Summer Sound Systems
Build A Sub-Woofer
It would be foolish to create a new line of speakers and not overcome these obstacles...
Gold-ens

Gold plated connector cables for the perfectionist.

- Highest degree of electron transfer and longevity will never corrode or add resistance with age.
- Spring steel strain reliefs.
- Ultra-low capacitance cables.

$8.00 per matched pair, 1 meter length.

From the people who brought you Discwasher.

At audio specialists worldwide.

discwasher inc.
909 University Ave., Columbia, Mo. 65201

Goldens

Audio

August 1976 "Successor to Audio Est. 1917" Vol. 60, No. 8

Feature Articles
24 Summer Sound Systems/Glen M. Ballou
34 Switched-On Bass/W.J.J. Hoge
42 Doppler Distortion in Loudspeakers/James Moir

Equipment Profiles
54 McKay-Dymek AM-5 Tuner & DA-5 Antenna/
Leonard Feldman
60 Duntech DL-15 Loudspeaker System/
Richard C. Heyser

Record Reviews
65 The Column/Michael Tearson & Jon Tiven
66 Canby's Capsules/Edward Tatnall Canby
67 Classical Reviews/Edward Tatnall Canby
68 Jazz & Blues/Henry, Lissner & Morgenstern

Audio In General
4 Audionics/Joseph Giovanelli
5 Tape Guide/Herman Burstein
10 Audio ETC/Edward Tatnall Canby
16 Behind The Scenes/Bert Whyte
70 Advertising Index
84 Classified Advertising

Editor Eugene Pitts III
Associate Editors
Edward Tatnall Canby
Bert Whyte
Assistant Editor Eugene J. Garvin Jr.
Publisher Jay L. Butler
Marketing Director Sanford L. Cahn
Design Frank Moore
Circulation Manager Jean Davis
Advertising Production Gloria Klaiman
Senior Editors
Richard C. Heyser
Bascom H. King
B.V. Pisha
Contributing Editors:
Herman Burstein, Martin Clifford,
Leonard Feldman, Joseph Giovanelli,
C.G. McProud, Dan Morgenstern,
Donald M. Spoto, Michael Tearson,
George W. Tillet, Jon Tiven.

AUDIO (title registered U.S. Pat. Off.) is published monthly by North American Publishing Co., Irvin J. Borowsky, President, Frank Nemeyer, and Jay L. Butler, Vice Presidents; R. Kenneth Baster, Vice President/Production; Vic Brody, Promotion Director; Mary Clathey, Circulation Director.

RATES—United States only: 1 year for $7.00, 2 years for $12.00, 3 years for $17.00; outside the U.S.: 1 year for $9.00, 2 years for $16.00, and 3 years for $23.00. Printed in U.S.A. at Columbus, Ohio. All rights reserved. Entire contents copyrighted 1976 by North American Publishing Co. Second-class postage paid at Philadelphia, Pa. and additional mailing office.

Back issues, $2.00 each.

World Library Congress
Number: ISSN 004-752X. Dewey Decimal Number: 621.381 or 778.5.

REGIONAL SALES OFFICES: Jay L. Butler, Publisher and Sanford L. Cahn, Marketing Director, 545 Madison Ave., New York, N.Y. 10022, telephone (212) 371-4190.
Jay Martin, 2525 West 8th St., Los Angeles, California 90057, telephone (213) 385-2917.

For Benelux and Germany, W.M. Saunders, Mgr., Herengracht 365, Amsterdam, Holland, telephone 24.09.08.
Japan: Japan Printing News Co., Ltd., No. 13.2 Chome Ginza Higasi, Chuho-ku, Tokyo, telephone 541-5795.

About the cover: "Summertime and the livin' is easy..." and what better time to listen to the refinements from that song while under the shade of a cool tree with a picnic lunch awaiting the first pangs of hunger. Loudspeakers are Electrovoice Musicaster IIs, and the models: Gloria Klaiman and David Shockley.
Before you buy your next turntable, consider why you want a new one.

In letters and warranty cards from new Dual owners, we find that some had owned manual turntables and came to prefer the convenience and safety of automatic start and stop. Others also wanted to be able to play records in an uninterrupted sequence. And a few gave reasons that modesty makes us hesitate to quote: "I wanted the best!" or "Everyone recommends Dual."

Whatever your reason may be for wanting a new turntable, consider your purchase carefully. Your record collection probably represents a bigger investment than all your other components combined. And your turntable is the only component that handles your records.

A thorough overall appearance and feel of a turntable's controls can tell you something about its quality appearances can be deceptive. For example, curved tonearms may appear interesting, but their unnecessary mass and increased resonance can only detract from the quality of music reproduction. All Dual tonearms follow a straight line from pivot to cartridge holder for maximum rigidity and lowest mass.

Some turntables apply stylus pressure by unbalancing the tonearm. This results in tracking which is adversely affected by record-warp conditions and turntable level. In every Dual, stylus pressure is applied around the vertical pivot via a long coiled spring. This maintains tonearm balance throughout play, and tracking is unaffected even if the turntable is tilted substantially.

Other Dual features and refinements include:
- cueing damped in both directions to prevent bounce;
- pitch control; anti-skating separately calibrated for all three stylus types. And internally; motor rotors and drive pulleys individually machined and tested with precision instruments to assure perfect concentricity.

All the above contribute importantly to quality performance.

Now, while you should never compromise with quality, convenience is a matter of choice. Which is why Dual quality comes in a variety of models: semi-automatic, single-play; fully-automatic, single-play; single-play/multi-play. Seven models in all as described below.

4. Dual 1249. Fully automatic, single-play/multi-play, Belt drive. 12" dynamically-balanced platter. Less than $260, less base. Full-size belt-drive models include: Dual 510 semi-automatic. Less than $203; Dual 610, fully automatic. Less than $250. (Dual C5601 with base and cover: Less than $750.)

United Audio Products, 120 So. Columbus Ave., Mt. Vernon, N.Y. 10553

Check No. 13 on Reader Service Card

Exclusive U.S. Distribution Agency for Dual
High Fidelity Amplifiers and Musical Instruments

Q. I have several, old mono tube basic amplifiers of undistinguished lineage. As they are of little use for hi-fi or stereo use, but are still capable of a fair amount of power (12-25 watts) I have been wondering if they could be used for instrument amplifiers, such as for electric guitar and bass.

I have been variously told that it would require a preamplifier or that the input from a guitar would be too strong, requiring cutting into the circuit somewhere or adding some complicated additional circuitry. What is your advice?—Steven Lindblom, Stratham, N. H.

A. Many musicians buy amplifiers which can produce 100 watts of power and up for use with their instruments and your amplifiers are not close to that figure. However, there are any number of small amplifiers designed for musical instruments which do not have any more power than those which you wish to use, so from this standpoint you should be fine.

With the volume of a guitar or electric bass turned up fully, I would estimate that we would get an approximately 0.1 volt of output signal. The actual output will vary over a wide range, depending on the physical effort the performer uses to play the instrument. While this 0.1 volt is more volume than is produced by most microphones, it is not as much volume as is produced by a tube tuner of the sort probably used when your amplifiers were popular. Thus, the musical instrument might not drive the amplifier to full output. The input sensitivity of your amplifier is, therefore, too low.

It all resolves itself to what input voltage, with the amplifier’s volume control turned up fully, will produce full output power? If this output is around 0.1 volt, your amplifier may be suitable just as it is. However, if you play the instrument very softly, then perhaps you won’t have enough signal to drive the amplifier to the volume level you might like.

In any event, you will not need any sort of circuit which would provide gain reduction, requiring you to cut into the amplifier circuit at some later stage.

What you probably need is some sort of voltage amplifier which will make up any difference between what your amplifier can do and what it has to do in order to be driven to full output. Such devices are available as “power boosters,” sold by dealers who sell musical instruments and amplifiers. These devices are small, battery-powered boxes, generally employing one or two transistors. They are much smaller than “fuzz” or vibrato generators, envelope modifiers, octave boxes, and the like.

If these amplifiers do not have their own tone controls, these circuits must be added. The makers of the power boosters also make simple units designed to boost either the bass or treble ends of the spectrum but not both at the same time. These inexpensive elements can be useful to you. Both booster amplifiers and tone controls are sometimes available for as little as $10.00 each.

Fidelity amplifiers do not have vibrato or reverb built into them as is the case with many guitar amplifiers. Therefore, you might need to add these devices externally, and units are available for this application.

You may find that these amplifiers do not sound just as they should when driven into distortion but this aspect of music is often useful to performers to create an effect. The character of this distortion is different in tube amplifiers from that in solid-state amplifiers. This is the reason that some performers still use tube amplifiers rather than solid-state units. From this standpoint you may be well served by the tube amplifiers you have.

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

Joseph Giovanelli
Look how simple Sansui's new LM speaker design* really is.

Complicated speaker designs very often compound the age old problems of sound reproduction. The end result of complexity is often far from the ideal of clean, crisp sound that a speaker should deliver. Sansui engineers therefore sought simplicity in their new design — the already famous LM series: speakers that can reproduce sound naturally and faithfully and with much greater dynamic range than you would expect in speaker systems of such size.

The LM series feature a new linear motion tweeter design on which there is a patent pending. This design overcomes the problems of transient and other types of distortion caused by enclosure or encapsulating the rear emanation of sound in an air tight cavity by directing this rear sound energy through three exponential horns thereby recovering and adding the energy to the sound that emerges at the front. Improved transient response, less distortion and a greater sense of stereo perspective are the highly desirable products of this outstandingly creative and innovative Sansui design. With only one crossover, these two way speakers are highly efficient. The musical image is extremely stable with an outstanding sense of presence — almost as if you were at the original source of sound.

Hear the modestly priced LM series — the LM 110, the LM 220 and the LM 330 — at your Sansui franchised dealer today. Listen. They speak for themselves.

*PATENT PENDING
Cabinets finished in simulated walnut grain.

Check No. 29 on Reader Service Card
"Extra wide response . . .
low distortion . . .
reminiscent of the very
best electrostats!"

Now you can take a giant step closer to reality by recreating the
depth and dimension of the original performance with remarkable fidelity . . . before the sound enters your ear. Even the best phones around today put left channel sound through the left earpiece . . . right channel sound through the right earpiece. Good sound, yes . . . but certainly not the sound you'd expect from an expensive, top-line speaker system.

Now listen to the AKG K-240 Sextett. Hear the difference. Six passive (slave) diaphragms surround a main driving transducer to reproduce in depth the sound of a live performance with a spatial quality that you've never heard from headphones.

Len Feldman (Feldman Report, Tape Deck Quarterly) writes "...the AKG headphones tend to minimize exaggerated and unnatural stereo effects . . . a listening quality reminiscent of what we hear (with) the very best electrostatic headphones around. Considering cost, that's quite an accomplishment."

