for the plotting, there were 1-dB varia-

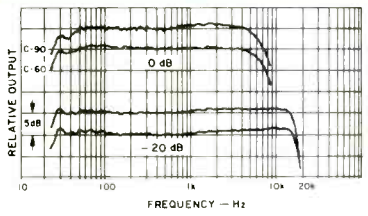
Normal-Bias Ferric Tapes—continued



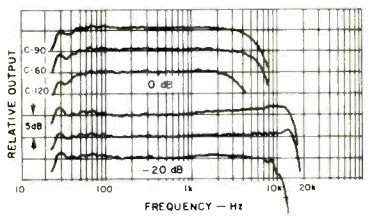
Royal Ultra-Linear



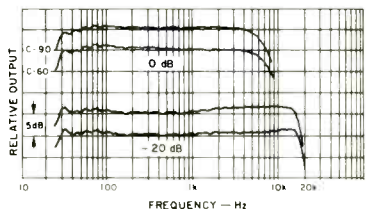
Sony LN, C-60 Only



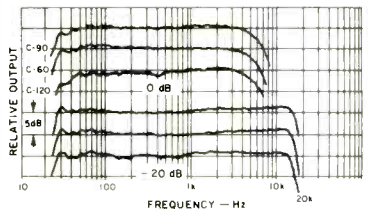
TDK Maverick



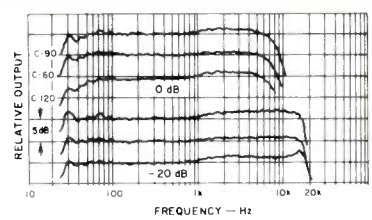
Scotch Highlander



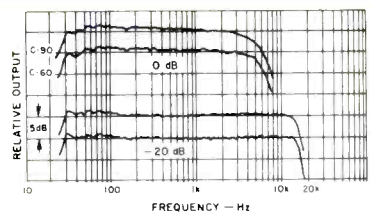
Sony UHF



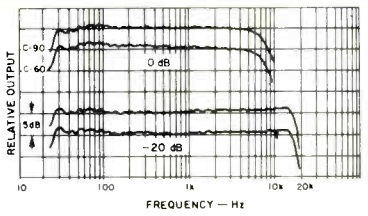
TDK D



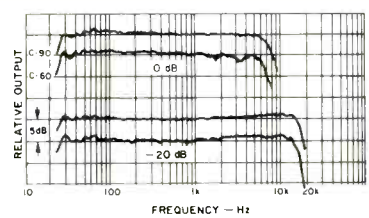
Scotch Dynarange



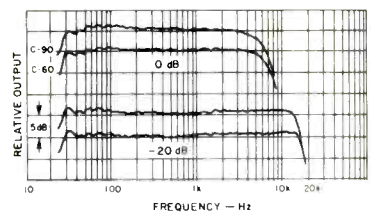
Superscope HF



TDK AD

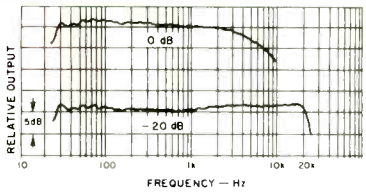


Scotch Master I

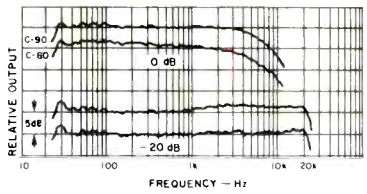


Superscope SHF

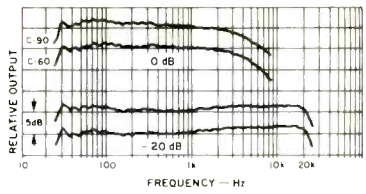
FerriChrome Tapes



BASF Professional III, C-90 Only



Scotch Master III



Sony FeCr

tions about every two seconds. Four minor drop-outs. Sonic-welded. Memorex box.

Nakamichi EX: The results were above average and quite similar to Maxell UD. Sensitivity, skew, and bias requirements were consistent among all samples. Amplitude variations were very small, and there were zero dropouts.

Nakamichi EXII: The response plots are above average, similar to Maxell UDXLI, but smoother. Outstanding consistency in sensitivity, skew, and bias requirements. Two medium and four minor drop-outs.

Realistic Supertape Gold: This tape, recently introduced by Radio Shack, had the widest frequency response at -20 dB for the ferrics. It was also one of the best in other areas, particularly MRL and S/N ratio. Sensitivity, skew, and bias requirements were very consistent for all samples of both lengths. There were some long-period variations in sensitivity of 0.8 dB. There were four medium and 7 minor drop-outs.

Royal Ultra Linear: This formulation had frequency responses and other characteristics that were average, in general. Skew was fairly close among all samples. C-60s were 2 dB more sensitive than C-90s with 1.5 dB less bias (-1.4 dB). Sensitivity variations occurred at times with a shift in level up to 2 dB. Drop-outs were minor.

Scotch Highlander: The frequency responses were below the group average, and the MRLs and the S/N ratios were low. Amplitude "breathing" at the higher frequencies prevented getting valid data on consistency. It appeared that the C-60s were quite close to the C-90s, but the C-120s required 1.6 dB less bias (-3.4 dB) and the sensitivity was 1 dB lower. Six minor drop-outs. Sonic-welded. Slide-in plastic box.

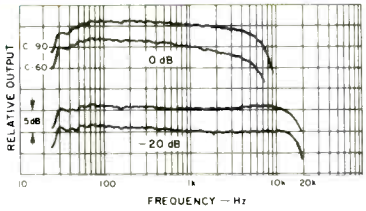
Scotch Dynarange: This tape delivers above average performance in every area, with the best response at 0 dB in this category. The MRLs were very good, with that at 10 kHz the best of all ferrics. Consistency was excellent among all samples and all three lengths. C-120s were exceptions in that they needed 0.5 dB less bias (-0.2 dB) and were 2 dB less sensitive. A few very minor drop-outs. Sonic-welded.

Scotch Master I: One of the best of the ferrics with smooth, wide frequency responses, high MRLs, and S/N ratios. C-90s consistent in all respects, but C-60s exhibited random and cyclic sensitivity variations which made adjustment difficult and interfered with the plotting. Fourteen minor drop-outs.

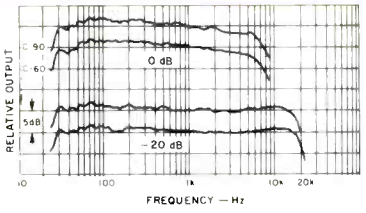
Sony LN: Average frequency responses, and close to average in other areas. Some variations in sensitivity, skew, and bias needs. Occasional 0.3 dB varia-

Continued on page 100

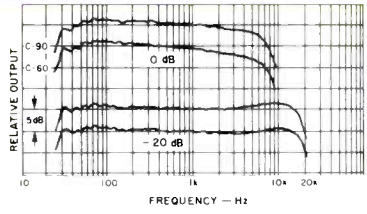
CrO_2 Tapes



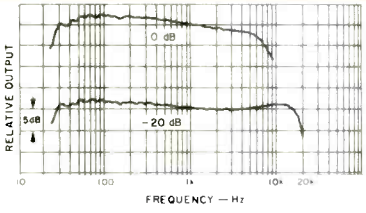
BASF CrO_2



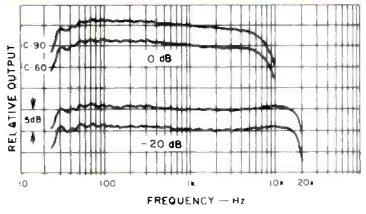
Memorex CrO_2



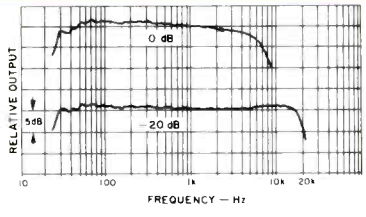
Sony CrO_2



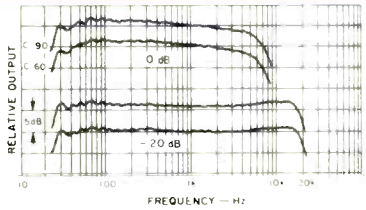
BASF Professional II, C-90 Only



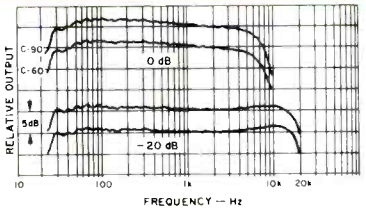
Realistic CrO_2



Superscope CrO_2, C-90 Only



Capitol CrO_2



Royal CrO_2

PERFORMANCE OF HIGH ENERGY MAGNETIC MATERIALS IN AUDIO CASSETTE RECORDING TAPES

Peter Vogelgesang*

The magnetic material which has been used almost exclusively in sound recording tapes for many years is the gamma form of iron oxide, or gamma Fe_2O_3. This material is a favorite because it is inexpensive, stable, and easily processed for tape manufacturing. Because early tape recording systems were limited in performance by electronic noise, mechanical instabilities, crude magnetic transducers, and by poor physical properties of magnetic tape, little attention was given to improving tapes by employing magnetic materials which had superior magnetic properties.

Today, solid-state electronic amplifiers produce only a small part of total system noise. Precision magnetic transducers can be manufactured of exotic ferrite materials or metallic alloys and have magnetic gaps controlled precisely to a few millionths of an inch. Magnetic tapes are slit to a width accuracy of one-thousandth of an inch, and tape surfaces have a mirror-like smoothness. Capstans, tape guides, and drive motors have been improved commensurately to utilize the improved physical properties of tape. And, a totally new improvement has been added; a preponderance of all magnetic tape manufactured today is enclosed in plastic cartridges or cassettes which protect it from both handling abuse and environmental contaminants.

As a consequence of these gradual improvements, the magnetic recording industry has seen a continued slowing of tape speed over the years. Full range audio recording once required a tape speed of 60 ips, but is now accomplished at the 1⅞ ips speed of the audio cassette. Limited bandwidth waveforms such as voice and background music are easily recorded at a speed of less than one inch per second.

With so many refinements occurring in related areas of magnetic recording, it was inevitable that improvement in the properties of the magnetic material used in tape would one day be required. Work directed toward this end was underway seriously in industrial laboratories in the early 60s.

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Today, consumers of audio cassettes have a choice of tapes using materials such as chromium dioxide (CrO_2), cobalt-modified iron oxide, and tapes made with multiple layers of these and other materials in combination. Manufacturers of cassette recorders have equipped their machines with multi-position switches to accommodate the new tapes by changing recording bias level and equalization.

The unique magnetic properties of chromium dioxide and cobalt-modified iron oxide used in these tapes are described by the generic term, "high energy." It is the purpose of this article to describe high energy materials and to show why and how they are used.

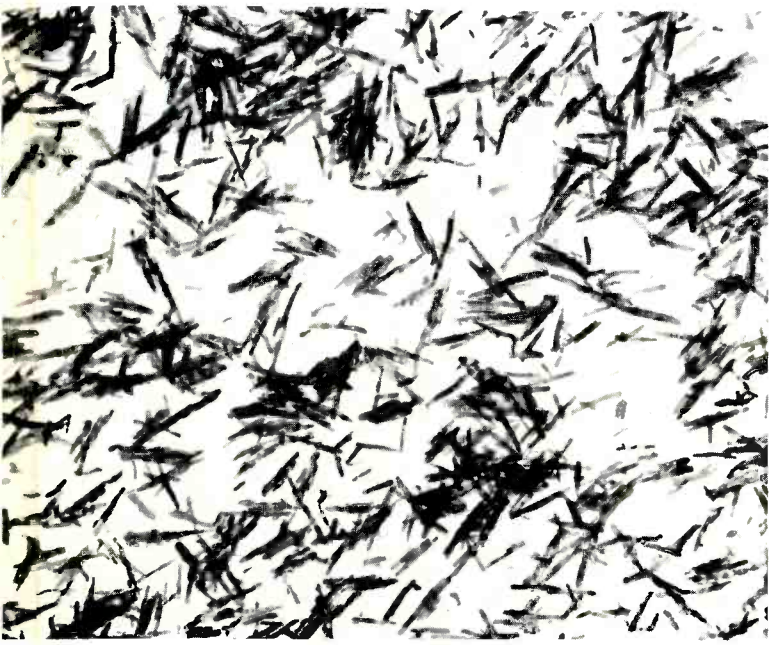

Fig. 1—An electron photomicrograph of a typical iron oxide magnetic material was made with a magnification of 45,000. The average length of these particles is about 0.4 microns, and the ratio of length to width is six to one.

Technical Background

Iron oxide magnetic material contained in recording tape consists of tiny, needle shaped or acicular particles which have an average length of 0.4 micron (16 millionths of an inch) See Fig. 1. These particles are mixed as a fine powder with a fluid binder, and the ingredients are milled using a process similar to the manufacturing of paint. The milled material, called a dispersion, is coated onto the surface of polyester film and then oven dried to make recording tape.

Each magnetic particle is an independent miniature permanent magnet. However, it behaves magnetically unlike a large magnetizable bar of iron with which we are all familiar. Because of the small size of the particles, each particle contains only a single magnetic domain. This domain cannot be demagnetized nor can it be made magnetically stronger or weaker. It is forever a permanent magnet of fixed strength, and the only magnetic change it will undergo is a polarity reversal of the magnetic field it produces. Fig. 2 shows how a single particle changes polarity and magnetization when immersed in a magnetic field which is reversing in a sinusoidal manner. A particle will behave in this manner when the direction of the applied field is parallel with the long axis of the particle. A very different characteristic is observed when the field is at right angles to the long axis. In magnetic tape, particles are aligned so that the long axis is parallel with the direction of the recorded tracks. Such orientation is achieved by immersing the coated tape in a strong magnetic field before the coating is dried, and while the particles are still mobile.

The time required for a single domain particle to reverse polarity, or switch, probably has never been measured (1) and may be considered instantaneous in any practical application of magnetic recording. In numerous laboratory investigations and computer simulations of the recording process, particle switching time has never surfaced as a limitation to the highest frequencies that can be recorded. Thus, designers of recording systems have built video recorders which record frequencies in the tens of megahertz without having to take into account a finite-response time of the magnetic tape.

Due to differences in size, shape, and chemical composition, particles within a bulk quantity of material will have a distribution of magnetic responses. In other words, although each particle within a batch switches at one critical intensity of applied field, the critical intensities of all particles are distributed in a manner which produces a familiar bell-shaped curve. Under the influence of a controlled applied field, a portion of the particles can be switched to one polarity, while the remaining particles stay in the original condition. Because the magnetic field produced by a bulk quantity of particles is the sum of all individual particle fields, the bulk quantity can be weakly or strongly magnetized, or it can be completely demagnetized. This effect is explained with the help of the magnetization curve of Fig. 3.

Coercivity of individual particles is largely responsible for coercivity of the bulk material. However, the density with which particles are packed together also influences the coercivity of a specific quantity of material (2). Coercivity of bulk material is reduced as packing density increases. Saturated remanent magnetization of bulk material also is dependent not only upon remanent magnetization of the particles, but on how closely particles are packed. Since the magnetic field produced by a quantity of material is the sum of the fields produced by individual particles, a greater number of particles in a given volume will produce greater remanent magnetization. Thus, remanent magnetization increases as packing density increases.

This fact has led to the necessity of distinguishing between the intrinsic remanent magnetization of particles and the magnetization of bulk quantities of particles. Intrinsic remanent magnetization essentially defines the remanence of isolated magnetic particles, and is determined by the chemical and physical makeup of the material. Remanent magnetization of a bulk quantity of material is dependent on this intrinsic property, but also upon how densely the particles are packed together. Remanence of a magnetic tape, then, is a function of 1) intrinsic remanence of the magnetic material, 2) density with which the material is packed, and 3) how thickly the material is coated on the tape.

Packing density in magnetic tape is limited by the percentage of polymer binder which must be used to hold particles together in a tough film. Attempts to increase magnetic material content beyond this point result in chalky coatings which will not withstand mechanical abrasion in recording machines. The "energy product" of a magnetic material is obtained by multiplying the values of M and H for a given point on the second quadrant of the major hysteresis curve. For the purpose of defining the performance of a particulate magnetic material used in recording tape, the "energy" of the material can be defined as the area enclosed by the second quadrant. Thus, energy can be increased by increasing either coercivity or remanent magnetization, and remanent magnetization, in turn, can be increased either by changing the intrinsic remanent magnetization of the particle or by increasing packing density of particles. For reasons which are the subject of the remainder of this article, increased remanent magnetization by either means should be accompanied by a corresponding increase in coercivity in order to obtain a maximum possible signal output of tapes used in audio cassette recording or any other kind of very short wavelength recording. The so-called "high energy" magnetic tapes avail-

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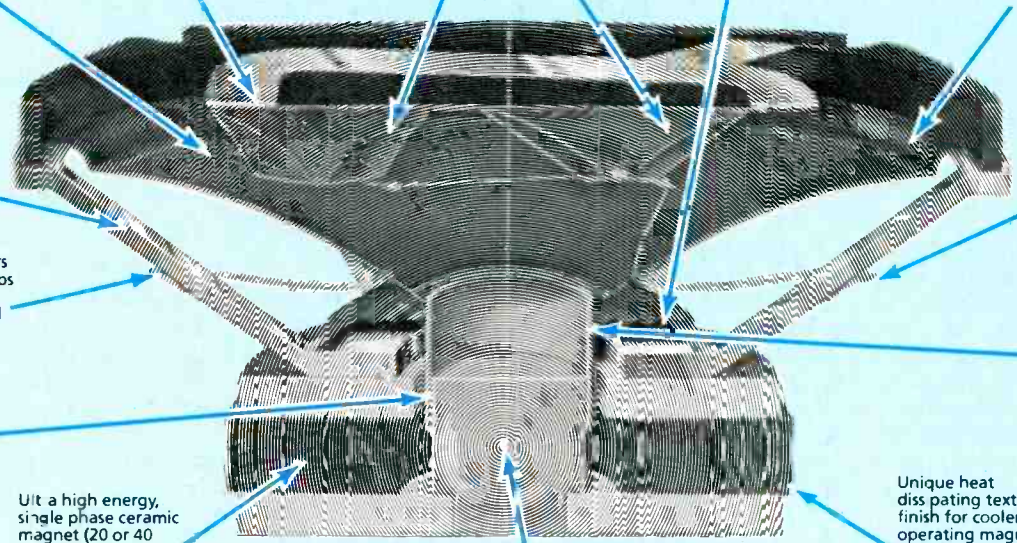

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Chrome Plate	Yes	No	Chrome plating in conjunction with die cast construction prevents rust.	40 oz.	60 RMS 120 Peak	not made	
Bi-Amp Capability	Yes	No	Permits hook up to the newer, more powerful dual output automotive systems being introduced.	Response:			The selection of totally solid state mid-range and tweeter elements produces superior sound in the 2,000 Hz range and beyond. Superior magnets and 50% larger voice coils provide greater low end performance.
Waterproof	Yes	No	Completely waterproof design is necessary for marine and outdoor use	20 oz. 5" x 7" coax	40/25,000 Hz	50/15,000 Hz	
				20 oz. 6" x 9" 3-way	30/25,000 Hz	40/20,000 Hz	
				40 oz. 6" x 9" 3-way	25/25,000 Hz	not made	
Voice Coil	1½"	1"	50% larger voice coil handles greater power and reduces distortion.	Warranty	5 Years	1 Year	Superior construction and design insures years of flawless performance without material or sound deterioration.
Unitized Magnet	Yes	No	Offers 1.6 times more energy than stacked magnets. This permits higher efficiency.	Price*	*$60.00	*$55.95	Great performance at a comparable price.

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able today in audio cassettes contain magnetic materials which have higher coercivity than gamma Fe_2O_3. The term "high energy" is a relative expression which uses iron oxide as the conventional standard.

The Effects of Demagnetization

The magnitude of a long wavelength electrical signal generated in a magnetic transducer during playback of a recorded tape is proportional to the remanent magnetization of the tape. A tape having twice the remanent magnetization of another will produce twice the electrical output. High transducer output is desired in order to obtain a high signal-to-noise ratio in the recording system.

As pointed out previously, remanent magnetization can be increased by 1) increasing the intrinsic remanent magnetization of the particles, 2) increasing the density of the magnetic material by packing more particles into a given volume, and 3) coating the magnetic material more thickly on the tape. At 1⅞ ips tape speed, none of these approaches to increasing remanent magnetization will produce a corresponding increase of high frequency output. A thicker coating will not increase high frequency output because short wavelengths are recorded only near the surface of a magnetic tape, and the thicker coating will create only an imbalance in the low and high frequency response of the recording system. The other two approaches to increasing remanent magnetization will not greatly improve high frequency output because of an effect known as "self-demagnetization."

Self-demagnetization in magnetic tape recording causes a loss of high frequency or short wavelength information at peak sound levels where the tape approaches magnetic saturation. Although a magnetic recording system may have an ideally flat frequency response at 20 dB below the maximum operating level (MOL) of the tape, the high frequency end of the audible spectrum becomes suppressed as the MOL is approached. Finally a point is reached where no amount of recording level increase will boost high frequency output, even though low frequencies retain a substantial headroom. Figure 4A shows that a cassette tape constructed with magnetic material having a coercivity of 340 oersteds is only 4 dB down at 19 kHz when the recording level is 20 dB below the MOL. At 0-dB recording level the output is 12 dB down at 10 kHz and is virtually non-existent at 19 kHz.

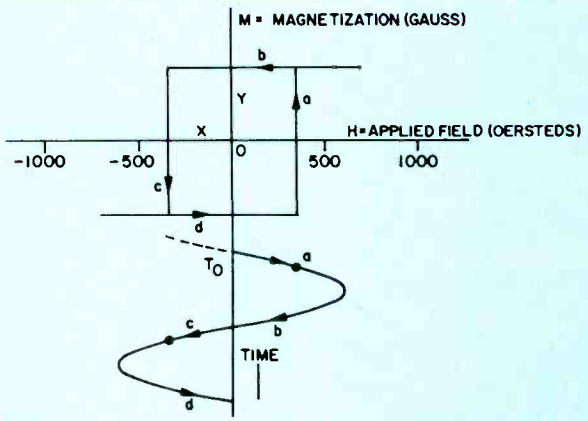

Fig. 2—The switching characteristics of a single-domain particle. The "X" axis represents the polarity and magnitude of a magnetic field, measured in oersteds, applied to a magnetic particle so that the direction of the field is parallel with the long axis of the particle. The sinusoidal waveform shows how the field changes with time. The "Y" axis represents the magnetization (M) of a single domain particle measured in gauss.

Starting at T_0, the applied field increases in a positive direction, passing through point A, which is equal to the coercivity (H_c) of the single particle, or about 340 oersteds for gamma Fe_2O_3. At this point, the applied field acts upon the particle to reverse its field virtually instantaneously. The new magnetization of the particle is exactly equal to the previous value, but polarity is reversed, producing a symmetrical figure.

The sinusoidal applied field returns to zero, but the particle remains magnetized in the positive direction. Not until the applied field reaches point C does the particle again switch to its original state. The pattern formed by these two variables is an ideal rectangle having sharp corners due to the instantaneous switching of the particle. This kind of figure is obtained with a single domain particle and will be considerably modified when particles having a wide distribution of coercivities are combined.

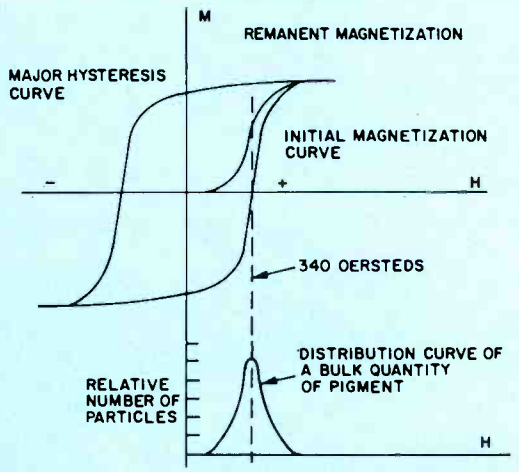

Fig. 3—The magnetization characteristics of a bulk quantity of iron-oxide particles which have a distribution curve in which a preponderance of particles switch at a coercivity of 340 oersteds. A small percentage have lower coercivity, and a similar percentage have higher coercivity, as shown in the figure. The distribution curve is essentially symmetrical. When initially mixed together, it can be assumed that the particles will be oriented in a random manner so that the net magnetic field produced by a bulk quantity is zero. In this state the bulk quantity can be considered demagnetized.

If an applied field is increased in the positive direction, magnetization of the bulk quantity follows an "initial magnetization curve" which is the integral of the distribution curve. The point of steepest slope of the initial magnetization curve coincides with the peak of the distribution curve, and this is the point where a maximum number of particles are switched. When the applied field is said to have reached saturation, and no further increase in applied field will increase magnetization.

Once saturated, the material then changes magnetic state in a manner described by the major hysterisis curve, and magnetization of the material in the absence of an applied field is termed remanent magnetization.

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★**318 MICROSECOND FREQUENCY RESPONSE TEST RECORD STR 170** Provides pickup designers and recording studios with a high-level, easily-equalized signal for frequency response and channel separation measurements. The STR 170 employs a 318 microsecond characteristic corresponding to the "test" or "flat" mode common to most disc recording equipment. Constant amplitude recording is employed in the region below 500 Hz with constant velocity recording in the region above. The transition is smooth, in contrast with the STR 100 which employs a sharp breakpoint at 500 Hz. The record is suitable for use with a graphic level recorder to provide permanent, visible records for precise evaluation.

★**WIDE RANGE PICKUP RESPONSE TEST RECORD STR 120** Makes possible the measurement of pickup response at frequencies far beyond the audible range, where elusive distortion elements can cause audible distortion. The low-frequency range includes glide-tones at twice normal level for the detection and elimination of arm resonance, loudspeaker cone and cabinet rattles. Other tests include: silent grooves for measuring rumble and surface noise characteristics; and standard level bands at O dB for overall system S/N measurements. This record is suitable for use with a graphic level recorder to provide permanent, visible records for precise evaluation.

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Although many people will not consider a loss of high frequency response at high levels to be a serious listening defect, intermodulation distortion which results from this problem has a profound effect upon the quality of recorded music. With most types of music this intermodulation distortion may be more destructive to good listening quality than harmonic distortion, and it will occur in a magnetic recording system at levels well below the conventionally accepted maximum output level.

Figure 4B contrasts the high frequency performance of a tape which employs a magnetic material having a coercivity of 550 oersteds. The improvement in short wavelength response is attributable to a reduction of self-demagnetization.

Loss of high frequencies due to demagnetization occurs because of the very short wavelengths produced by a tape speed of only 1⅞ ips. The cassette is most vulnerable to this problem. Demagnetization losses at tape speeds of 15 and 7½ ips are negligible. Let us examine the causes of demagnetization using the familiar example of bar magnets.

Any permanent magnet has both an internal and an external magnetic field. The shape and intensity of both fields are dependent upon the physical shape of the magnet. The ratio of length to cross-section dimensions of a magnet is called the proportionality factor. That part of the internal field which passes through the body of the magnet has a demagnetizing effect which limits the magnitude of remanent magnetization, that is, it limits the strength of the magnet after the magnet has been withdrawn from a magnetizing field. As shown in Fig. 5, the pole ends of a long permanent magnet are far apart, and much of the internal field extends into air around the magnet. A magnet with this configuration will experience little demagnetization, and therefore it can be magnetized to a fully saturated state. The magnet in Fig. 6 is broad relative to the distance between pole ends. In this case a larger part of the internal magnetic field will exist in the body of the magnet, causing demagnetization. Even though these two magnets may be subjected to the same magnetizing field, the short magnet may have less remanent magnetization when withdrawn.

Demagnetization is resisted by maintaining a certain ratio between remanent magnetization and coercivity. A magnet having relatively low remanent magnetization will not have an intense internal field, and thus will remain saturated even though it may have a corresponding low coercivity. But a high remanence

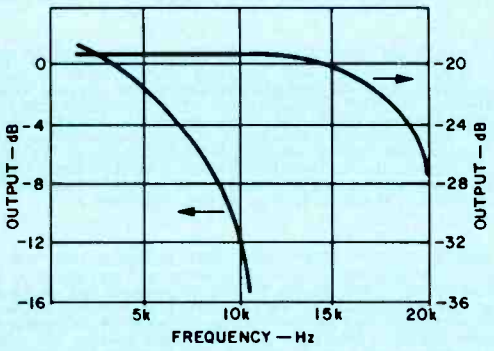


Fig. 4A—Frequency response of a gamma Fe_2O_3 tape at widely separated recording levels. Frequency response of a cassette tape is almost ideally flat when operated at a recording level 20 dB below the maximum operating level, which is generally defined as that level which produces 3 per cent third harmonic distortion in the reproduced signal at a frequency specified by a particular standard. High frequency output is greatly reduced when the tape is operated at the maximum output level, creating intermodulation distortion.

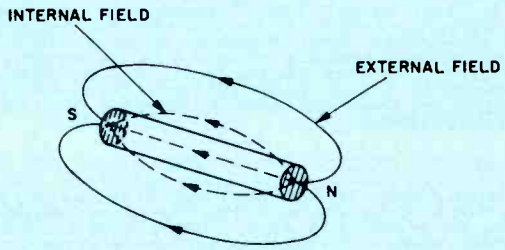


Fig. 5—The internal magnetic field of a long, thin permanent magnet exists largely in the air. This configuration will produce minimum self-demagnetization.

Fig. 4B—Less severe high frequency suppression occurs in a tape made with "high energy" magnetic material having a coercivity of 550 oersteds because of reduced self-demagnetization of the recorded signal.

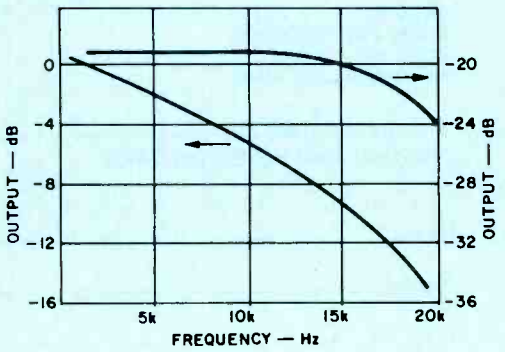
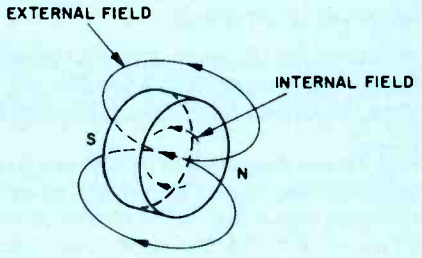


Fig. 6—Most of the internal magnetic field of a short, broad magnet passes through the body of the magnet, increasing self-demagnetization.



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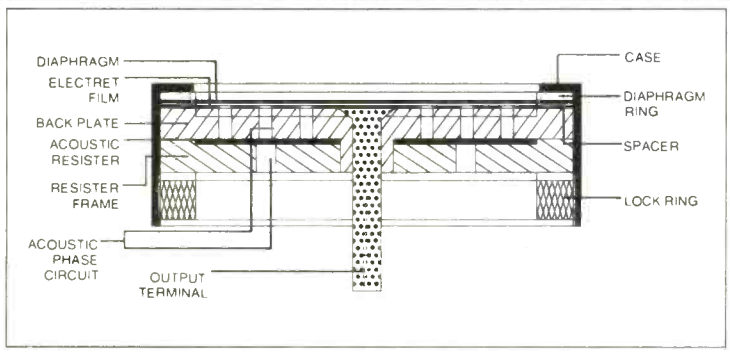

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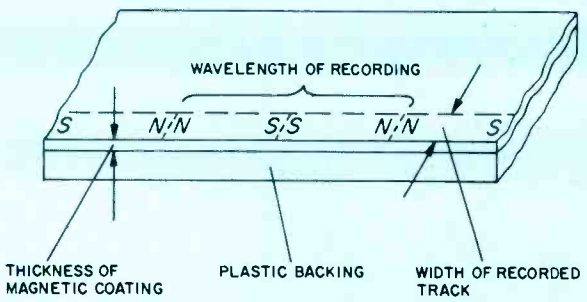

Fig. 7—The thickness of the magnetic coating and the wavelength of the recorded information establishes the proportionality factor of the "magnets" in a long wavelength recording. Even though the magnetic material is continuous, the magnets behave as though they were physically independent. The magnets grow shorter as the recorded frequency increases and will also become thinner at wavelengths shorter than one thousandth of an inch (about 2 kHz) because short wavelengths are recorded only near the surface of the tape.

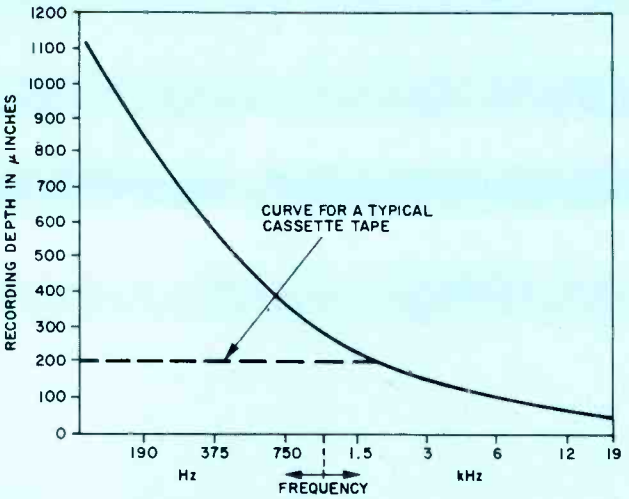

Fig. 8—In this recording depth vs. wavelength curve, the solid curve shows the recording depth that would occur in a thickly-coated magnetic tape moving at 1 ⅞ ips. Such a tape would produce far greater relative output at low frequencies than at high frequencies because more magnetic material would be utilized at the longer wavelengths. A typical cassette tape is coated only 200 microinches thick, so recording depth below 2 kHz is limited by the physical thickness of the coating.

magnet must also have a high value of coercivity, otherwise the internal field will spontaneously demagnetize the magnet, reducing remanence to a level which the coercivity will sustain.