And they're light on your head, too. Ultra-soft pads assure virtually no wearer fatigue. Earcups are fitted to the AKG auto-adjust headband. For modest budgets listen to the AKG K-140.

At selected dealers everywhere.

PHONES
PHONO CART/IDGES
MICROPHONES

AKG ACOUSTS
PHILIPS AUDIO VIDEO SYSTEMS CORP.
Audio Division, 91 McKee Drive
Mahwah, New Jersey 07430 (201) 529-5900

Check No. 2 on Reader Service Card

Reverse Delay
Q. The reverse mechanism of my Concord Mark IV auto-reverse tape deck is triggered by sensing the no-signal period at the end of the tape. The reversing mechanism has a built-in time delay of 7-8 seconds to preclude reversal in the middle of a selection. I find this delay to be insufficient and would like to know if the delay can be increased to 11-12 seconds. Would this be a complex and/or costly adjustment and perhaps one that I could perform myself?—David Wilson, Newton, Mass.

A. I don't think the change would be difficult. Probably it only involves changing the value of a resistor and/or capacitor in order to obtain a greater time constant. When you locate the time-delay circuit, try experimentally increasing its capacitor by about 50 per cent.

Background Noise
Q. (1) When my Roberts 770X tape recorder is on, I can hear broadcast stations in the background. What can I do about this? (2) How may I record from my mono cassette into the Roberts and vice versa? (3) What part of my Roberts recorder should I connect to for ground? Should it be grounded to the a.c. outlet or the amplifier ground terminal? I already have my tuner and phono turntable grounded to the amplifier terminal. (4) I want to put conversation on the tape at the same time that I am recording it. How may this be done? (5) In recording from FM and discs, what should be the tone control settings?—Tommy Allen, Highland Park, Mich.

A. (1) Try a small capacitor (up to about 50 pf) between the first stage input and ground. (2) If your cassette does not have an output jack, take the output signal from across the playback gain control. Take your cassette machine to your local audio store to ascertain what connecting cables and plug you will require for input and output. (3) I surmise you have a hum problem and have found that grounding helps overcome it. Any screw in the tape recorder chassis would provide a ground. But one often finds experimentally that some grounding points do a better job of reducing hum than others. Your tape recorder is already grounded to the amplifier via the connecting cable. If you are going to run a separate ground from the tape machine to the amplifiers, this might increase hum. If a separate ground from the tape machine to the amplifier doesn't help, then try connecting the ground to the a.c. outlet (earth) ground. (4) If your tape recorder does not already provide mixing facilities, you will have to acquire a separate mixer in order to combine input sources. (5) Adjust the tone controls according to what your ears prefer. The settings should ordinarily be electrically flat, unless you are trying to compensate for some unbalance in the source material.

Cassette Changes
Q. I have been using Scotch C-90 and C-120 cassettes with very good results, but I have had difficulty with them. Upon playback I have found the recording to be fuzzy. Going back to my older cassettes, I obtained the usual good results, confirming that my recorder is not at fault. Thinking that the new C-90s and C-120s might be part of a bad run, I purchased more of these, but the recordings turned out just as badly—F. S. Kemp, Sterling, Conn.

A. You may be getting new tape formulations under the old label, perhaps requiring different bias and equalization. In an effort to make the cassette competitive with open reel, there have been rapid developments in tape formulation. Fuzziness may be due to the fact that your machine provides insufficient bias for the newer tape.

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.

AUDIO • AUGUST, 1976
DYNAMIC DUO

Power and performance to equal the best, in a new state-of-the-art tuner and amplifier from KENWOOD

An AM/FM tuner so sophisticated FM-stereo reception is brought to new highs of high fidelity. A stereo amplifier so advanced, a complete new concept of audio power unveils the hidden beauty you never knew existed in stereo reproduction. Together the new KT-7300 and the KA-7300 continue the tradition of KENWOOD, bringing you stereo at its finest.

For complete information visit your nearest KENWOOD Dealer, or write:

KENWOOD
15777 S. Broadway, Gardena, CA 90248

152-02 Fifty-first Ave., Woodside, New York 11377

In Canada: Magnasonic Canada, Ltd.

Check No. 18 on Reader Service Card
The component look.

By design.
A-400

The 450 redefined the cassette deck as a true high fidelity component. That remarkable transport design generated a new found measure of respectability for the cassette format.

Our engineers then determined that a vertical transport was best suited for a front load application. In terms of overall design integrity and mechanical stability. So rather than adapt one transport design to fit another need, we produced a completely new, highly streamlined mechanism. From the inside out. It’s called the A-400.

Twin rotary levers control the transport functions with smooth, positive cam action. Which means unnecessary mechanical linkages have been eliminated. You get peace of mind instead, because fewer moving parts assure greater reliability and long term dependability.

Since the cassette loads vertically into the A-400, the adverse effect of gravity on the cassette package itself is eliminated. So tape jams are prevented and smooth, even tape packs are predictable.

If new design concepts superbly executed appeal to you, put an A-400 through its paces. Just call (800) 447-4700* toll free for the name and location of your nearest TEAC retailer. You’ll find that the A-400 delivers definitive TEAC performance with the added convenience of a front load component. All by design.

*In Illinois, call (800) 322-4400.

TEAC
The leader. Always has been.

TEAC CORPORATION OF AMERICA 7733 Telegraph Road, Montebello, Calif. 90640
©TEAC 1975
Edward Tatnall Canby

So the single inventory comes to America in a big way! Columbia Records. Last December, you will remember, I made a strong pitch for this strategically useful integration of the quadraphonic disc into "regular" lines (stereo) as an absolute necessity if we were to save the whole of the quadraphonic biz, software, hardware and all. Last autumn, that British giant, EMI, one of the largest record makers and an early SQ licensee, suddenly dropped its Columbia-style dual release system—a quadraphonic disc and another beside it for stereo—and went over to a single release, thus building its quadraphonic into the "regular" record line. From thence onwards EMI discs have appeared as stereo/quadraphonic, SQ encoded, or as plain stereo, unencoded, according to need and judgment; no lol—now it has happened. The first of our major record producers to go over to the single-inventory on its own. (Capitol/Angel, you understand, is the American arm of EMI.) True, some canny small labels had already seen the light and got there first. But their tails couldn't wag the big dog. (His Master's Voice is an EMI trade mark.) I mean the American. Columbia is that dog, or a large hunk of him.

Henceforth, then, there will be only one Columbia release for each catalogue item. As at EMI, it will be stereo/quadraphonic or stereo, to choice, at one price either way. No more deluxe extra-cost quadraphonics, no more duplicate releases. If there is SQ, and there will be, it will be totally integrated, right on the regular record at the standard price difference and the stereo/quadraphonic, the only release of the material, serving as the stereo record. A daring move, since it exploited the much vaunted "compatibility" to its total conclusion as the dual system certainly did not.

Silent Indecision

Well, the reaction over here, for all anybody could say, was nil. A deafening silence. Our big companies plodded right along towards their quadraphonic doom, just as if nothing had happened. Discouraging. But these things take time. I seem to have been onto the right message.

Four-Channel Software

This is the only way to project that new system into "the" system, the one point at which we can really integrate the new and the old, right down the line. Because where the disc goes, so goes the rest of quadraphonic. The disc is the first source, the greatest source, the mass source for software: it's also the seed, the sprout of an idea, the first contact for new audiences, new distribution. Quadraphonic equipment can only follow.

And so I find Columbia's decision extraordinarily sensible. Because, at some sacrifice—an unpleasant internal reorganization, a lot of pride swallowing—the change could end the past painful history of the quadraphonic disc, which has tottered on, year after year, neither a failure nor really a success in the face of competing stereo, always on the verge of extinction as unprofitable, equally on the edge of a real expansion and prestige. The thing just has to go one way or the other. And as the disc goes, again, so goes quadraphonic, the works. Major companies the world over have adopted quadraphonic on disc. Other major companies have ignored its existence, at least in public. A waiting game. Now maybe we'll see. Columbia's move is surely the beginning of the end and it could be a positive ending.

Let me say again that via the single release quadraphonic is taking the traditional road to a place in record history, as have all previous radical innovations that have been absorbed into the mainstream. We have always returned, after new changes, to the single form of record though for awhile there may have been several parallel and (maybe) compatible versions.

Only a genuine difference in content has ever allowed an alternative release form to survive for long. That includes, of course, such diversities as the 45 record and the numerous LP repackagings now available. Note that the 45 disc is still with us, but the 45 album, directly paralleling the LP, quickly died. History says emphatically that on disc we will not accept two forms of the same content for
TDK SA. WE DEFY ANYONE TO MATCH OUR VITAL STATISTICS.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Brand</th>
<th>MAGAZINE A</th>
<th>MAGAZINE B</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDK</td>
<td>SA</td>
<td>66.5</td>
<td>66.0</td>
</tr>
<tr>
<td>AMPEX</td>
<td>20:20+</td>
<td>56.4</td>
<td>—</td>
</tr>
<tr>
<td>FUJI</td>
<td>FX</td>
<td>60.0</td>
<td>—</td>
</tr>
<tr>
<td>MAXELL</td>
<td>UD</td>
<td>—</td>
<td>58.5</td>
</tr>
<tr>
<td>MAXELL</td>
<td>UDXL</td>
<td>62.5</td>
<td>55.0</td>
</tr>
<tr>
<td>NAKAMICHI</td>
<td>EX</td>
<td>60.0</td>
<td>64.0</td>
</tr>
<tr>
<td>SCOTCH</td>
<td>CHROME</td>
<td>—</td>
<td>64.0</td>
</tr>
<tr>
<td>SCOTCH</td>
<td>CLASSIC</td>
<td>62.5</td>
<td>64.0</td>
</tr>
<tr>
<td>SONY</td>
<td>FERRICHROME</td>
<td>64.0</td>
<td>64.0</td>
</tr>
</tbody>
</table>

S/N Ratio Weighted in dB, Output @ 3% THD, S/N in dB (re: 3% THD), THD at 0 dB (%)

Decks used for tests: Magazine A-Pioneer CT-F9191 (cross-checked on DUAL 901, TEAC 450); Magazine B-NAKAMICHI 1000.

Two leading hi-fi magazines working independently tested a wide variety of cassettes. In both tests, TDK SA clearly outperformed the other premium priced cassettes.

The statistics speak for themselves. TDK SA provides a greater S/N ratio (66.5 dB weighted and 66.0 dB @ 3% THD), greater output sensitivity (+4.2 dB @ 3% THD), and less distortion (THD 0.9%) than these tapes.

When you convert these statistics into sound, TDK SA allows you to play back more of the original signal with less distortion and noise.

Put these facts and figures together and TDK SA adds up to the State of the Art because it provides greater dynamic range. This means cleaner, clearer, crisper recordings, plain and simple.

Sound for sound, there isn’t a cassette that can match its vital statistics.

Statistics may be the gospel of the audiophile, but the ultimate judge is your own ear. Record a piece of music with the tape you’re using now. Then record that same music at the same levels using TDK SA. You’ll hear why TDK SA defies anyone to match its sound.

Or its vital statistics.


Check No. 33 on Reader Service Card

Wait till you hear what you’ve been missing.
more than a trial period. True, quadraphonic is a somewhat special case, for it will not supplant stereo but, rather, supplement it and live beside it. All the more reason, you see, for a single type of record to meet both needs! And with the price difference removed, and that fluid inter-compatibility, the disc playable either way, quadraphonic will be carried right along, wherever the disc may go. You don’t have to play four ways. But you always can. You might want to try ... one of these days. Nice set-up, yes?

Tape & Radio
Umm...um. So you have reservations. Let me try to answer them. Is the disc that important? Does quadraphonic really depend on it? There’s always tape. And radio. Could not quadraphonic survive well enough with their aid?

As for tape, in theory it is the ideal medium since it accommodates four totally discrete channels with no trouble at all. But as we know, there are peripheral problems which tend to become central. Tape hasn’t yet put any form of disc out of circulation. In a sense, it has simply expanded the disc market, into new places, new outlets, using basically the same original material. It has not anywhere replaced the disc, if by that you mean that there is no disc version. Not beyond the peanuts stage, anyhow.

Reel-to-reel tape, even four-way, is obsolescent, rightly or wrongly, a very thin reed on which to base expensive equipment. The easier, cheaper plug-ins tapes run into cost problems, still, and their clumsiness in manufacture is no match for the easily multiplied and distributed disc (which still maintains its averaged-out quality edge). They run into procedural difficulties, on the one hand, and technical limitations, on the other. Yes, we might maintain a very modest all-tape quadraphonic market, but would that be enough? Not really. Maybe for autos via Q-8. Not the home.

And for radio, curiously, it also is basically an adjunct to the disc as far as listening to recorded material is concerned. We get our disc sound in two ways, either on our own home players or over the air via radio’s turntables (or via taped equivalents—the argument isn’t changed). Radio is a useful alternative for consumer listening—to whatever is available in recorded form.

But what is available? I can only say that if there were no quadraphonic discs, there would be precious few quadraphonic broadcasts—via any system. Minus disc, I do not think quadraphonic on the air can be sustained, any more than via tape, not to mention the necessary home equipment. Everything is tied, eventually, into the disc. For now. Maybe later something different. Not yet.

FCC Delays
Also, as of now, we have only the two matrix types of broadcast quadraphonic, QS and SQ, filing it out as usual but actually reasonably inter-compatible in the listening, on the air or at home. Other broadcast systems hang, the F.C.C. deliberates. Which system? No CD-4 until the F.C.C. finishes its deliberations and even then it might come out with some other way. An even thinner reed, this one, for any industry to lean upon, through nobody’s fault in particular.

So, back to the disc. With its solid support, tape goes along very well and so does radio. Quadraphonic broadcasts of the allowed types are, as the produce market puts it, in considerable supply. Live pickups are a heady supplement to recorded material. Things are going well in radio. But the disc remains the economic pillar that holds it all together. And there is that ever-more-important quadraphonic enhancement of stereo sound, which may be had just as easily via broadcast as via home playing.

For a long time I’ve been saying that the biggest innovation in the quadraphonic area in terms of musical significance is this variable enhancement of millions of existing stereo recordings into a four-way sound that is often startlingly superior to the stereo effect out of two speakers. “Now more than ever!” as the ads say. Improved and sophisticated logic decoders, new special enhancement circuits designed to give a maximum four-way impact to the partially random separations inherent in the stereo disc. This thing has taken on a big importance as a part of the quadraphonic scene—but, oddly, minus the quadraphonic disc itself. A big importance but not a total one. Even the real four-way improvement of the stereo disc is not enough by itself to sustain an equipment market, simply because via any of the systems the true quadraphonic disc gives a more precise and less random control over four playback channels. And thus, potentially, its effect is always better than uncontrolled randomness, however inspiring. It’s as easy as that. We need the quadraphonic disc. Same old message. And we also need stereo on disc. NOT separately. One line of discs, for
The world’s best speaker?

An outstanding new AR speaker gives the state of the art a shot in the arm

AR speakers have always been considered the standard of the high fidelity industry in just about any price category the company cared to field an entry. From the original top-of-the-line AR-1 to the incredible AR-7, which set new standards for loudspeakers of diminutive size, it has been AR speakers against which all others were judged by reviewers, by competing manufacturers, and by the public. Now, after seven years, a new standard has been introduced at the top of the AR line, and the State of the Art is advanced another notch.

The AR-11 is the most accurate speaker system ever made by Acoustic Research—which means that it is a very likely candidate for the most accurate loudspeaker ever. Its main advance over earlier AR speakers is its ability to produce ‘flat energy response’ in virtually any listening room. This means simply that music played over a pair of AR-11s is clear, transparent, and razor-sharp, not only in one listening location, but practically anywhere in the room. Whatever is contained on the record, radio broadcast, or tape is accurately transmitted to essentially all listeners.

And of course AR is still the master of the acoustic suspension woofer principle, which we introduced to the public way back in 1954. For lifelike, bone-rattling bass when it should be there, and no interfering coloration when it shouldn’t be, AR speakers are still the ones to beat... and the AR-11 is the best of the lot.

Accuracy is what high fidelity is all about. Loudspeakers in particular, of all hi fi components, find this ideal goal especially elusive. But the AR-11 does bring it one step closer, and for that reason its introduction is one of the most significant events in recent audio history. It has to be heard.

Additional information can be obtained directly from Acoustic Research:

Acoustic Research
10 American Drive
Norwood, Massachusetts 02062

Check No. 1 on Reader Service Card
all purposes. Otherwise—no quadraphonic at all.

**Stereo/Quadraphonic Sound**

Now about the degree of sacrifice implied by this joint stereo/quadraphonic record as now promoted. We will soon have concrete material for test. We will hear for ourselves via Columbia’s new output. Not A-B! There won’t be an A-B comparison since there will be but the one release. So we must, and should, judge simply by over-all results. Do we notice any degradation in the quadraphonic product? (And, maybe, is the stereo aspect in any noticeable way compromised, as we listen?)

I strongly doubt it. With so many other variables, the wildly different forms of music, mike techniques, hall acoustics, performances, the vast latitude in editorial mixdown from multi-track original, 99 per cent of us will find that the hypothetical compromises in the stereo/quadraphonic discs, played either way, are lost in the general shuffle. We will be happy with what we get, in either mode, four or two, or we will be unhappy but for some other and more usual reason—music, acoustics, recording balance and so on.

Yes, there are compromises that must be made, variably, as the special Columbia SQ team that put forth the separate SQ records must now ruefully be saying. Some of our ears, those that are honed to hear sound first and music second (and that is plenty of us) will perhaps notice differences, aberrations from the ideal best stereo, or best quadraphonic. I am not one of these people myself; I hear music first, though I can detect the hi and the fi when I have a mind to. Some damage done, admittedly. But in the over-all the stereo/quadraphonic record, via any of the existing systems, is not a major compromise in the artistic sense. We can live with it. We can make it grow, too.

After all, I must say once more, there are still choices, there is emphasis. We may well shift over, as we go on, from stereo towards quadraphonic until we end up exactly where we have been before—a quadraphonic disc that will also play stereo. And we must understand that the techniques of the joint operation are in flux and will quite inevitably improve—for more of both, better stereo and better quadraphonic. (Remember when we made stereo and mono discs separately, with quite different techniques? We merged them, out of necessity, into the stereo/mono all-purpose disc. We haven’t really suffered.)

Whether we can tolerate compromises or not is beside the point. The point is SURVIVAL. With the single-inventory combined disc, even with variants for all three present operating systems, all of which do have the potential for stereo compatibility (as they so often tell us), we will establish a much broader and bigger base for the rest of the quadraphonic industry. So that, now, we can at last begin to expand away from the esoteric, the complicated, the prohibitively expensive, into much wider areas and on down into that no-man’s-land, that every-man’s-land, the “trade” biz.

What a dismal scene, there, from the quadraphonic viewpoint! Stereos galore, hundreds of them, thousands, mostly looking just like their granddaddies in hi-fi componentry and a lot of them not back in any serious consider. Every last one of them brings some sort of stereo sound to a buyer. And not a quadraphonic anywhere. Just try any big department store or radio/TV outlet. Look in Sears Roebuck and Montgomery Ward. Nothing.

No—we won’t take quadraphonic quite down to the grisly mass bottom. But we can now take it a lot further than before, much further, what with quadraphonic discs, marked that way right on the label and the cover, going out to unheard-of new areas all over the place, and just asking to be played. “You saw it on TV”—the perennial come-on. Well, now you saw it on the record store shelf. Didn’t you? Maybe I’m cress, but I know this works, and I won’t forget that the lowly cheapeo supports the high-bred hi-fi. More than ever.

**Prognostications**

Ah yes, those comparisons I was going to make between the quadraphonic disc systems, back in May. Deliberately, I didn’t. Because at that time every feeler inside me said look out—something is going to happen and it’ll change everything. And so it has. Now, you see, we re-evaluate all the systems in the light of the single-repository spreading-out of quadraphonic software. But it’s early. At least for me, writing here. Remember, I’m back in the day before yesterday. What about RCA—has it jumped? Maybe you know but I don’t. Is London standing pat, or staying pat? What about the big import labels—will they join up? We shall see—that is, I shall see. You probably know already.
Uncompromised stereo/quadriphony
—Undeniably Shure.

The new Shure M24H Cartridge offers audiophiles the best of both worlds: it is the only cartridge on the market that does not compromise stereo reproduction to add discrete quadriphonic capability. It eliminates the need to change cartridges every time you change record formats! This remarkable performance is achieved at only 1 to 1½ grams tracking force—comparable to that of some of the most expensive conventional stereo cartridges. Other M24H features include the lowest effective stylus mass (0.39 mg) in quadriphony, a hyperbolic stylus tip design, an exclusive "Dynetic® X" exotic high-energy magnetic assembly, and a rising frequency response in the supersonic carrier band frequencies that is optimized for both stereo and quadriphonic re-creation. If you are considering adding CD-4 capability, but intend to continue playing your stereo library, this is the ONE cartridge for you.

Shure Brothers Inc.
222 Hartrey Ave., Evanston, IL 60204
In Canada: A. C. Simmonds & Sons Limited

Manufacturers of high fidelity components, microphones, sound systems and related circuitry.
As most readers are aware, the Audio Engineering Society holds three conventions each year...one in Los Angeles, one in New York, and one in a European city. Three conventions per year for an industry is an extraordinary fact in itself, and frankly, there have been some rumbles that this is overdoing things a bit. Yet the field of audio is so dynamic, with research going on all over the world, and with an ever expanding input of new technology, that these conventions are well supported. The AES as an organization is enjoying phenomenal growth. In this country and abroad, new sections (chapters) are constantly being formed, and as a glance at the Journal of the AES will verify, each month shows a healthy influx of new members.