Permanent magnets are used generally in magnetic "circuits" where magnetic fields are directed through soft iron poles. Examples of such uses are loudspeakers and permanent magnet motors. In these instances the soft iron circuits reduce the internal fields of the magnets, reducing susceptibility to demagnetization.

It is the self-demagnetizing effect that promotes the practice of placing a "keeper" across the pole ends of horseshoe shaped magnets to prevent demagnetization when not in use. The keeper is made of soft iron, and it short circuits the magnetic field to prevent the internal field from causing self-demagnetization.

Because the strength of the total field in and around a magnet is also dependent upon the level of magnetization, a magnetic material which is weakly magnetized will not demagnetize itself even though it may have a very poor proportionality factor. Self-demagnetization occurs primarily when an attempt is made to saturate the magnet or in other words to subject it to an intense magnetizing field which will leave it magnetized to the maximum level it will sustain. Summarizing, self-demagnetization in a saturated magnet is a function of 1) the dimensions of the magnet or proportionality factor, 2) the coercivity of the magnetic material, and 3) the remanent magnetization of the material.

Self-demagnetization induced by a poor proportionality factor is an important cause of loss of high frequency information in magnetic tape when high frequencies are recorded at short wavelengths (slow tape speed). If a square wave is recorded on magnetic tape, the recording signal will magnetize the magnetic layer in a series of end-to-end alternately polarized magnets, as illustrated in Fig. 7. The magnetic intensity of the magnets will be dependent upon the recording level and on the remanent magnetization of the tape. The length of the magnets is established by the frequency being recorded and the speed of the tape across the recording transducer. At low frequencies (long wavelengths), the proportionality factor of the recorded magnets, which is established by the thickness of the magnetic coating on the tape and the recorded wavelength, is favorable towards preventing self-demagnetization. Consequently, the tape will sustain a high level of magnetization at low frequencies. At very short wavelengths the proportionality factor is poor because the magnets are shorter. The recorded magnets will relax back to less than saturation at the instant they leave the magnetizing field of the recording transducer.

Recalling that self-demagnetization is greatest when an attempt is made to saturate a magnet, it can be seen that a low-level recording (low magnetization) will produce little demagnetization at either long or short wavelengths, and output of the tape is relatively uniform at all frequencies. But at high levels of magnetization, short wavelengths will spontaneously demagnetize as the recorded areas of tape move away from the recording transducer. Under this condition high frequencies will be suppressed relative to low frequencies.

The foregoing analysis of self-demagnetization versus recorded wavelength can be easily visualized in a physical sense. Although a typical magnetic tape may have a coating thickness of about 200 microinches, studies of the recording process (3) have shown that a thickness of only 50 microinches is utilized in recording a wavelength of 0.0001 inch (which is the wavelength generated by 19 kHz at 1⅞-ips tape speed) (see Fig. 8). Thus the cross-section dimension or thickness of the recorded magnets can be considered to be 50 microinches. The length of a recorded magnet is one-half the recorded wavelength, also about 50 microinches at 19 kHz frequency. The end-to-end magnets at this wavelength are only as long as they are thick, and this proportionality factor of one-to-one gives rise to substantial self-demagnetization.

The second quadrant of the M-H curve of a magnetic material, as shown in Fig. 9, can be analyzed to approximate the effect of self-demagnetization of tape for various wavelengths and val-

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Twelve years ago, musicians all over the world were drowning in tape noise. We jumped in and began saving everyone we could, with our professional Dolby noise reduction system. Today, virtually every recording company in the world uses the Dolby system to make quieter master tapes.

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R2D2 appears courtesy of 20th Century Fox.

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ues of coercivity and remanence. Remanent magnetization of a tape recorded at very long wavelengths is indicated by the point at which the second quadrant magnetization curve intersects the M axis. This point also corresponds to the saturated output level of the tape at low frequencies, and is determined by the intrinsic remanent magnetization and packing density of the material used in the magnetic coating.

The saturated output level of the tape at high frequency can be determined by using a "demagnetization loss" line drawn through the M-H curve. The angle of this line is dependent upon wavelength, and the angle will rotate counterclockwise as the wavelength becomes shorter (3). At the point where the loss line intersects the M-H curve, a second line is drawn perpendicular to the M axis. The point where this second line intersects the M axis represents the magnetization of the tape for a specified wavelength. Note that remanent magnetization (and output) at 20 kHz is substantially less than that of long wavelengths for a tape having a coercivity of 320 oersteds.

As mentioned earlier, the angle of a demagnetization loss line is a function primarily of wavelength, and will be the same for any tape tested. This angle was determined empirically by testing numerous tapes having widely separated magnetic properties and variable thicknesses. In every case, measured output of the tapes correlated closely to a demagnetization loss line of the same angle for a given wavelength (4).

Figure 10 shows second quadrant magnetization curves for eight tapes which have widely ranging ratios of remanent magnetization to coercivity. The angle of the demagnetization loss line drawn through the tape curves corresponds to 0.1 mil wavelength. If the intersections of this line with the magnetization curves ideally define magnetization of the tapes (and consequently output), then measured outputs of the tapes should all fall on the line of Fig. 11. Note that an excellent correlation is obtained.

This method of predicting demagnetization applies only to the near saturated case, and therefore applies to tape output where the recording level is near the maximum operating level of the tape.

It should be pointed out that, in addition to demagnetization of a recorded signal caused by poor proportionality factor of the recorded "magnets," another type of demagnetization occurs as the result of magnetic interactions of the tape and the recording transducer. This second kind of demagnetization is termed "recording loss," and is included in the total demagnetization predicted by the demagnetization loss line. A definition of recording loss is beyond the scope of this paper.

Numerous conclusions can be drawn from the loss line method of predicting demagnetization losses. First, it can be observed from the curve of tape 2 in Fig. 10 that an increase in remanent magnetization without a corresponding increase in coercivity will not produce a proportional increase in 20-kHz output. The intersection of the 20-kHz demagnetization loss line occurs at a nearly vertical slope in the second quadrant curve, so increasing the height of the curve will produce only a small change in the height of the intersection point. In attempting to develop superior magnetic pigments for short wavelength audio recording, a mere increase in remanent magnetization is of limited value.

Second, remanent magnetization or output of a tape at 20 kHz can be substantially improved without any increase in the intrinsic remanent magnetization of the magnetic material. By increasing coercivity from 320 to 550 oersteds, as shown in Fig. 9, demagnetization at 20 kHz is reduced to half. This result clearly points to the direction of increasing coercivity to obtain improved short wavelength saturated output.

Third, the greatest improvement of short wavelength saturated output is obtained by simultaneously increasing both remanent magnetization and coercivity. High remanent magnetization is needed to produce magnetic fields of high intensity, and coercivity is needed to prevent spontaneous demagnetization that would otherwise occur.

Fourth, and finally, the shape of the magnetization curve can also have a significant effect upon demagnetization. If one imagines a second quadrant curve which has a sharp corner as opposed to a slanted curve, the point of intersection on the demagnetization loss line would be much higher on the M axis (5). Since the shape of the curve is a function of the distribution of coercivities of the magnetic particles, narrow distribution is a quality to be sought. Distribution is made narrow principally by maintaining uniformity in size and shape of the magnetic particles, and by obtaining chemical purity of the material.

The effect of reducing demagnetization by narrowing distribution can also be visualized as an elimination of those low coercivity particles of pigment which are most susceptible to demag-

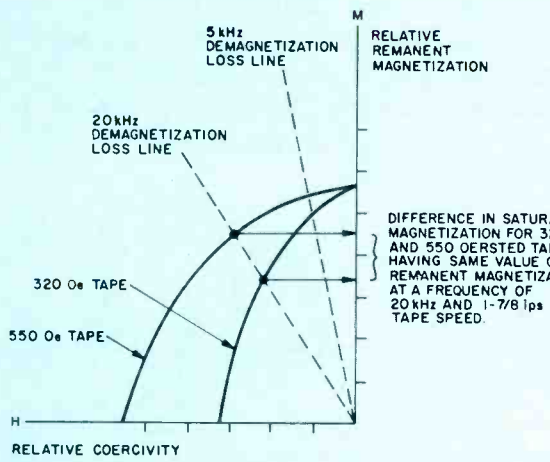
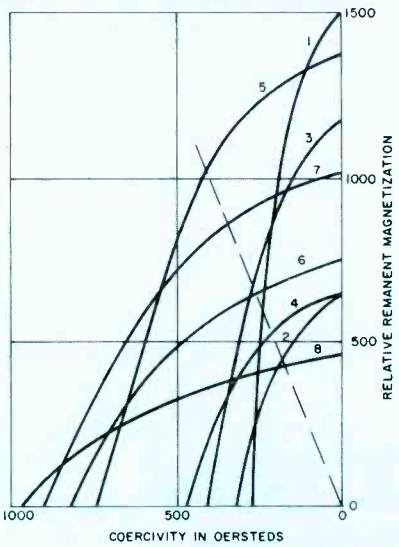


Fig. 9—This figure shows the second quadrants of the M-H curves of two tapes. Saturation magnetization at a given frequency, after self-demagnetization, is predicted by the points of intersection of the curves with the "demagnetization loss" line.

Fig. 10—Second quadrant analysis of eight experimental tapes shows the demagnetization loss line for a recording wavelength of 0.1 mil represented by the dotted line. Note that the predicted output of tape 1 is very much lower than might be anticipated by remanent magnetization alone. This tape provides an extreme example of self-demagnetization.



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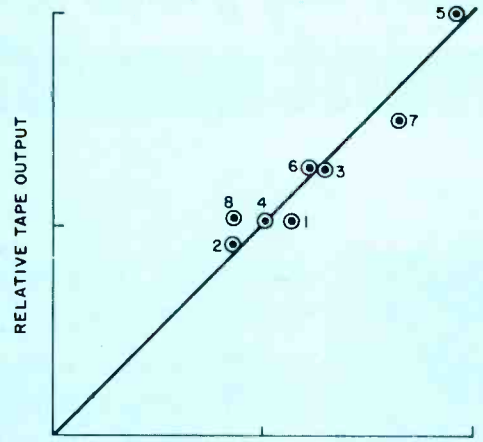


Fig. 11—Measured output of eight experimental tapes. The second quadrant analysis of self-demagnetization would predict that the output of the eight tapes of Fig. 10 would fall on the line.

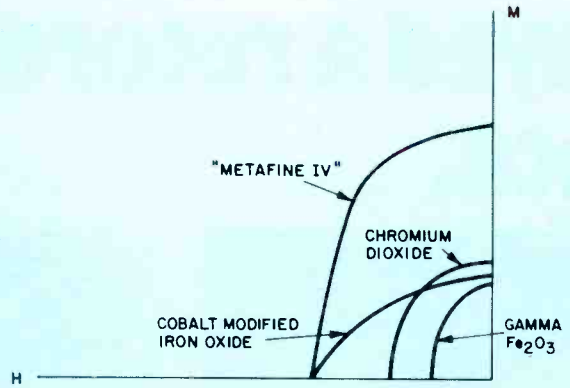


Fig. 12—The relative energies of four magnetic recording pigments. The area enclosed by the second quadrant of the hysteresis curve represents the "energy" of a magnetic material. Coercivity of cobalt-modified iron oxide can be adjusted in the manufacturing process to cover a very broad range, from that of Fe_2O_3 to well beyond the recording capabilities of a magnetic transducer. Metallic magnetic materials are probably the materials of the future since they combine an exceptionally high remanent magnetization with high coercivity.

netization. As remanent magnetization of a pigment is increased, the low coercivity particles will be the first to demagnetize. If these particles represent a large portion of the total material, then demagnetization will be appreciable, even though the value of coercivity represented by the center of the bell-shaped curve is high.

In certain types of short wavelength recording, such as FM video and high density digital recording, a very narrow distribution is highly desired. In fact, a magnetization curve similar to that of a single particle would be ideal. But audio recording is an analog recording process where the instantaneous magnetization of the magnetic material in the tape must be exactly proportional to the instantaneous value of the audio signal. If distribution is too narrow and if the magnetization curve is too steep, sensitivity of the tape becomes too critical to allow proper setting of recording levels. Fortunately this problem is not encountered in particulate magnetic materials because small variations in physical shape and dimensions, as well as variations in chemical composition of particles inherent in the manufacturing process, combine to produce a slope in the magnetization curve which is suitable for analog recording.

The foregoing analysis provides a quantitative means of translating several bulk magnetic properties of materials to performance of a tape, but more importantly, it clearly shows the direction that must be taken in the future development of magnetic materials. All areas of magnetic recording, including television, digital data, and instrumentation recording, are trending toward shorter wavelengths. Advanced materials having higher coercivity and remanence must be developed to meet future needs in all areas.

Material with increased coercivity is the most recent development to find a way into the marketplace. Chromium dioxide and cobalt-modified iron oxide became available in audio cassette tapes several years ago. The coercivity of chromium dioxide is nominally 550 oersteds, as compared to 340 oersteds of gamma Fe_2O_3. This value of coercivity is determined by the chemical nature of the material and by the size and acicularity of the magnetic particles. Approximately one-third of the coercivity is attributable to chemical composition and two-thirds to size and shape. A coercivity of 550 oersteds is a fortuitous characteristic of CrO_2 particles, since this value is ideally suited to compensate for demagnetization losses which occur at 1⅞ ips tape speed. Saturated remanent magnetization of CrO_2 is slightly greater than that of gamma Fe_2O_3.

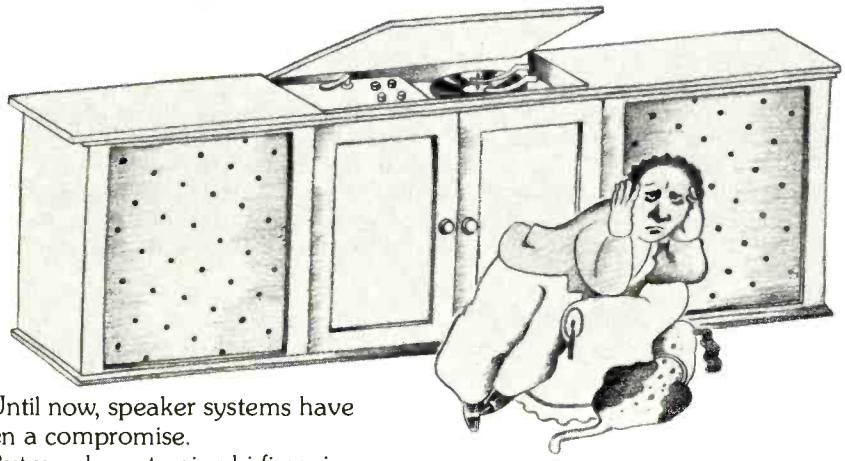
Unlike CrO_2, cobalt-modified iron oxide obtains a high coercivity by combining a small amount of cobalt with the iron oxide crystal. Coercivity can be controlled over a very wide range, up to 2,000 oersteds, by adjusting the amount of cobalt introduced into the iron oxide. This flexibility allows cobalt-modified materials to be adjusted precisely to the application.

Future Limits

If magnetic materials could be tailored to any magnetic properties desired, what are the limits to which remanent magnetization and coercivity could be taken? Certainly many different limits are imposed. Not the least significant is the magnitude of the magnetic field which can be generated by recording transducers. Materials which form the pole piece of transducers become magnetically saturated when attempts are made to record on tape having a coercivity of, say, 1500 oersteds. Even though a tape with this coercivity is highly resistant to self-damagnetization and will provide excellent short wavelength output, no practical method exists for placing a distortionless recording on the tape. Until significant improvements in head materials are made, a coercivity of 1200 oersteds is a practical limit for tape in most applications.

With this limit for coercivity established, it is a simple matter to show by analysis of the second quadrant curve what level of remanent magnetization can be employed before self-demagnetization at short wavelengths occurs. These values of coercivity and remanent magnetization become the goals of future pigments, established by the characteristics of magnetic recording transducers and firmly fixed until advances in transducer materials are forthcoming.

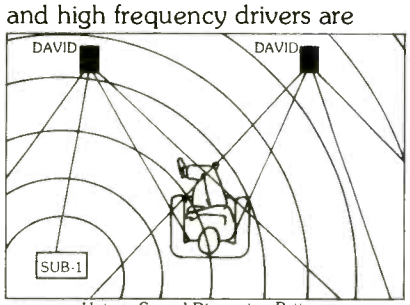
Speaker Systems: Then And Now



Until now, speaker systems have been a compromise.

But you have to give hi fi engineers credit. They've been doing their best under difficult circumstances.

You see, optimum bass reproduction requires a large enclosure for the bass driver. But then, the mid and high frequency drivers are



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added to this enclosure. The result is often two bulky, and sometimes unsightly cabinets which are difficult to place for maximum stereo sound reproduction and tasteful interior decoration.

Adding to this dilemma is the knowledge that furniture, carpets, and walls are factors which can cause the bass to sound weak, dull, or false.

Yet, moving the speakers to improve bass response destroys the stereo imaging. So you end up doing what hi fi engineers have been doing. You compromise.

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Visonik's three-way SUB-1/DAVID® system utilizes two DAVID® 502 or 602 speakers to reproduce the mid and high range and impart the proper stereo imaging, with a single sub-woofer to radiate the low bass throughout the room.

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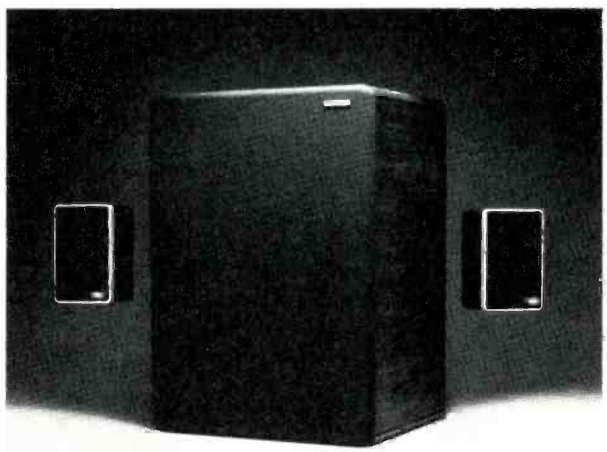

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The limits of coercivity and remanence established by recording transducers are reached in a new generation of magnetic materials which utilize particles existing in a metallic state. Materials of this type are being developed in several laboratories around the world. One such material, identified by the brand name "Metafine IV," is supplied by the 3M Company. Such particles have an intrinsic remanent magnetization close to the theoretical limit for single domain particles. A comparison of the second quadrant area of the fine iron material and gamma Fe_2O_3 is shown in Fig. 12. As the figure suggests, the output of a tape made with this material is far greater than that of gamma iron oxide tape.

Magnetic materials having very high remanence are difficult to handle in the tape manufacturing process because of a tendency of the particles to cling together in clumps. Magnetic attraction and repulsion between particles in the fluid dispersion causes them to find stable physical relationships wherein opposite poles are locked together, end to end and side by side. This produces chains of particles which appear under a microscope much like the chains of iron filings used to demonstrate magnetic fields. Chained magnetic particles in tape will not behave as individual particles since the switching of one particle will have an influence on neighboring particles. The result of this infectious switching could be poor signal output from the tape.

Clumping or chaining is controlled by dispersing magnetic materials in fluid polymers and binders in which the chemical forces holding particles apart are greater than the magnetic forces pulling them together. The chemistry needed to achieve this equilibrium becomes more difficult as the remanent magnetization of particles is increased. Thus, chemical dispersion technology must be developed in concert with developments in magnetic materials, and advanced magnetic tapes are not made simply by substituting magnetic materials.

The development of advanced magnetic tapes involves much more than simply increasing the energy of magnetic materials. The magnetic component is only one ingredient in a complex chemical system, and the entire system must be redesigned whenever this component is substituted or modified.

Summary

This paper has explained the effects of demagnetization on short wavelength saturated recording, and has presented an empirically derived method of equating magnetic properties of particles to short wavelength performance of tapes. Although the examples used relate to cassette audio recording systems, the same principles apply to other short wavelength recording systems, and particularly to the whole new generation of video recorders now available to consumers. The trend toward shorter wavelengths, which has been seen in the past, will go on into the future, and refinements of all aspects of recording systems will continue. Development of magnetic materials having increased remanent magnetization, higher coercivity, and narrower distribution will be a large part of this effort.

The author wishes to acknowledge the work of Dr. T. J. Szczech, of the Data Recording Products Division Laboratory of the 3M Company, whose studies of the magnetic recording process are principally responsible for the information contained herein.

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S/N: Mono, 83 dB, stereo, 74 dB.
THD: Mono, 0.05 per cent @ 100 Hz, 0.07 per cent @ 1 kHz, and 0.2 per cent @ 6 kHz; Stereo, 0.1 per cent @ 100 Hz, and 1 kHz, and 0.2 per cent @ 6 kHz.
Frequency Response: 30 Hz to 15 kHz, +0.2, −0.5 dB.
Capture Ratio: 1.0 dB.
Selectivity: 80 dB.
Image and i.f. Rejection: 120 dB.

When the Pioneer SX-1980 first reached our test laboratory, it had the distinction of being the "world's most powerful receiver." Almost before we could unpack it and get it up on the bench, that title passed on to Technics by Panasonic who now offers a 330-watt-per-channel receiver and, it is entirely possible that by the time you read this, someone will have surpassed that power level in an all-in-one receiver.

If high power alone were all that this receiver boasted, we would probably not be writing and publishing this report. In fact, the Pioneer SX-1980 is an exceedingly well-designed unit that offers just about every conceivable control feature that you might want even if you were shopping for "separates." And, while it is quite large and heavy, the cubic volume it occupies is probably a good deal less than would be the case if you purchased separates that performed as well. In terms of cost, the truism about better cost/performance ratios holds true for this receiver (as compared with separates) despite its huge power output capability.

Major controls along the lower section of the front panel include nine toggle switches and six rotary knobs. Four of these knobs take care of bass and treble settings. As in previous Pioneer receivers, main and sub-bass and treble controls are provided, each pair having different turnover frequencies for an almost limitless combination of tonal settings. A small channel balance control is located at the lower right, next to a large dB-calibrated, step-detented, master volume control. The nine toggle switches are a power *On/Off* switch, *Tone Defeat*, *Tape Duplicate and Monitor*, *Stereo/Mono*, *Loudness*, and *Audio Muting*.

Above these controls and switches, framed in the large dial area of the panel, are a row of 13 pushbuttons, two rotary switches, a phone jack at the left, and a microphone input jack at the extreme right. The two rotary switches offer variable phono-1 cartridge loading (providing resistive choices from 10 to 100 kilohms and capacitive loading choices from 100 to 400 pF). Three of the pushbuttons choose up to two of the three sets of speakers which can be connected to the receiver. The next two buttons activate the low-and high-cut filters. Three more buttons provide an audible indication of multipath problems, 25 or 75 microsecond de-emphasis, and muting defeat. Five more buttons select desired program source. Of the two phono inputs available, one can be used as an alternate microphone input.

Below the dial scales themselves are four movable "indexing tabs" which can be positioned for easy referencing of favorite stations. Above the linearly calibrated FM dial scale and the AM dial scale are four meters, two for center-of-channel and signal-strength indication and two for monitoring power delivered to the speaker loads. Above the tuning meters are speaker and program-source indicator lights, while to the right are the stereo indicator light, a light that tells the user to "fine tune" the signal, and another light which illuminates when the signal has been properly tuned in and is "quartz locked" by this tuning feature which is associat-

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Power Output: 270 watts per channel, 8 ohms, 20 Hz to 20 kHz.
Rated THD: 0.03 percent.
Rated IMD: 0.03 percent.
DaFping Factor: 40.
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S/N "A" weighted: Phono, 87 dB; High Level, 100 dB.
Tone Control Range: Main Bass, ± 10 dB @ 100 Hz; Sub-Bass, ±5 dB @ 50 Hz; Main Treble, ±10 dB @10 kHz; Sub Treble ±5 dB @ 20 kHz.
Low Filter Cutoff: 15 Hz @ 12 dB/ octave.
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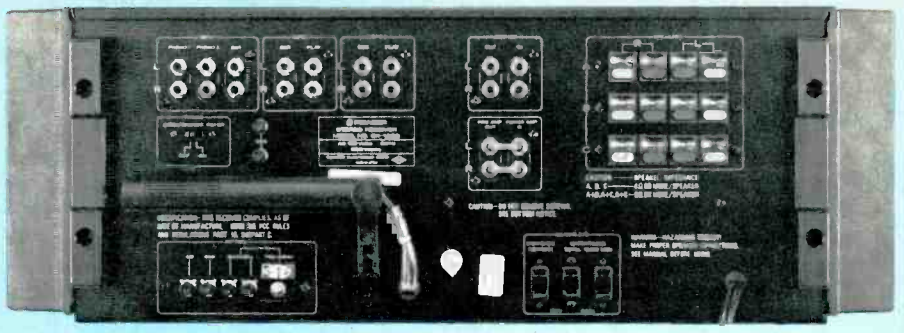
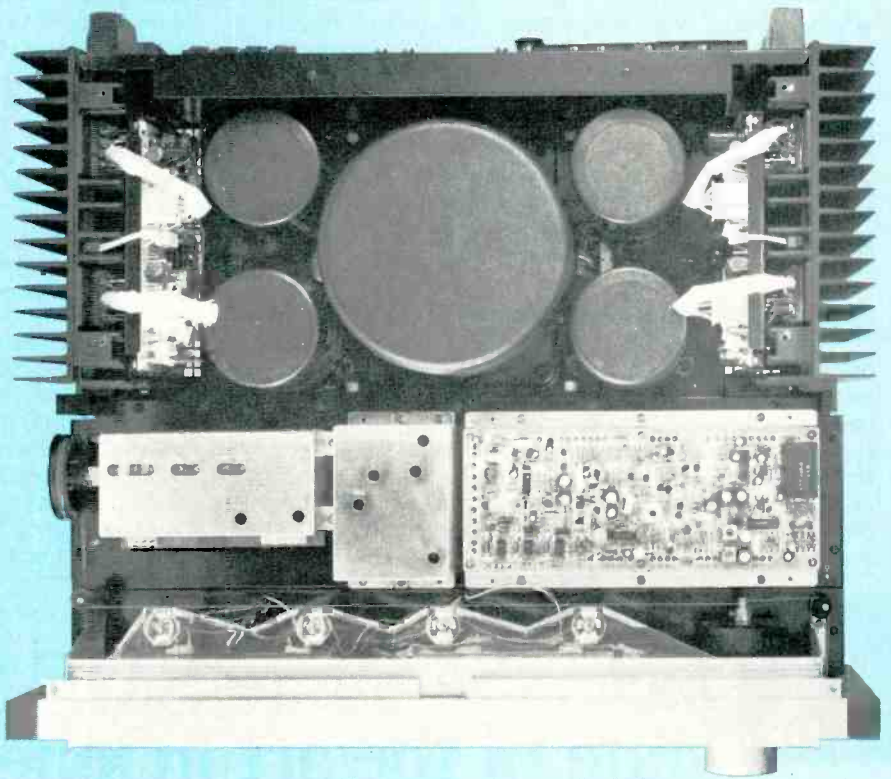
General Specifications
Maximum Power Consumption: 1400 W, 120 V, 60 Hz.
Dimensions: 22 1/6 in. (56.3 cm) W x 19 9/16 in. (49.6 cm) D x 8 5/16 in. (21.1 cm) H.
Weight: 78 lbs. (35.4 kg).
Price: $1250.00.

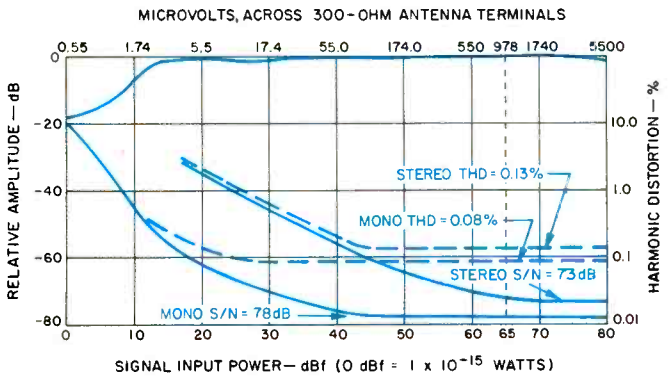




ed with the large tuning knob and activated when the user releases the tuning knob.

The rear panel of the Pioneer SX-1980 has three banks of spring-loaded speaker terminals and, near these, there are preamp-out/main amp-in jacks plus three convenience a.c. receptacles (two unswitched, one switched). Antenna inputs for 300 ohm, 75 ohm coaxial, and external AM are located below the pivotable built-in ferrite bar antenna. Tape-in and tape-out jacks, phono (two pairs), and AUX jacks are at the upper left of the panel and below the phono inputs is an interference filter switch which can be activated to reduce r.f.i. and other forms of external interference. Additional output and input jacks are located above the preamp-out/main amp-in jacks for possible connection of accessory devices such as a Dolby noise reduction unit, dynamic range expander, graphic equalizer, etc.

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



Construction and Circuit Highlights

The large, toroidally wound power transformer, visible in the internal view of the SX-1980, has individual secondary windings which supply separate, dual-polarity voltages for each channel's output stages, and 22,000 μF filter capacitors are used. The power amplifier stage is d.c.-configured, with all capacitors removed from the feedback loop. A single-stage differential-input amplifier is used with low-noise dual transistors, a current-mirror load, and a three-stage Darlington triple single-ended push-pull output stage. The pre-drive amplifier section features a power limiter circuit and an overdrive limiter which control the power output so that the power transistors are protected from damage when excessive loads are applied under high power conditions.

The FM front-end incorporates a two-stage r.f. circuit using a five-gang tuning capacitor and three dual-gate MOS-FETs. The i.f. amplifier section combines five dual-element ceramic filters with four ICs including a quadrature detector. The stereo MPX circuit

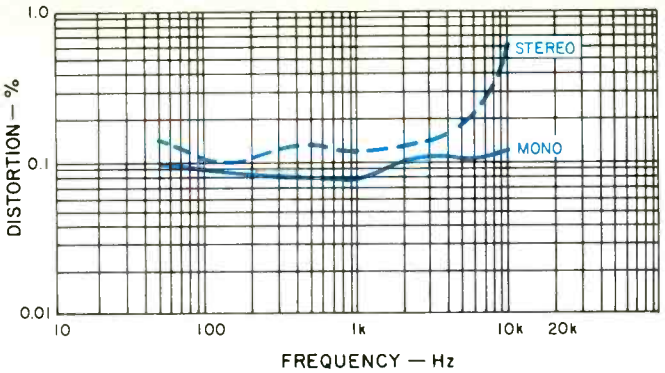


Fig. 2 — Distortion vs. frequency in the FM section.

employs a PLL IC with a self-contained, pilot-cancelling circuit.

The local oscillator is "locked" by means of a reference quartz-crystal oscillator in 100-kHz increments using a circuit that Pioneer has dubbed its APC (Automatic Phase Control) or "touch tuning system."

A dual-FET is used in the first-stage differential amplifier of the phono equalizer circuit while the final stage employs a pure complementary single-ended, push-pull configuration. Equalizer components have been chosen with close tolerances to maintain correct RIAA playback response within 0.2 dB.

FM Tuner Section Measurements

The FM tuner section of the SX-1980 is one of the best we have ever measured on an all-in-one receiver. Usable sensitivity measured 1.5 μV (8.7 dBf) exactly as claimed (and as low as we have ever measured). Usable stereo sensitivity was a low 4.0 μV (17.3 dBf), and 50-dB quieting was obtained with a mono input signal of only 2.0 μV (11.2 dBf) as against 2.2 μV claimed, and 28 μV (34.2 dBf) for stereo as against 36 dBf (34 μV) claimed. Best signal-to-noise ratio in mono measured 78 dB, and 73 dB for stereo. For a 1-kHz test modulating signal, THD was 0.08 per cent in mono and 0.13 per cent in stereo, a bit short of values claimed but, nevertheless, low enough to be insignificant in listening terms. Quieting and THD characteristics as a function of signal input levels are graphed in Fig. 1. Distortion at other frequencies are plotted in Fig. 2 for both mono and stereo modes. At the IHF test frequencies of 100 Hz and 6 kHz, the unit measured 0.09 per cent and 0.12 per cent for mono and 0.15 per cent and 0.2 per cent for stereo. Frequency response, plotted together with separation characteristics in Fig. 3, was flat from 30 Hz to 15 kHz, within +0, −0.5 dB. Stereo separation measured an outstanding 58 dB at mid-frequencies and remained at 55 dB for 100 Hz and 43 dB at 10 kHz. Stereo threshold was measured at 4.0 μV (17.3 dBf), while muting threshold was set at 6.0 μV (20.8 dBf).

Selectivity measured 83 dB, and capture ratio was exactly 1.0 dB as claimed. Image, spurious, and i.f. rejection were all in excess of 100 dB (the limit of our test equipment capability), while AM suppression measured a very high 63 dB. Sub-carrier products were "buried" beneath the noise floor in stereo, as was an SCA test signal.