As I have noted before, the excitement quotient of AES conventions varies...they are never less than interesting, but now and then one comes along that is fairly bursting with new ideas and technology, innovative and even revolutionary professional audio equipment. The 54th AES convention, held May 4th through 7th at the Los Angeles Hilton, generated just that sort of pizazz.

Technical Treatises

As always, there are interesting papers presented at the technical sessions. I should point out that reprints of these papers are available from the AES in New York at a modest cost. For a list of papers, write to the AES at 60 East 42nd St., New York, N.Y. 10017. At the risk of slighting many fine papers, I found particularly intriguing 

-1131, “A Time Align Technique for Loudspeaker System Design,” by Ed Long, and -1115, our own Dick Heyens mind-blowing dissertation on what he calls “Holomorph Recording.” Don't ask me to explain...can't be done in a few words...but it is a far-out concept and well worth reading about. In keeping with the trend at recent AES conventions, seminars on pertinent audio subjects were presented. At the 54th, it was David Klepper and Stan Miller on Sound Reinforcement, and Big John Woram of the Institute of Audio Research on Echo and Reverberation, and Compressors and Expanders.

As usual, the exhibit areas of the Hilton were crammed with the new, novel, and nifty versions of every conceivable kind of professional audio equipment. There was the usual plethora of portable mixers, consoles everywhere, with computerized mix-down facilities more and more in evidence. Rupert Neve made a big splash in this respect with a system in which the control pots are physically positioned from information in the stored program. Automated Processes was showing its Model 1024 programmer which uses a digital data cartridge to store programming information and has over 1000 control channels. Good Heavens! To think I used to record Woody Herman and Stan Kenton with two ('count 'em) microphones directly into the recorder!

The big multi-track studio recorders, with up to 24 channels, appeared with new models from Ampex, MCI, Scully, Studer, and Stephens. The Ampex MM1200 accepts up to 14-inch reels, as do some of these other machines, and this size appears to be a growing trend. There were new microphones from Shure, Sennheiser, and AKG, and Electro-Voice introduced a wireless microphone system. New multi-purpose test instruments were shown by Sound Technology, Amber Electro Design, and Tektronix. I am happy to say that UREI is now into production of its Model 200/2000 automatic frequency response plotter, and I should have one by the time you read this. Needless to say, there were scads of other interesting new equipment, but I must get on to the items which made this 54th AES convention so memorable.

“Idealized” Recorder

Ampex held a press conference just before the convention opened and bowled us over with the totally unexpected introduction of a fabulous new tape recorder, the ATR-100. In my opinion, and the opinion of many of the audio press fraternity, the ATR-100 was that overworked but apt term “the hit of the show.” The ATR-100 is not one of the massive multi-track recorders using 2-inch tape. It is available from mono full-track and two-track stereo on quarter-inch tape up to four channels on half-inch tape. Quite simply, the ATR-100 represents the distillation of years of input from engineers in the field, as to what they would like to see in an “idealized” tape recorder. Given virtually free rein, Ampex engineers spent better than three years on the design of the ATR-100. Here are some of the details of this new recorder...For a start, the ATR-100 has no pinch roller! Both reel...
THE TAPE THAT'S TOO GOOD FOR MOST EQUIPMENT.

Maxell tapes are not cheap. In fact, a single reel of our most expensive tape costs more than many inexpensive tape recorders.

Our tape is expensive because it's designed specifically to get the most out of good high fidelity components. And unfortunately, there's not much to get out of most inexpensive tape recorders.

So it makes no sense to invest in Maxell unless you have equipment that can put it to good use.

And since even a little speck of dust can put a dropout in tape, no one gets into our manufacturing area until he's been washed, dressed in a special dust-free uniform and vacuumed.

(Yes, vacuumed.) Unlike most tape-makers, we don't test our tape every now and then. We test every inch of every Maxell tape.

Which is why every Maxell tape you buy sounds exactly the same. From end to end. Tape to tape. Year to year. Wherever you buy it.

And Delrin rollers. Because nothing sticks to them.

A lot of companies weld their cassettes together. We use screws. Screws are more expensive. But they also make for a stronger cassette.

Our tape comes with a better guarantee than your tape recorder.

Nothing is guaranteed to last forever. Nothing we know of, except our tape.

So our guarantee is simplicity itself: anytime you ever have a prob-

Our guarantee even covers acts of negligence.

Give our tape a fair hearing.

You can hear just how good Maxell tape sounds at your nearby audio dealer.

(Chances are, it's what he uses to demonstrate his best tape decks.)

No other tape starts off by cleaning off your tape recorder.

We clean off the crud other tapes leave behind.

After all the work we put into our tape, we're not about to let it go to waste on a dirty tape recorder head. So we put non-abrasive head cleaning leader on all our cassettes and reel-to-reel tape. Which is something no other tape company bothers to do.

Our cassettes are put together as carefully as our tape.

Other companies are willing to use wax paper and plastic rollers in their cassettes. We're not. We use carbon-impregnated material.

Every employee, vacuumed.

You may be surprised to hear how much more music good equipment can produce when it's equipped with good tape.

Maxell Corporation of America, 150 West Commercial Ave., Moonachie, New Jersey 07074

Check No. 19 on Reader Service Card
TUNE UP

The Model 210 can be used to "fine tune" any sound system for the ultimate in definition and clarity. Room, speaker and recorded material variations can often "gobble up" or overemphasize certain audio frequencies. Authoritative tight bass, open highs, brassy horns and smooth solos are all in their place with the 210's individual octave energy controls. All without adding any audible noise or distortion. To wit:

- Less than 0.01% IM distortion
- Over 100 dB dynamic range
- 600 ohm outputs drive any system
- Free five year service contract
- PLUS long throw silicone dampened controls for better accuracy, crossover synthesized inductors for ultra-low distortion, full switching facilities for EQ line/bypass and tape monitor, as well as full range unity gain level adjustments. The 210R Rack Mount version is also available.

SPECTRO ACOUSTICS, INC.
1309 E. Spokane [509] 545-1829
Pasco, Washington 99301
Check No. 32 on Reader Service Card

Delay Acoustics

If the Ampex ATR-100 was widely lauded as an item of equipment, then Acoustic Research must be given kudos for the sensational experiment and demonstration they conducted in their soundroom on the fourth floor of the Hilton. Billed as a "16-channel, programmed delay network," it is, in essence, a method of electronically simulating concert hall acoustics which can be added to the reproduction of ordinary stereo records. I think this development is one of the most significant audio advances in recent years, and I want to give in-depth coverage to it and explore its many fascinating ramifications. That will be in a forthcoming column, so my description of this time will necessarily be brief. A Hewlett-Packard 9821/9862 calculator-plotter computer was used to compute a mathematical model of the acoustic properties of a concert hall (in this case, Boston Symphony Hall) which provided the data to set the controls of a 16-channel digital time-delay system. Sixteen segments of a hemisphere in the hall have their characteristic early reflection patterns and, of course, differing time delays. In the AR room, presided over by Bob Berkovitz and David McIntosh, the research people on this project, there were a pair of standard AR 11 speakers in normal stereo configuration, and then on the front, side, and rear walls, a total of 16 AR-7 speakers, each driven by its own 10-watt amplifier. There was also a standard preamp/amplifier driving the AR 11 speakers, and AR turntable for record playback. The digital delay network has 16 individual pots for setting delay levels to each of the 16 amp/speakers. It should be stressed that this is not a reverb system, and time-delay simulation is only possible when the recording contains decay information. Since most engineers strive to record hall ambience in classical recordings, such recordings work very well with this system. Recordings with "dry" acoustics will have a strange "outdoor" sound on this system. Given a good classical recording (Bob used an excellent Janacek choral recording), you hear it "straight" through the AR 11 stereo speakers, and then when the 16 channels of time delay are switched in, the effect is simply staggering. The walls of the listening room do indeed "fall away," and you are hearing the music as it would sound if it were being performed in Boston Symphony Hall! The realism is simply breathtaking. Needless to say, other speak-
Bring home a legend.

When you go out to buy a stereo system, you'll be matching sophisticated, expensive components from a vast array of choices.

More important (because good music means a lot to you), you'll be selecting an important part of your personal environment.

So you don't want to be let down, not even a little bit. That's why the speakers you bring home should be Bose 901s.®

You'll be impressed with your new 901s as soon as you unpack them. They're much more compact than their performance, reputation, or price would lead you to believe, and they're beautifully crafted from fine materials.

By the time you have the system set up, you'll somehow be expecting something new and better in the music, something you've never been able to hear before.

You won't be disappointed.

You will hear an extraordinarily open, spacious sound that very effectively reproduces the feeling of a live, concert-hall performance, a sound that has been acclaimed by reviewers all over the world.

That unique sound is the result of several interrelated technical developments.

First, the 901s are Direct/Reflecting® speakers. Sound reflects off the walls of the room, surrounding you with the correct proportions of reflected and direct sound, all frequencies in balance, almost everywhere in the room. In contrast, conventional direct-radiating speakers tend to beam high frequencies, limiting optimum listening area, and producing a sometimes harsh sound.

Second, the 901 has no conventional woofers or tweeters, just nine identical, 4 1/2-inch, full-range drivers, acoustically coupled inside that very compact 901 cabinet. Coupling tends to cancel out, across all nine drivers, the small imperfections found in any speaker (ours included). The result is a smooth, life-like sound that's virtually free of distortion.

Third is the Active Equalizer, a compact electronic unit that automatically boosts power at frequencies that need a boost. This produces consistent sound output up and down the frequency range, with full, clear highs and solid, powerful lows.

The first time you listen to your new 901s, you'll know you've brought home the right speakers. Years later you'll have the continued satisfaction of owning and using a product of uncompromising quality.

We invite you to go to a Bose dealer, listen, and compare the 901 to any other speaker, regardless of size or price. Then you'll begin to know why the Bose 901 has become something more than a loudspeaker system for thousands of music lovers all over the world.


AmericanRadioHistory.Com
ers can be used for the normal stereo pair if you don't dig AR, and the same holds true for the delay speakers. However, considering the small energy content in each channel, and the non-coherent nature of the sound, the little AR7s seems well suited for this system, and from an aesthetic viewpoint, their size is an advantage. Everyone who heard this demonstration at the convention was mightily impressed, and what had started out as an experiment, now appears to be shaping up as a product. Plans call for a simplified “domestic” version and a model of the “all-out” system. Once again, this shows the great interest in acoustic enhancement by means of time delay and is why equipment to accomplish this is coming on the market. One of these is the Sound Concepts unit, a bucket-brigade delay device, the other is a real digital-delay unit from a firm called Audio Pulse. I expect to have an Audio Pulse unit before long, and we'll give it a whirl.