AM frequency response is plotted in the frequency-sweep display of Fig. 4 and was no better than that observed for most stereo

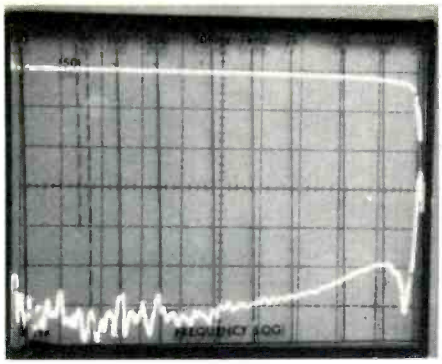


Fig. 3 — Frequency response and separation. (Each vertical division equals 10 dB.)

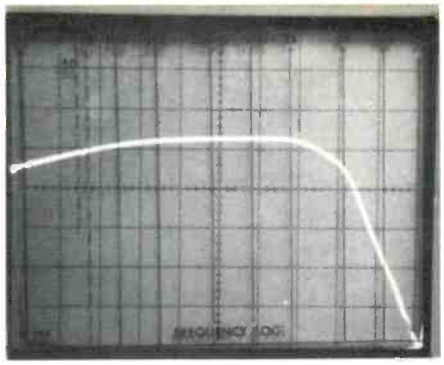


Fig. 4 — AM frequency response.

receivers, with roll-off beginning at around 2.5 kHz. Sensitivity was good, however, thanks to the three-gang tuning capacitor and separate r.f. stage used in this circuit. Distortion was quite low, with readings of under 0.5 per cent for a 30 per cent modulation level at 1 kHz.

Power Amplifier Section Measurements

As readers of *Audio* Magazine are aware, the IHF (Institute of High Fidelity) has recently approved new Standard Methods of Measurement for Audio Amplifiers (See June, 1978, issue of *Audio*). We are gradually converting our test procedures to comply with these new standards. In order to permit valid comparisons between manufacturer's claimed performance and our test results, however, we will continue to offer "old" and "new" test readings, where applicable, until manufacturers have had an opportunity to convert their specification sheets to the new standards.

As for the power amplifier section of the SX-1980, it delivered 283 watts per channel of average continuous power into 8-ohm loads for the rated THD of 0.03 per cent. For rated IMD (0.03 per cent), equivalent power output was 302 watts per channel. At rated power (270 watts per channel), THD measured a very low 0.006 per cent, while IM (using the SMPTE method) was 0.017 per cent. FTC-rated continuous power measured 276 watts, and power band for rated power extended from 14 Hz to 20 kHz. Low-frequency damping factor (measured at 50 Hz) was 40, as claimed. Dynamic headroom measured 2.3 dB. Power output (for a 1-kHz test signal) versus distortion-plus-noise and IMD is plotted in Fig. 5, while distortion versus frequency at rated output is graphed in Fig. 6.

Preamplifier and Control Section Measurements

RIAA equalization was among the most accurate we have measured for any receiver, remaining within ±0.1 dB of the prescribed playback curve from 30 Hz to 15 kHz. Phono input overload (for a 1-kHz test signal) measured 330 millivolts. Signal-to-noise referred to actual input sensitivity and full output ("A" weighted) was 87 dB while, using the new IHF method (5-mV in and 1-watt output) with an "A" weighting filter, the S/N became 79 dB. Weighted S/N using rated output as a reference and applying 140 mV with volume control at full measured 107 dB. Using a 0.5-V input and 1-watt output as a reference, the S/N measured 80 dB. Residual hum and noise ("A" weighted) with volume control at minimum,

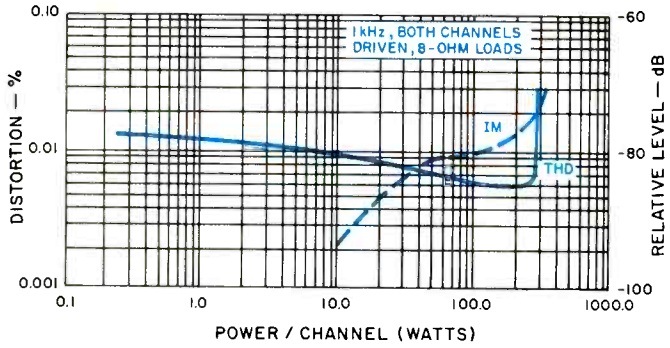


Fig. 5 — Power output vs. distortion.

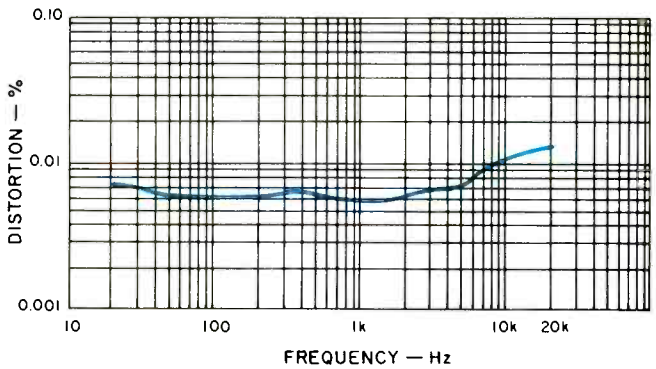


Fig 6. — Distortion vs. frequency in the amplifier section.

referred to 1 watt, measured 84 dB, corresponding to 108 dB below full rated output. Overall frequency response via the AUX inputs extended from 3.5 Hz to 110 kHz for the –3-dB roll-off points.

Main- and sub-tone control characteristics of the SX-1980 are plotted in the 'scope photos of Figs. 7 and 8. It should be noted that each of these bass and treble controls operates independently, so that combined use of both is not only possible but provides a very great variety of tonal settings to meet acoustic needs of the listening room and to compensate for subtle deficiencies in speaker or other component response. If there is one clear advantage in having the enormous power capabilities of the SX-1980 available, it is the ability to apply as much or as little bass or treble boost as one deems necessary without having to worry about amplifier overload, even when using relatively inefficient speaker systems. Needless to say, however, extreme use of the controls (and especially the "main" treble control) could lead to tweeter failure at high power levels, since most tweeters cannot sustain the kind of power levels deliverable by this receiver.

The sub-sonic filter characteristics are not visible in the sweep-frequency plot of Fig. 9 because the range of sweep on our spectrum analyzer extends from 20 Hz to 20 kHz, whereas the sub-sonic filter begins to act just below the 20-Hz low-frequency extreme. The sharp action of the high-cut filter, however, confirms its 12 dB/octave characteristic and is seen to be optimized at a suitable cutoff frequency to effectively reduce high-frequency hiss without seriously impinging upon musical fundamentals. Nor is the response of this high-cut filter redundant with any of the possible cut positions of either the main or sub-treble controls. Figure 10 is a display of the action of the loudness circuit which is typical of those found in most receivers and of somewhat questionable usefulness, since no means is provided for setting desirable input levels from either the phono or the auxiliary inputs to provide meaningful and correct loudness compensation. Still, for those who prefer this kind of bass and treble boosted lower level listening, there it is.

Use and Listening Tests

Calibration of the FM dial scale was almost perfect, with a maximum error of only 50 kHz observed at the 88 MHz extreme. Station reception was limited only by the quality of the transmission and program material. We found the audible multipath indicator to be extremely effective in reducing this form of interference and insuring proper antenna orientation. Happily, the "quartz lock" feature (unlike some others we have tested) is perfectly aligned with respect to the i.f. and detector system so that it can remain in use (it is defeatable when the muting button is depressed) even for weaker stations and provides tuning which results in lowest measured distortion at all frequencies on the FM dial.

Though Pioneer does not make too much of a point regarding their variable capacitance and resistan3e selector associated with the phono input, in the course of our listening tests we came to regard this as a very important feature indeed. It is surprising how few people realize the importance of proper cartridge loading for best pickup response and tonal quality. Even those who do seldom bother to add the required amount of capacitance across their phono cartridge terminals. We used several cartiridges in our listening tests and, aside from variations in tracking ability, were pleased at how "close" they sounded to each other once we selected the correct cartridge load.

As for overall sound quality of the amplifier/preamplifier combination, it was without serious fault. Transient reproduction was as good as that we have heard on some of the finest separate d.c.-configured power amplifiers and integrated amps. Hum and noise in phono were well below program-source's residual noise, making the dynamic range capability of the receiver awesome to hear. While I can think of few instances in which I would actually require 270-plus watts of continuous power per channel, I can imagine that there are instances in which multiple speaker operation in more than one room (or even stacking double pairs of speakers in a single listening room) might justify such power levels for home listening.

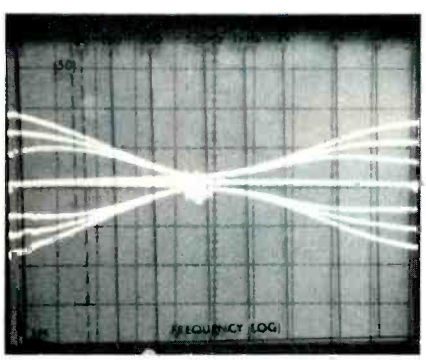


Fig. 7 — Range of main bass and treble controls.

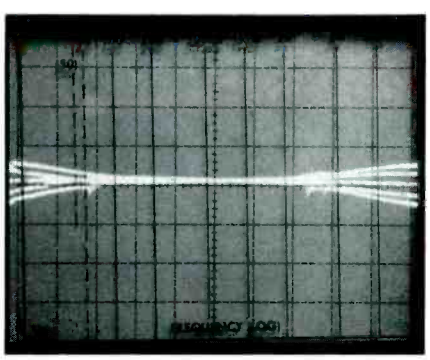


Fig 8 — Range of secondary bass and treble controls.

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FM Sensitivity (IHF) — 1.7 μV; **FM Selectivity (IHF)** — More than 80 dB; **Stereo Separation** — More than 42 dB at 1 kHz.

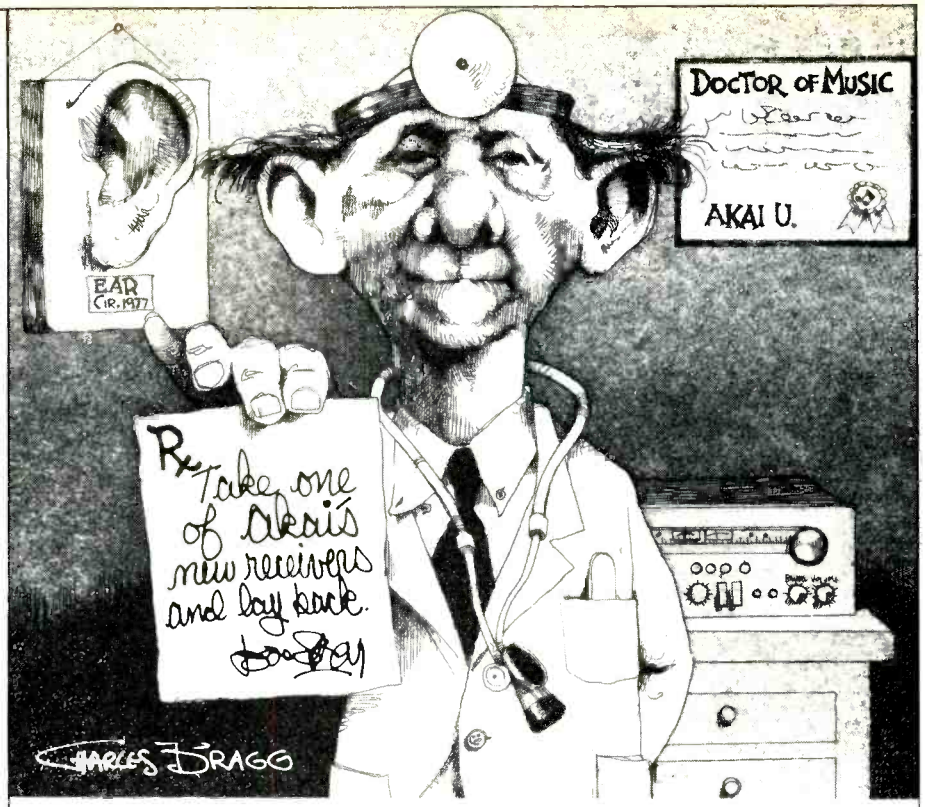
AA-1175 AM/FM Stereo Receiver:
Continuous Power Output of 75 Watts/ Channel Min. RMS at 8 ohms from 20 to 20,000 Hz with no more than 0.08% Total Harmonic Distortion, 2 Tape Inputs, 1 Phono Input, 3 AC Outlets, Separate Tuning and Signal Strength Meters, High and Low Frequency Filters, Separate Bass, Midrange and Treble Controls, Dual Power Supply for Reduced Transient Crosstalk.
FM Sensitivity (IHF) — 1.7 μV; **FM Selectivity (IHF)** — More than 80 dB; **Stereo Separation** — More than 42 dB at 1 kHz.

AA-1150 AM/FM Stereo Receiver:
Continuous Power Output of 50 Watts/ Channel Min. RMS at 8 ohms from 20 to 20,000 Hz with no more than 0.1% Total Harmonic Distortion, 2 Tape Inputs, 1 Phono Input, 2 AC Outlets, High and Low Frequency Filters, Separate Tuning and Signal Strength Meters, Tape Dubbing Facilities and Tape Monitors.
FM Sensitivity (IHF) — 1.8 μV; **FM Selectivity (IHF)** — More than 70 dB; **Stereo Separation** — More than 42 dB at 1 kHz.

AA-1135 AM/FM Stereo Receiver:
Continuous Power Output of 35 Watts/ Channel Min. RMS at 8 ohms from 20 to 20,000 Hz with no more than 0.2% Total Harmonic Distortion, 2 Tape Inputs, 1 Phono Input, 2 AC Outlets, Tape Dubbing Facilities and Tape Monitors, FM Mute Switch.
FM Sensitivity (IHF) — 1.8 μV; **FM Selectivity (IHF)** — More than 70 dB; **Stereo Separation** — More than 40 dB at 1 kHz.

AA-1125 AM/FM Stereo Receiver:
Continuous Power Output of 25 Watts/ Channel Min. RMS at 8 ohms from 20 to 20,000 Hz with no more than 0.3% Total Harmonic Distortion, 2 Tape Inputs, 1 Phono Input, Phase Lock Loop Multiplex Section.
FM Sensitivity (IHF) — 1.9 μV; **FM Selectivity (IHF)** — More than 70 dB; **Stereo Separation** — More than 40 dB at 1 kHz.

AA-1115 AM/FM Stereo Receiver:
Continuous Power Output of 15 Watts/ Channel Min. RMS at 8 ohms from 40 to 20,000 Hz with no more than 0.5% Total Harmonic Distortion, Phase Lock Loop Multiplex Section, Tape Monitor, Speaker Selector Buttons for 2 Sets of Speakers, Tape Dubbing, Loudness Switch, Enumerated Bass and Treble Balance and Volume Controls.
FM Sensitivity (IHF) — 1.9 μV; **FM Selectivity (IHF)** — More than 60 dB; **Stereo Separation** — More than 40 dB at 1 kHz.



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AA-1115	15	8	40-20,000 Hz	no more than 0.5%
AA-1125	25	8	20-20,000 Hz	no more than 0.3%
AA-1135	35	8	20-20,000 Hz	no more than 0.2%
AA-1150	50	8	20-20,000 Hz	no more than 0.1%
AA-1175	75	8	20-20,000 Hz	no more than 0.08%
AA-1200	120	8	20-20,000 Hz	no more than 0.08%

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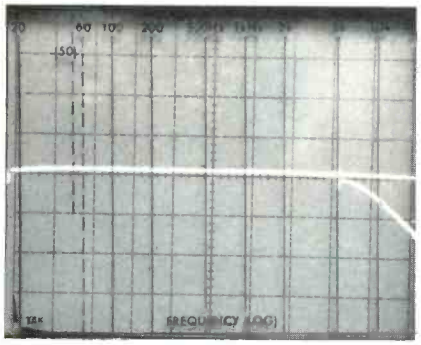

Fig. 9 —
Response of the high-cut filter.

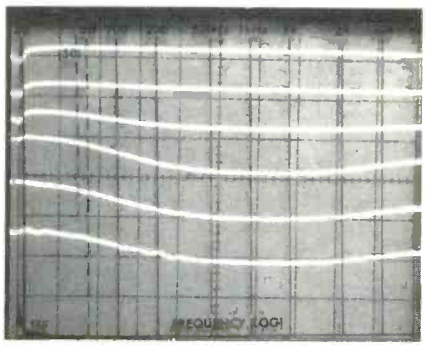

Fig. 10 —
Response of the loudness control at various levels.

Thumbing through a recent listing of popular home loudspeaker systems, I found relatively few that could handle this power level without being damaged. This suggests that speaker fusing would be important if you plan to use this receiver with anything but those few speakers that can take in excess of 300 watts of raw power without going up in smoke. Don't depend upon the built-in power meters to warn you of excessive power levels to the speakers, since they are strictly average-reading devices calibrated in terms of 8-ohm resistive loads. Even "8-ohm" speakers can exhibit impedances well below their nominal values at several frequencies at which time the "voltage" read by the meters would produce far more power than is indicated. Though the new "Dynamic Headroom" measurement is specified in dB, it should be mentioned that based upon the short-term signal used to measure the 2.3 dB headroom of this amplifier, it was producing nearly 460 watts of short-term power under these test conditions!

In summary, the chief appeal of the SX-1980, to me, is *not* its enormous power capability, but rather its excellent tuner circuitry (at least in the FM section), its enormous control flexibility, and the overall sound quality which it delivered during more than a week of solid listening tests. If Pioneer wants to engage in the power race, I am at least pleased to see that in doing so they have not sacrificed the more important characteristics of receiver design.

Leonard Feldman

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The most powerful argument for our new receiver is not just power.

True, it's tempting to be swept up by our power.

150 watts per channel minimum RMS at 8 ohms, from 20Hz to 20kHz, with no more than 0.07% Total Harmonic Distortion, is nothing to sneeze at.

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You get a combination of features and controls that are impressive on their own—but almost unheard of in a single machine.

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The advantages of our tuner, though, need no decoding. They include a normal and narrow FM IF bandwidth selector. It makes life simple for people in areas where their signals are crowded together elbow to elbow.

In our preamp section, the V7 comes equipped with a special phono EQ circuitry. Thanks to Sony's high IQ, it allows for direct connection of a low-output, moving-coil cartridge phono source. Without calling for an external step-up transformer or pre-preamp.

When you're gifted with as much power as the V7, you need a way to keep track of it. This receiver keeps tabs with two power-output meters, monitoring the power being fed to the speakers. So overload can't result from oversight.

And all that power comes from our direct coupled DC power amp. And our power is stable, thanks to a high-efficiency, high regulation toroidal-coil transformer.

There's a lot more to the STR-V7 than power. This receiver takes the best that contemporary technology has to offer, and offers it in a single machine.

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McIntosh Model C-27 Stereo Preamplifier

MANUFACTURER'S SPECIFICATIONS

Rated Outputs: Main, 2.5 V (maximum greater than 10 V) into 22-kilohm or greater load; Tape, 0.25 V (maximum greater than 10 V) into 22-kilohm or greater load, and Center Channel (L + R) 2.5 V into 22-kilohm or greater load.
Input Sensitivities: High Level, 250mV @ 100 kilohms, and Low Level (Phono 1 & 2), 2 mV @ 47 kilohms and 100 pF.
Frequency Response (any input): 20 Hz to 20 kHz, +0, −0.5 dB.
Hum and Noise: Phono, 80 dB below 10 mV input unweighted, 85 dB IHF "A" weighted; High Level, 85 dB unweighted, 90 dB IHF "A" weighted.
Dimensions: Front panel, 16 in. (40.6 cm) W x 5 7/16 in. (13.8 cm) H. Chassis, 15 in. (38.1 cm) W x 5 in. (12.7 cm) H x 13 in. (33 cm) D, including PANLOC shelf and back-panel connectors. Required knob clearance in front of mounting panel is 1½ in. (3.8 cm).
Weight: 20 lbs. (9.1 kg).
Power Requirements: 120 V, 50/60 Hz.
Price: $749.00.

The venerable firm of McIntosh Laboratory, Inc., seems intent upon changing at least part of its corporate image. Whereas "Mac" has, in the past, been extremely slow to introduce new products, they presently seem to be engaged in a major engineering effort aimed at bringing forth several new audio component products annually. It is barely a year since we tested and reported on their *ne plus ultra* C-32 preamp and yet, here we have another new preamplifier, the Model C-27, which seems destined to replace the long-lived C-28 preamp that has been around for several years. While the C-27 retains the familiar front-panel look which instantly identifies the unit as a McIntosh product, internal circuitry is brand new — from the preamp equalizer section to the audio output stages.

The C-27 falls somewhere between the two extremes of control-chassis design philosophy. It is neither a "straight wire with gain" design (which generally eliminates just about every control but volume and program selection) nor is it a "no holds barred" design replete with every tone-tailoring and signal-processing circuit imaginable. Rather, the C-27 takes a mid-course approach, providing those controls and switching functions

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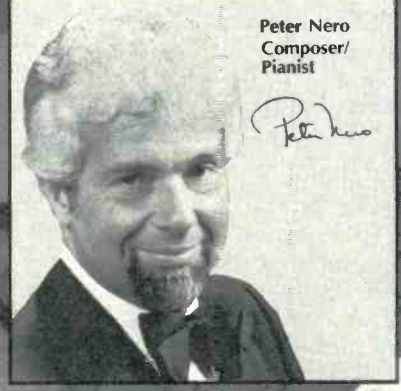

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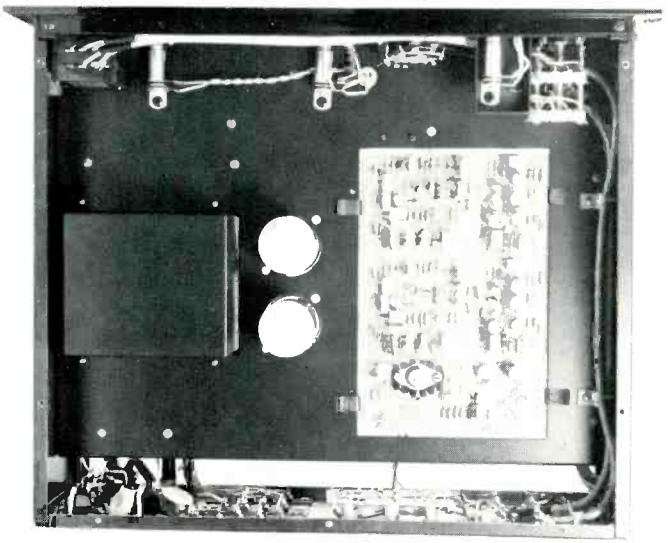
which are deemed most important by those audiophiles who are honest enough to admit that perhaps their listening environment is not acoustically perfect and that, perhaps, even their speaker systems are not flat from d.c. to Channel 5. Rather than forego tone controls and cut-off filters, such audio buffs prefer to have these facilities in a control unit providing their presence in the signal path does not introduce any new form of distortion.

While the C-27 pictured here is shown mounted in an optionally available wood cabinet. McIntosh's familiar *Panloc* mounting arrangement makes for easy mounting of the unit into a wood-panel furniture cabinet or shelf, with the usual metal brackets and needed hardware supplied as part of the package. The front panel exceeds chassis size in both of its dimensions, which makes for a non-critical panel cutout for custom installations. The front panel of the C-27 is anodized gold and black with McIntosh's familiar gold-teal blue panel nomenclature illumination which magically appears when power is applied. Rotary controls along the top of the panel include a five-position program input selector *(AUX 1, AUX 2, Tuner, Phono 1,* and *Phonc 2),* a mode selector (left or right to both outputs, stereo reverse,



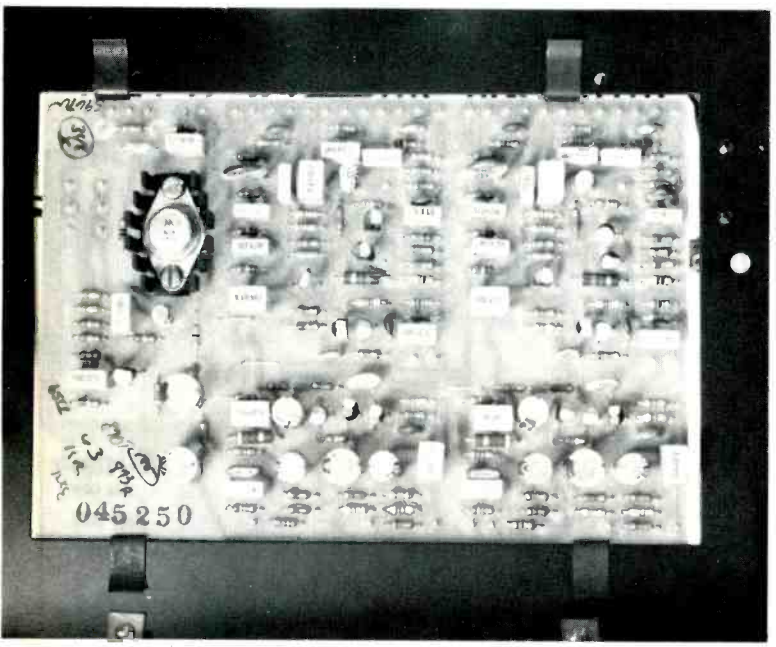


Fig. 1 — Close-up view of the major P.C. board of the McIntosh C-27 preamplifier.

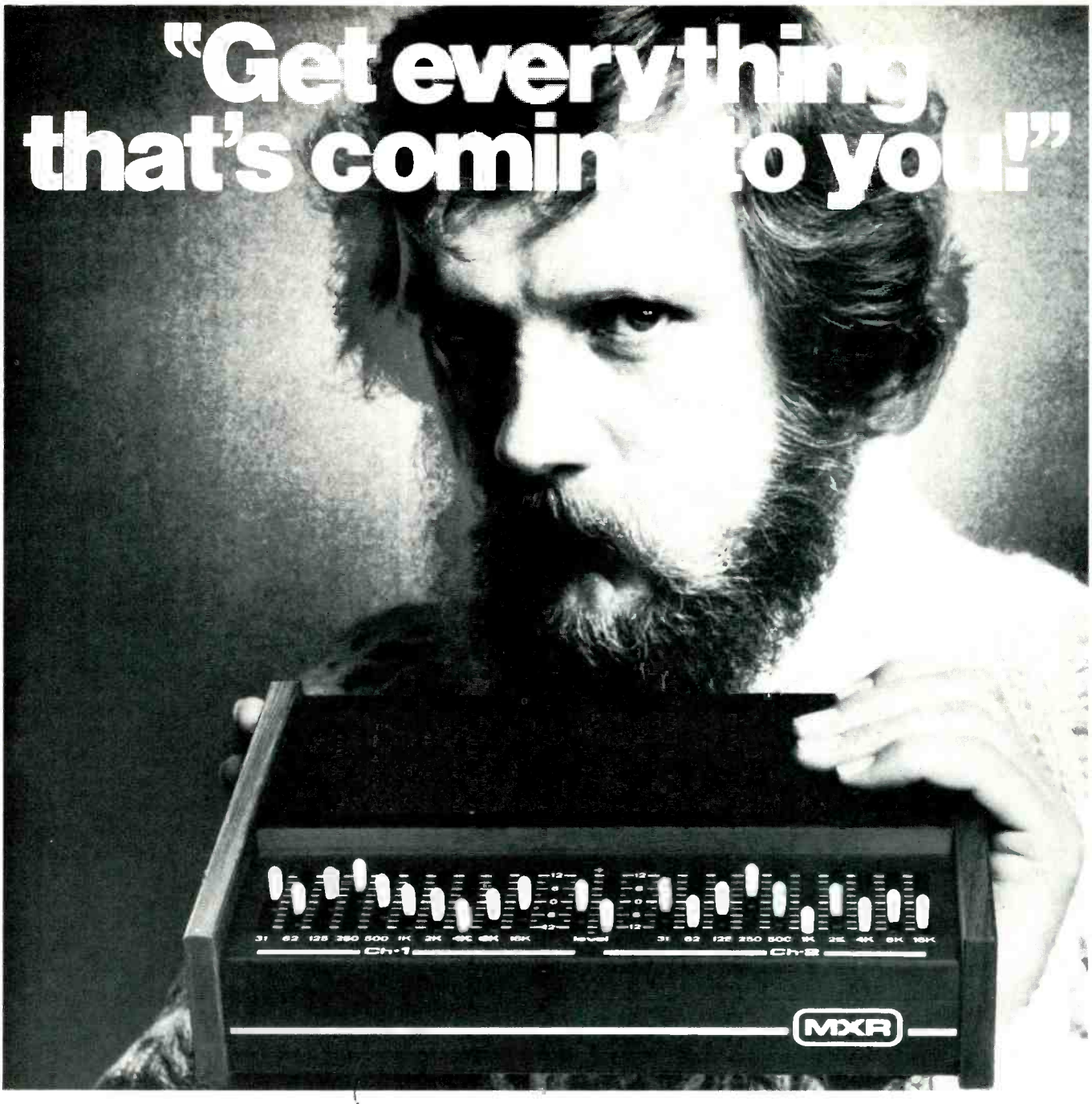
stereo, L + R mono, left plus right to left or right outputs) and, at the extreme right, the master volume control. The four rotary control sets at the lower right of the panel are dual concentric types. The first of these introduces, singly or in combination, the high- and low-cut filters and selects either or both sets of loudspeakers which can be switched via the front panel providing the power amplifier's outputs are connected to the rear of the C-27 instead of directly to the speakers. Bass and treble tone controls permit tonal tailoring of each channel separately, while the right-most control in this group is a combination balance and loudness control. The loudness control of the C-27 works a bit differently from that in the C-32. The user is instructed to set the volume control for maximum lifelike listening levels while the loudness knob is set to its "flat" (counterclockwise) position. Then, for lower listening levels, the *loudness* control is rotated (rather than the volume control) and proper Fletcher-Munson compensation is introduced as listening levels are lowered to the desired level.

Completing the panel layout is a group of pushbuttons and a headphone jack at the lower left. The buttons, five in all, take care of the two tape-monitor circuits and provide tape dubbing from either of two connected tape decks to the other. The final button turns on power to the unit and has an illuminated rectangle just above it to indicate that power is on.

Adjacent to the four switched and one unswitched convenience a.c. receptacles on the rear panel are three sets of spring-loaded terminals which require only that the stripped ends of power amplifier and speaker connecting cables be inserted into the small holes exposed when the terminal keys are depressed. It is this arrangement which brings speaker switching capability to the front panel of the C-27, and a handy feature it is too since most high-quality basic power amplifiers are normally equipped with only one set of speaker terminals. The right portion of the rear panel is equipped with the necessary phono-tip jacks for signal inputs, tape-in and tape-out circuits, two pairs of main output jacks (in case you want to feed two separate power amplifiers) and a "center channel" output for feeding the sum (L + R) of both channels to a separate monophonic power amplifier for background music in an alternate location or for powering a center-channel speaker system in the main listening area. A 0.5 ampere line fuse holder completes the rear panel layout.

Circuit Highlights

A second internal view of the C-27 chassis is pictured in Fig. 1, a detailed view of the major circuit board which contains all of the active audio signal handling circuitry, including the preamplifier-equalizer low level stages. Smaller PC modules include the pushbutton switch circuits, input terminal boards, a switch indicator circuit board (for illuminating the front panel LEDs which light up when tape monitoring or tape copying is employed), and a power supply module. Signal paths can be traced by consulting the block diagram of Fig. 2. The input selector routes the different input signals within the C-27. Isolating networks are present at each high-level input and shorting-switch contacts ground unused inputs. The isolating networks also block any d.c. voltages that might be present, preventing pops or clicks when changing inputs. The phono preamp section uses three selected transistors per channel. Low impedance components are used in the RIAA equalization network, drive for which is provided by the final stage which operates at an adequate current level to drive the low impedance without slew rate limiting. Isolating networks are included at each tape output and input. The volume control is a step-attenuator type having 32 steps



Everything but the effects of poor room acoustics, poor speakers or poor program quality with the MXR Stereo Graphic Equalizer.

You've got a room that's a lot like a sponge . . . rugs, drapes, overstuffed chairs. And every time you turn on your system, most of the aural glory gets soaked up. Or, you've bought a sound system that has an impressive price but alas, a depressing sound. Your records, tapes and radio sources may sound good to some, but to you, the high fidelity just isn't high enough. And you'd lose if you made a trade.

Get into control with the MXR Stereo Graphic Equalizer. It lets you tailor frequency responses and adjust acoustics to your desires. Control 10 frequencies plus level on each of two channels. Play with the lows, boost the mid-ranges, and soar with the highs. Bring each speaker closer, or move it farther away at the touch of a slide control. The MXR Equalizer's frequency controls not only adjust for the interior of your room, but also for the interior of your system, making a small system sound big . . . a big system sound mammoth.