**Quadraphonic Front**

On the quadraphonic front, JVC was flying the flag for CD-4 in a demonstration room on the ballroom floor of the Hilton. CD-4 expert John Eargle was on hand and was showing a new JVC demodulator, which had all the usual goodies like PLL, etc., but in addition had a new “noise gating” system which works only on the high frequency carrier. With this in the circuit, the noise level of conventional stereo records and the noise levels of CD-4 recordings are now equal. With CD-4 records cut with the new JVC Mark-3 cutting system or its RCA equivalent, the “Quadulator,” plus this new noise-gating circuit, the sound quality of CD-4 records can be outstanding. A case in point is a recording of the music from the film “Jaws,” which John played for me. While this recording was made in Hollywood by MCA, it was cut and distributed in Japan and is not available here. (Although if enough people bug JVC, they might make it available.) The sound quality on this CD-4 recording is not only exemplary for this medium, but rivals anything heard on a stereo record. It had plenty of level; deep, solid bass, and an amazing dynamic range. Some of the fortissimo passages will blow you out of your seat. All in all, a stunning recording job and, as played through properly set up CD-4 equipment, proves this medium has come of age.

Certainly, the sound I heard in the JVC room was among the best at the convention.

**Stereo AM**

Finally, mention must be made of the demonstration of AM stereo by Sansui. Sansui is the proponent of two different methods of broadcasting AM stereo, with other systems proposed by RCA, Motorola and several others. These systems are being evaluated by a committee formed to investigate the feasibility of AM stereo. In Sansui's preferred embodiment, an AM-AM system, mono transmissions become a carrier and single side-band and uses only half of the presently available band. This would also permit compatible QS AM broadcasting. All I can tell you is that in an actual closed circuit transmission in the Sansui room, both systems worked well, and we were listening to what was undeniably stereo AM.

Highlight of the AES Banquet Thursday evening was a performance by the internationally renowned Roger Wagner Chorale with a repertoire of folk, popular, and semi-classical tunes for a fitting finale to this year's Los Angeles Convention.

---

**Could Your Speaker Pass This Test?**

Conventional speakers all use some form of paper for the cone. The problem with paper is that it's not stable in terms of performance. It's affected by humidity and dryness.

Did you ever notice how your newspaper feels on a rainy day?

So our Chief Engineer spent years seeking out a new and different material having the lightness of paper, but with stability that would not change characteristics as the weather changed.

Our cone is only one of many innovative design features of Hartley speakers.

To learn about the others, write:

**Hartley Products Corporation**
56 North Summit Street, Tenafly, N. J. 07670
(201) 871-8442

---

**The Hartley polymer speaker is so impervious to moisture, it can be played underwater without damaging the cone.**
AKAI INTRODUCES ITS LOADED DECK.

The new Akai GXC-570D is our top-of-the-line stereo cassette deck. And it’s loaded.

It utilizes a 3 head recording system — a GX glass and crystal combination head so you can source monitor when recording and, if you don’t like what you’ve got, an erase head.

It has a closed loop dual capstan drive system which not only pulls, but feeds the tape across the heads, smoothly. That’s the best drive system there is.

It has Akai’s exclusive Sensi-touch® control system so you can go from one mode to another without ever pushing a button. You just touch them, lightly.

It has 3 motors, dual process Dolby® remote control (optional) and as many switches and features as cassette decks costing a lot more. Plus something brand new — an electrically operated control panel cover. Just so you can impress people.

Plug in our GXC-570D and you’ll know you’re playing with a loaded deck. That’s the strength of the Akai line. Quality. Performance. Loaded. From top to bottom.

After all, nobody should be playing with half a deck.
Sound amplification has become as common in our life as Coke, and rightfully so. People should not be required to concentrate on listening to the sound, but should be able to concentrate on absorbing the message.

Sound-reinforcement systems range from those designed to cover 100,000 people and costing more than $250,000 to a small system to cover 20 people and costing $250. Public address or PA systems are usually limited-response, inexpensive sound-reinforcement systems. PA systems do, nevertheless, have their place and are very necessary for the small "picnic" type sound systems where ease of installation and operation are very important.

Every system, no matter what size, must satisfy four basic parameters:
1—They must be loud enough.
2—they must cover the entire audience area.
3—they must be able to be understood.
4—they must be capable of performing all functions the customer requires.

This article will cover the above parameters and their solutions for the small "picnic" type outdoor PA systems.

**Loudest and Coverage**

It is often said of PA systems, "It was so loud it hurt my ears" while another person might say of the same system, "It was so soft I couldn't make out what he said." One of the most difficult problems encountered in outdoor "picnic" PA systems is the ability to make the system loud enough everywhere without making some areas excessively loud and the entire system distorted. This is usually best corrected by placing the speakers properly and by using high efficiency speakers with good projection patterns.

Unfortunately, all outdoor PA systems must follow the laws of physics, and such phenomena we cannot change. One of these laws is known as the "inverse square of sound attenuation," which states every time the distance is doubled, the sound pressure level (SPL) is reduced 6 dB or to 1/4 of the reference sound intensity.

Outdoor PA systems require more power than indoor systems to produce a specific SPL at a specified distance. This is because outdoor systems very closely follow the "inverse square law" while indoor systems get help from reflections from the side walls, floors and ceilings to a point where, at $D_c$ (critical distance) and beyond, apparent level remains constant. Critical distance is defined as the distance where direct and reverberant sound are equal in level, often 8 to 20 ft. in the average room.

Because the inverse square law is followed outdoors, a speaker 4 ft. from an observer must produce an SPL of 110 dB to give a SPL of 76 dB at 200 ft. A level of 76 dB is the minimum level one should accept at the maximum required distance as 70-dB SPL is a fairly common noise level where the "picnic" type PA system is used. A 110-dB SPL is the same level as standing one foot from a man's mouth when he is shouting, while 76-dB SPL has the same level as being 50 ft. from the same shouter.

This difference in SPL between any two points can be determined by using the graph of Fig. 1. To determine the difference in SPL between any two distances, locate the differences in Fig. 1, go vertically to the diagonal line and then horizontally to the attenuation. Subtract the near distance attenuation from the far distance attenuation for the difference between the two. To determine this mathematically, see the appendix.

Let us assume that $d_f$ is the farthest distance the loudspeaker must project and $d_N$ is the closest distance the loudspeaker will project to. Raising the speaker in the air and moving it away from the audience does not appreciably increase $d_f$; however, it does increase $d_N$ substantially as in Fig. 2. Raising the speaker 4 ft. and moving it back 4 ft. changes $d_N$ from 4 ft. to 9 ft. while only changing $d_f$ from 200 ft. to 204 ft. With an SPL of 110 dB at 4 ft. from the speaker as before, the front of the audience area will be 103-dB SPL or the same level as 2 ft. from the shouter and the rear of the area will still be 76-dB SPL.

Raising the speaker to 12 ft. and moving it back 12 ft. changes $d_N$ to 20 ft. and $d_f$ to 212 ft. This would mean with 110-dB SPL at 4 ft., the front of the audience area SPL would be reduced to an SPL of 96 dB or a level equivalent to 4 ft. from the shouter, while the rear of the audience area would be 75.5-dB SPL.

As can be seen, this position of the loudspeaker only decreased the $d_f$ SPL 0.5 dB, while decreasing the $d_N$ 14 dB. A difference in level of ±10 dB subjectively sounds about one-half or twice as loud as the reference sound. In an outdoor system a -3SPL of 4 dB would be ideal, however, 15 to 20 dB is acceptable as long as the system is being used for announcements, etc., and not as a sound-reinforcement system for high-quality music amplification.

Raising the speaker higher will reduce the SPL difference between the front and rear of the audience area, however methods of mounting and effects of wind and temperature on sound limit useful height to about 20 ft.

Once we have determined the relative acceptable levels between the front and rear of the audience area, we can determine the power required to drive the speakers. To do this, we
must know the speaker's sensitivity and horizontal and vertical dispersion and the coverage angle required to cover the audience area.

Published speaker coverage angles or dispersion vary from a 60 to 120° circular coverage pattern (Fig. 3) to a rectangular pattern from 20 x 40° to 60 x 120° (Figs. 4 & 5). Unfortunately, sound waves are not all that easily controlled and the angle decreases as the frequency increases (Fig. 6). As can be seen, it is not uncommon for the dispersion angle of the speaker to vary from 220° at 200 Hz to 20° at 10 kHz. The dispersion angle is often given at 2-3 kHz and, therefore, for even coverage to 5-6 kHz, additional speakers are required.

It is very unusual, in outdoor systems, to require a large vertical coverage angle as the audience is usually either standing or sitting on ground level. Speakers with rectangular dispersion have an advantage over speakers with a circular or square dispersion for two reasons:

1—Outdoor sound has no precise boundaries, therefore, any sound which is not absorbed in the audience area is apt to project to unwanted areas (neighbors, etc.).

2—A driver which has the ability to produce a specified SPL into a sphere (omnidirectional) will have a much higher SPL when projected into a portion of that sphere. This translates to less required power input. This is described in the appendix.

We know that we require an SPL of 75 dB at 212 ft. Most speaker manufacturers rate their speaker sensitivity at either 4 or 10 ft. with one-watt electrical input power. Assuming the speaker sensitivity rating is at 4 ft. and we require an SPL of 75 dB at 212 ft., the speaker therefore must deliver 110 dB at 4 ft. This can be determined by adding the dB attenuation for dF as found in Fig. 1 to the SPL required at dF. In our example, using Fig. 1, go vertically from 212 ft. to diagonal line, then horizontally to attenuation of 34-dB SPL. Add this to the required SPL at 4 ft., i.e., 34 dB + 76 dB = 110 dB SPL.

Unfortunately, doubling the speaker power does not increase SPL by 6 dB, but only 3 dB, hence it is important, when running outdoor systems (often on battery), to use efficient speakers with controlled dispersion. If the manufacturer's speaker rating was 99 dB @ 1 W at 4 ft. and we require 110-dB program SPL at 4 ft., our Electrical Power Required to the speaker (EPR) would be 12.6 watts of program power (see appendix).

All signals, with the exception of

Fig. 1—Inverse square law attenuation of Sound.

Fig. 2—Effect of moving the loudspeaker away from the audience.

Fig. 3—90° circular dispersion horn speaker, EV AR-150.

AUGUST 1976
pure sine waves, have a crest factor. This means that the peaks of the signal are much higher for a given average power than if it were a sine wave. A crest factor of 10 dB or 10 times is common, therefore, the EPR of the amplifier for 12.6 watts of program power would be 125 watts (see appendix). Many paging horn loudspeakers have a sensitivity of 107 dB or more. This would reduce the EPR to the speaker to 2 watts program or 20 watts total.

Often the required coverage is much larger than the area covered by one speaker, therefore, more than one speaker is required to cover the area. The published speaker dispersion angle is that angle where the acoustical output is 6 dB down from the output on the speaker axis. To ensure uniform coverage, the speakers must have at least 20 per cent overlap.

If the speakers are stacked and splayed, rather than mounted side-by-side, the frequency response will be more uniform (Fig. 7).

Solid-state amplifiers can become very unhappy when the load impedance is less than the specified output impedance taps of the amplifier. If more than two 8-Ohm speakers are used, it is preferable to use the 70-volt output common on the pro amplifiers and 70-volt transformers on each speaker. This also allows level adjustment for each individual speaker. If four or five speakers are always used and wired in parallel, the speakers can be connected between the 8-Ohm and 16-Ohm taps of the amplifier with only a small loss of power. Since solid-state amplifiers require very little idle power, 10 watts for a 25-watt amplifier and 20 watts for a 100-watt amplifier, it is advisable to use a 60- to 125-watt amplifier for most "picnic" PA systems. This and efficient speakers guarantee adequate volume so it may be heard over the background noise.

**Articulation**

It is often said "The system was plenty loud, but I couldn't understand a thing he said." This condition is more prevalent in indoor systems where reverberation is an important factor affecting articulation. Outdoors, reverberation usually does not affect articulation, however, echo, poor signal-to-noise ratio (S/N), distortion, and poor frequency response can all affect articulation. In the reverberant areas, a required S/N of 25 dB is not unusual. In outdoor installations, where reverberation is minimum, a S/N of 3 to 6 dB is usually adequate, however, 5 to 10 dB would be preferred. In fact, the fantastic computer in our head can separate the signal from the noise when the S/N is less than 6 dB.

Echo affects articulation two ways, by increasing the noise level and by adding confusion. A good way to better understand this type of confusion is to talk over the PA system while listening to yourself over a speaker placed 110 feet away. Since sound travels approximately 1,130 ft./sec., it takes 0.1 seconds for the sound to travel back to the talker. When talking over such a system, the talker usually slows down to give the sound time to catch up to him which, of course, it can't do. Next, move the speaker 40 feet away and normal talking can be resumed. Therefore, never have speakers more than 40 feet apart and the first speaker of a string of speakers more than 40 feet from the talker.

Inexpensive microphones, amplifiers, and speakers often have distortion exceeding 10 per cent. Under ideal conditions, 10 per cent distortion is probably acceptable as far as articulation is concerned, however, when S/N is borderline, 10 per cent distortion could increase the articulation loss beyond acceptable limits.

Since most amplifiers have low distortion (2 per cent) and good fre-
Get more advantages with our top professional.

Engineering. Features. Styling. Everything about the new JVC S600 stereo receiver is professional. The kind of professionalism that offers you more to do more. Hear more.

Advantage #1: More precise tone controls.
JVC's exclusive SEA graphic equalizer system has five tone-zone controls covering the complete audio range. Together, with a tone cancellation switch, they help you overcome the shortcomings of room acoustics, poor recording and placement of speakers.

Advantage #2: Instant reserve power when you need it.
The S600 delivers 110 watts per channel minimum RMS, at 8 ohms, from 20 to 20,000 Hz, with no more than 0.1% total harmonic distortion. Its advanced toroidal coil power transformer instantly produces reserve power for better transient response. What's more, you can constantly monitor the power being fed into your speakers with a pair of direct-reading power meters. JVC's patented 3-way protection circuit helps safeguard power transistors and your speakers against unexpected surges of power.

Advantage #3: The great performance of a separate tuner.
The FM tuner section of the S600 brings in stations smoothly and cleanly with remarkable channel separation. The reason: advanced design that incorporates a dual-gate MOS FET plus a 4-gang tuning capacitor, phase lock loop IC circuitry and a quadrature detector.

Advantage #4: Innovative styling.
S-600 styling is totally uncluttered. Direct-action pushbuttons and slide controls for all functions and switching make operation completely simple and absolutely precise.

Advantage #5: Greater versatility.
The S600 gives you 2-way tape dubbing, electronic phono switching and stereo/mono switching, high/low filters, signal strength and center-channel tuning meters, FM muting, loudness control, and a switchable noise reduction circuit for Dolby FM broadcasts.

Call toll-free 800-221-7502 for your nearest JVC dealer: JVC America, Inc. 58-75 Queens Midtown Expressway, Maspeth, N.Y. 11378 (212) 476-8300.

Approximate retail value of the S600 is $750.

Check No. 17 on Reader Service Card

Smooth, precision tuning with gyro-bias knob.

Direct-action pushbuttons simplify source selection and switching.

5-zone SEA graphic equalizer system offers tone adjustment over entire musical range.

Instantaneous monitoring of power with twin direct-reading power meters.
Frequency response (50 Hz to 10 kHz + 2 dB), they are not usually the problems in PA systems. Components which change acoustic energy to electrical energy (microphones) and electrical energy to acoustic energy (loudspeakers) are the hardest to make acceptable and require the expenditure of more time and money.

Frequency response of 300 to 3500 Hz, with a peak at 3000 Hz, may be ideal for telephone communications where a broad frequency response would create poor S/N because of long unshielded lines. The narrow frequency response is also acceptable because conversation is usually short. In outdoor PA systems, this frequency response is not acceptable because the aggravation it produces causes the audience to block their ears to the system, reducing articulation. While the stereo enthusiast would prefer a frequency response that is flat from d.c. to infinity, it is not practical for small outdoor PA systems. What is important is to be able to reproduce some of the lower fundamentals of the male voice, 250 Hz minimum (100 Hz would be better) and to reproduce up to 6 to 8 kHz to assure proper reproduction of the sibilance of the speech, i.e. S's, Z's, etc. Using speakers with a relatively smooth response of 250 Hz to 8 kHz assures fairly good reproduction of the voice and at least acceptable reproduction of background music.

Microphones

There is always much discussion on the pros and cons of cardioid and omni-directional microphones. In outdoor systems, where the acoustic field is not reverberant, cardioid microphones will increase gain before feedback, particularly when the back of the microphone faces the loudspeaker. A second advantage of the cardioid microphone is that it can be used to discriminate between signal and noise. The heart-shaped pickup pattern of the microphone means that the talker or signal must be directed towards the front of the microphone, not towards the side or rear, and that the rear of the mike should be towards the unwanted sound or noise. Talking into the side of the mike would reduce output about 6 dB, while talking to the rear would reduce mike output up to 20 dB.

All microphones should have an "on-off" switch so the announcers can turn the microphones off when not in use, reducing noise and allowing conversations to be carried on in the vicinity of the microphone. For a simple one-microphone system, the Shure SM82 microphone with built-in preamplifier and limiter can be used directly into a power amplifier, bypassing low level preamplifiers and reducing susceptibility to noise, etc.

Outdoor PA systems are susceptible to electrical interference (radio stations, hum, ignition, etc.) because of poor grounds, or lack of grounds, along with the lack of external shielding from building structures, so all microphone inputs should be low impedance and balanced to eliminate noise pickup and allow long microphone lines.

Required Functions

Now that the system is designed to work well (a microphone input gives good quality speaker output), we must make the system do what the customer wants it to do. It is common to require battery power in portable outdoor systems. Many solid-state amplifiers are ideal for operating on battery power as they operate on a 14 V d.c. or 28 V d.c. power supply. This means they can easily be powered by 12 V auto batteries of 12-24 V Ni-Cad batteries. The advantages and disadvantages of automotive lead-acid batteries and Ni-Cad batteries are as follows:

Lead Acid Batteries

Advantages
1—High power capabilities (5-10 amperes for 8 hours).
2—Easy to obtain.
3—Can be connected in series for higher voltage.

Disadvantages
1—Heavy.
2—Cannot be tipped.
3—Require large connectors.
4—Require maintenance.

Ni-Cad Type Batteries

Advantages
1—Small.
2—Lightweight.
Size isn’t everything

Japan. Land of the audio giants. Companies like Pioneer, Sony, Yamaha. Each with 100 times more engineers, production efficiency, research facilities, marketing resources, and sales — than your average good-sized U.S. or U.K. manufacturer.

November 3rd, 1975, Prince Hotel, Tokyo. The scene of a hallmark event — the 5th annual Japan Stereo Components Grand Prix Contest. An occasion which has indeed become the Grand Prix of the Japanese audio scene. Stereo components from Japan, the U.S., the U.K., and Europe — to be judged on the basis of performance and design by eight famous Japanese hi-fi journalists.

Among the entrants: a small speaker, the UL6, recently launched by a not-so-big company: Celestion of England.


Surprising? Not really. All the engineers, efficiency, marketing and money in the world are not sufficient to build a great speaker. Intangible resources are needed: experience, intuition, and dedication. Resources which Celestion has more of than any other speaker company in the world.

Since 1924, Celestion engineers have dedicated themselves uniquely to one art — that of building great speakers. And to doing it all by themselves — from scratch.

Starting from the outside, we see that styling is a special feature of the UL6, with beautiful dark walnut finish on all sides — even on the front baffle-board which is normally concealed by the grille. The grille consists of a slim frame carrying two stand-off ribs to give a three-faced appearance when the black, acoustically transparent cloth is stretched over it.

Now for the guts. UL6 deploys the new HD1000 ultra-wide dispersion 1” dome tweeter, a new Celestion mid-bass unit with massive magnet system and specially treated Bextrene diaphragm, and a new ABR (auxiliary bass radiator) which extends bass response, raises sensitivity and reduces distortion to negligible limits. These advanced precision components were totally researched, designed and built by Celestion to optimize overall performance in the UL6. The result is clean, tight, smooth response from 35 Hz-28 kHz. Performance so superlative that we realistically predict that UL6 will become the reference standard for bookshelf-size speakers.