Built with the same ingenuity are our Compander which enhances sound for home recording, and our new Dynamic Processor, which brings recorded dynamics to life and removes impulse noise.
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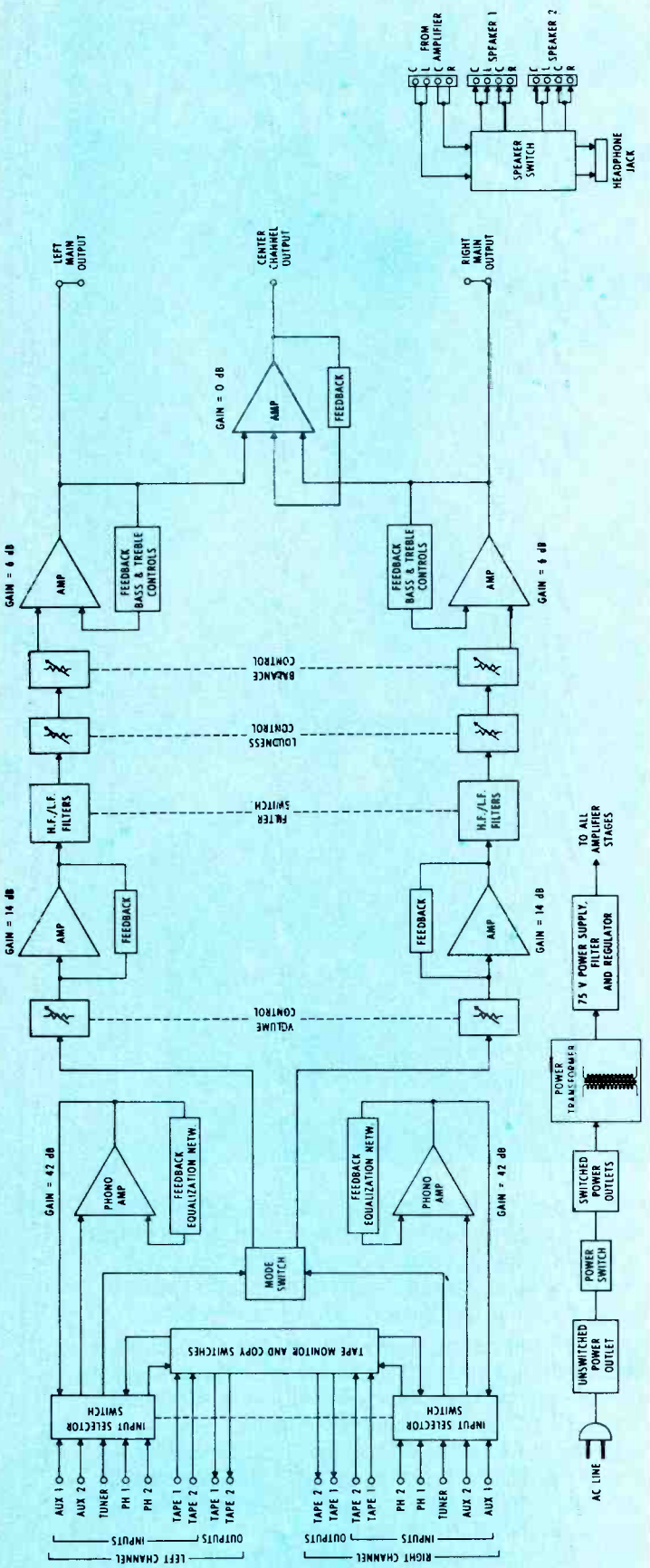

Fig. 2 — Block diagram of the C-27 circuits.

and 70 dB of range, plus a total attenuation position. A voltage gain stage follows the volume control and provides 14 dB of gain. High- and low-cut filters follow, with the signals then passed along to the loudness and balance control, and then to another gain stage for an additional 6 dB of amplification. This last gain section is used for the bass- and treble-control circuits and consists of a three-stage linear amplifier with tone controls included in a negative feedback circuit using precision capacitors and resistors for shaping the desired frequency response characteristics depending upon the setting of the tone controls. The output of this amplifier is fed to the two pairs of main output jacks.

The C-27 power transformer uses a grain-oriented, silicon-steel core, plus copper and magnetic steel shields to eliminate radiated magnetic hum fields. The power supply uses zener-diode reference voltage regulation and electronic filtering. Turn-on and turn-off time characteristics of the power supply are controlled to prevent switching transients. The total semiconductor complement of the C-27 includes 18 silicon-planar transistors, four silicon diodes, and five light-emitting diodes.

Laboratory Test Measurements

All of our measurements were made with respect to rated output (2.0 volts from the main output terminals) unless otherwise stated. We first studied the performance of the phono-equalizer section. Input sensitivity for rated output measured 2.3 millivolts for both phono inputs. Though McIntosh does not provide a "limit spec" for phono overload, we consider this to be an important specification. The phono inputs were able to handle signal levels of 135 millivolts at 1 kHz before noticeable first-stage distortion occurred — considerably more than is likely to be delivered even by a high-output cartridge tracing the most heavily-modulated record grooves. Signal to noise in phono, referred to a 10 mV input, measured 82 dB unweighted, increasing to 89 dB when an "A" weighting network was inserted in the path between the output and the measuring instruments.

A word is called for regarding the playback curve measured via the phono inputs as shown and photographed from the face of our spectrum analyzer's CRT tube. McIntosh has elected to adopt the new IEC standards for playback which call for an additional roll-off time constant of 7960 microseconds in addition to the three time constants normally prescribed for RIAA equalization. This final low-end roll-off makes sense, since it reduces needless amplification of turntable rumble components which serve no purpose other than to overload the bass power output capabilities of modern power amplifiers (especially those that have response down to "d.c.") and to cause speaker cones to fluctuate wildly, sending the voice coils into non-linear regions of operation. The final low-end roll-off or turnaround of the new curve is clearly visible in our 'scope photo of Fig. 3, and, although our frequency sweep extends only down to 20 Hz, the response continues to roll off below that frequency at a 6-dB-per-octave rate, exactly as prescribed by the new IEC standards. If you try to measure the phono response against the "old" RIAA curve, however, you will find that at 30 Hz it differs from the old prescribed point-by-point plot by approximately 1.3 dB. In terms of the IEC playback curve, the equalization of the C-27 was so accurate that it varied by no more than 0.1 dB at any of the remaining test points measured.

Figure 4 is a plot of distortion versus frequency (at rated output) via the high-level inputs, as observed at the main output terminals. Over the entire spectrum from 20 Hz to 20 kHz, harmonic distortion never exceeded 0.025 per cent and at mid frequencies it measured an extremely low 0.009 per cent. Since the distortion measured from the phono inputs to the tape outputs was even lower, we did not bother to plot these results since the high-level section would govern actual distortion of the output signals under actual use conditions. Though McIntosh does not quote IM distortion figures for the C-27, we neverthe-

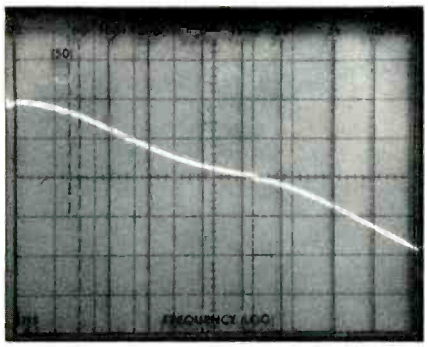

Fig. 3 — The RIAA playback response.

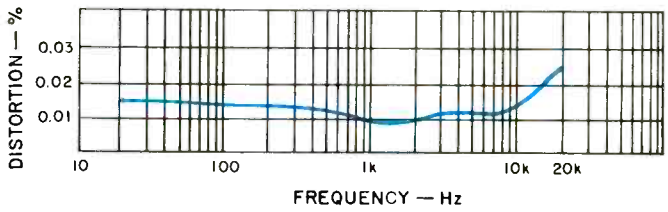

Fig. 4 — Distortion vs. frequency for the rated output of 2.0 volts (AUX input to Main outputs).

less measured this important parameter as well and, for rated equivalent output from the main output terminals, obtained a reading of just under 0.04 per cent. Maximum output obtained from the main output terminals was 10.0 volts for a rated figure of 0.05 per cent harmonic distortion.

Tone-control action of both the bass and treble controls is so precise and well calibrated that we decided to trace overall response for each of the 10 possible settings for each of those controls. The results are displayed in the 'scope photo of Fig. 5. Flat response is represented by the center curve of this series and was measured as flat within 0.5 dB from 10 Hz to 23 kHz. Th ±3 dB points in response occurred at 4 Hz and 60 kHz. Signal-to-noise ratio in the high level settings measured 86 dB below rated output, unweighted, and 92 dB with an "A" weighting network inserted, both figures exceeding specs published by McIntosh. Volume control tracking was found to be accurate from left to right channels within 0.2 dB from maximum settings down to a ±70 dB level.

The action of the high- and low-cut filters is illustrated in the 'scope photos of Fig. 6. While the slope rates are clearly only 6 dB per octave (we prefer steeper slopes ourselves), McIntosh wisely set the cut-off points at sufficiently high and low frequencies (50 Hz for the low-cut and 5 kHz for the high-cut) so that their introduction into the signal path would not take too big a "bite" out of musical content or program sources that require "cleaning up" because of background hiss or low-frequency noise and rumble.

The action of the previously described loudness control is clearly illustrated in the three response plots shown in Fig. 7. Note that these curves were achieved with a *constant* setting of the master volume control and only the loudness control setting itself was varied, from one extreme to the other. Total level variation afforded by this control amounted to approximately 22 dB (each vertical division in Fig. 7, as well as in Figs. 3, 5, and 6 represents an amplitude difference of 10 dB).

Use and Listening Tests

All in all, McIntosh seems to have come up with a brand-new, carefully designed and constructed preamplifier/control unit that should mate nicely with better power amplifiers, speaker systems, and program-source components.

We played a variety of direct-to-disc records through the C-27 which was used to drive a high-quality 110-watt-per-channel stereo power amplifier which, in turn fed our reference loudspeakers. Response was balanced and uncolored and, using a reference tuner and our newly acquired Sound Technology 1100 signal processor, we were able to compare self-produced high-quality programming recovered from our reference tuner by feeding it first directly through the power amp and then through the combination of the C-27 and the power amp, with all gains equalized for identical sound levels. We were unable to detect any difference between the two modes of reproduction, affirming the fact that the "straight wire with gain" sound can be achieved even when tone controls are incorporated in a preamplifier.

The phone jack derives its power from the speaker outputs, which, as mentioned, can be connected at the rear of the C-27 (along with the power amplifier outputs) so that front panel speaker/headphone switching becomes possible. Users of the C-27 who own headphones will want to avail themselves of this feature even though a self-contained phone amplifier (provided in the more expensive C-32) is not incorporated in the C-27 and an "off" position on the C-27's speaker switch makes this form of listening possible and convenient.

By eliminating some (but not all) of the features of the higher-priced C-32, McIntosh has come up with what will undoubtedly be another long-lived preamplifier that will be affordable to a greater number of potential purchasers. In our opinion, its suggested price is not at all inconsistent with the level of performance it achieves or with its excellent and rugged design and construction features.

Leonard Feldman

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Fig. 5 — Tone control range of the C-27.

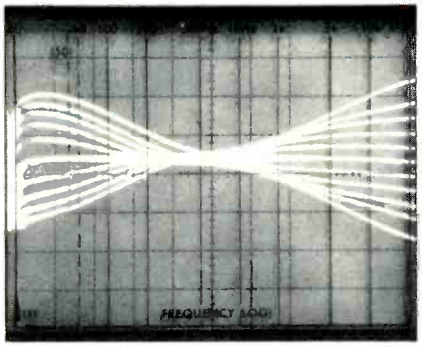


Fig. 6 — Low- and high-cut filter response.

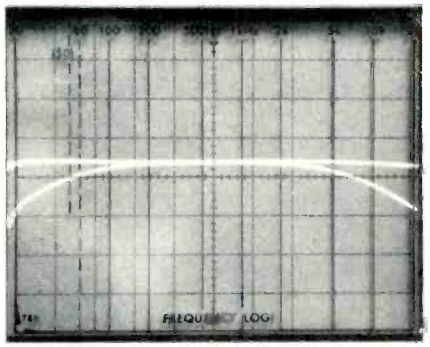
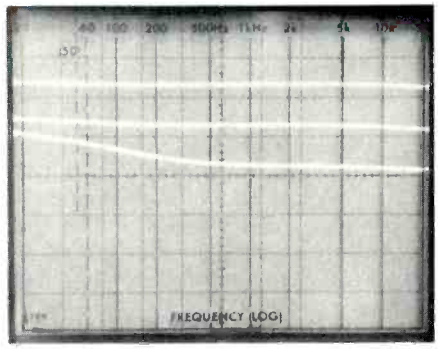


Fig. 7 — Action of the separate loudness control.



Studer ReVox Model B77 Open-Reel Tape Recorder

MANUFACTURER'S SPECIFICATIONS

Frequency Response: 30 Hz to 16 kHz @ 3 ¾ ips, 30 Hz to 20 kHz @ 7½ ips.
Harmonic Distortion: 1 per cent @ 3 ¾ ips, and 0.6 per cent @ 7½ ips.
S/N Ratio: 59 dBA @ 3¾ ips, 62 dBA @ 7½ ips.
Crosstalk: -45 dB.
Erasure: 75 dB.

Input Sensitivity: Mike, Lo Z, 0.15 mV, Hi Z, 2.8 mV, Line 40 mV.
Overload Margin: 40 dB.
Output Level: Line, 1.55 V; Headphone, 5.6 V (open circuit) for 200- to 600-ohm phones.
Flutter: 0.1 per cent wtd. peak @ 3¾ ips, 0.08 per cent wtd. peak @ 7½ ips.
Speed Tolerance: 0.2 per cent.

Wind Times: 135 seconds for 3600 feet.
Dimensions: 17.8 in. (45.2 cm) W x 16.3 in. (41.4 cm) H x 8.14 in. (20.7 cm) D.
Weight: 37.4 lbs. (17 kg).
Price: $1295.00.

The Studer ReVox B77 open-reel recorder retains the advantages of the A77, eliminates limitations of the earlier models, and adds features of its own. (The A77 remains in the product line, at least for the time being.) The front-panel styling of this high-class audiophile recorder is similar to that of the professional A700 model. Interlocked push-button switches select speed, 3¾ or 7½ ips. Below are the large-handle toggle switches for power and monitor selection and paralleled jacks for headphones. This can be a handy feature at times, providing a front-panel output in addition to one for a set of phones. The level at these jacks is controlled by a dual-section, slip-clutch pot, which does not affect the regular line outputs on the back panel. The output selector switch, however, does affect all outputs including metering, and can be set for stereo, reverse stereo, left channel to both outputs, right channel to both outputs, and mono which combines the two channels and feeds the mix to all jacks. The choices provided with this switch facilitate a number of tasks without the need to change connections and use adapters. The smooth-acting input level pots have knobs of a good size, an improvement over those on the A77. Alongside are the record presets with a large status light above each switch, illuminated when the recording process starts. The large toggle handles are convenient, but were judged to be subject to inadvertent switching. The input selector switches have posi-

tions for both low- and high-impedance single-ended microphones, *Radio* (DIN), AUX, and for feeding in the output of the other channel for sound-on-sound recording. Mike inputs are standard phone jacks, and it might be noted that mike/line or other mixing is possible, if recording is done on just one channel.

The two level meters have even illumination and excellent legibility. The peak indicators are located in the meter faces which gives a continuous, no-effort display without diverting attention from the VU meters. The light-touch tape motion switches are logic controlled, and any order of commands will be followed, including *Pause* in a wind mode. Unfortunately, it does not latch in, and the button must be held for the duration of the pause. The logic also permits going into record from fast wind, as long as the record presets are in and *Play* is held until recording starts.

Behind a flip-down cover are the reel-size switch and the *Cue/Edit* slide switch, which puts the tape in contact with the heads from *Stop*. It is released by moving the pinch-roller arm or by going into play. When in *Cue/Edit*, fast-wind modes become momentary-contact controlled for any needed tape shuttling. Tape threading is quite straight-line, and there is notably more clearance than on the A77. There is easy access for cleaning and demagnetization and, with removal of the snap-on head assembly cover, alignment adjustments become immediately available. To the right is another aid to editing, a small splicing block with a built-in, shear-type cutter. The counter and its reset are above the head assembly. The reel turntable shafts have spring-loaded retainers which work directly on small reels and will hold on the adapters required for large-hub 10½-inch reels.

The line-in/line-out phono jacks and their level-set pots on the back are clustered together with sockets for DIN-type systems and for optional remote controls for tape motion and capstan speed. The tape-motion control includes record and timer-start functions. The speed control, in conjunction with tape-speed selection, can provide speeds all the way from 2.5 to 11 ips. Just above are the voltage selector, a fuseholder, and the socket for the detachable power cord. With the addition of another plug-in module (not in the unit evaluated), the B77 can have a slide-sync function. The carrying handle on the top of the high-impact polypropylene cabinet allows one-hand transporting for that live recording, very possible with the admirably low weight of 37.4 lbs. After removal of the four retaining screws, the recorder assembly on its rigid, box-girder frame was pulled out for inspection.

There are 10 PCBs with high-quality components, and all had excellent soldering. The overlay on the cover for the plug-ins was marked to show the location of adjustments behind the panel, but the parts on the cards themselves were not identified. Plug-type connections were used for most purposes, with a minimum of interconnection soldering. Many items conveyed the impression of ruggedness for long-term reliability, but the turntable and capstan motors along with the brake and play solenoids were most notable. The capstan frequency pick-off was rigidly mounted adjacent to the slots in the rotor shell, fundamental elements in the ReVox drive system which are basically immune to variations in line voltage or frequency.

Performance

The playback response of the B77 was within 2 dB at both speeds with the exception of 50 Hz at 7½ ips. The pink-noise/RTA checks showed that the record/playback responses were very good for Ampex 456, Maxell UD, Memorex Quantum, and TKD Audua, as well as with Scotch 206/207 for which the unit had been adjusted. Meter indications for the reference levels on the test tapes were very close, with the zero indication within 0.5 dB of the 257 nWb/m ReVox specification. The reference record level used was that for 200 nWb/m fluxivity at 1000 Hz, which was about −1.5 dB on the meters. (Note that flux levels at other frequencies are different even when the record/playback response is perfectly flat.) The response with Scotch 206 at reference level and 7½ ips (Fig. 1) was within 3 dB from 17 Hz to 18 kHz for the left channel, to 20 kHz for the right. The responses 20 dB lower were from 16 Hz to 23.5 kHz (left) and 25.5 kHz (right). With the record level +10 dB, the-3 dB points were at 21 Hz and about 7 kHz. These results for Scotch 206 are not all that unusual at the high frequency end, but the smoothness over the entire frequency range is excellent indeed.

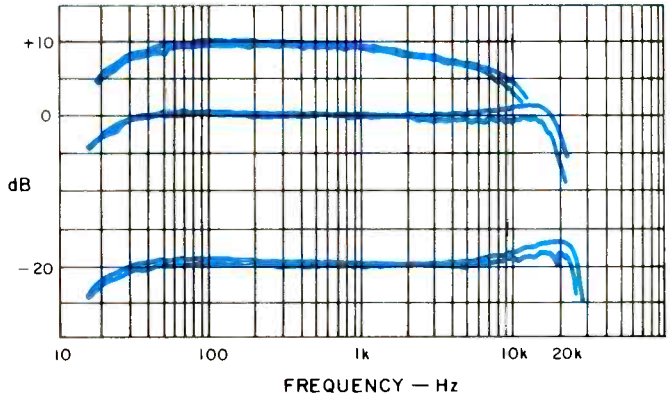


Fig. 1 — Record-playback response using Scotch 206 at 7½ ips. (Record 0 reference level is that for 200 nWb/m fluxivity at 1 kHz.)

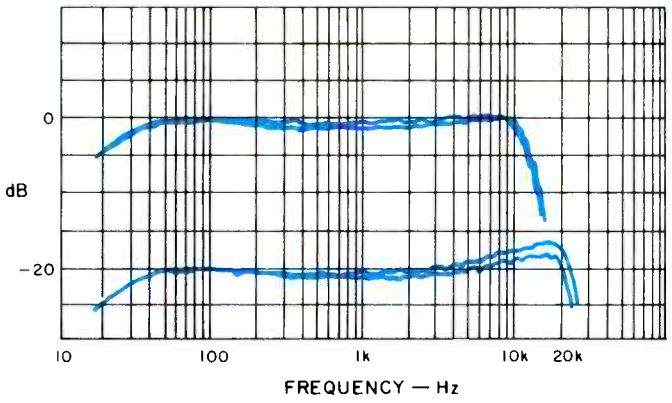


Fig. 2 — Record-playback response using Memorex Quantum at 3¾ ips. (Record 0 reference as above.)

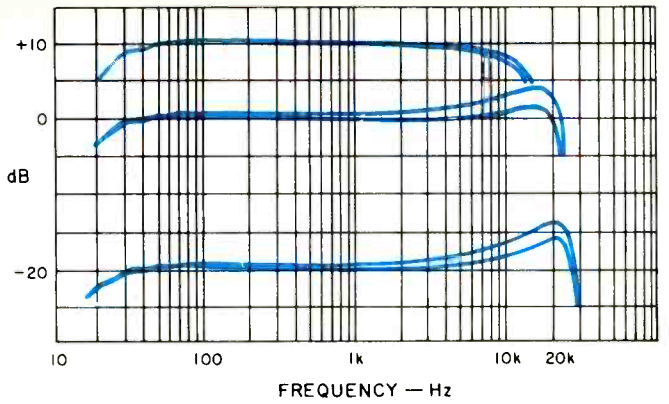


Fig. 3 — Record-playback response using Maxell UD at 7½ ips. (Record 0 reference as above.)

Studer ReVox claims for superior head design are graphically illustrated with the extended low-frequency response with just the slightest indication of head contour effects, superb performance. Similar plots were made using Memorex Quantum at 3 ¾ ips (Fig. 2). At reference level, response was from 20 Hz to 13 kHz. At the –20-dB record level, the upper limit moved out to 23.5 kHz (average), but there was a peak in the response around 17 kHz. With Maxell UD at 7½ ips, the responses extended further than with Scotch 206, but at the expense of excessive peaking at the highest frequencies (Fig.3). This deviation could be reduced greatly with a slight increase in bias. The small discrepancies between the two channels could be eliminated in similar fashion. Studer ReVox, however, takes the position that bias switches or pots should not be readily accessible because of possible abuse by unqualified users. That is a valid point, but I suspect that the more technically oriented owners will drill access holes in the bottom of the cabinet, just as many have done with the A77s.

The playback of a recorded 10-kHz tone had a 30-degree phase discrepancy between channels, evidence of very good alignment between the heads. Phase jitter at 7½ ips was 15 degrees, also very good. The bias residual in the output was down into tape noise, excellent design and adjustment. The playback of a recorded 1-kHz square wave had relatively small tilt (Fig. 4), another demonstration of the superb low-frequency response, and some short-duration ringing at the EQ peaking frequency. Some momentary, partial dropouts appeared in the stored waveform.

Plots were made of HDL_3 vs. record level for Scotch 206 at both speeds and Maxell UD at just 7½ ips (Fig. 5). On a dB-dB basis, the functions were the most linear ever measured, with just a slight upturn near the 3 per cent points. At the low end, HDL_3 continued to reduce to the noise limits of the test equipment, with little evidence of distortion in the electronics. From 30 Hz to 7 kHz, HDL_3 was very low, particularly at 10 dB below reference level. Throughout this entire range, other harmonics were consistently very low, excellent magnetic design. Signal-to-noise ratios with IEC "A" weighting at 7½ ips were 58.7 dBA for Scotch 206 and 59.3 dBA for Memorex Quantum at reference level, and 67.0 and 70.0 dBA for the same tapes for HDL_3 =3 per cent. At 3¾ ips using the Memorex tape, the figures were 57.1 dBA at reference level and 65.2 dBA at the 3 per cent point. These are all excellent figures, and don't forget — without Dolby NR. With CCIR weighting, the relative results were the

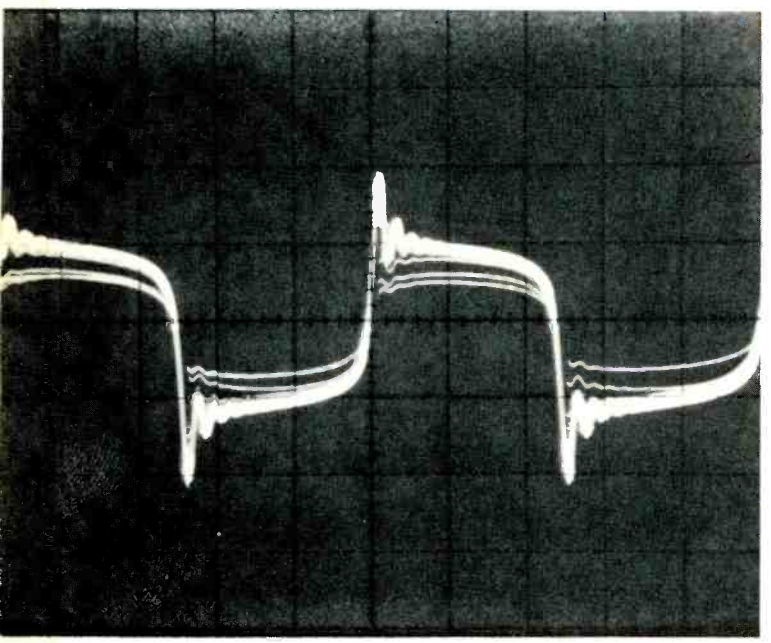
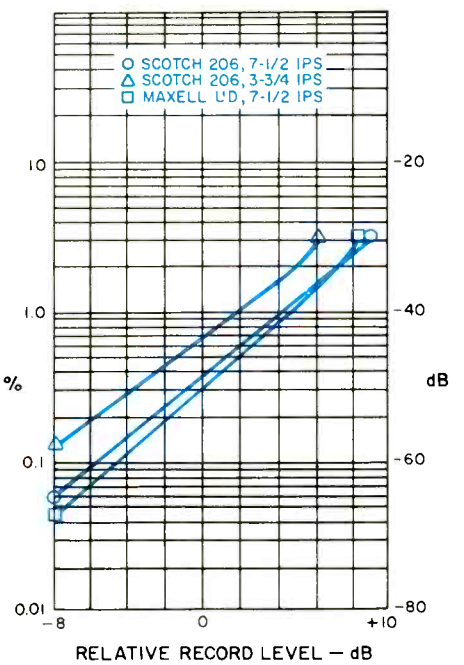
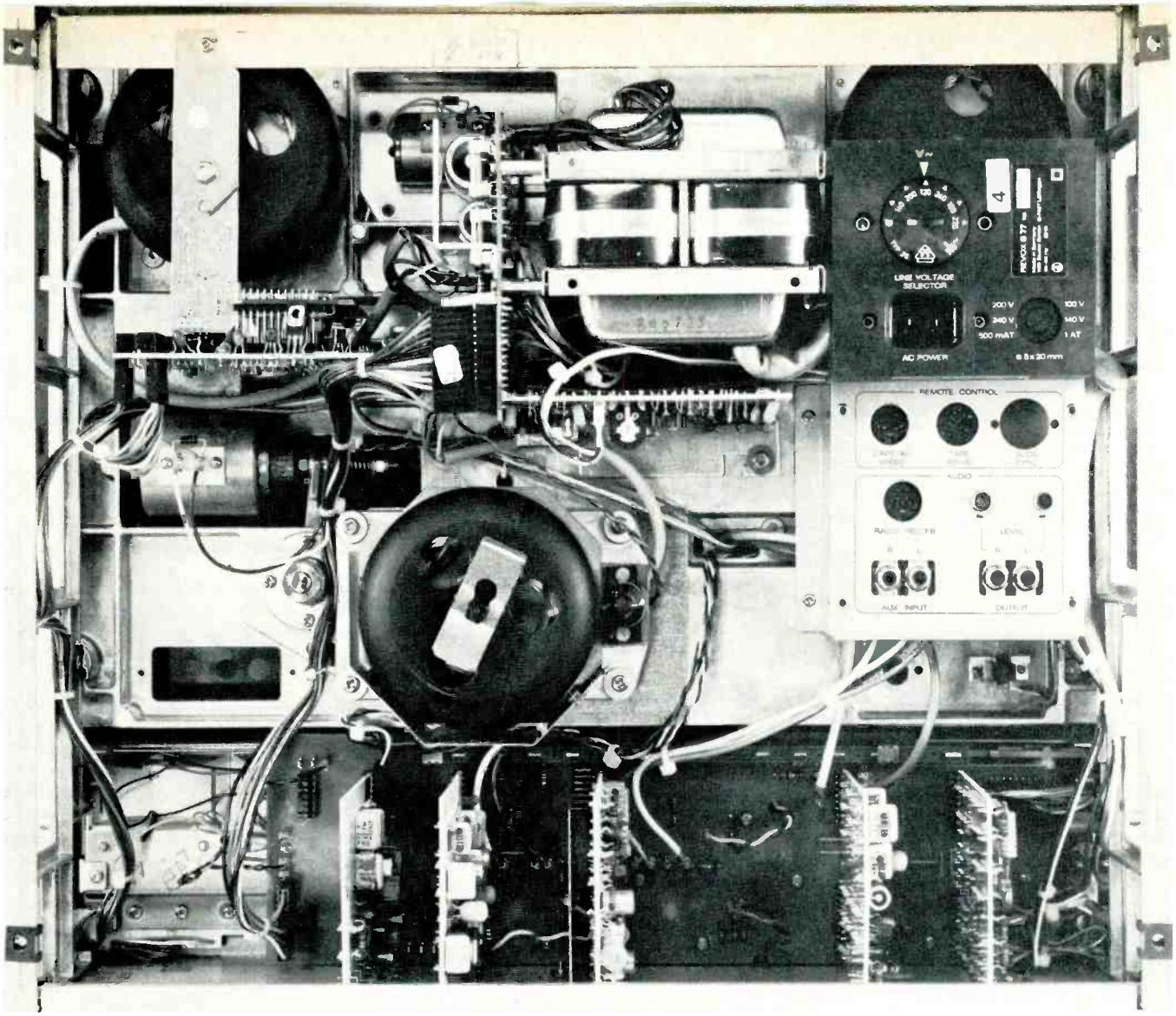


Fig. 4 — Playback of recorded 1-kHz square wave. (Scale is 0.2 mS/div.)

Fig. 5 — Third harmonic distortion vs. record level at 1 kHz. (Record 0 reference level as in Figs. 1-3.)





same, but all of the figures were 8 to 9½ dB less (smaller number). Separation from one channel to the other was a good 51 dB, and crosstalk to the adjacent track of opposite play direction was a good 69 dB. The erasure of a 1 kHz was excellent by any standard, down at least 90 dB.

The input sensitivity for low-impedance mike was all the way down to 0.046 mV, and even with the high-impedance setting only 1.4 mV was required. The line sensitivity was much higher than that normally encountered, just 17 mV for a zero indication. All of the measured sensitivities were six dB or more better than the specifications. Input overload was 48 dB or more above the sensitivity figures listed. Output clipping at the line-out jacks was reached at a level equivalent to a +17 meter indication. The input level pots tracked within a dB for the same pot positions. In accordance with ReVox specifications, the output levels were measured with the meters at +6. The line outputs averaged 1.48 V, just a little less than the spec. The headphone output was 5.5 V open circuit, 2.75 V with a matching 220-ohm load. Although the manufacturer recommends headphones with impedances from 200 to 600 ohms, the circuit will deliver a very adequate 190 mV to 8-ohm loads. (Many so-called 8-ohm headphones are actually 100 ohms or so.) The line-output level-set pots were left at maximum for all tests, although they provide up to 26-dB attenuation for system matching. The sections of the monitor pot tracked within ½ dB over most of its rotation. The total spread in output levels for all positions of the output selector switch was ½ dB, indicative of carefully set internal adjustment pots. The dynamic response of the two meters was in accordance with VU standards, but the extended frequency response to over 200 kHz is subject to question. The peak indicator threshold was very close to +6 VU with a CW input, and was still firing with a toneburst with duration reduced to 15 mS. The meter scaling was very close with maximum errors of 0.2 dB.

All indications from test tapes and a strobe were that the recorder tape speeds were close to exact. There were no indications whatsoever of speed changes from 100 to 130 line voltage. At 3 ¾ ips, the typical weighted peak flutter was 0.06 per cent. At 7½ ips, the flutter was 0.028 per cent on the average, with a maximum value of 0.04 per cent (Fig. 6). These results are well within the specifications and are direct evidence of superb tape motion. There were substantially no shifts in record-to-playback speed, and a slight shift plotted in one case was from drift in the metering. The wind times for a 3600-foot 10½-inch reel was 132 seconds. The time required to go from fast wind to play was less than two seconds at all times, smooth *and* fast.

Listening & Use Tests

Tape loading was easy and direct with little to snag the tape on, and there was good access for regular cleaning and demagnetization. Snapping off the head assembly cover did improve access to the capstan and scrape flutter filter. There was a good feel to all of the pots and switches during all phases of the testing. The logic-controlled, tape-motion switching performed without error, including the usual "torture" test. As stated before, a latch-in pause control did seem a definite lack at times. There was good meter action, and the placement of the overload LEDs seemed ideal in actual use.

There were some troubles with tape motion, but the major

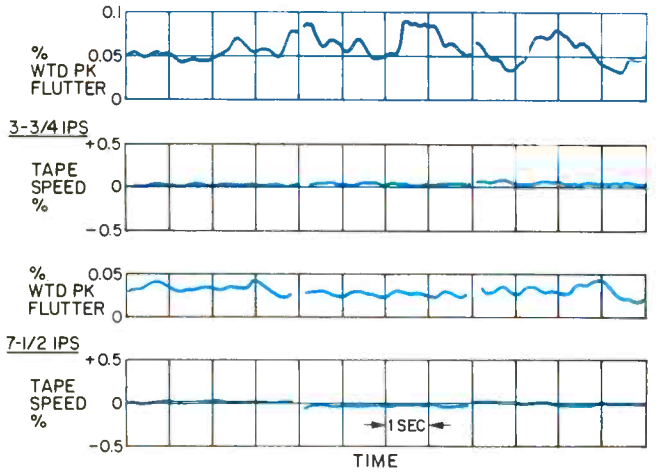


Fig. 6 — Peak-weighted fluttter and tape speed variations at 3¾ and 7½ ips.