Sole North American Distributors:

ROCELCO INC. 160 Ronald Dr., Montreal, Canada H4X 1M8 Phone (514) 489-6842

Also Distributors for Decca Cartridges and Record Cleaning Devices
Appendix

1—The difference in dB SPL between any two points can be determined by the following formula:
\[
\Delta SPL = 20 \log \frac{d_f}{d_N}\text{ where }
\]

\[
d_f = \text{far distance}
\]
\[
d_N = \text{near distance}
\]

Subtracting \( \Delta SPL \) from the near distance delivers the SPL at the far distance and conversely, adding \( \Delta SPL \) to the far distance gives the SPL at the near distance.

\[
\text{SPL}_f = \text{SPL}_N - \Delta SPL
\]
\[
\text{SPL}_N = \text{SPL}_f + \Delta SPL
\]

2—The formula for determining the SPL of a sphere is:

\[
\text{SPL} = 10 \log \left(\frac{W \cdot Q \cdot 10^{10}}{4 \pi r^2}\right) + 10.5
\]

\( W = \text{acoustic watts} \)

\( Q = \text{directivity factor} \)

\( r = \text{distance from source} \)

Using \( W = 1 \text{ watt} \)

\( Q = 1 \) (omni directional)

\( r = 4 \text{ ft.} \)

The maximum SPL = 107.47 dB SPL

\( Q \) is the directivity factor or the ratio of the area of a window on the sphere to the entire surface area of the sphere. The average speakers have coverage angles between 90° and 180° and, therefore, their \( Q \) can be determined by the formula:

Rectangular Dispersion

\[
Q = \frac{180}{\arcsin \left(\frac{\sin \theta/2}{\sin \phi/2}\right)}
\]

where \( \theta \) = horizontal angle

\( \phi \) = vertical angle

Circular Dispersion

\[
Q = \frac{2}{1 - \cos \phi}
\]

If we use a hypothetical speaker with a dispersion of 40° X 100°, our \( Q \) would be 11.85, therefore our SPL, under the same conditions as the previous sphere, would be 118.2 dB SPL for a gain of 10.73 dB.

If the same driver was mounted in a speaker with a 100° circular dispersion, the \( Q \) would be 5.6, therefore, the gain over the sphere would only be 7.48 dB. This means that this speaker would require 2.11 more power than the same driver on the speaker with a 40° X 100° dispersion.

3—Electrical Power Required formula is:

\[
\text{level required at 4' = speaker sensitivity}\frac{10}{100} \text{ dB}
\]

Program EPR = 10

110 dB - 99 dB

Or in our case, EPR = 10 log

= 12.6 Watts

4—The total amplifier power output per speaker is equivalent to the program power plus the crest factor, and it is calculated by the following formula:

\[
\text{Total Amp power/spkr.} = \text{EPR program (crest factor)}\frac{10}{10}
\]

or Total Amp power/spkr. = EPR (10)

This means in our example, we would require

12.6 Watts (10) = 126 Watts

Summary

Now that we have looked at the problems of outdoor PA systems, does it mean we must go through all the preceding formulae every time we install a portable PA system? By all means, no; however, by knowing the problems and their solutions we can, through our own logic and good judgment, purchase and install outdoor "picnic" type sound systems with improved quality and articulation.

By following these do’s and don’ts, acceptable outdoor "picnic" PA systems can be installed.

Do

1—Have adequate amplifier power.
2—Use efficient speakers.
3—Use speakers with rectangular dispersion.
4—Mount speakers in the air and parallel for other than standard capabilities.

Disadvantages

1—Ampere-hour ratings indicated are not for one hour, but 20 hour discharge, therefore, a 4.5 ampere-hour battery will supply 0.225 amperes for 20 hours or 4.5 amperes for 30 minutes.
2—Internal impedance very low, therefore, battery can be destroyed by shorting.
3—Batteries left on shelf for long periods require exercising to bring back their full capacity.

Many amplifiers have a built-in battery charging circuit (Fig. 8), however, those that don’t, can have one easily installed. All that is required is a power rectifier which is forward biased when operating on battery, in parallel with a power resistor which charges the battery when the amplifier is operating on a.c. power (Fig. 9).

Amplifiers should have a minimum of two low-impedance microphone inputs, as many outdoor PA systems are used for entertainment along with general paging. In this day of small, battery-operated, cassette tape recorders, it is also important to have an auxiliary high impedance input. All inputs must have their own volume controls.

30
If you're surprised to learn that tubes solve some amplifier problems best, you have something to learn about amplifiers.

And about LUX.

It may seem courageously retrogressive for a company to introduce a tube amplifier—even a highly advanced type—to the semiconductor audio world of 1976. Especially for a company only recently established in the U.S. market with a comprehensive line of solid-state amplifiers and tuners. But for LUX, it is simply consistent with our philosophy whatever path may lead to improvement in the accuracy of music reproduction will be explored by our audiophile engineers. Whether it leads to transistors or tubes.

Certainly, transistors are not about to be obsolesced by tubes. However, there are some amplifier problems that tubes still handle better than transistors. Overloading is one such problem.

When a solid-state amplifier is driven beyond its rated power, it clips abruptly. Engineers call it 'hard clipping.' The term is apt, as the sound from the spurious high-order odd harmonics is raspy and irritating. Further, if the overall circuitry is not stable, and the protective circuits not very well-designed, the distortion is extended in time beyond the moment of overload. Drive a tube amplifier beyond its rated power and it too clips the waveform, but gently and smoothly. This 'soft' clipping introduces much smaller amounts of odd harmonics. The distortion is far less irritating, hence less noticeable.

Notch (or crossover) distortion, present in many transistor amplifiers, is another source of spurious high-order odd harmonics. It occurs when the transistor output circuits are not able to follow the musical waveform accurately at the points where it changes from positive to negative and back again. Since notch distortion, unlike clipping, is at a constant level regardless of the power the amplifier is delivering, the ratio of this distortion to signal is worse at lower power. The gritty quality heard from many transistor amplifiers, particularly when they are playing at low levels, is usually due to crossover distortion.

Of course, tubes also have their limitations. Especially conventional tubes. The only tube previously capable of high-power amplification—the pentode—has inherently higher levels of distortion than the triode. Existing lower-distortion triode tubes cannot deliver sufficiently high power as a simple push-pull pair. But LUX, together with NEC engineers, has developed the first of a new breed of triode tube—the 8045G, which with other related technological advances, makes possible a high power, low distortion triode amplifier—the Luxman MB-3045. Among the differences in this new triode: the plate electrode uses a special bonded metal with high heat radiation characteristics. Also, the filament structure further aids heat dissipation.

LUX also developed a low-distortion high-voltage driver tube, the 6240G, capable of delivering over 200 volts of audio signal to the output triodes. Also, a new output transformer (LUX's long-time special area of expertise) has been designed to take optimal advantage of the triode configuration feeding it. The quadrafilar winding and core technology of this transformer represents another breakthrough. Overall, from input to output, the use of advanced design direct-coupled and self-balancing differential amplifier stages ensures stability and minimum phase shift.

The MB-3045 produces a minimum of 50 watts continuous power into 4, 8, or 16 ohms, at any frequency from 20 to 20,000 Hz, with total harmonic distortion no more than 0.3%. As the MB-3045 is monophonic, a pair of them connected to a stereophonic preamplifier will not be subject to stereo power supply interaction.

Now, we don't expect the MB-3045 to become the world's best selling amplifier, any more than our highest-power solid state power amplifier, the M-6000 priced at nearly $3000. You'll find both at our carefully selected LUX dealers who will be pleased to demonstrate them for you. And of the other dozen or so LUX models it's why they are LUX dealers in the first place.

LUX Audio of America, Ltd.

200 Aerial Way, Syosset, New York 11791
In Canada: AMX Sound Corp. Ltd., British Columbia. Gentronic Ltd., Quebec

AmericanRadioHistory.com
The phono cartridge that doesn't compromise any modern record.

AT15Sa

UNIVERSAL BEST FOR 1/2-4 CHANNEL

Choosing an AT15Sa can add more listening pleasure per dollar than almost anything else in your hi-fi system. First, because it is one of our UNIVERSAL phono cartridges. Ideally suited for every record of today: mono, stereo, matrix or discrete 4-channel. And look at what you get.

Uniform response from 5 to 45,000 Hz. Proof of audible performance is on an individually-run curve, packed with every cartridge.

Stereo separation is outstanding. Not only at 1 kHz (where everyone is pretty good) but also at 10 kHz and above (where others fail). It’s a result of our exclusive Dual Magnet* design that uses an individual low-mass magnet for each side of the record groove. Logical, simple and very effective.

Now, add up the benefits of a genuine Shibata stylus. It’s truly the stylus of the future, and a major improvement over any elliptical stylus. The AT15Sa can track the highest recorded frequencies with ease, works in any good tone arm or player at reasonable settings (1-2 grams), yet sharply reduces record wear. Even compared to ellipticals tracking at a fraction of a gram. Your records will last longer, sound better.

Stress analysis photos show concentrated high pressure with elliptical stylus (left), reduced pressure, less groove distortion with Shibata stylus (right).

The AT15Sa even helps improve the sound of old, worn records. Because the Shibata stylus uses parts of the groove wall probably untouched by other elliptical or spherical stylus. And the AT15Sa Shibata stylus is mounted on a thin-wall tapered tube, using a nude square-shank mounting. The result is less mass and greater precision than with common round-shank styli.

It all adds up to lower distortion and smoother response. Differences you can hear on every record you play.

Don’t choose a cartridge by name or price alone. Listen. With all kinds of records. Then choose. The AT15Sa UNIVERSAL Audio-Technica cartridge. Anything less is a compromise. away from the front of the audience.
5—Aim speakers at the audience.
6—Stack and splay speakers when using more than one speaker for coverage from one point.
7—Use speakers with smooth frequency response 250 Hz to 8 kHz.
8—Use 70 V speaker lines when speakers are more than 100 ft. from amplifier or more than two speakers are used.
9—Have battery-powered capabilities for amps.
10—Have at least two microphone inputs and one auxiliary input.
11—Use balanced low-Z microphones.
12—Use cardioid microphones for increased gain and improved S/N.
13—Place microphones between 25 and 50 feet from speakers. This gives adequate gain without time delay.
14—Have adequate coverage to insure no dead spots.

Don’t
1—Don’t put speakers on ground. Sound cannot go through or around people and objects.
2—Don’t aim speakers in the air as this causes sound to go into unwanted areas.
3—Don’t string speakers out more than 40 feet apart as this causes echo.
4—Don’t boost bass control on the amplifier when speaker response is limited to 250 Hz. This will increase distortion and can destroy speakers.
5—Don’t allow total speaker impedance to be lower than amplifier load impedance.
6—Don’t connect speakers in series—parallel, as in temporary systems; this becomes confusing and often requires complicated wiring.
7—Don’t allow people to plug cheap Hi-Z unbalanced microphones into a system as it will cause noise, oscillation, and poor quality.
8—Don’t run speaker wires and microphone lines together as this will cause oscillation.
9—Don’t run wires on the ground where people can trip on them, causing personal injury or defeating the PA system.
10—Following the above recommendations and using logic and common sense, outdoor "picnic" sound systems can be made to be a positive force in any outdoor function, rather than a "necessary evil."

Handy references are Sound Systems Engineering by Don and Carolyn Davis and Altec's Tech. Topics 221, 212A, and 218.
ONCE AGAIN, THE EPI 100 HAS RECEIVED TOP RATINGS FROM THIS PRESTIGIOUS PUBLICATION.

In its February issue, the leading independent consumer testing magazine rated the EPI 100 the best speaker for the price among medium-priced speakers. That's the good news.

The bad news is, because of its policy of strictly enforcing the copyright laws, we can't name the magazine or quote it directly.