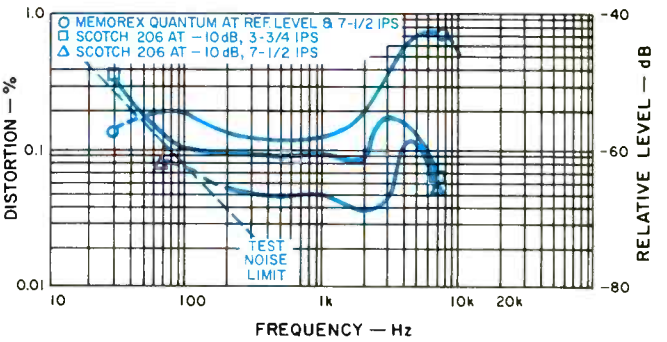


Fig. 7 — Third harmonic distortion vs. frequency.

difficulties disappeared with use. When first started in play, there was a scraping noise from the right reel turntable. Removing the front panel aided in making the tentative conclusion that some brake lining glue was rubbing against the brake band. In any event, the sound was gone by the time the testing was complete. A minor ailment, but annoying, was slippage in the counter. The errors were not great, but they kept creating confusion on where the exact start/stop points were.

The 44-page trilingual instruction book is logical and thorough with good descriptions complemented by clear illustrations. No schematic is included, but there is an excellent signal-flow block, and circuits are given of the remote control units, so you could even make your own. Clicks from pause and stop were 5 dB out of tape noise; the record click itself was covered by tape noise. Different sources were recorded, and there was nothing to fault in the playback. The B77 really shone when it was used to record the revised *Mass* by Leonard Kastle. (The earlier version had been performed on national PBS TV on Christmas 1977). The whole combination of this easy-to-carry high-performance unit with its excellent metering and of the inherent qualities in the music and its performance generated a tape which caused many a comment on its excellence. The $1,295.00 price tag will be more than tough for some, but in a number of the important areas of recorder performance, the B77 is superior to units costing a fair amount more. Studer ReVox may very well have another winner. *Howard A. Roberson*

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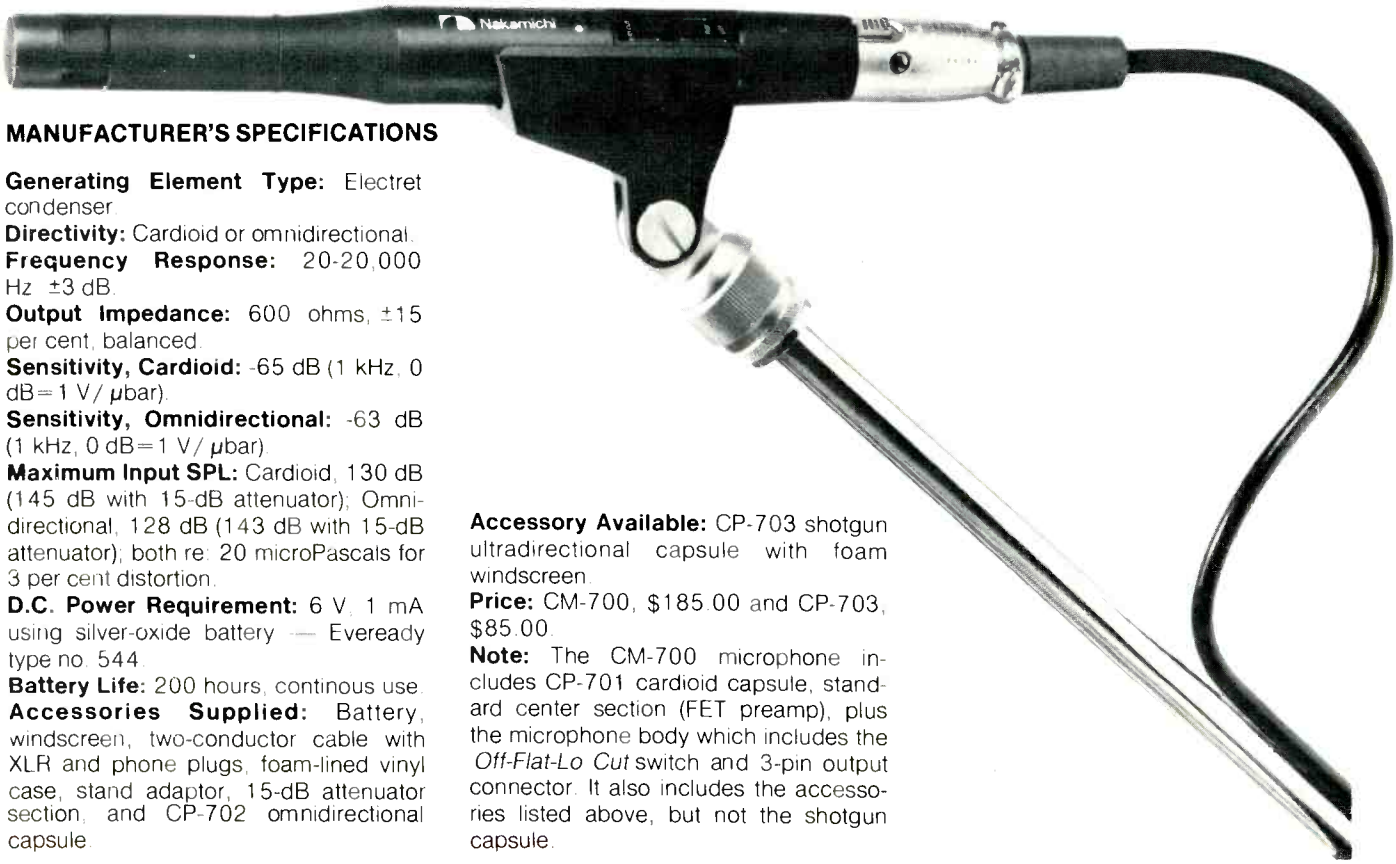
Nakamichi Model CM-700 Electret Condenser Microphone Systems



MANUFACTURER'S SPECIFICATIONS

Generating Element Type: Electret condenser.
Directivity: Cardioid or omnidirectional.
Frequency Response: 20-20,000 Hz ±3 dB.
Output Impedance: 600 ohms, ±15 per cent, balanced.
Sensitivity, Cardioid: -65 dB (1 kHz, 0 dB = 1 V/ μbar).
Sensitivity, Omnidirectional: -63 dB (1 kHz, 0 dB = 1 V/ μbar).
Maximum Input SPL: Cardioid, 130 dB (145 dB with 15-dB attenuator); Omnidirectional, 128 dB (143 dB with 15-dB attenuator); both re: 20 microPascals for 3 per cent distortion.
D.C. Power Requirement: 6 V, 1 mA using silver-oxide battery — Eveready type no. 544.
Battery Life: 200 hours, continous use.
Accessories Supplied: Battery, windscreen, two-conductor cable with XLR and phone plugs, foam-lined vinyl case, stand adaptor, 15-dB attenuator section, and CP-702 omnidirectional capsule.

Accessory Available: CP-703 shotgun ultradirectional capsule with foam windscreen.
Price: CM-700, $185.00 and CP-703, $85.00.
Note: The CM-700 microphone includes CP-701 cardioid capsule, standard center section (FET preamp), plus the microphone body which includes the *Off-Flat-Lo Cut* switch and 3-pin output connector. It also includes the accessories listed above, but not the shotgun capsule.

This is a high-quality electret system, having a very small diaphragm (16 mm), and is suited to audiophile music recording applications as well as in sound reinforcement for the performing arts. The cardioid and omnidirectional capsules are most useful for the former application and the shotgun capsule for the latter. The system is suited to professional use from the viewpoint of audio quality, but applications in studios and permanent sound systems may be limited because the CM-700 cannot be remote powered. (Remote-powered mikes usually cost more than the CM-700.) The shotgun attachment is good for special purposes involving long distance sound pickup such as wildlife sound recording and surveilance applications.

The CM-700 microphone system is perhaps unique among electret or air-condenser microphone systems because the FET preamps, as well as the condenser transducer capsules, can be interchanged. All of these pieces are included in the CM-700 system, and there is nothing extra to buy except perhaps the CP-703 shotgun capsule. This is logical because not all users will need this accessory. Our first impression was that you get quite a lot of parts for the money, and if worked only half as well as advertised, it would still be a bargain. The CM-700 system plus the CP-703 shotgun posed a formidable challenge for our laboratory because if we tested all possible combinations of pieces in all possible ways, it would require ten-to-the-nth hours!

The principal parts of the CM-700, starting at the connector end, are the main body with the *Off-Flat-Lo cut* Switch, the battery, the center piece containing the FET preamp, and the condenser-transducer capsule. The battery fits into the barrel of the main body and the center piece screws on and holds the battery in place. You have a choice of two preamps plus two capsules (three including the shotgun). One preamp (unmarked) yields flat response and normal sensitivity. The preamp marked "-15 dB" yields flat response, 15 dB lower sensitivity, and correspondingly higher sound pressure capability. The cardioid or omni cap-

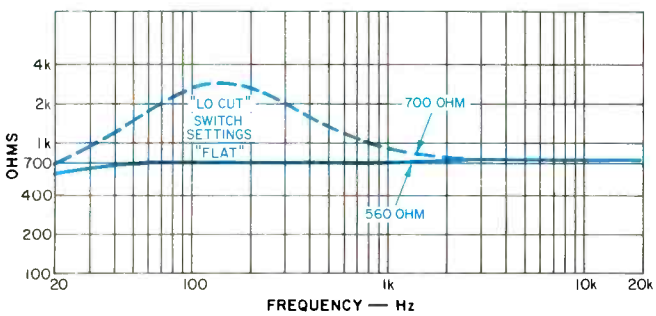


Fig. 1 — Impedance of the Nakamichi CM-700 microphone system with the CP-701, 702, 703 capsules, and 0 or -15 dB preamps (center section).

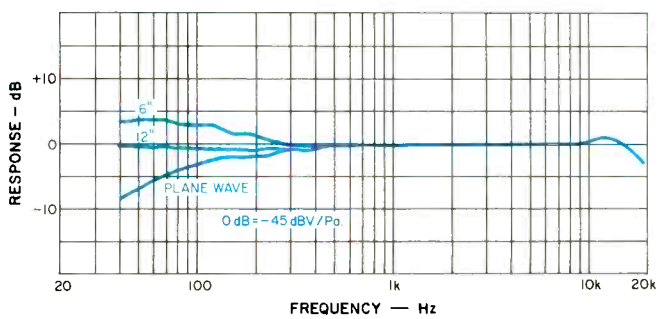
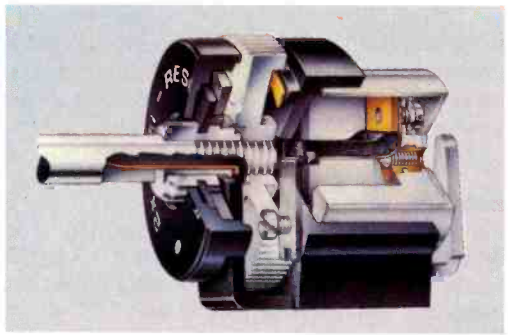


FIG. 2 — Frequency response vs. distance with the CP-701 cardioid capsule.

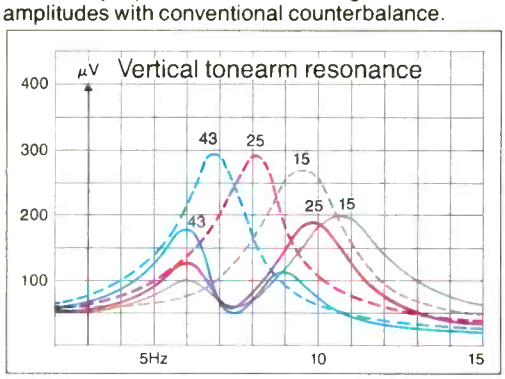
If the bass isn't as clean as you'd like...

The problem may be your tonearm. Not your amplifier or speakers.



Cutaway view of anti-resonance counterbalance. (A feature of Dual models 604, 621, 721 and 1246)

Solid lines show effectiveness of anti-resonance filters in damping resonant amplitudes of three different cartridges (compliance 15, 25 and 43 x 10^{-6} cm/dyne). Broken lines show higher resonant amplitudes with conventional counterbalance.



If you've been wondering why your high-powered amplifier and great speaker system don't deliver deep bass as cleanly as you'd like—especially at high listening levels—the problem may well be the effects of resonance on the stylus.

Ideally, the stylus should move only in response to the contours of the record groove. But in reality, the stylus tip also responds to various resonances: its own (with the stylus shank) and the combined resonance of the tonearm/cartridge system.

These subsonic frequencies, though inaudible in themselves, can have very audible effects. Especially with warped records. They can drain amplifier power and cause excessive movements of the low frequency driver. They can cause the tonearm to vibrate and even to momentarily leave the groove. All of which results in audible distortion.

Competent tonearm designers know all this and do their best with materials, masses and compliances to establish the inevitable resonances at the least harmful frequencies (usually between 8 and 10 Hz) and with the lowest possible amplitudes.

Dual's tonearm designers have taken a significant step beyond this.

The unique counterbalances of our direct-drive models (604, 621 and 721) and our top belt-drive multiple-play model (1246) contain two mechanical anti-resonance filters. These are specially tuned to damp resonant energy in the tonearm/cartridge system and chassis.

The startling effectiveness of these filters in lowering the resonant amplitude of three cartridges having different compliances can be seen in the graph. Whether the improvement in the bass is subtle or obvious to you depends on the other components and your listening environment.

We've prepared a technical paper on this subject which we'll send to you if you write us directly. You may discover that you don't have to replace your amplifier or speakers after all.

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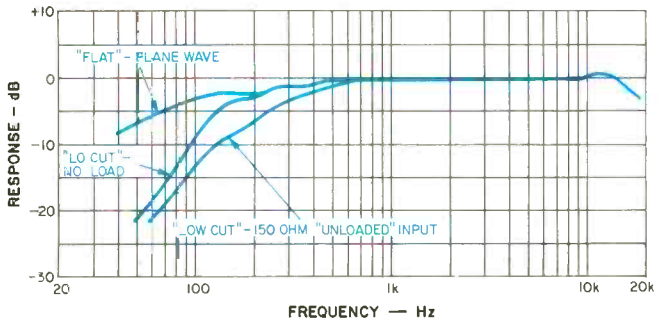

Fig. 3 — Effects of loading on "Lo-Cut" frequency response with CP-701 cardioid capsule.

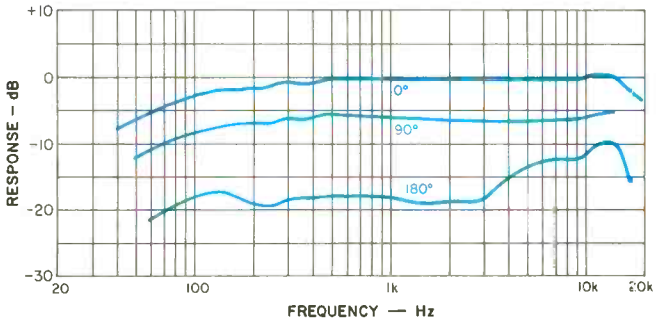

Fig. 4 — Frequency response vs. angle with the CP-701 cardioid capsule.

sule may be used with either preamp. The rigid plastic windscreen can be slipped over the capsule to a positive stop at the base of the preamp, and this screen is more durable than a foam sock which eventually deteriorates.

The CP-703 shotgun capsule is not simply a capsule . . . it consists of a condenser capsule attached to a 16-in. long tube, of ½-inch diameter, with a series of small holes along the length of the tube. This assembly is screwed onto a FET preamp, which is unmarked, but appears identical to the preamp/center section that is used with the other capsules. We mixed up these two preamps and had to make an acoustic response test to sort them out. They are electrically different — the shotgun preamp frequency response is specially tailored for maximum speech intelligibility. A foam windscreen covers the entire length of the shotgun pipe, capsule, and preamp.

Our entire kit included three capsules, three preamps, two windscreens, a mounting swivel, and a cable assembly. The cable is terminated in a ¼-inch phone plug for use with unbalanced inputs such as on Nakamichi equipment, but the mike may be used with balanced inputs, center-tap grounded or floating, by using a standard mike cable with an A3F connector on the mike end. The system is available in any color as long as you choose black, in keeping with Nakamichi's "black look."

Laboratory Tests

Figure 1 shows the impedance curves. The impedance on "flat" setting conforms to the 600-ohm nominal spec value. EIA Standard SE-105 states that a *low impedance* microphone shall be 600 ohms or less, but states a maximum value of 180 ohms as standard. This is being ignored by many makers, and the *Audio* October, 1977, Directory issue shows that today's hi-fi microphones range from 150 to 600 ohms. We experienced no loading effects when testing the mike into the 150-ohm "unloaded" input of our broadcast mike preamp with the mike switch on "Flat" response, but on "Lo Cut" experienced loading effects because the mike impedance exceeds 2000 ohms at 150 Hz. More about this later, but we recommend that the user

make certain that his equipment input is "unloaded" before connecting the mike to a 150-250 ohm input. Most inputs are "unloaded," that is, the actual impedance is 5 or 10 times nominal value.

Figure 2 shows the on-axis frequency response of the CM-700 with cardioid capsule and normal gain FET preamp. At 12 inches, the response is ruler-flat and equal or better than any air- or electret-condenser mike we've tested. The rolloff above 16 kHz may be ignored. If we interpolate to a distance of 50 cm (20 inches), our curve matches the factory curve supplied (this may not be supplied with your mike), within about ±1 dB. Results on sensitivity agree precisely with the factory value. The factory curve was not corrected to plane-wave conditions so the low-end rolloff appeared slight. Our "Testing Update" article discusses the plane-wave testing problem. For distant miking, the cardioid capsule response is lacking in bass. Some cardioid condenser mikes have a bass rolloff which is good for many field uses, where very low frequency ambient noise is present and for pop music which has lots of bass. For classical music, bass boost may be desired, and we will describe an inexpensive way to equalize the mike.

Figure 3 shows the impedance loading effects. For "Flat" setting, response was the same into our preamp or into an open circuit. With "Lo Cut" setting, the preamp produced more bass rolloff than an open circuit. In the voice frequency range above 200 Hz, the preamp loading helps to compensate for proximity effect, but your preamp may not exhibit the same loading as ours.

The frequency response at various angles (Fig. 4) gives a hint of the superlative quality of the CM-700/CP-701. The 90-degree curve is nearly identical to the 0-degree curve. Presumably, the frequency response is unchanged throughout the entire front hemisphere. The small diaphragm size is responsible for this uniformity. All ½- or ⅝-inch diameter laboratory microphones generally have rather uniform directivity to 15,000 Hz, but ⅞- or 1-inch diameter microphones do not. Precision sound level meters are now equipped with ½-inch diameter microphones to permit accurate measurements at high frequencies in reverberant rooms where sound wave direction is random.

The CP-702 omnidirectional capsule (Fig. 5) has ruler-flat bass response and a nice compromise adjustment of the high frequency response. There is a slight excess of highs in the 0-degree curve for close miking and a slight deficiency in the 90 degree or random incidence responses for distant miking, such as when the mike is suspended over an orchestra. The small variation in response from 0 to 90 degrees is scarcely audible and, again, is a result of the small diaphragm.

The plastic windscreen produced little change in response (Fig. 5), less than most foam screens. The screen was found to be effective outdoors in winds up to 10-15 knots. There is a problem with screen I.D. tolerances, because one screen fit too tightly and marred the mike finish, while another fit too loosely.

The CP-703 shotgun capsule was tested at six feet outdoors due to its great length. (See the "Testing Update" article.) Figure 6 shows the frequency response, and it may be assumed that a plane wave exists at this distance. Our data does not correlate with the factory curve, undoubtedly because of the big difference in distances to the source — 50 cm vs. 6 feet. We presume our test is more accurate. The "Flat" response is generally undesirable for shotgun applications. The rising response on "Lo-Cut" appears ideal for long distance outdoor speech pickup, as it will reduce low-frequency noise and emphasize the higher frequencies so critical to intelligibility. Figure 7 shows a non-standard condition where we used the preamp section from the cardioid/omni capsules. The response is considerably flatter, and we thought might be more ideal for quiet locations, as in a studio or auditorium. Note the increased sensitivity. The foam screen for the shotgun was not terribly effective on a breezy day, and tests had to be postponed until the wind was less than five mph.

Figure 8 reveals the excellent directional characteristics of the CP-703. Essentially null response is obtained at 90 and 180 degrees. A microphone of this type should degrade to a cardioid pattern below about 500 Hz, but Nakamichi has apparently defied the laws of physics, maintaining uniform directivity at low as well as mid and high frequencies. (Some years ago we stated in a Patent Application that a shotgun mike must be 22-feet long to obtain this performance!)

So far, all of these data show that the CM-700 is equal (and dare we say superior?) to any air or electret condenser we have tested. The small diaphragm size is responsible. But it is well known that ½- or ⅝-inch laboratory condenser mikes have poor signal-to-noise ratio; that is the noise level expressed in equivalent SPL is high, reducing usable dynamic range. The noise test (see "Testing Update" article) is critical to proving or disproving the superiority of this microphone.

Our test results shown in Fig. 9 reveal a fairly uniform noise spectrum, and the unweighted and "A" weighted levels are 29 and 22 dB, respectively. The one-third octave levels are a few dB higher than a good air condenser at mid frequencies (see our January, 1978, review), but the low frequency noise levels are significantly lower. The 22 dB "A" weighted scale level means that microphone noise will be less than ambient noise in a very quiet studio, church, or auditorium. Our BK-5B reference mike measured only 3 dB "A" weighted scale less noise, and it has no internal amplifier to make noise! Again, Nakamichi appears to have repealed the laws of physics. We see little reason to purchase a larger, more costly air-condenser microphone, unless you need special features such as remote powering.

The dynamic range, frequency response, and directional properties of the CM-700 with the omni capsule are ideal for sound measurement as well as for speech and music pickup. Specifically, *the omni capsule is suitable for Type 1 precision sound level meters meeting ANSI Standard S1.4-1971*. The cardioid is particularly suited to loudspeaker tests in rooms because of its uniform frequency response and ability to reject reflected sound. A cardioid mike may be ideal to use for system/room equalization because, not unlike your ears, it discriminates against reverberant sound. [The editor reminds us that TDS equipment, *a la* Dick Heyser, discriminates against reflections, permitting an omni mike to be used for speaker testing in rooms.]

The phasing test showed pin-2 positive in accordance with the prepared revision to the EIA standard. The clipping level with cardioid capsule and closeup speech was 129 dB re: 20 microPascals. The measured output of the "-15 dB" preamp was approximately 15 dB less than the standard preamp, and we can only assume that the clipping level increased to at least 129 + 15.0 = 144 dB re: 20 microPascals.

Listening and Use Tests

The Nakamichi CM-700 sounds identical to our BK-5B reference microphone except for a slight decrease of "presence" when reproducing speech at 6- to 12-inches distance. The BK-5B has a smoothly rising response from 50 to 6000 Hz and a ruler-flat mike sounds a bit dull by comparison. Similar results were obtained with CP-701 capsule and "Lo-Cut," and CP-702 capsule and "Flat" response.

Then we tried the shake test and heard a loud rattle in the earphones. It required considerable patience and skill to find that there were two similar rattles caused by loose-threaded rings in the bottom of the cardioid capsule and in its preamp. We removed the ring from the capsule because of curiosity, and the entire back plate and insulator assembly fell out! Looking inside the capsule housing, we saw the foil electret which was translucent to light. This was the first electret mike we've taken apart where the foil electret wasn't cemented to the rim of the backplate. We held out little hope of making the capsule work again. We recalled that electret foils more or less sit on the back plate and, hoping that no critical airspace was involved, we reassembled the capsule.

Well, the cardioid capsule talked again, so we repeated the frequency response test. Lo and behold the response and sensitivity were within about ±¼ dB of that shown in Fig. 2! Has Nakamichi repealed the laws of physics again? [Editor's note: Nakamichi promises they'll either tighten the rings or supply a spanner wrench with every mike!]

With a sigh of relief, we resumed our listening tests. Now, nothing rattled. Vibration sensitivity with the cardioid capsule was higher than the BK-5B, and rubbing the mike generated a substantial amount of high frequency sound. This is no worse than a good air condenser, and, similarly, the CM-700 should be resiliently mounted where vibration is a problem. The CM-700 with omni capsule has equal vibration sensitivity, and is not highly recommended as a hand-held vocalist's mike. Another reason not to let a vocalist hold it (besides not wanting it dropped) is that the switch may be accidentally actuated.

The windscreen affords excellent "pop" protection for either capsule, as well as the previously mentioned wind-noise reduction. "Pop" sensitivity was only a little higher than the BK-5B with its large 4-inch diameter accessory screen. We recommend using the screen in all but the most pristine environments and on all occasions when picking up speech or close-miking instruments. Without the screen, the CM-700 has very high wind and pop sensitivity.

The CM-700 has less hum pickup than the BK-5B, which puts it in the "excellent" category. This, no doubt, contributes to the low noise output and lack of 60 Hz and harmonics in the spectrum.

Continuing our talk test versus the BK-5B, we compared sound at 90° off-axis and discovered that the CM-700/CP-701 sounds just the same as on-axis, but the BK-5B has a distinct nasal quality off axis. This aroused our interest, and we fired-up our RCA MI-10006A condenser mike (See *Audio Cyclopedia* and "Update" article) for comparison. We were amazed by the result: On-axis, the two sounded identical, but off-axis the MI-

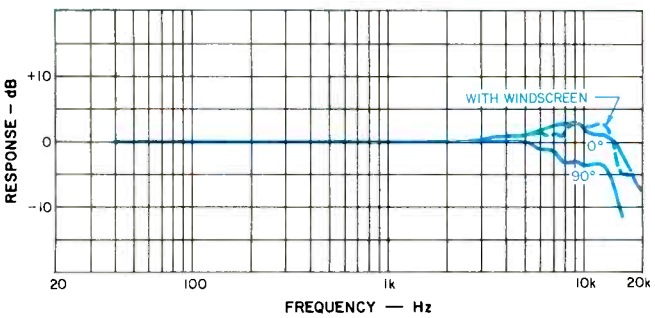

Fig. 5 — Frequency response with the CP-702 omnidirectional capsule.

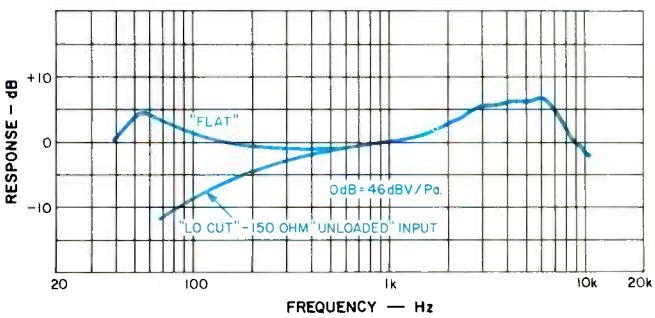

Fig. 6 — Frequency response with the CP-703 shotgun capsule.

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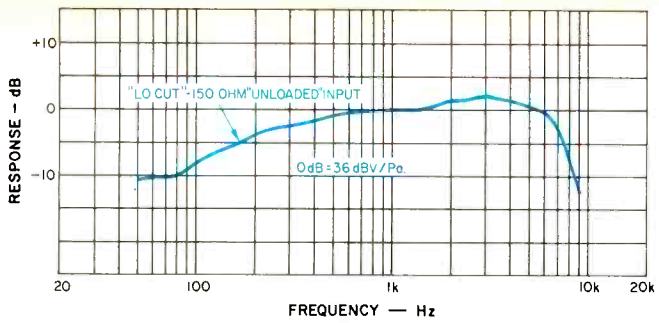


Fig. 7 — Frequency response with the CP-703 shotgun capsule using preamp (center section) for cardioid and omni capsules.

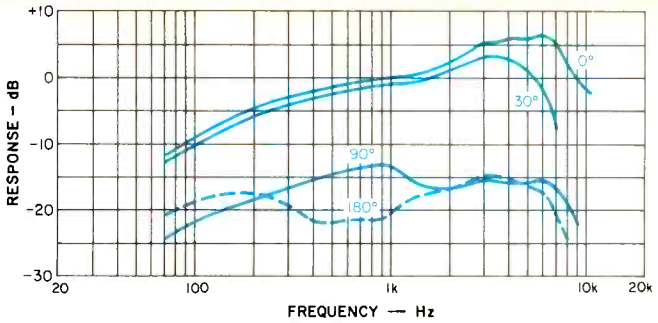


Fig. 8 — Frequency response vs. angle with the CP-703 shotgun capsule on "Lo-Cut," 150 ohms impedance, and "Unloaded" input.

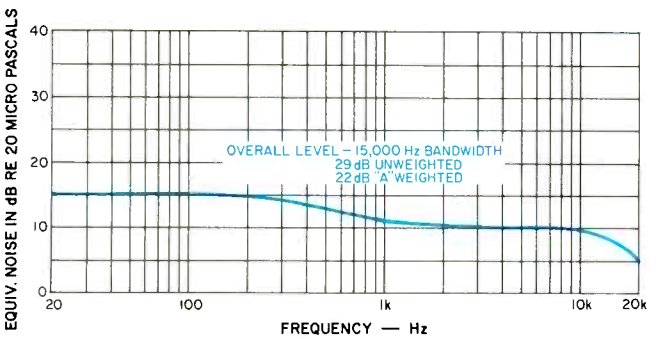
10006A sounded completely muffled compared to the natural sound of the CM-700.

Then we compared the CM-700/CP-701/CP-702 in the studio with recorded music and were astonished to hear an entire top-octave not present in the BK-5B! (The BK-5B has fairly uniform axial response to 15,000 Hz, but at 90° it is not uniform.) Our recorded sources did not have much music in the top octave because the tapes were recorded with BK-5s or 77-DXs, so we tried an acoustic guitar. A lot of very high pitched harmonics were heard with both CP-701 and CP-702 capsules that were inaudible with the BK-5B. The Nakamichi microphone plus earphones enabled us to perceive these sounds more clearly than by ear alone.

The strikingly beautiful sound of the CM-700 on strings inspired us to borrow a second system and substitute CM-700/CP-701 for BK-5Bs to make a recording of the Bach *B Minor Mass* with chorus, soloists, and orchestra, including pipe organ and harpsichord. The location was a high-ceilinged church, seating about 600, and with a reverberation time of approximately three seconds. We used a ReVox A77 reel-to-reel tape deck that we tuned up with Maxell UD tape for ±1 dB, 30-20,000 Hz frequency response and 10-dB headroom above 0VU. Fortunately, we were able to compare our tape to a previous *B Minor Mass* recorded in the same place with the same machine, but using 77-DX microphones.

Playback in our studio revealed that although the 77s sounded a bit better on the chorus, the top-octave-plus was missing. Of course, the (on-axis) string section sounded better with the CM-700/CP-701, but the sound of off-axis instruments was most startling. The harpsichord on the right could be heard at all times, but at my location in the church I could not always hear it. The brass on the far left were almost too loud, and rich with harmonics. By comparison, the 77-DX sounded as if it were "focused" on the centrally located sources which were chorus, strings, flute, and woodwinds, but off-axis instruments were muffled. In this church, the orchestra stretches from left to right and subtends a wide angle from the microphones which are positioned in the third row. Bass viol was slightly stronger with the 77-DX, which exhibits uniform response to 40 Hz for plane waves.

Fig. 9 — One-third octave band noise spectrum with the CP-701 capsule on the "Flat" response setting.



The CM-700/CP-703 shotgun was subjected to an entirely different set of listening tests. First we positioned a portable radio, set on a news station, outdoors about 100 feet from the building. It was adjusted for normal speech, 65 dB re: 20 micro-Pascals at one meter. We set up our listening equipment on the roof and compared the Nakamichi to the MI-10006A condenser with its set of pipes, which are the same length as the Nakamichi. We would expect these mikes to be similar. With our unaided ears, we could understand a very few words above the (low frequency) ambient noise, primarily auto and truck traffic. Aided by the Nakamichi, we understood about 80 to 90 per cent of the words. It had to be precisely aimed at the source, but actually performed a little better when aimed at a sloping section of roof which apparently acted as a reflector. The RCA mike picked up only low-frequency noise — no speech was heard at all!

The preamp that is attached to the CP-703 worked best — the other flat response preamp yielded a poorer signal-to-noise ratio. "Lo Cut" had to be used at all times to reject noise.

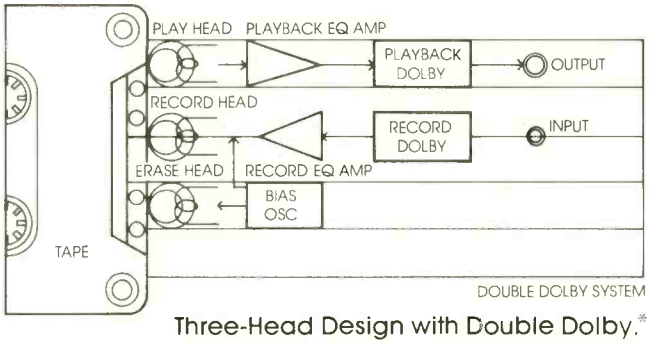
Then, our son tried the CM-700/CP-703 for stage reinforcement of vocalists in a high school musical show. The outstanding discrimination enabled weak vocalists to be heard above the orchestra and with realistic audio quality, although the rising-response preamp was used, plus "Lo Cut." The director, who has a lot of professional experience, indicated the CP-703 was the best stage mike he'd heard. To achieve these results, a full-time operator was needed in the orchestra pit to aim the mike accurately. In our large auditorium, we need three mikes and three operators to cover the entire stage. The operators should have had monitor phones to assist aiming and handling of the mike.

The mechanical quality of the CM-700 system is excellent, save for the easily-fixed problem of loose rings. The system components have fine threads which may be damaged by careless cross-threading. On our mike, the external threads were not masked during finishing, and we experienced some binding during the first few engagements. The swivel mount incorporates what appears to be a tapered ½-inch pipe thread. It fits an iron pipe having a tapered thread, but not the Atlas AD-1 RCA Adaptor which has a straight pipe thread. Microphones should have a straight thread, specified as "½-inch NPSM." An adaptor to fit ⅝-27 mike stands is included but it doesn't have a knurled shoulder as the AD-1 does, and pliers were needed to remove it from the stand each time we used the microphones.

The acoustical performance of the Nakamichi CM-700 system is superior to comparable microphones tested to date. The CP-701 cardioid capsule is perfect, save for the bass rolloff on distant sources. It occured to us that a simple passive equalizer could provide linear bass response.

Figure 10 shows a suitable equalizer that may be inserted into the mike line. Figure 11 shows the measured frequency

ALL THREE-HEAD CASSETTE DECKS LET YOU HEAR AS YOU RECORD. OURS LETS YOU RECORD PRECISELY WHAT YOU HEAR.



Three-Head Design with Double Dolby.*

Not all three-head cassette decks are created equal. Some manufacturers have designed their decks with separate erase, record and playback heads primarily for convenience. So you can tape monitor as you record.

But our new KX-1030 uses separate heads primarily for performance. Each designed with the optimum gap to record or play back sound more accurately.

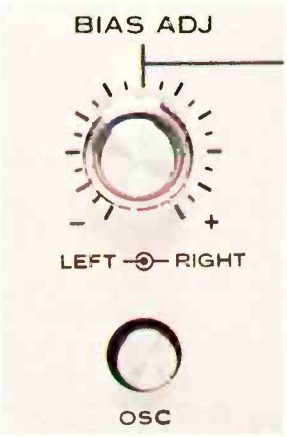
As a result, the KX-1030 has a frequency response of 35-18,000 Hz(±3 dB using CrO_2 tape.)

And to let you take full advantage of the separate record and playback heads, the KX-1030 has a Double Dolby* system with separate circuits for the record amplifier and the playback preamplifier. That way, as you record with Dolby, you can also tape monitor with Dolby, so you hear the sound precisely as it's being recorded.

The KX-1030 also has a Variable Bias Adjustment Control and a built-in oscillator, so you can adjust the exact bias for the type or brand of tape you use.

We also built in a number of other features like MIC/LINE mixing, memory rewind and a peak indicator.

But as good as all this sounds, wait until you hear the price. Because at $425.00,** no other comparably priced cassette deck can match the performance and features of our new KX-1030.



Variable Bias Adjust compensates for tape differences.

Of course the only way you're really going to appreciate the KX-1030 is to visit your Kenwood dealer. Once you do, you'll be convinced: Performance, convenience, and value set the KX-1030 apart from all the rest.

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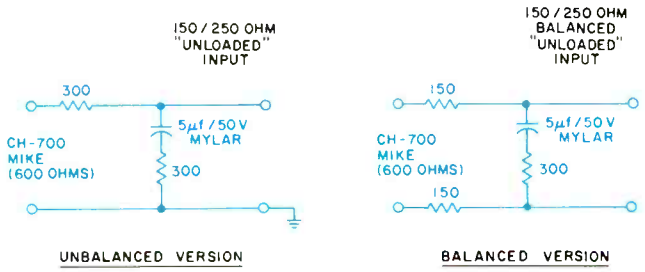


Fig. 10 — Diagram of a corrective equalizer and 12-dB pad for the CM-700 microphone and CP-701 cardioid capsule.

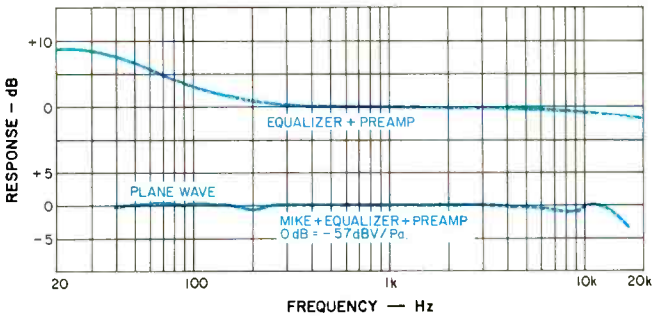


Fig. 11 — Measured response of equalizer for the CM-700 microphone and the CP-701 cardioid capsule, and the computed response of the system.

response of the equalizer, plus our BA-31 preamp, and the resulting ruler-flat acoustical response for plane waves. Of course, electrolytic capacitors are a "no-no" for this application; we use small 50-V mylar capacitors.

This equalizer does two additional useful things: 1) The 12-dB loss reduces the acoustic sensitivity to equal ribbons or dynamics and restores a "normal" gain setting on our ReVox, which in close miking, could prevent recorder overload and would eliminate the need for the -15 dB preamp in cases where SPL is less than 130 dB; and 2) the output impedance (at mid and high frequencies) is reduced to 225 ohms which presents a more suitable source impedance to 150/250-ohm inputs, which are still required to be "unloaded."

In the future we will try this equalizer at a live recording session. We hope it will provide the desired bass without picking up too much VLF ambient noise, and we will also be checking for noise from the recorder preamp. This equalizer is not needed when the source is closer than three feet from the microphone, so it's mostly for classical recording applications. Others, who want an extra heavy bass sound, may find it useful.

The CM-700/CP-703 omni capsule is an excellent system, requiring no bass equalization, but we can't use them as permanently suspended recording mikes until we figure out how to power them from a remote source. We would appreciate learning of schemes for remote powering, experiences with equalization, and other comments from users. We tried the omni capsule for recording a concert where the mikes were aimed straight up and the instruments and vocalists surrounded the mikes. Sound quality was as good as with the cardioid capsules, and we were spared the complexities of setting up many cardiod mikes.

We highly recommend the Nakamichi CM-700 system for the most exacting applications in music recording and sound reinforcement for the performing arts. To those who doubt that a moderate cost mike system can do justice to a multi-thousand dollar recording or reinforcement system, we say "Try it — we think you'll like it." *Jon Sank*

Start playing with a full deck.

The AIWA AD-6800. It has everything you should expect in a top-flight cassette deck. And that includes our Flat Response Tuning System (FRTS) that adjusts to the optimum bias level for any tape on the market, precisely and effortlessly.

The AIWA AD-6800 uses its own circuitry to measure the precise bias figure of not just one or two, but every brand of cassette tape, whether it's LH, FeCr or CrO_2. The result; a flatter-than-ever frequency response with any tape on the market.

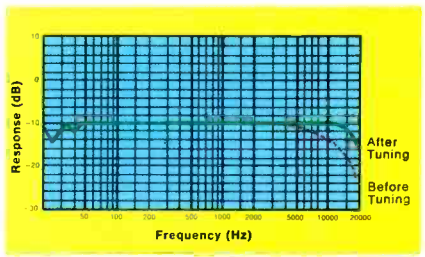
And the new AIWA 3-head Flat Response Tuning System is a snap to use.

First, slip in a cassette and the AD-6800 will load it automatically.

Next, set the Input Selector to "test" and push the "record" key to automatically activate the 400Hz and 8kHz built-in oscillators. You're all set for test recording.

Slide the Azimuth Adjust control for optimum head alignment and adjust the Bias Fine Adjust knob that corresponds to the type of tape you're using. The AD-6800 will let you know the exact bias necessary for the flattest possible response when the right (8kHz) and left (400Hz) VU meters are in corresponding positions. Now you're ready to record. It's that simple.

Bias Fine Adjustment allows precise fine tuning for optimum response.



The AIWA Flat Response Tuning System achieves flattest response possible for maximum recording results.

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And with the AD-6800 you get an incredibly low wow and flutter of 0.05% (WRMS), and with Dolby* on and FeCr tape, an S/N ratio of 65dB, and a frequency response of 20 to 19,000 Hz.

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58 Cassettes

continued from page 53

tions in sensitivity. One medium and four minor drop-outs.

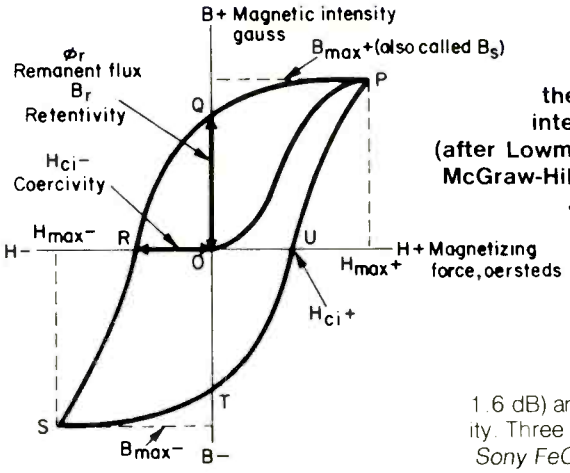
Sony UHF: Overall, close to average in performance for the normal-bias ferrics. Very good consistency of sensitivity, skew, and bias requirements for all samples. Occasional shifts in sensitivity of 0.8 dB. Ten minor drop-outs.

Superscope HF: Frequency responses were smooth at -20 dB, a bit limited at the high end, more so at 0 dB. Other results were also about average for the group. Skew and bias requirements were consistent for most samples. C-60s were 1.4 dB more sensitive than C-90s. Sensitivity varied 0.3 dB quite continually. One medium and 10 minor drop-outs. One C-90 jammed. Sonic-welded.

Superscope SHF: Frequency responses were quite similar to HF, but this tape does provide the benefits of higher MRLs and lower noise. About average in performance, overall. Very good consistency in all respects, with the exception of one C-90 which had a somewhat different skew. Random shifts in sensitivity of 0.5 dB. One medium and 11 minor drop-outs.

TDK Maverick: Average frequency responses, but poorer than average in the other areas, except for modulation noise which was lower than most. Excellent consistency of sensitivity, skew, and bias needs for all samples. Zero drop-outs. Cardboard box.

TDK D: The comments on TDK Maverick apply, in general, although modulation noise was average. The C-120 length required 0.9 dB less bias (-1.9 dB) and was 1.7 dB less sensitive. C-180 samples could not be matched for performance and were dropped from the testing. Sensitivity shifts of 0.5 dB appeared randomly. One medium and eight minor drop-outs.



The hysteresis loop shows the relation between magnetic intensity and magnetizing force (after Lowman's "Magnetic Recording," McGraw-Hill, 1972). See Vogelgesang's article in this issue for a discussion of how to analyze the hysteresis loop.

TDK AD: Wide, smooth frequency responses, high MRLs and low noise make this one of the best ferrics. Consistency was outstanding with substantially no variation in sensitivity, skew, or bias requirements among all samples. Zero drop-outs.

Ferrichrome Tapes

BASF Professional III: Wide frequency response at -20 dB, characteristic of the FeCr tapes. High MRLs, in general, and highest S/N ratio of all tapes tested, but also highest modulation noise in category. Excellent consistency among the three C-90 samples. Two minor drop-outs.

Scotch Master III: Wide frequency response at -20 dB, best response of group at 0 dB. Other excellent results including high MRLs and best modulation noise in group. Sensitivity variations and high-frequency amplitude "breathing" with some samples prevented a complete assessment of consistency. C-60s appeared to need 1.1 dB less bias (-1.6 dB) and to have 0.7 dB less sensitivity. Three minor drop-outs.

Sony FeCr: This tape had the widest frequency response of all tapes at -20 dB, but only a little greater than the other FeCr tapes. Sensitivity was quite consistent for all samples. C-60s required 0.8 dB less bias (-0.2 dB), and there were variations in skew. Two medium and two minor drop-outs.

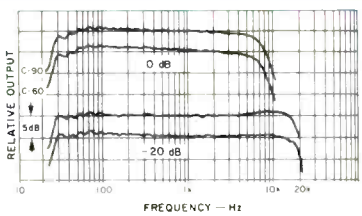
CrO_2 Tapes

BASF: Fairly wide response at -20 dB, but poorest of the group at this level and at 0 dB. Overall, the poorest of the CrO_2 formulations. Most samples consistent in skew and bias needs. Some samples required change in bias of 0.5 dB. C-60 sensitivity 0.9 dB lower. Two medium drop-outs.

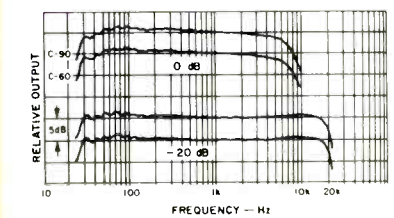
BASF Professional II: One of the best of the CrO_2 tapes in response, with high MRLs and S/N ratio, along with low modulation noise. Consistency very good in all respects, except that one sample required more bias. Minor continual amplitude variations. One medium and three minor drop-outs.

Capitol Music: Frequency responses below average for group. Other characteristics were generally about average. Considerable variations were evident in skew and sensitivity. C-60s required 1.1

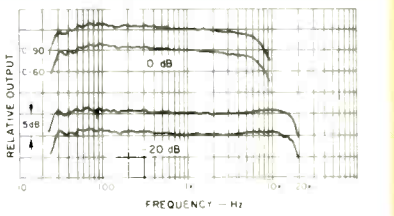
High-Bias Non-CrO_2 Tapes



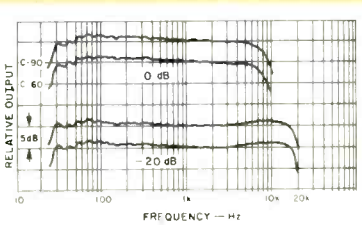
Fuji FXII



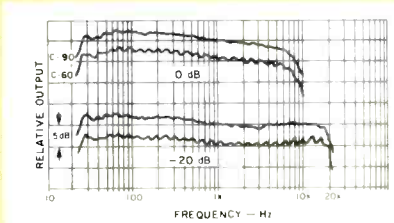
Nakamichi SX



TDK SA



Maxell UD-XL II



Scotch Master II

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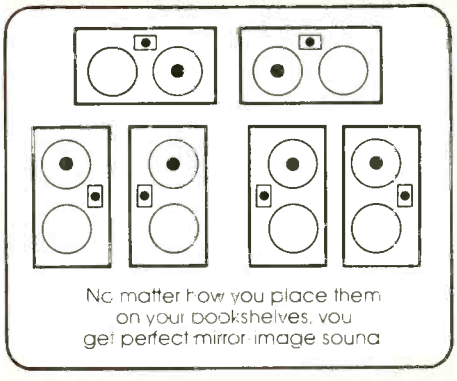
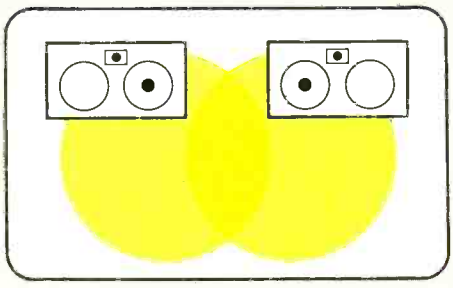
The new Koss CM/530 bookshelf speakers with the perfect mirror-image sound.

Here is truly a remarkable achievement in loudspeaker design and performance. The Koss CM/530 bookshelf loudspeaker sets an entirely new standard in extended bandwidth response, high efficiency, low distortion and perfect mirror-image for speakers in its size and price range and within today's technological capabilities.



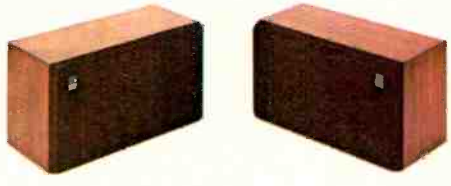
By designing a left and a right channel configuration for the passive radiator, the woofer and the tweeter, Koss engineers



have created a perfectly matched set of bookshelf speakers that can be placed horizontally or vertically without losing the perfect right to left imaging, an incredible degree of dispersion and the beautiful Sound of Koss.

To create the breathtaking depth and clarity in the CM/530, Koss engineers used an 8-inch passive radiator to radiate the sound energy over the lower two octaves. This allowed them to use an 8-inch woofer to reproduce the critical sounds in the midrange up to 3,000 Hz. In addition, the CM/530's 1-inch dome tweeter reproduces an exceptionally flat energy output and unusually low distortion that provides for a transparency and liveliness not found in other competitive speakers.

Ask your Audio Dealer to give you a live demonstration of a matched pair of bookshelf speakers. You'll be amazed at their perfect mirror-image sound. And while you're at it, try the perfect answer to private listening: Koss stereophones. But by all means, write, c/o Virginia Lamm, for our full color speaker and stereophone catalogs. The Sound of Koss will do great things for your records or tapes . . . and your image.



KOSS® CM/530 BOOKSHELF SPEAKERS

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dB less bias (-1.1 dB) and were about 1 dB more sensitive. There were random shifts in sensitivity up to 1 dB. Two major and 10 minor drop-outs. No auto-switch sensing holgs.

Memorex: Frequency responses and modulation noise were better than average, while other characteristics were average for this category. Skew and bias requirements were very consistent for all samples. Sensitivity of the C-90s had a spread of 1.0 dB, but the average was close to that for the more consistent C-60s. Sensitivity shifts of about 1 dB appeared every several seconds. Three minor drop-outs. Sonic-welded. Memorex box.

Realistic: This was one of the better tapes in the group, with the best frequency response at -20 dB and better than average MRLs and S/N ratio. Modulation noise, however, was the poorest. The majority of the samples were consistent, but some had different skew. C-60 bias was 0.6 dB higher (-0.1 dB) than the C-90s which had a large spread in sensitivity. Sensitivity varied 0.7 dB with some regularity. Four minor drop-outs. Sonic-welded.

Royal: This formulation produced above-average results in most areas listed in the table. Consistency was poor, however, not aided by the fact that mislabelled C-60 samples were really Royal APC/LN. Two C-90s tripped the end-of-tape sensor because of excessive drag, and two C-60s jammed. The samples that continued to work had minor sensitivity variations. Two minor drop-outs. No auto-switch sensing holes.

Sony: The -20-dB response and most other results were average for CrO_2 tapes. The 0-dB response and the modulation noise were the best in this group. Excellent consistency in skew and bias requirements and in C-90 sensitivity. C-60 sensitivity had a 1.5 dB spread and was 0.8 dB lower, on the average. Two minor drop-outs.

Superscope: The -20-dB response was quite smooth and above average in extent, while the sensitivity, skew, and bias needs were all very consistent for the C-90s tested. Minor sensitivity variations with time. Three minor drop-outs. No sensing holes.

High-Bias non-CrO_2 Tapes

Fuji FX-II; The frequency responses were the poorest in this category, but not at all far below others, and better than the average for the CrO_2 tapes. Other results were slightly below average in most cases. Just two samples each of C-90 and C-60 had been obtained, but since the consistency of skew, sensitivity, and bias was so outstanding among those four, other samples should be expected to show similar excellence. The sensitivi-

ty was very stable with time, with 0.2 dB wiggles at the most. Zero drop-outs.

Maxell UDXLII: One of the best tapes in this group and in all categories with extended frequency response, especially at 0 dB, high MRLs and low noise. Consistency was excellent with insignificant variations in sensitivity, skew, or bias among all of the samples. One medium and six minor drop-outs.

Nakamichi SX: Perhaps the poorest tape in this group overall, but superior to the average CrO_2 tape. Not quite equal to the same-source TDK SA reported below. (Being earlier samples might be a cause.) Outstanding consistency with constant sensitivity, skew, and bias for all samples. Three minor drop-outs.

Scotch Master II: This formulation was one of the best performers in most areas of interest, with wide frequency response, high MRLs and the best S/N ratio in the group. On the other hand, sensitivity and skew variations with half the samples caused amplitude changes up to five dB in both cyclic and random fashion. Four major and 12 medium drop-outs.

TDK SA: Average performance for this category, but superior to most CrO_2 tapes. Excellent consistency of sensitivity and skew. C-60s required 0.5 dB less bias (-0.4 dB). Sensitivity variation of 0.3 dB every 2.5 seconds. One major and eight minor drop-outs.

In Summary

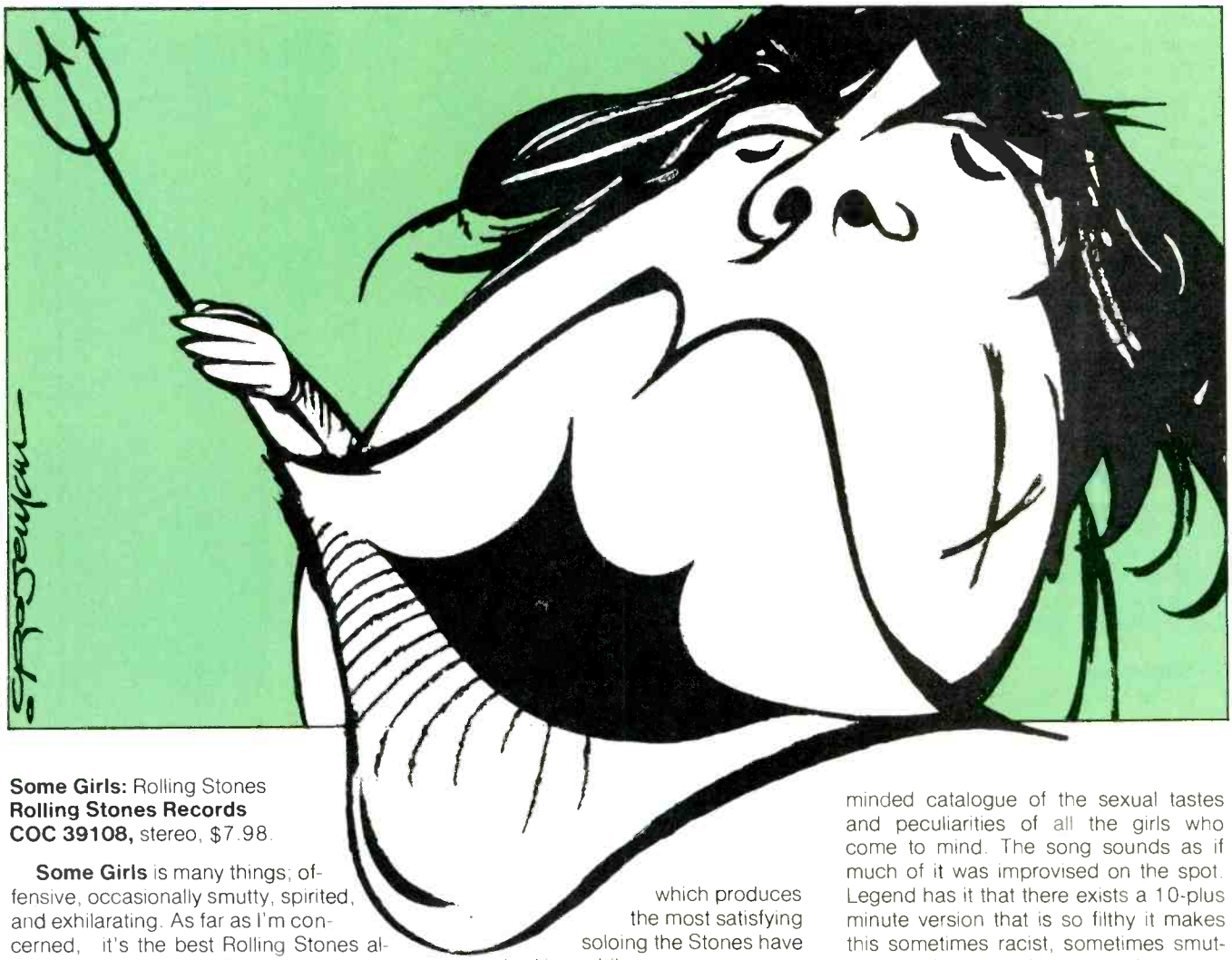
Is there one best tape to buy? No. There are really a fair number of well-performing tapes to choose from, with various trade-offs to be weighed according to your own particular needs. We can say that the low-bias ferrics are unacceptable, but in the normal bias range there are a number to choose from. Most of the really good ones have bias quite close to zero, so that will not be a major factor in switching from one to another. Do keep in mind, however, what the effects of bias differences are. The FeCr tapes provide better performance for more money. Are they worth it to you? The non-CrO_2 high-bias tapes gave superior results to the averages for the CrO_2 tapes, but not necessarily when compared to the better ones in that category. The non-CrO_2 tapes had slightly higher flutter, but these differences were very small. The flutter readings varied more from time to time with the same cassette than they did from one type to the other. Your final choice could very well depend upon local availability, best price/performance ratio, or even the ease of writing on the labels.

The general recommendation is to use a tape that offers the combination of performance at least as good as you need, consistency in all respects, and acceptable cost. A

Jon Tiven

Michael Tearson

The column



Some Girls: Rolling Stones
Rolling Stones Records
COC 39108, stereo, $7.98.

Some Girls is many things; offensive, occasionally smutty, spirited, and exhilarating. As far as I'm concerned, it's the best Rolling Stones album since **Let It Bleed** nine years ago.

Their previous studio album was **Black and Blue.** I hated it. At the time it sounded tired, bored, and forced. The single *Hot Stuff* sounded like ersatz disco, uncomfortable and affected. The recent live album **Love You Live** was a bitterly disappointing obvious turkey that only reinforced many doubts. This time out the boys sound far more interested. The playing is fiery with a nearly-out-of-control feel missing from the Stones' music machine for far too long. Perhaps a good part of the tentative feel of **Black and Blue** was due to the revolving door lead guitar situation the Stones faced with Mick Taylor's defection. This, the first album with Ron Wood fully integrated into the band, has no such problem. Woody and Keith Richards (he's using the "s" at the end of Richards again) play spitfire lead guitars hand in glove which produces the most satisfying soloing the Stones have had in a while.

As a group, the songs show a return to edge city. Those reliable old Chuck Berry licks drive *Respectable,* which along with *Lies* is an instant vintage Rolling Stones rocker. *Beast of Burden* sounds oddly like a Smokey Robinson melody with its faint echoes of *Tracks of My Tears.* It is a pretty, almost wistful song. *Before They Make Me Run,* the song Keith sings on **Some Girls,** seems a somewhat obvious comment on the shaky nature of his legal future.

Shattered and *When the Whip Comes Down* both evoke the Velvet Underground. Mick Jagger takes on an early Lou Reed-styled delivery on these. The melody and arrangement of *When the Whip* sound not far from the Velvet's classic *Waiting for My Man.*

The title song has attracted the quickest controversy. Its lyric is a simple-minded catalogue of the sexual tastes and peculiarities of all the girls who come to mind. The song sounds as if much of it was improvised on the spot. Legend has it that there exists a 10-plus minute version that is so filthy it makes this sometimes racist, sometimes smutty, sometimes tasteless, sometimes scabrous song sound tame. Taken seriously it insults every woman everywhere, but I'm not sure that's how to take it. It is so simple minded that it sounds like a children's playground song more than anything else. Taken satirically it's uproarious, outrageously funny and one of **Some Girls'** most exciting tracks what with some blistering guitar leads.

Far Away Eyes is another satire. This one, with a nod to Gram Parsons and the decadent feel of the first Flying Burrito Brothers album, takes on honky-tonk Country & Western and radio religion, the "put your hands on the radio" stuff. Strange, haunting material.

Miss You, the first single out of the album, is terrific. Charlie Watts' disco-influenced, metronomic drum part is the ramrod of a superb Rolling Stones performance, nothing like the forced fake of

Hot Stuff. A fascinating development with the single's release is the appearance of no fewer than four different mixes of the song. The album version times out at 4:50; the promotional single has mono and stereo versions at 3:47. That stereo single version is the one on the commercially available 45. This much is not uncommon in the record biz. What is uncommon is the release (to radio only as I write this, but with commercial release likely) of a 12-in. single with an 8:36 extended length. Differences are obvious. The stereo single and disco mix have the most life — a positively vibrant sound. The mono mix homogenizes the sound, bringing the vocals, particularly the backing vocals, much farther up front with a creamier texture. Oddly the album's mix suffers by comparison. It clearly lacks the extra edge in the drums and some cutting edge in Jagger's voice.

Other parts of the album, noticeably the uptempo rockers, have some of the edge missing on *Miss You.* Generally Mick's voice is clearer than usual. You can usually even understand the words. It plays best at higher volumes so you can feel the rough edges. Played softly it moves me to turn it up. In contrast **It's Only Rock and Roll,** perhaps the most melodious of Stones albums, plays very well softly and not so well loud. The rougher the album, the better the Stones sound loud. Consider *19th Nervous Breakdown* and *Get Off My Cloud.* In the end you makes your decision and you takes your choice. Therefore, the sound rating below reflects more on the power achieved, rather than on technique.

On **Some Girls** the Rolling Stones sound dangerous, and I haven't been able to say that in years. Whether these rich jet-setters are as dangerous as they sound may be another question, but the music has a natural flow and strength, a "Stones-ness" that makes it work. Whatever the future of the band, **Some Girls** does prove one thing conclusively: There is rock past 35. *M.T.*

Sound: B Performance: A

Some Girls: The Rolling Stones
Rolling Stones Records COC 39108, stereo, $7.98.

Finally these boys have regained the right to lay claim to the title of their choice, be it the "Crown Princes of Rock" or whatever the pundits are shouting this week, for **Some Girls** is veritably *Some Album.* Aside from the fact that they've steered totally away from acoustic numbers and Jagger's piano ballads (Have Mercy!), and that the one disco tune on the album (*Miss You*)

is infused with so much personality and humor that it transcends the form, this sounds like an impassioned band rather than a bored bunch of drug abusers. Whatever can be said about their ineptnesses on a technical level is washed away by the fact that they haven't assembled an album of tracks this strong in — dare I say it — a decade.

It seems that the Stones are able to produce whenever there's an incentive to improve, the bait this time being a new record deal which allows them free studio time in addition to close to a million dollars per album. When you put that kind of temptation in front of Mick Jagger (with a divorce pending and carrying a price tag approximating said figure), he has risen grandly to the bait; our boy Michael has even taken the occasion to pick up the electric guitar and make The Rolling Stones the first band with three rhythm axemen at the helm and no striking lead player. But I'll hold my cheap shots, for although the guitar breaks are disjointed, no one ever claimed The Rolling Stones' forte to be improvisation, and there's little quarrel to be had with the guitar fills/frills, save for the obvious lack of distinction between Keith Richards' and Ronnie Wood's riff-work.

One is strongly led to suspect that Mick dominates the album composition-wise, although all songwriting credits are Jagger-Richards. The best tracks on **Some Girls** are the title track (a Dylanesque poke at international womanhood), the fast-moving & hysterical *Shattered,* an unusually pretty song called *Beast of Burden,* Keith's anthem *Before They Make Me Run* (though Keith's lead vocal leaves something to be desired), and a Country & Western "tour de farce" called *Far Away Eyes.* The other five tracks are all quite listenable as well, the only complaint being that some take too long to end. Mick's greatest contribution to **Some Girls,** above all else, is his ability to sing with more character and excitement than I believed him capable of. His voice has hardly been in the best of form on recent albums, particularly his croaking on **Love You Live,** but it appears that his pipes and brain are razor sharp and honed to kill these days.

The group sound is more consistent, recognizably Stones rather than their limp delivery of albums past. Seven out of the 10 tunes feature the 44-year-old Bill Wyman on bass, a remarkable showing for the guy who's been edged out of said position many times in the past by Mr. Richards and now must contend with ex-Jeff Beck bassist Mr. Wood as well. Charlie sounds good — even when he plays badly (e.g. the guitar break in *Shattered)* his snare cuts through in his inimitably sloppy style. The guitar playing is hardly the most biting ever for these fops, but the combination of the heavily-treated rhythm guitars and Ian McLagan's keyboards make for a lush rhythmic texture, the solidest body of music Jagger's had to sing against in a long, long while.

Now that we know these old men can do this well, there's no reason to make excuses for them in the future. **Some Girls** will be a reference point against which forthcoming Rolling Stones albums will be measured, and, like it or not, it won't be easy to beat. Jagger's talked of doing a highly experimental record a la **Satanic Majesty's Request** for some time, and that may be the only direction for them to attempt. When it comes to flat-out, straight-ahead rock 'n' roll, **Some Girls** is one of the finest examples of the form to be had in 1978— and what do you have to say for yourselves Mr. Johnny Rotten, Mr. Rod Stewart, and Mr. Bruce Springsteen? *J.T.*

Sound: A Performance: A+

Return To Magenta: Mink DeVille
Capitol SW-11780, stereo, $7.98.

Though the group Mink DeVille has risen from the tired corpse of the New Wave/New York Scene, there are several noticeable differences between them and the rest. First off, whereas Television purports to be Tom Verlaine & Co., The Ramones are a "group," and Talking Heads seem to maintain a semblance of synergistic direction, there is no doubt in anybody's mind that Mink DeVille *is* Willy DeVille. The group is OK, and still going through personnel changes (thank you-know-who they sacked the drummer!) but really nothing special; Mr. DeVille, on the other hand, is a major songwriter and strong singer with a style and identity all his own. The other big difference is that he's had the sense to submit himself to a knowledgeable producer (Jack Nitzsche) who's been able to bring out the artist in Willy.

The first album was just a warmup for this one, where Mr. Nitzsche displayed that he did learn something working as Phil Spector's right hand man all those years, and in fact he seems to be the only person right now carrying on the legacy of "that sound" and achieving any kind of commercial success. **Return to Magenta** is the Righteous Brothers album that never was — *Guardian Angel* and *Just Your Friends* are the spacey-but-lush anthems that the Seventies needs, with string arrangements stolen right from Gene Pitney/Phil Spector's *Every Little Breath I Take. A Train Lady*

has Willy singing both Bill Medley and Bobby Hatfield's parts, theoretically speaking, and *I Broke That Promise* is the Drifters song that they never recorded. It doesn't matter that *Soul Twist* is a verbatim rewrite of *One-Way Street* from the last Mink album, and that there are a couple of filler tracks on the album . . . the fillers make the really special tracks sound even better. This may be the best r&b album ever recorded by a fair-skinned individual, and I dare say that he's still growing as an artist and has a long way to go before he starts falling off. **Return To Magenta** is one of the most striking, soulful, and creative albums ever recorded, and it puts most contemporary balladeers, rockers, and rhythm & blues outfits to absolute shame. *J.T.*

Performance: A Sound A

Jazz: Ry Cooder
WB BSK 3197, stereo, $7.98.

Jazz could be the least commercial album Ry Cooder has made. It has a totally different direction than the Tex-Mex and Hawaiian oriented sounds of his last several albums. Here Cooder creates a new seminal jazz music from the late 19th and early 20th centuries. There is *The Dream*, a whorehouse song from around 1880 played with the great Earl Hines. There's a Jelly Roll Morton piece recorded by Cooder alone as an overdub ensemble. And there are three of Bix Beiderbeck's songs of which the solo performance of *Flashes* and the small group setting of *Davenport Blues* stand out. Then there is the complementary material. Three vaudeville songs are present, a lively *Big Bad Bill is Sweet William Now, Shine* complete with introduction, and Bert Williams classic *Nobody* for which Ry chooses to affect a Negro accent vocally, a device that is distracting at best. Finally the album is framed by three hymns rearranged into a "string /brass band" setting that is most faithful to the peculiar guitar playing of the remarkable Bahamian Joseph Spence.

The musicianship of **Jazz** is on an extraordinarily high plane. With all acoustic instrumentation, the recording has been able to achieve a natural and warm sound that lets the delicate interplay shine. Additionally, Cooder's liner notes on the inner sleeve shed a lot of light on the genesis of the project.

A brave, thoughtful and exquisitely crafted album, **Jazz** by Ry Cooder deserves much more attention than it is likely to receive from the big mass audience. *M.T.*

Sound: A Performance: A

Theater music

Donald M. Spoto

A Little Night Music: Original Soundtrack Recording
Columbia KS 35333, stereo, $6.98

Something is drastically wrong with **A Little Night Music** since it has become a soundtrack recording. Hollywood has vulgarized again, and what was originally a delicate, sophisticated musical has been reduced to an embarassingly amateurish fiasco.

Although many of the first **Night Music** people are still involved here (music supervisor Jonathan Tunick, director Harold Prince), the music itself has somehow become flatly mechanical, arthritically timed, crassly orchestrated (the *Night Waltz* sounds like a silly carnival tune)—and disastrously engineered: In the middle of one band, *A Weekend in the Country*, there is a very noticeable silent gap between the song's final solo and the choral conclusion. Perhaps engineer Warren Vincent dozed off for a second.

The record boasts an impressive cast: Elizabeth Taylor (Did she really sing all the songs written for Desiree? It doesn't always sound like her!), Diana Rigg, Len Cariou, Hermione Gingold. They all manage to perform most ineptly, even when speaking the bits of mawkish dialogue which are annoyingly dispersed throughout the album. Only Diana Rigg, who doesn't pretend to know how to sing, succeeds, with her tongue-in-cheek bitchiness. Her rendition of *Every Day a Little Death*, although musically dead, is rather intelligent and human.

Columbia has not recorded the soundtrack well: Often many voices sound muddy — as if everyone's got a lisp.

An Unmarried Woman: Original Soundtrack Music by Bill Conti
Twentieth Century Fox Records T557, stereo, $6.98.

The soundtrack of **An Unmarried Woman** is as upbeat and cosmopolitan as the film itself, upbeat without being banal, and sophisticated without being dull. It's just the right mixture of Hollywood and reality.

Produced by Jerry Peters and composer Bill Conti, the music has appealing jazz overtones and a moving love theme. Only one band should be eliminated, a lyricized version of the title theme music itself. It is tiredly performed by Michelle Wiley, who also wrote trivial, uninspired lyrics for it. (Fortunately, this song is not in the film. And is this the reversion to an old tradition? Remember the sung title theme from Hitchcock's *Torn Curtain* over a decade ago? Universal wanted to make it big on the pop charts too, and the song, as here, never appeared in the film!)

Everything else is fine, the major piece is lively *Chase Me*, an endearing and brief pacer, and *Loft Party* is bubbly and exuberant. The final band, *Erica Leaves Saul*, is the most exhilarating on the disc. Expertly executed, it's guaranteed to lift your spirit.

An Unmarried Woman is finely recorded on Twentieth Century Fox Records. The film is, as they say, cleaning up. The record deserves a hearing too.

HOLOCAUST: Music From the NBC-TV film, written and conducted by Morton Gould
RCA Red Seal ARL 1-2785, stereo, $7.98.

Holocaust caused something of a small sensation when it turned up as a 9½ hour television movie in the spring of 1978. Newspapers and magazines devoted a good deal of space to the pros and cons of this treatment of the Nazi era. Eager to capitalize on the debate, RCA (the same family as NBC, after all . . .) has just released Morton Gould's extended suite. Long associated with popular music, Gould has also written three symphonies, ballet music and numerous short pieces. The music for *Holocaust* is essentially Hollywood spectacle fare, but there are some extraordinarily lovely touches. The *Berta/Josef Theme*, a kind of *lied* for piano and strings which expresses what the composer has called the "Old World love the couple has for each other;" the *Lullaby*, a sad and gentle slumber song for a young mother and her dead baby; the music for an ugly rape scene, which has some surprisingly Coplanesque dissonances (which means it's really quite traditional!); and the *Rudi/Helena* theme — a quietly moving serenade, glistening in its pale sonorities, pure, free of cliché.

But alas, the clichés are there. The theme for the whole thing, in fact, and the *Fanfares and Transport* for the sequences to the concentration camp, as simple movie spectacle set pieces, and the score gets runny and annoyingly unimaginative. For the recording, Gould has composed an *Elegy* to conclude — "a personal musical comment," he says, but it reminds me of the famous Gershwin *Lullaby*. Rich in orchestration, nicely conceived, this — like the score's best moments — sticks in the feelings perhaps more than the film itself. The recording, done in England with the National Philharmonic, is first-rate; every range is crystal clear, and the bass is never muddy.

Two's Company: Bette Davis and Original Broadway Cast
RCA Legendary Broadway Shows Series, CBMI 2757, mono, $7.98.

Apparently not content with its reissuance several years ago of vintage movie soundtracks, RCA is beefing up its nostalgia-mania with a series of "legendary cast albums." **Two's Company** is certainly legendary — but not in the way RCA meant. It opened on Broadway in December, 1952, and ran a whopping 90 performances, closing, it is said, because of Bette Davis' jaw infection.

That was, the jacket tells us, the last in a series of misfortunes that plagued the Vernon Duke-Ogden Nash musical revue. During Broadway tryouts, various show "doctors" were called in (Josh Logan and Arthur Laurents among them) to salvage it. If we're to believe this album, however, nothing worked. It's a monument to banality, both in melody and prosody, and none of it is redeemed by Bette Davis, who belts, lunges, coughs, and tears her way through *Turn Me Loose on Broadway* and *Roll Along, Sadie* (which fails at being a send-up of Maugham's moist tale of the tropical prostitute), and *Just Like a Man*. We don't for one minute believe a word of the lyrics ("high" rhymes with "sky" — you know, that sort of thing), and the music has all the freshness and spontaneity of a Midas Muffler commercial. Ellen Hanley, who sounds like the producers were priming her to be what Barbara Cook in fact became, sings the love songs with somnambulistic indifference, and the orchestra, under Milton Rosenstock's direction, thumps along gamely, pounding and murmuring as if little mattered. And it doesn't. Why this revue has been resurrected is a mystery. Once was certainly more than enough; twice is a moral issue. The final blow is that it's a flat, poorly mixed monophonic release!

European records

John Wright

It is peculiar how when one new recording of a work appears, competitive versions are issued in rapid succession from other major record companies. At the moment this seems to be centered around Liszt's *Sonata in B minor*. Only a short while ago I had reason to enthuse about the outstanding performance by Berman on the Melodiya label (ASD 3228), which is comparatively unemotional but freely exploits the artist's dexterity. This has been swiftly followed by a performance of Vladimir Horowitz in his **Golden Jubilee Recital** disc on the RCA label (RL 12548). Considering his age, this is equally flamboyant but with many inexactitudes accompanied by an over-emphasis of contrasts. And now the latest release by Alicia De Larrocha recording on Decca (SXL 6756) provides a more romantic and whimsical interpretation of this rather formless sonata. It is played with a technical expertise, that in contrast to these other performances, makes it sound so easy. The piano tone is convincing, portrayed with an adequate sense of spaciousness, and the nearest comparison from my collection for such positive sentimentality and complimentary acoustics is the 1971 recording by Agustin Anievas (EMI HQS 1246) which still weathers well. However, with due consideration between these renditions, my first choice would now lie with this new Decca as the most tasteful musical/engineering balance. Albeit, perhaps, less spectacular, the record reincarnates my initial adolescent attraction to the work . . . even after repeated playings.

Alicia De Larrocha

In my last record column I had cause to enthuse over Alfred Brendel's interpretation and Philips' recording of Schubert *Impromptus*. This month I give equally unreserved praise for Brendel's contribution to the Liszt catalogue — this time with a selection of items including the well-known prelude and fugue on the name *B-A-C-H*. It is surely the sign of a great performer, be he actor or musician, if he can lend himself equally to a multitude of roles. The "organ-like" playing which Brendel brings to this work is in complete contrast to any other works that I have heard him play. From a technical viewpoint this release (9500 826) retains that uncanny naturalness that epitomizes the best of Philips and as such is the best *recording* of the Liszt discs mentioned in this issue.

Also in the last column I recommended two Haydn Symphonies, *The Philosopher* and *The Schoolmaster*, played by Neville Marriner and The Academy of St. Martin-in-the-Fields (9500 198). Continuing the series, we have two more releases which are recorded in an equally luscious way, yet being clean and crisp. Haydn *Symphonies 94 & 96, The Sunrise* and *The Miracle*, are properly and frivolously performed on 9500 348 while *Symphonies 44 & 49, The Mourning* and *La Passione*, on 9500 199 are less immediately attractive but perhaps for this are longer lasting in their appeal.

A quick mention of a great event is that in celebration of Vivaldi's birth 300 years ago, I Musici, celebrating their 25th Anniversary, are engaged in the recording of 10 volumes totalling nearly 50 LPs of his chamber works! Obviously at the expense involved nobody is going to purchase all or even part of this marathon on the basis of cursory remarks from me, but judging by a sampler (available at a reasonable price) I can concur that Philips have maintained their high standards of chamber music recording for which they are justifiably renowned. On 6833 247, this sampler at least is really too good to miss.

Moving forward in time, musically speaking, works for two flutes by J.S., W.F., and C.P.E. Bach are played by Stephen Preston and Nicholas McGegan on DSLO 518. It is an "in-the-room" presentation being slightly dry and in need of a large listening area, allowing a good seating distance from the loudspeakers. The high cutting level results in low background noise, revealing breathy action sound of the instruments. The performance as such I would describe as "straight-laced."

News from Enigma, which was started in June, 1976, by John Boyden and Peter Whiteside (being joined in December of that year by Tony Faulkner as recording manager), is of a recent takeover by WEA Records, a subsidiary of Warner Communications Inc. In less than two years Enigma has issued 45 records in addition to some 25 others already taped but not yet released. Initially it was the company's policy to concentrate on the British market but the future will involve more and more international artists. It is interesting that one of the most dynamic and modern pop record companies should have bought Enigma who are almost alone in making a classical product based upon simple microphone techniques, rejecting with scorn the widespread anti-musical multi-microphone, multi-track techniques of the pop studio.

Something magical generally happens when Sir Adrian Boult conducts while Parker & Bishop record for EMI. Their latest recording of Beethoven's *Symphony No. 6 Pastoral* with the Lon-

don Philharmonic on ASD 456 is no exception. It is unashamedly warm and lyrical and is accompanied by subjectively unrestricted low frequencies, resulting in a sonic experience that can only rate as "superb." It is therefore slightly a pity that in the same period the same engineers should record the LSO conducted by Eugene Jochum performing Beethoven's *Symphony No. 5* (ASD 3484) for which if there had been no direct comparison would have deserved a similar rating sound-wise. However, this just misses that higher echelon, being slightly brasher — but perhaps correctly so?

In complete contrast by way of balance, Brian Couzens provides a BBC type "seat-in-the-audience" perspective of the complete Sibelius *Tone Poems* played by the Scottish National Orchestra conducted by Sir Alexander Gibson (RCA RL 25136: 2 records). Apart from some minor pressing flaws, which are becoming more prevalent on this label of late, this whole rendition is likely to appeal mostly to the purists among us and reproduces well at low levels when listening in a quiet environment.

Containing equally good distance effects, HMV's new recording of Bizet's *The Pearl Fishers* creates a highlight on the operatic scene (SLS 5113, 2 discs). It is rare for me to recommend opera records, and this is, regrettably, because they are usually too contrived for my tastes. While I acknowledge the dilemma presented to the engineers by this art form, I do object to "full frontal" soloists thrown before a receding orchestra. Not so in this box set, where the front-to-back perspective is fine in every respect, with the orchestra (enjoyable to listen to on its own) is extended in both range and dynamics, yet with the soloists well positioned, even if synthetically, only just in front. Conceding the insuperable difficulties of opera recordings as a home entertainment medium, this version is difficult to fault and the Chorus and Orchestra of the Paris Opera, conducted by Georges Prêtre, provides an authenticity coupled to some of the loveliest music which has rightfully become very popular.

Returning to music more suited to the home, Elly Ameling, accompanied by Dalton Baldwin (piano), sings *Songs for Gretchen, Ellen and Suleika* by Schubert on Philips 9500 169. Including the famous *Ave Maria*, this has similar qualities to their earlier discs of 16 *Leider* (6500 774), possessing a "single-microphone" feeling about the balance. Equally it is emotional but unsentimental, conveying a depth of feeling yet without embarrassment. The ambience suggests a deceptive cutting level. In fact the record is not too easy to track, and I found it necessary to keep the stylus impeccably clean, but this is a small sacrifice for the satisfaction provided.

It is coincidental that within the same quarter RCA should choose to issue a two-record set of Schumann *Romantic Lieder* sung by Peter Schreier, accompanied by Norman Shetler on RC 25126, which in its way is outstanding. It is a forward and onward going interpretation, if perhaps a little over-dedicated, but has similarities to the Schubert in the plushness of balance although comparatively sibilant in places.

The market seems insatiable for records of Stravinsky's *The Rite of Spring*. Why this should be defeats me, since for my money if one had to extract the single Stravinsky ballet that stands repeated listening without the visual element, it would be *Petrushka*. However, I must be in the minority since the number of records in my collection alone disproves this. Maybe it is that, in short doses, parts of *The Rite of Spring* make ideal demonstration material for hi-fi enthusiasts. Following this line of thinking, and looking back through the most popular releases, there has been a distinctly "contrived" versus "purist" battle between engineers. Each strategy has succeeded within its own right, but only to a certain extent. One of the most successfully "contrived" discs with particularly impressive brass is that conducted by Sir Georges Solti on Decca SXL 6691, while a comparatively "purist" approach was taken by Philips and Haitink on 6500 482. Bridging the two approaches then came Lorin Maazel on Decca SXL 6735. And now we have yet another new disc which really does not fit into any of these categories.

Conducting the Concertgebouw Orchestra, this time Colin Davis records for Philips (9500 323). It has that distinctive "laid-back" sound but with special crispness, detail, glistening transients, and differentiated timpani. So often where there is an extended bass drum, it results in a homogenous wedge. Not so here where every skin struck can be heard as a separate entity. I hesitate to call it natural but certainly it does possess that quality demanded by the pseudo-purist (despite Enigma's recent release). Containing impact, this is the very best "compromise" recording so far. Very little need be said about the playing except that it embodies a deliberately punctuated interpretation. Surprisingly for the extraordinary results achieved, there is no need to play this record loudly to maintain excitement and neither, despite the nature of the work, is it particularly tiring. To sum up I don't know how this record was made, but the results are so fine I don't even care. A

Classical reviews

Edward Tatnall Canby

Beethoven: Triple Concerto, Op. 56. Beaux Arts Trit London Philharmonic, Haitink. **Philips 9500 382,** stereo, $7.95.

Here's one of Beethoven's biggest and least known works, out of the fruitful early-middle period, the time of the *"Eroica" Symphony*, No. 3. It presents problems — it always has. And Philips, in this latter day, has not entirely solved them, as many hopefuls in the distant past have equally foundered.

The problem is — a concerto with three diverse soloists; piano, cello, and violin. It's a late version of the earlier "concertante" (Mozart, Haydn) — but if the earliest works were necessarily long, this one, in a time of much expanded length, has super-difficulties in that respect. Like a hostess with three literary lions at her party — she gets all flustered trying to introduce each of them in proper order — it is the same with Beethoven. By the time things get properly under way, the first side is over.

Philips' problem is a heartening one, the all-American Beaux Arts Trio, which they should know by this time, having recorded them often; a bunch of powerhouses and especially Manahem Pressler at the piano, that irrepressible artist whose mere presence in a recording session radiates enough energy to knock you down. Pit Pressler and his excellent colleagues, Cohen and Greenhouse, on violin and cello, against the mere London Philharmonic under that important but somewhat lethargic Dutchman, Haitink, and you have an imbalance supreme. It is, unwittingly, made more by the Philips engineers, who unwisely have blown up the Beaux Arts Trio to, in VU measurements, slightly larger than the entire London Phil. (see cover). The result is inevitable. A lacklustre orchestral opening (starting *pp*) and then WHAM, the three soloists practically overwhelm the orchestra, one by one! Interesting, and typical Beau Arts, but not really good Beethoven. I enjoyed it but for the wrong reasons. The B. A. Trio is my favorite.

Sound: B+ Recording: C+
Surfaces: B–

Mozart: The Two Flute Concertos, K. 313, 314; Andante in C, K. 315. Eugenia Zukerman; English Chamber Orch., Pinchas Zukerman. **Columbia M 34520,** stereo, $7.98.

With the excellently stylish Leppard-trained English Chamber Orchestra, the two Zukermans do a pleasant recording here of Mozart for flute and orchestra — though you may want to allow contrasting music to intervene after a whole side. The extra movement is probably an alternative slow movement for the first Concerto. The orchestra here sounds very much as it does on Philips, bathed in a big, warm liveness; but in this case the soloist is placed fairly close and loud, though still very much surrounded by orchestral sound.

Note: In some of my reviews there will be new letter ratings for the recording itself. Three separate factors will be rated: a) the sound in terms of fidelity; b) the recording technique . . . acoustics, mike placement, balance, etc., and c) the disc surfaces on my copy.

I rate **B** as honorably average or up to the current standards, **C** is deficient, and **A** is marvelous.

Disc surfaces, being irregular, are averaged out. Many recordings have ticks at the beginning but smooth out later on, and this is taken into account.

E. T. C.

Columbia has served up some fairly dreadful surfaces in recent times, full of pops and crackles — but not here. These are smooth and very nearly pop free, and not much to choose between Columbia and Philips, as far as this orchestra is concerned. But who knows — maybe your copy, from a different pressing run, may be poor. Suffice it to know that Columbia is doing at least some fine pressing!

Sound: B Recording: B+
Surfaces: B+

Heinz Holliger and Aurele Nicolet Play Oboe and Flute (Bellini, Molique, Moscheles, Rietz). Frankfurt Radio Symphony, Inbal. **Philips 9500 070,** stereo, $7.95.

Handel: 3 Oboe Concertos; Concerto Gross No 3 in G Minor; Sonata A 5 in B Flat. Heinz Holliger, oboe, Engl. Chamber Orch., Leppard. **Philips 6500 240,** stereo, $7.95.

Heinz Holliger is a modest but really excellent oboist, who adapts equally easily to the Baroque demands of Handel and the very Romantic minor music of the mid-Nineteenth century featured on the first of these two discs. Together with the knowledgeable Leppard, the assorted Handel Holliger plays here is sprightly, full of life, and up to the latest (and easiest-to-listen) standards for Baroque playing, short of the use of old-type instruments; these are normal modern. (*Sonata A 5* means a five-part work for solo instruments — this one is adapted for strings and violin solo, played by Kenneth Sillito.)

There are four oboe works on the "Romantic" record, one with flute as well, each of them a characteristic semi-concerto, brief enough by the standards of the time though very much longer than anything by Handel. Neither of the two works by the fairly well-known names, the opera composer Bellini and the pianist Moscheles, are more than standard fare, expert enough but padded out with conventionalities. The best work by far is by the virtually unknown Molique, a quite lovely oboe rhapsody with Schumann-like harmonies. I'd buy the record just for that.

Sound: B+ Recording: B+
Surfaces: A– & B+

Music of C.P.E. Bach. Joan Benson, early piano and clavichord. **Orion ORS 76223,** stereo, $7.98.

Haydn: Trios, E Flat, G Minor, C Major, H. XV: 29, 19, 27. Amade Trio (Malcolm Bilson, fortepiano, Sonya Monosoff, vl., John Hsu, cello). **Titanic TI-12,** stereo, $8.00.

For those who find that older music is a revelation when played well on the instruments for which it was designed,

these two discs should be an immense pleasure. All the instruments, though some are newly made, are approximately those the composers might have used.

Carl Philipp Emanuel Bach, the middle Bach son, was the deep thinker among the three, a highly personal Romantic before introspection became common as, say, with the popularity of Chopin. Bach's special instrument was the clavichord, a one-man instrument, inaudible across a room but capable of expressive melodic lines and even a vibrato. In his later years he wrote also for the early piano — which was far closer to the clavichord than to the more formal harpsichord — and never was this relationship better illustrated than on this record, with one side for each instrument. (Turn the clavichord volume *down!*) Joan Benson is a thoughtful and discriminating player of both instruments.

All three instruments in the Amade Trio are "original," the violin and cello both old and in the original condition, not "modernized," the fortepiano a 1969 copy of a Viennese instrument of Haydn's time. The effect is indeed a revelation — since these players are all three superb musicians, absolutely top-rank for the music. Such robustness, such strength! The modern piano and violin and cello are louder, but not, decidedly not, stronger in this music. Especially the whirlwind piano with its wide range of tone color, from wiry metallic clangs to gentle and sweet *pianissimi*. THIS is what Haydn wanted!

Sound: B+ & B Recording: B– & B+
Surfaces: B & B

Beethoven: "Appassionata" Sonata, No. 23 in F minor, Op. 57. Ikuyo Kamiya, piano. **RCA Mastering Lab RDC-4,** stereo, (45 rpm), (Direct to disc).

RCA returns to the classical 45 (remember 1949?) in a curious way via this all-Japanese Mastering Lab Series, direct cut in Japan. The label is the old familar one but some of the extensive booklets are entirely in Japanese characters—not this one, however, which gives us a detailed account of the whole process of direct-to-disc recording of the giant Bosendorfer Imperial piano, the incredible monster that you may have seen in the ads, sitting incongruously in an outdoor park. It took them two days just to get the recording equipment to the Bosendorfer — might have been just as tough vice versa.

It is an interesting recording musically. With all their incredible and growing knowledge of Western music, the Japanese still tend, not unnaturally, to miss a few stylistic and harmonic subtleties here and there as compared with "core" per-

formances out of Europe and the central tradition. This little lady is a powerhouse, with all the drive and the technique you could ever want and more. The piano itself, being German, has a good sound for Beethoven, somewhat unlike our familiar Steinway et al. But there are those curious lapses, not the notes but simply the appreciation of certain pivotal moments and their dramatizing in the playing. Not a thing most listeners will find bothersome.

Don't expect any enormous bass from your hi fi. Beethoven's own piano, for which this music was written (probably an English Broadwood) had a sonorously twangy bass, full of overtones, almost like a harpsichord. And the German monster is a refined product, its long strings never sounding thumpy or boomy—it is a musical instrument, not a hi-fi maker. But for clean percussives, within the musical framework, this disc will do very nicely.

Janet Baker sings Beethoven and Schubert. English Chamber Orch., Leppard. **Philips 9500 307,** stereo, $7.95.

If you think all the great voices are in grand opera, try Baker. She is rapidly becoming the finest all-around soprano of our time, in the Flagstad league—not only a tremendous big voice but a consummate musician, who throws herself into every work she sings with an intensity that has to be seen to be believed—I saw her live on British telly last summer, doing Benjamin Britten's last big work, a cantata with solo soprano.

Here, she is at her best—and for once, Philips has the sense to get back a bit and allow her huge voice to blend in with the orchestra. (They ruined her recording of Berlioz' *L'Enfance du Christ* by too-close miking.) Moreover, it is an orchestra that, like the singer herself, is perfectly attuned to Beethoven and Schubert—note the superb Beethoven *4th Symphony* with this group, recently reviewed here.

Side 1 is Beethoven, some minor music from *Egmont* as a warmer-up, then a most interesting "Woo" piece (early music without opus number), a grand Italian classic area; and then the grandest of them all, the same thing later on—Ah, perfido!, and such an electrically marvelous performance I have never before heard. It ought to make your hair stand on end even if you are mostly bald. Then side 2, comes Schubert opera arias chosen from that tragic wealth of great music the composer wrote for operas that never got anywhere, and still mostly haven't. But what incredibly top-rank stuff! The big treat here is *Lazarus*, a huge piece out of an abortive *Easter Cantata* that is surely the greatest Schubert ever written, yet to this moment I had never heard a note of it. Baker elevates this one as she does the big Beethoven, and it is very much the same type of music, though in German.

Arthur Loesser—Bach: The Well-Tempered Clavier, Books 1 & 2. Telarc 5029 (5 discs), stereo, $39.90.

Love conquers all! Love of music plus a dedicated ear. The late Arthur Loesser of Cleveland made these recordings in 1964, here updated in, no doubt, improved sound. I found them wholly acceptable from a technical viewpoint.

My first reaction, musically, was — NO! Impossible. In this age when Bach is normally played on the instruments of his own time as intended by him, "piano Bach" is always moot, as far as public performance and recording is concerned. (Home playing is another story.) In 50 years, only a handful of pianists have made great reputations via Bach on the piano. Some did it by gentleness, some via a moderate simulation of the older instruments; most however have simply treated the piano as a piano and Bach as the "universal" composer he has often been called, good for any age, any style.

Within minutes I had come around to

Loesser—even though his is a startlingly individual, highly Romantic piano approach. He uses astonishing *rubato*, the expressive unevenness of tempo made familiar by the great pianists of the early part of the century but now generally unthinkable in Bach. No neo-classic beat for this man! And he colors up Bach until at times it is like Schumann. At first, all this nearly slayed me. But not for long. The man is just too musical. He has worked and thought for so many years upon these short pieces that the sense of them, even in his unique versions, comes through resplendently. The further along you go, the more convincing they sound.

P.S. One often sore point with piano Bach, Loesser's ornaments are always absolutely *right!* Also the dotted rhythms. Take that, you purists and harpsichordists.

Wagner: Ride of the Valkyries; Tristan Prelude Act I; Siegfried's Funeral March; Forest Murmurs. Los Angeles Philharmonic, Leinsdorf. **Sheffield Lab 7** (direct-to-disc), stereo, $14.00.

Prokofiev: Romeo and Juliet, excerpts. Los Angeles Philharmonic, Leinsdorf.
Sheffield Lab 8 (direct-to-disc), stereo, $14.00.

Interesting contrast. These two, out of the same D/D recording session, are musically very different and the difference seems to be a result of the music itself. I found the Wagner excerpts, fi or no, to be remarkably routine and uninspired, except the *Tristan*, which takes on some musical life. On the other hand, the Prokofiev is excellent—you can hear it in seconds. This music the musicians feel is real for them, and they make it sound that way. I cannot believe that the difference is in the conductor, who is an old-line European-trained pro, ex-Boston Symphony, and surely very knowledgeable as to Wagnerian tradition. But it is possible that Leinsdorf, too, finds the Prokofiev more enjoyable to produce, in this late time. How low has the great opera composer sunk, from his palmy days!

The recordings were done in typical West Coast fashion, in a huge Hollywood "scoring stage," built in 1927 for the earliest sound films with music; 16-inch film discs of a filmed "Romeo and Juliet" (not Prokofiev's ballet, which came later) were still on the premises. The sound, according to Sheffield's account, is "quite live, similar to a concert hall" — well, maybe. In the recording, as compared with the norm today, it rates as moderately dead though not unpleasantly so. There was plenty of room for good balance and the L.A. orchestra is well recorded. This slightly dry sound is best for the Prokofiev, which fits neatly

into the period — it was composed in 1935. On records, Wagner needs a bit more mystery and atmosphere (i.e. reverb) to sound right.

For your money you get a big book, names of every member of the orch. and the enormous technical crew—which includes one gent whose title is "Master of the Groove" —and pictures of practically everybody, in addition to program notes.

The pressing, I should add, is near perfect. Alas, it is not West Coast—Teldec GMBH in Germany. Not only ultra-clean but minus the slightest trace of low-frequency rumble and bumble. Can't we do this too?

Sound: A Recording: B–
Surfaces: A

Music of Hugh Aitken, Cantatas 1, 3, 4; Piano Fantasy. Gary Kirkpatrick, pf., Charles Bressler, tenor, Jean Hakes sopr., instr. soloists. **CRI SD 365,** stereo, $6.95.

Contemporary music on records is usually difficult, but sometimes rewarding. CRI, at least, makes sure that the audio aspect of each of their many recordings is up to high standards, which helps us in the audio fraternity to make some sort of connection. Even the pressing of this item is—for the U.S. of A.—not bad at all.

Before this one, I had indignantly turned off another "contemporary" recording after maybe two minutes; militant, self-satisfied conventionality, I said to myself in disgust. Lotta noise; they sure think they're pretty good. So it wasn't a good mood that I brought to the most difficult, and first, of these Aitken pieces. More contemporary bombast?

Being New York performances, from New York musicians, these are hard and brassy, not very listenable in the outward sound. Inevitable in our greatest city, where life is necessarily brash, or else! But if you will turn the volume down a bit and follow the printed texts, you will hear the wealth of humanity and of musical feeling underlying the New York exterior. Believe you me, it is there, but definitely. I like this music. And I like the performances.

CRI has even manged to acquire some reasonably quiet pressings. Not up to non-American standards, but at least the best we can do, or so it seems. (Now don't go and tell me they sent these to Germany for pressing!)

Jan Ladislav Dussek: Complete Piano Sonatas, vols. 1, 2. Frederick Marvin, piano **Genesis GS 1068/9** stereo, $6.98 ea.

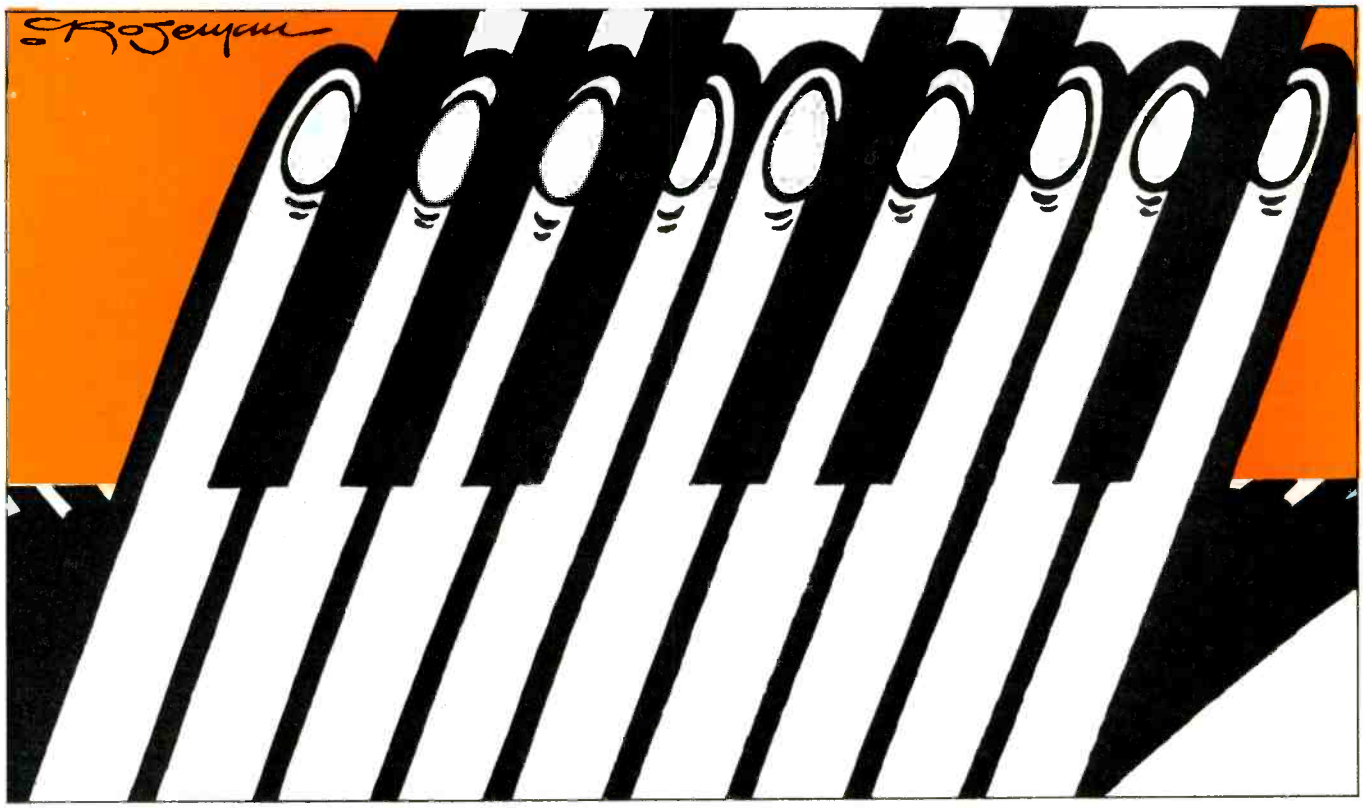
Those who are into the piano music of Beethoven and Schubert will perhaps be astonished at the work of this Czech-born composer, 10 years older than Beethoven, who died in 1812 and was one of the outstanding composers of his time — Beethoven or no. In a way he was more advanced than Beethoven himself, closer to the Romantic school, as is abundantly clear in these Sonatas. True, he did not have the Beethoven punch, the all-out drama and telling conciseness. But even that, oddly, was forward looking, towards the days of Wagner and Berlioz and Liszt when music sprawled out at enormous lengths.

Dussek was a somewhat pathetic genius, a great keyboard man and thinking composer but, like Rossini, prone to overweight; in the end, he was so huge he could not get out of bed. But there is nothing fatuous about his music, both early and late, as played in a Romantic vein here by Frederick Marvin. It probably sounded just this way, given an earlier-type piano, in Dussek's own day.

Volume 2 is much the best. The *Opus 34 Number 3* is turn of the century in style, florid in the manner of Weber and Rossini of later years—who were very probably influenced by Dussek. The late *Op. 61,* a funeral sonata in honor of Dussek's patron, the Prussian Prince Louis Ferdinand, a splendid musician, killed in battle in 1806, is a startlingly vigorous and modern piece, first rank. The last Sonata, *Op. 71* on Volume 1, is less vigorous, though still forward looking.

The Genesis surfaces, my copies, sound like a lively brush fire. Millions of ticks and bumps. Volume 1, maybe because of *Op. 71*'s length, is cut at a lowish level and seems somehow unfocussed. Volume 2 is louder and the sound more incisive.

jazz & blues



Unfinished Boogie: Western Blues Piano, 1946-1952.
Muskadine 104, mono, $6.98.

Unfinished Boogie is a long-overdue anthology of blues, boogies, and stomps by West Coast pianists from the immediate post-WW II era. Whereas the sophisticated, jazz-inflected balladry of Charles Brown and Cecil Gant dominated California blues in this period, the emphasis on this album is on the rawer, more rural sounds associated with farm and factory workers newly transplanted to the Coast from Texas, Oklahoma and Louisiana.

The "star" of the album is an underappreciated Houstonite named Wilson "Thunder" Smith. *Thunder's Unfinished Boogie* is, fittingly enough, a thunderous boogie with a romping right hand and a powerfully rolling bass line. *Little Mama Boogie* (with Smith's old partner, Lightnin' Hopkins — Thunder and Lightnin'!—on acoustic guitar) is a killer stomp with a left-hand riff guaranteed to knock you over. *Low Down Dirty Ways* sounds like a Texas counterpart of Professor Longhair's New Orleans gumbo-shuffle; note Luther Stoneham's curious one-chord guitar riff. *New Worried Life Blues* is obviously from the same family as Big Maceo's *Worried Life*, though it's a considerably different song. Smith also backs Stoneham on the latter's *Mable Blues;* the singer-guitarist is most notable for the novel way in which he varies the ends of lines.

The best-known artist here is Jimmy McCracklin, whose three tracks are early (1946) samples of his lackadaisical vocal approach. At this time he had not developed his piano technique, so he's backed here by J.D. Nicholson, who complements McCracklin's vocal lines with colorful downward splashes. *Baby, Don't You Want To Go* is, as you might suspect, a *Sweet Home Chicago* variant, with the locale shifted to the Mexican border.

Mercy Dee Walton had an r&b smash (circa 1951) called *One-Room Country Shack*, and much of his subsequent material was, more or less, patterned after that hit. Nonetheless, his highly original lyrics, lethargically beefy vocals, and inventive piano commentaries made Mercy Dee a consistently interesting artist. *Straight and Narrow* and *The Pay Off* are fine examples of his *Country Shack* formula, while 1949s *Baba-Du-Lay Fever* (his first recording) is an uncharacteristically jiving scat blues number.

Little Son Willis is an undeservedly obscure singer-pianist with a very interesting right-hand technique, featuring bright-colored, imaginatively diversified chords. Little Willie Littlefield is best known as a singer (he did the original version of *Kansas City*, while his Charles Brown-flavored *Ruby, Ruby* is still heard on "oldies" radio shows); *Little Willie's Boogie*, recorded in 1948 at age 17, finds him in the unaccustomed role of Albert Ammons emulator.

Most of the original 78s were far from sonic masterpieces, and many were well-worn by the time they were gathered for this collection. Under the circumstances, Muskadine should be congratulated for making them sound as presentable as they do. Available from Advent Productions, P.O. Box 635, La Habra, CA 90631. *Tom Bingham*

Performance: B+ to A

I'm Ready: **Muddy Waters**
Blue Sky JZ 34928, **stereo, $7.98.**

If Muddy Waters has ever before recorded two consecutive albums as strong as **Hard Again** and **I'm Ready,** it has been longer than I care to remember. Arguably, **I'm Ready** is as good as

any other collection he has ever done. Like **Hard Again,** Johnny Winter is a featured guest in a band that includes Jerry Portnoy, "Pine Top" Perkins, Bob Margolin, and Willie "Big Eyes" Smith from his regular touring outfit with the further addition of blues greats Big Walter Horton on harp and Jimmy Rogers on guitar. This group is as solid as a blues band is ever going to be. With superior modern recording unavailable for the great primitive originals of up to 35 years ago, the album bloody well ought to be a killer. And it is.

Muddy has rarely sounded more on top of his music, whether it's a standard like *I'm Ready, Hoochie Coochie Man, Rock Me Baby,* or *Good Morning Little Schoolgirl* or some of his recent songs. Indeed the remakes may well have outdone the originals. And Muddy's slide guitar on *Screamin' and Cryin'* is a bone-chiller.

Hey there, blues people, it is *all* here on **I'm Ready.** This one is brand-new Muddy Waters that is sure to be recognized as both classic and vintage.

Michael Tearson

Sound: A Performance: A+

Chameleon: Maynard Ferguson
Columbia PC 33007, stereo, $6.98.
Conquistador: Maynard Ferguson
Columbia PC 34457, stereo, $6.98.

It's impossible for big band lovers and jazz buffs to ignore Maynard Ferguson although many would like to. But like him or not, Maynard may have the best big band in what's left of the band business. MF's current crew, is without question a blazing powerhouse that offers a strident, efficient brashness; it is, quite honestly, unbeatable at the kind of music it produces. What's more, it is the only big band, aside from Buddy Rich's, with a youthful mass following. (The Stan Kenton and Woody Herman bands have an appeal to some young people, however it is an elitist appeal to sophisticated young musicians, usually members of high school and college lab and stage bands.) Ferguson, on the other hand, is currently embracing the masses, including hundreds of thousands of tone-deaf dummies who dance at the discos and wouldn't know an eighth note from a flatted fifth.

There is tremendous vitality and excellent musicianship in the Ferguson band as demonstrated on these two recent Columbia releases. Ferguson's band as demonstrated on these two recent Columbia releases. Ferguson's shock troops, with fortissimos upfront, put on the kind of brassily vehement exhibition that turns on the rock generation. It is virtuoso stuff, but it is also an appeal that is often more visceral than musical. **Chameleon,** for example, offers rock/pop/soul fans the sonic kick and hyper energy they require. On numbers like the title tune, and on Chick Corea's *Fiesta* and Paul McCartney's *Jet,* Ferguson is able to harness the power and wattage of rock/soul with the boisterous brass voicings that were always his forte.

Like Dizzy Gillespie and Harry James in his younger days, Ferguson paces his brass section impressively. At 49, he is an immensely powerful and accurate trumpet player when leading the section; his ensemble work shines on both **Chameleon** and **Conquistador.** As a soloist Ferguson remains a player with astonishing technical prowess; in terms of technique and range, he is the only trumpet man in jazz able to work comfortably in the high register. Unfortunately, his solos often have a way of degenerating into tasteless shrieking; it is the kind of bombast that ruins an otherwise fine version of Chick Corea's *La Fiesta* on the **Chameleon** album; *La Fiesta* also boasts a flashing chorus by Alan Zacod's electric piano. *I Can't Get Started* on the same album, is a surprise; except for an ear-splitting opening statement, Ferguson plays this classic fairly straight with a full, round, warm tone almost in the Bunny Berigan tradition; he also takes the vocal and updates the lyrics with references to his ex-boss Stan Kenton and porn star Linda Lovelace.

With **Conquistador,** Ferguson enters the disco sweepstakes. Accepted on its own terms, the best-selling album is impressive. The precision-drilled brass performs immaculately on things like the theme from Star Trek, and bouncy, catchy disco tunes like Bob James, *Soar Like an Eagle* and the Theme From Rocky. The latter comes complete with lush strings, wah wah guitar figures, and a back-up femme soul group; it's a performance that I confess a certain weakness for, and as a single, I understand it is holding its own with Donna Summer, Thelma Houston, and the Sal-Soul Orchestra. George Benson is on hand to take a few nice licks on the mellow *Mr. Mellow* track, and Ferguson has a tasty, relaxed solo here, staying mostly in the middle register. I have played MF's **Conquistador** for a few young-ish distaff friends of mine who cannot seem to get into Goodman, Basie, or Ellington.

The **Chameleon** album was engineered in NYC and attains Columbia's high sonic standards. The tracks on **Conquistador** were recorded at Media Sound in New York, CBS Studios in San Francisco, and the Wally Heider Studios in San Francisco. The stereo sound is absolutely stunning, combining a powerful big band's macho dynamics with sharply etched detail.

John Lissner

Sound A+ Performance: A

Body Love: Additions to the Original Soundtrack: Klaus Schulze
Island ILPS 9510, stereo, $7.98

Contemporary, non-academic electronic music generally falls into three categories. The most popular is the imitative synthesis of Isao Tomita and Walter Carlos. These musicians take the synthesizer and mimic conventional instruments and sounds. It's ultimately a dead end since it rarely explores the new sound potential of the synthesizer and is limited to conventional harmonics. Groups like Cluster and Kraftwerk make up the nucleus of the second category which consists of a metronomic minimalism. Short melodies and cyclic rhythms dominate this music in which the synthesizer is employed as a precision instrument.

But the third category is not just a synthesis of electronic sounds but also a synthesis of musical philosophies. It maintains a traditional sense of classicism without being imitative. The synthesizer is combined with other keyboard instruments for shifting textured layers of sound. With this group Klaus Schulze has a few competitors, such as Tangerine Dream and Ash Ra Tempel, but no peers.

Body Love: Additions . . . is the ninth solo Schulze album but only the first to be released in the U.S. He was an original member of Tangerine Dream, appearing as a drummer on the first album **Electronic Meditations.** But he soon left the group to go solo as an electronic musician. The main body of his work concerns itself with dark liquid surfaces and a drawn-out melodicism that's derived from eastern religious music, as much as western classicism. Rhythms are felt as soft pulsations rather than metered beats.

But his early experiences as a drummer and his urge for spontaneous improvisation have surfaced in some more energized Schulze recordings such as *Picture Music, Moondawn,* and the two *Body Love* soundtracks. Here Schulze uses the drums to create a definable percussion rhythm on top of which he layers stretches of synthesized drone, melotron choirs, and sustained organ chords. Finally there is a solo line which strings itself out through the entire piece.

In **Body Love: Additions** . . ., the soundtrack to a German hard-core pornographic film by Lasse Braun, Schulze touches both aspects of his work for another in a string of compelling works. For pure visceral energy, *Stardancer 2* is an ecstatic screamer. A sparse opening of electronic drones and random, rumbling percussion shifts into a roar of sound. Schulze emerges with a vivid syn-

thesized etching across driving rhythms. *Moogetique* is a sensual dark passage of phased electronic sheets and echo drenched piano. The nearly 30 minutes of *Nowhere-Now Here* divides itself between a contemplative opening and a tension-building development of contrapuntal swirls.

Body Love, like most Schulze recordings, must be heard on good sound systems to be fully appreciated. He can pour out of the speakers like lava or shoot like a laser beam. He surrounds you on all levels of the aural spectrum.

John Diliberto

Sound: A Performance: A

Beggars and Stealers: Robin Kenyatta **Muse MR 5095,** stereo, $6.98.

Robin Kenyatta is one of those tertiary figures who is always on the scene but pops out only occasionally to make a statement of his own. Such times were his Vortex recording from '68, **Until,** and **The Girl From Martinique** on ECM in the early 70s. Both were strong, individual statements which showed him to be a fine reed player and a spirited improviser. But they did not garner him sufficient of notoriety and the mid part of the 70s sees him floundering artistically and financially in the land of Funk.

Beggars and Stealers, mostly taken from an early '69 concert, shows us what we've lost. That's not to say this is an exceptional performance. It equals neither of the two performances mentioned. Kenyatta plays tenor here rather than his more familiar alto and soprano. His playing is thin and often unfocussed as on *Nairobi Hot 5*. His back-up band, with the exception of Alphonse Mouzon is adequate but nothing more. But the inspiration which lights these performances has the potential to explode at any moment. Such a time is the title track. Kenyatta plays like bubbling fudge, gurgling and slurring in one place and spurting in others. Mouzon's undermiked drums provide a fleet rhythm pattern while Larry Willis (piano) and Walter Booker (bass) hang out ledges for Kenyatta to jump from.

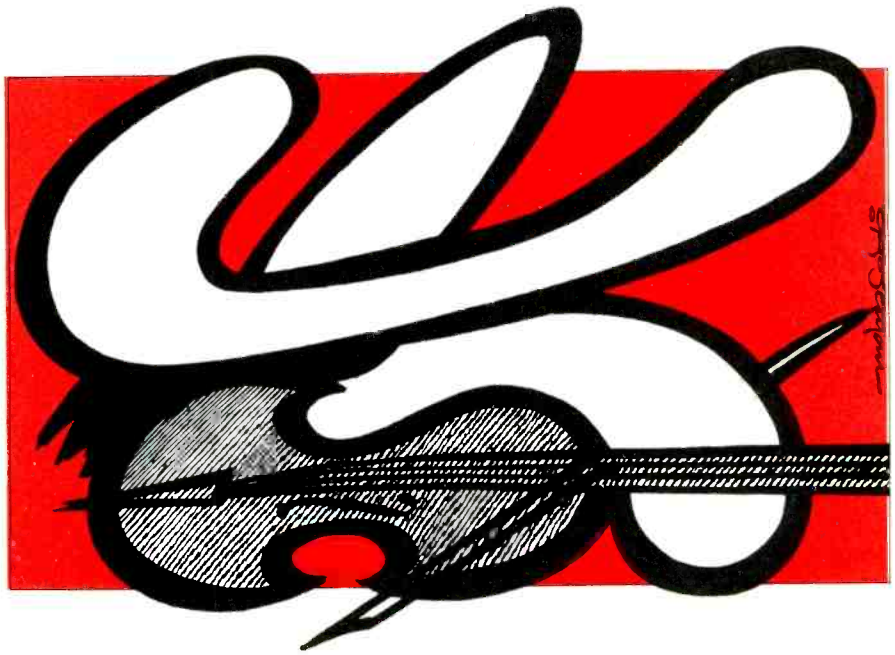
The album concludes with a piece recorded in 1975, a duet with Muhal Richard Abrams. *Ruby My Dear* is a sweet ballad with Kenyatta on smokey alto and Abrams playing piano a bit more florid than usual.

The live portions are poorly recorded and mixed, and add to the thinness of Kenyatta's tenor sound. **Beggars and Stealers** stands as a signpost that Kenyatta (and Mouzon for that matter) have passed by.

John Diliberto

Sound: C Performance: B–

Folkbag



Ramon Ayala y Los Bravos del Norte Tex-Mex TMLP 7022, stereo, $4.98.

Ramon Ayala rose to prominence as half of Los Relampagos del Norte, an enormously popular Norteno conjunto of the 50s and 60s. This self-titled follow-up to Ayala's somewhat lackluster **Corridos Famosos** (TMLP 7021) indicates that he's no longer content merely to rest on past laurels, but ready to carve his niche as a solo performer.

Truth be told, he doesn't have the most attractive voice in the Rio Grande Valley — somewhat dry and inflexible, with a limited range — but he has a likeable "everyman" personality with which audiences easily identify.

His primary talent is in his maginative accordion work. Note the way he injects flashy double-time figures into his inventive melody lines, which seem to be a natural extension of the songs (particularly on *Te Equivocaste* and *Por Un Disgusto).* His extemporizations are seldom less than resourceful, his finest moments coming on the extended solo on the *cumbia, Adios Reynose,* and his beautifully paced obbligato to the bolero, *Llorando en Silenco.* Not only are his conceptions appealingly tuneful, he pops the buttons with such an energetic bounce (hear the sprightly *La Mas Bonita* and the irresistible instrumental polka, *El Oso Negro)* that the music easily transcends language barriers. The one exception is *El Gallo Copeton,* a novelty song oscillating between a *cumbia* and a sort of Mexican twist, which will no doubt leave most gringo listeners (myself included) scratching their heads.

Ayala's unidentified backup trio, Los Bravos del Norte, adds an easy lilt to the polka-tempoed rancheras which dominate the album. The bajo sexto and bass are fashionably restrained. The spirited drumming, on the other hand, not only perfectly complements Ayala's brisk accordion, it's virtually a textbook in Norteno percussion style. The drummer quietly keeps time with hi-hat cymbals for the most part, but spices the beat with simple, yet varied combinations of rolls and crashes at interfaces, during intros and bridges, etc. (hear *Cruz de Palo* and *Por Que Te Fuiste* for examples). The drummer does a particularly fine job of coordinating tom-toms, cymbals, and cowbell on *Adios Reynosa.*

The recording has considerably more clarity and definition than most regional-label ethnic albums. The accordion could have used more bite, though. The surface is a bit scratchy, but again better than most Norteno pressings. The 27-

minute playing time is about average by border-area standards. Distributed by Marsal Productions, Inc., 2015 Castroville Rd., San Antonio, Texas 78237.

Tom Bingham

Sound: B– Performance: B+

Irish Music: The Living Tradition: The Martin Mulvihill School
Inisfree-Green Linnet SIF 1009, stereo, $6.98.

This is the first in a probable flood of recordings of Irish music in America from one of a number of small companies which have had people out in the field over the past few years. In this case, the company has the double advantage of a producer who is himself a native-born Irishman now working and performing in this country, as well as the cooperation of the head of perhaps the most flourishing school of traditional Irish music in the United States.

Mick Moloney, the producer of this album, was born in Limerick, grew up with native Irish music, and had a successful career as a member of a folk-singing group, The Johnstons, before emigrating to this country to study folklore at the University of Pennsylvania. As an emigrant himself, he shares with Martin Mulvihill a common concern for the fate of their native traditions in this country. The empathy between Maloney and Mulvihill, the shared respect and mutual affection for the talented young Irish-Americans from the Bronx who star on this album, shines through every line of Moloney's notes to the album (an inner sleeve contains biographies of the young musicians, as well as identifications of the tunes and their backgrounds).

This album was made, in part, for the purpose of recording the new and vital tradition of young American-born children of Irish-born parents learning the traditional music of Ireland in this country (and then going back home and beating the bejaysus out of the young kids there in the annual All-Ireland Championships each year too). Mulvihill chose three separate "ceilidh" bands from among the ranks of his school up in the Bronx, together with a selection of the solo stars from each group, and a trio which has won its own separate titles. If the impression this gives you is of a star-studded school of young prodigies, the fact is that Martin Mulvihill's patient teaching and careful supervision has as much to do with their success as native talent; at the same time, there can be no denying the role of such talent. Take, for example, the case of young Eileen Ivers, who has already won three All-Ireland Championships on the fiddle, since she began with the instrument a scant four years ago — when she was eight.

The Eire Og Ceili Band is the youngest, from ages 9 to 13, featuring the heavy use of the tinwhistle, the traditional introductory instrument for young Irish musicians, here and at home. (Eileen Ivers plays with them.) The Glinside Ceili Band ranges in age from 14 to 16, and includes Bernadette Lucey, who, along with Michael Joe Carolan (now, is that a name!) and the aforesaid Eileen Ivers, won an All-Ireland Championship as a trio in 1976. And the Glincastle Ceili Band, ages 16 to 19, includes the driving tenor banjo of Gail Mulvihill, one of Martin's talented daughters, who won an All-Ireland in that division in 1976, too.

The tunes are all jigs, reels, hornpipes, and marches, the same kinds of music on which the young musicians are normally judged back home in the competitions. The sound of a dozen young virtuosos all playing in unison, however, may at first be hard on the ears of those listeners who have come to expect various kinds of counterpoint and ensemble playing from the examples of The Chieftains and The Boys of the Lough. But unison playing is in fact much closer to the normal Irish tradition than the orchestrated compilations of The Chieftains or the close-order trade-offs of The Boys of the Lough; and of course the slow airs employed by these adult musicians (ah, Cathal!) give a variety to the repertoire that is necessarily absent from this album of competition music by younger players.

Another point that might be noted is the absence of the bodhran, the hand-held drum played with a double-ended stick, which many people have also come to associate with Irish music in its better-known form. But again, the snare drums featured on this album agree more closely with the actual instrumentation and practice of street parade bands back home than the relatively-novel concert hall use of the bodhran. Once more, what may be at first startling to American ears coming to this music from The Boys of the Lough or The Chieftains should be recognized, rather, for the normal and traditional practice that it actually is, rather than regarded as deviating from that norm.

Once these barriers to appreciation are overcome — along with the concomitant response to the tender ages of some of the musicians — then it should be possible for the unbiased listener to hear more clearly the remarkable achievement of Martin Mulvihill and his pupils from the Bronx. Children of emigrants who had once feared that their traditions would die out with them, the various bands and soloists featured on this album are both carrying on the old tradition in this country and also, in the process, creating their own for the

future. Perhaps the best compliment that can be paid them comes from the perceptive Moloney, in his liner notes: "Such is the drive of their playing that it is very hard, when listening to their music, to imagine them as anything other than top adult bands." How accurate you will find this comment will, of course, depend upon your own prior exposure to Irish music, and your ability to separate the romance of youth from the technical competence and artistry displayed on **Irish Music: The Living Tradition.** But I'll go with Mick Moloney any time.

Order from Inisfree Records, 70 Turner Hill Rd., New Canaan, Conn. 06840. *John McLaughlin*

Sound: A | Performance: B

Love Can Take You Home Again: Carol McComb & Friends
Bay 302, stereo, $6.98.

Way back in the 1960s a pristine folk album by Kathy & Carol appeared, and next to nothing has been heard from either lady until this 1975 release. Carol McComb still sings occasionally with Kathleen Larisch. In fact an album highlight is their *a capella* duet of Richard Farina's *Quiet Joys of Brotherhood.*

In The Bay Records tradition, **Love Can Take** is a home-made album played by friends with understanding and warmth and minimal overdubbing. Carol's songs are honest and heart-felt. The performances avoid gratuitous virtuosity, and the whole flowers as a result. Songs like *Thistle and Thorn, Renaissance,* and *Dreams Are So Hard to Break* are as butterflies next to most manufactured pop. Real yet lovely, and romantic in the poetic sense of the word. *Michael Tearson*

Sound: C+ | Performance: B+

Too Late to Turn Back Now: New Grass Revival
Flying Fish FF-050, stereo, $6.98.

If there is such a thing as progressive bleugrass, then New Grass Revival is the leading exponent. Both the "New" and the "Revival" in the name are completely accurate, and the "Grass" is the pivot.

Too Late to Turn Back Now is a live album recorded at the "1977 Telluride Bluegrass and Country Festival" in Colorado. The revival's material is modern country, things like *Lonesome and a Long Way From Home* and other songs by Peter Rowan, Willis Alan Ramsay, and Gene Clark with Bernie Leadon, the ex-Eagle *(With Care from Someone).* The other three cuts are group originals.

The underpinning of New Grass's sound is the electric bass playing of John Cowan. He's usually playing rock-style lines while the others are picking country or pure bluegrass. The rock input gives them a jolting kick for a 'grass band. In addition they take liberal stretches to improvise showing both ambition and reach, even if their meandering occasionally gets a bit obtuse.

The recording quality is always at least adequate or better. The live mix is sometimes muddy with one or two players all but inaudible in spots, but enjoyable as a whole.

What I like best about New Grass Revival is that their music defies quick categorization and disposal. They take chances, and that's exciting. *Michael Tearson*

Sound: B– | Performance: B

Banish Misfortune: Malcolm Dalglish and Grey Larsen
June Appal JA 016, stereo, $5.50.

Those of you familiar with the Chieftains' first four albums will recognize the majority of the tunes on **Banish Misfortune (Chieftains 3,** Island ILPS 9379, being a particularly fecund source).

Certainly, tunes like *The Road to Lisdoonvarna, The Nine Points of Roguery,* and the fascinating Irish marches, *March of the King Laois* and *Brian Boru's March* can only benefit from increased exposure. But even more importantly, few if any of them have ever been arranged for hammered dulcimer before, especially by a virtuoso of Malcolm Dalglish's caliber.

Dalglish has a light, buoyant touch which is enhanced by skillful precision (note the triplets and clusters which ornament the title track and *Brian Boru's March),* dazzling agility even on fast-tempo reels (the *Pigeon on the Gate* medley and the *Growling Old Man and Cackling Old Woman* set), and admirably tasteful imagination (such as his sensitive interweavings on the North Hebridian *Christ Child's Lullaby).* His self-built instrument has a soft, lovely chime with a haunting accumulation of overtones, and hardly a trace of metallic brittleness.

Grey Larsen accompanies Dalglish on several instruments, including concertina, whistle, and guitar (in some cases employing overdubbing). While he's not the master musician that Dalglish is, Larsen never detracts from the dulcimerist's artistry. Indeed, his use of different instruments adds variety to the album, the combination of such disparate elements as concertina and dulcimer, or alto recorder and dulcimer, furnishing some intriguing tone colors. While Larsen occasionally stumbles during his solo spots (most obviously on his concertina feature, *O'Connell's Lamentation),* he generally picks himself right back up.

Considering that neither of the Cincinnati-based duo was exposed to Irish mu-

sic until their college days, they've assimilated its winsome melodic qualities and sprightly rhythms to contribute some excellent original compositions. Dalglish's *Midnight Mountain Road* has a strikingly unusual melody, while his *Dog in the Mustard* (great title!) provides an expedient bridge between Larsen's flute air *Tar Hollow* and that familiar standby, *Kid on the Mountain*. Best of all is Larsen's Drunkard's Path, which sounds so much like an old favorite that it's not the least bit out of place sandwiched in between The *First of May* and *Ah Comhra Donn*. Also worthy of mention is sides two's schottische medley, learned from melodeon player Michael Kennedy.

The recording is less clangorous, more intimate than many hammered dulcimer albums, befitting Dalglish's gentle instrument. Dulcimer addicts might consider Larsen to be over-balanced slightly, but only on *Foxhunter's Jig* does his dense rhythm guitar drown out the dulcimer. The surface is audible during the quietest moments. Available from June Appal Recordings, Box 743, Whitesburg, KY 41858. *Tom Bingham*

Sound: B– *Performance: B+*

Kora Manding: Mandinka Music of Gambia
Ethnodisc ER 12102, mono, $7.95.

The Republic of Gambia is not only famed as the birthplace of Kunta Kinte, it's the home of a magnificent 21-stringed instrument called the *kora*.

The kora, which is most often used to accompany singing, is classified as a "harp-lute." Its playing technique and sound resemble a high-pitched somewhat metallic harp, while its construction in many ways parallels the lute and its descendants. The kora plays short, constantly reiterated background figures—called *kumbengo*—which are melodically appealing, gently rhythmic, and hypnotic in their tranquil insistence. To keep this *ostinato* from becoming monotonous, it is frequently punctuated by tuneful descending phrases called *birimintingo*.

Tutu Jara, an instrumental kora duet, is an excellent illustration of the interplay of these two elements, with Suntu Suso playing intricate *birimintingo* counterpoint to Amadu Kanuteh's wistful *kumbengo*. Amadu Bansang Jebateh's *Bamba* is a virtuoso kora showpiece, with a bare-bones *kumbengo* serving as a framework for a dazzling display of the kora's many functions—supplying melody, harmony, rhythm, and percussion (courtesy of the *nyenyemo*, a resonator rattle attached to the kora's bridge).

The vocal selections illustrate another aspect of Gambian music, the contrast between a song's melodic phrases *(donkilo)* and its semi-spoken narrative sections *(sataro)*. On *Lambango*, Fatumata Jebateh sings in a sure, sharp-toned voice, with a hoarse, impassioned shout at the beginning of her melodious *donkilo*. Amadu Kanuteh's *Maki*, on the other hand, is constructed almost entirely of *sataro*, spiked with well-thought-out *birimintingo;* at eight minutes, though, most listeners will undoubtedly find it overlong. There is also a brief, but very emotional unaccompanied vocal, *Suolu kile*, sung by Nyulo Jebateh with fierce intensity.

Ala I'a ke provides an opportunity to compare differing approaches to the same tune, as the song also appears on Aliaji Bai Konte's superb kora album for Rounder (5001). Whereas Konte uses the song as a springboard for rapidly ornamented, flamenco-like *birimintingo*, Kunye Saho takes off on an astonishingly jazz-like improvisation with a Latin-funk sway to the rhythm. Nyama Suso's *Sunkariba* incorporates *Ba Toto* (a more complete version of which appears on Bai Konte's album), a descriptive piece supposedly imitating Gambian river frogs, though the charmingly dissonant, high-pitched strumming heard here sounds nothing like "ribb-it."

Sound quality varies considerably from track to track. Though the clarity and presence of the Rounder album is lacking, the album is generally quite acceptable sonically. Indeed, the outdoor recordings, with their birds and village sounds, are very atmospheric. Order from Pachart Publishing House, P.O. Box 6721, Tucson, AZ 85716.
Tom Bingham

Sound: C– Performance: A

Byron Berline & Sundance Live at McCabes
Takoma D-1061, stereo, $7.98.

This happy reunion of hot blues grassers led by several times national fiddle champ Byron Berline is a good, if not stand-out album. It is a standard mixed bag of bluegrass and country tunes with plenty of fast picking. Average level recording is clear but not *ringing* clear. Byron's fans will be especially pleased. *Michael Tearson*

Sound: C – Performance: C+

El Principe del Acordeon: Flaco Jimenez
DLB 1037, mono $4.98.

Thanks to appearances on PBS' "Austin City Limits," the "Chulas Fronteras" film, and records by Doug Sahm and Ry Cooder, Flaco Jimenez — the most fabled of all modern Norteno accordionists — is finally attracting attention beyond the Rio Grande Valley. His records, however, have yet to receive

much exposure outside the Chicano market.

Actually, there are two substantially different types of Flaco Jimenez recordings — those that present Flaco, the *conjunto* —leader, and those spot-lighting his abilities as a polka accordionist. In the *conjunto* context, where he accompanies *ranchera* duets, he spins out quick-thinking, intricate improvisations between the vocal lines, often reaching dazzling heights of imaginative fancy.

On instrumental albums like the newly released **El Principe del Acordeon,** in which the accordion is the sole lead instrument (the bajo sexto, bass, and drums playing strictly subservient — albeit crucial — rhythmic roles), the full burden of the melody rests on his shoulders. Because a straightforward, hummable tune is as essential to a polka as a danceable beat, Flaco's improvisations must of necessity be limited to embellishments on the melody. Nevertheless, he ornaments his tunes with well-chosen grace notes and triplets, delightfully pliant rhythmic twists (note *Una Tarde en el Alamo, Los Naranjales,* and *Mi Caballo Bayo,* among others), and skillful alterations in tone color that keep the songs from ever becoming repetitious. You won't hear the imaginative off-the-wall extemporizations of Flaco's ranchera albums here, but that hardly means his accordion playing is any less inimitable.

The repertoire on this album is refreshingly varied. *Luna de Plata* ("Silver Moon") turns out to be the pop standard, *Sail Along Silvery Moon,* played with a jaunty pop-country bounce. *Juarez* is a smoldering Latin-lover tango, while *Los Tres Sabinos* is an old-fashioned, nostalgic waltz. Eight of the 12 tracks are polkas, including such typical Norteno melodies as *La Puntada, Evangelina,* and a medley of Tex-Mex favorites called *Acuarela Nortena. Emilia* sounds like a French sidewalk-cafe tune set to a polka beat; who else could get away with making a polka out of *La Paloma?*

The recording is generally respectable, though some distance removed from "alta fidelidad." *Sobre Las Nubes* is quite muffled, while *La Paloma* and a couple others are on the shrill side. The surface is pocked with numerous ticks, pops, and whatnot.

By the time you read this, his first national release (**Flaco Jimenez and his Conjunto,** Arhoolie 3007) should be out. In the meantime, DLB has nine Flaco Jimenez albums, including three from his earlier career as half of Los Caporales. Write to DLB at P.O. Box 37250, San Antonio, Texas 78237

Tom Bingham

Sound: C – Performance: A –

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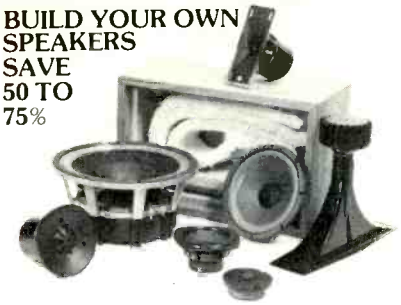

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Record Ecology from Discwasher—a substantial bargain.

(Walnut tray and dust cover are available separately as the Discorganizer, $12.50.)

All from Discwasher, Inc., 1407 N. Providence Rd., Columbia, Missouri 65201.