But we can tell you this: This is the third time running the EPI 100 has been so rated by the publication. And no wonder.

The EPI 100 offers EPI's celebrated Linear Sound: a pure, uncolored, natural sound from top to bottom. With no artificial boosting of the bass to impress the innocent. And all the nuances at the treble end that, on most speakers, just fade away.

The Model 100 doesn't just deliver the Linear Sound of EPI straight ahead, either. In fact, up to 15,000 Hz, the speaker's off-axis dispersion is down an average of only 3 db.

With its excellent dispersion and EPI's Linear Sound, we'd say the EPI 100 is clearly the finest speaker you can get for the money.

But don't take our word for it. Take ours.

The Model 100 is available in a hand-rubbed walnut veneer or a vinyl finish (Model 100v).

THE LINEAR SOUND OF EPI

EPI is a product line of Epicure Products Inc., Newburyport, Mass. 01950

Check No. 14 on Reader Service Card
For example, it is now common practice to record an electric bass by plugging it directly into the recording console via a matching transformer. This avoids the deficient bass of most open-backed guitar speakers and provides a signal much richer in the fundamental, but the bass still only goes down to 41.2 Hz. To go farther down the spectrum, we must switch from instruments with acoustical signal generators to ones with electrical signal sources.

Dr. Moog’s Synthesizer contains a set of electronic function generators and can produce low bass notes with very strong fundamentals. It is very easy to produce a low distortion sine wave with a synthesizer, a 16.4 Hz note which is 99-44/100% fundamental, for instance. Over the past few years musicians have become proficient with synthesizers, and a sizeable catalog of good electronic music is available on phonograph records. Should an engineer design loudspeakers to handle these records? What does it cost to extend the frequency response down an octave from the 40 Hz cut off, required by most music, to 20 Hz for electronic music? Remember, there is no such thing as a free lunch.

Some Theory

Dr. R. H. Small of the University of Sydney has “done the math” on this problem as related to direct-radiator loudspeakers and gives us the following equation which relates reference efficiency ($\eta_0$), low frequency cut off ($f_\text{L}$), and total enclosure volume ($V_B$):

$$\eta_0 = k_f f_L^2 V_B$$

where $k_f$ is a constant related to the type of system (vented, closed-box, or passive radiator) and response alignment (Butterworth, Chebbychev, etc.). If $\eta_0$ is expressed in percent, $f_L$ in Hz, and $V_B$ in litres, then the maximum possible value of $k_f$ is $3.9 \times 10^{-7}$ for a vented-box and $2.0 \times 10^{-7}$ for a closed box.

Let us assume the case of a typical vented-box with $k_f$ of $3.0 \times 10^{-7}$, $V_B$ of 60 litres (2.1 ft³), and $f_L$ of 40 Hz. This gives an efficiency of about 1.2%. Now, let us lower $f_L$ to 20 Hz. If we keep the same alignment (hold $k_f$ constant), then either the efficiency must drop to around 0.14% or the enclosure size must go up to 480 litres (17 ft³). This is expensive in terms of either amplifier horsepower or timber.

Small also points out an approximate relationship between distortion ($D$) and low frequency cut off:

$$D \approx \frac{1}{f_L^2}$$

Thus, all other things being equal, a system with a 20 Hz cut off will have 16 times the distortion of one with a 40 Hz cut off. The largest part of the distortion results from the intermodulation of the higher frequency components of the signal with the lower ones.

We now begin to see why almost all commercially available systems cut off between 40 and 60 Hz. There is little of musical interest below 40 Hz and system distortion increases rapidly as the system low frequency cut off goes down.

But suppose, Gentle Reader, that you, like the author, still want to feel those 20 Hz signals from a synthesizer while retaining reasonable efficiency and tolerable distortion in your system. This can be done with the addition of a sub-woofer. A sub-woofer is a low bass loudspeaker, generally used in a bridged-center configuration, which handles material below the range of the normal system’s woofer. It offers two advantages. One, quite obviously, is extended bass response and the other is reduced distortion in the main system. This reduction in distortion is caused by easing the low-frequency requirements on the main woofer. Let us apply

---

*CTS of Paducah, Inc., Paducah, KY 42001

W. J. J. Hoge*

Recent studies have shown that most music has little program content below 40 Hz. The open E string of a bass (acoustic or electric) produces a note with a fundamental of 41.2 Hz, the low A on a piano has a fundamental of 27.5 Hz, and an organ with a 32-ft pipe produces a low C with a 16.4 Hz component. However, the fundamentals of the notes produced by all of these instruments are very low in amplitude compared to the harmonics. Tests have shown that a loudspeaker with a 40 Hz cut off is adequate for reproduction of almost all music. But there are exceptions to these general rules.

---

*American Radio History.com
Fig. 1—Inside dimensions of loudspeaker box.

Fig. 2—Vent details for the loudspeaker box.

Fig. 3—Installation of the front panel gasket. Note the damping material, braces, and vent.

Fig. 4—Sub-woofer crossover schematic.
current loudspeaker synthesis procedures to the design of a sub-woofer and see what sort of system results.

**Designing a Sub-Woofer**

Before going any farther, we need to firmly establish our design objective. Let us try for a low frequency cut off of 20 Hz in a system with maximally-flat response. With this goal in mind, we must now choose the type of system and the alignment we will use. Since the low cut off requires a large box for reasonable efficiency, we should choose a type of system and alignment which will maximize efficiency per unit volume, and this means a vented-box. For an alignment, let us choose the 4th-order Butterworth (B4) which is maximally-flat. The Quasi-Butterworth 3rd-order (QB3) alignments are also flat, but require the driver resonance frequency to be lower than the system cut-off frequency. In the case of a 20 Hz cut off, this is an unreasonable requirement. Also, the QB3 alignments are more prone to problems caused by infrasonic signals, such as turntable rumble, than is the B4.

Next, we must fix the enclosure volume. 600 litres (21 ft³) is about the largest box that the author can squeeze into the living room of his small apartment; therefore, let \( V_B \) be 600 litres. This volume, when plugged into Eq. 1 along with the \( k_W \) of a B4 alignment and 20 Hz cut off, gives an efficiency of just over 1.0%.

Similarly, we must set the upper frequency limit for the sub-woofer. The 60-litre bookshelf systems (A & L Sound A660s) in the author's apartment have a moderate 4th-order Chebbychev (C4) alignment with a 45-Hz cut off. Good engineering practice requires about an octave of overlap between the crossover frequency and the acoustical cut off of a driver.

\[
2 \times 45 \text{ Hz} = 90 \text{ Hz}
\]  

which can be rounded off to 100 Hz. This figure will give suitable overlap for systems with \( f_s \) in the 40- to 60-Hz region. The sub-woofer's response should extend an octave above the crossover. The formula below gives an approximate relationship between advertised basket diameter in inches (AD) and the upper acoustical cut off \( (f_{PR}) \) of a driver.

\[
AD_{max} = 11,000 / f_{PR}
\]  

Plugging \( f_{PR} \) of 200 Hz into Eq. 4, we find that a driver with an advertised diameter of up to 55 in. would be useful. Since no one makes a 55-in. loudspeaker, we should try something smaller. We could use an 18-, 24-, or 30-in. unit. Since there are so few drivers from which to choose, let us limit ourselves to 15-in. units.

A. N. Thiele has given us a very useful table of potential vented-box system alignments. The table was reprinted in the August, 1975, issue of *Audio*. Referring to the table we find that for a 20-Hz B4 alignment in a 600-litre box, we want to use a driver with a resonance frequency \( (f_s) \) of 20 Hz, a total \( Q (Q_{TS}) \) of 0.38, and a compliance equivalent volume \( (V_{AS}) \) of 850 litres. The table gives the parameters of three potentially useful drivers, the Altec 416-BA, the CTS 51W38C, and the JBL 2205A. In the case of the Altec driver the \( Q_{TS} \) is too low, but it may be raised by adding a series resistor \( (R_S) \) which should have a power rating comparable to that of the driver. The \( V_{AS} \) of the JBL driver is too low to allow for a B4 alignment, but does allow a C4 alignment with less than 0.1 dB of amplitude ripple. Again, the \( Q_{TS} \) needs to be adjusted with a series resistor.

**How to Build a Box**

Each of the three possible systems uses the same basic enclosure with changes in the length of the vent and the addition of a series resistor being the only variations on the
Invisible Sound
Invisible Sound
Invisible Sound

The ADS 710

An opinion from an expert: The ADS 710 is a three-way bookshelf speaker of acoustic suspension design. It differs from other speakers of that genre in that it is very efficient, and is actually designed for shelf placement. The efficiency is achieved by the use of very strong magnetic assemblies in all of the drivers, substituting two 7” woofers for the more common single, larger unit. The end result is a speaker that has superb frequency response without sacrificing the equally important transient characteristics. The sound of this speaker system is incredibly open and well defined, and the effect is that of listening to music, rather than to a loudspeaker.

- Martin Clifford, Renowned Technical Editor

We couldn't have said it better.

ADS, Analog & Digital Systems
64 Industrial Way, Wilmington, MA 01887
theme. The inside dimensions of the enclosure are $21 \times 33 \times 53$ in. The walls should be made of 3/4-in. (or thicker) plywood. All the joints should be braced with glue blocks and secured with screws and glue. Note the use of the 1 x 4-in. braces. These steps are to insure that the enclosure is free of spurious rattles and resonances. The vent may be constructed of 1/2- or 3/4-in. plywood or particle board.

The enclosure should be lightly lined on three of the inside surfaces (e.g. top, back, and one side) with an absorptive material. The purpose of this material is to control standing waves inside of the box; it is not for the purpose of acoustic damping of the driver. Therefore, the material should be used sparingly and kept away from the driver and the vent. The principle "some is good, so more is better" does not apply in this case.

The first box standing wave will be in the stop band of the crossover filter. A small amount of damping material, together with the action of the crossover, will keep the standing waves from being excited by transient material such as music. In the prototype system, one layer of 1/2-in. thick polyurethane foam, similar to the type used for microphone windscreens, was found to be sufficient.

The front panel should be secured to the enclosure with plenty of screws. A gasketing material, such as Moretite, should be used to seal the joint between the front panel and the rest of the enclosure and to seal the joint between the driver and the front panel.

The Crossover

Unless a huge amount of floor space is available, it is best to use the sub-woofer as a bridged-center speaker. While it is possible to realize a passive network to go between the two power amplifiers, the two main speakers, and the sub-woofer, the inductors and capacitors would have to be very large and very expensive. The author was fortunate to have a spare mono power amplifier and, so, implemented an active crossover. The crossover consists of 3rd-Order Butterworth (18 dB/octave) networks. The reasons for selecting this filter type are beyond the scope of this text. (Author's Note: I wanted to use that line in a paper or article since I was a sophomore in college; I hope the Kindly Editor leaves it in the article. For a good discussion of crossovers, see Ashley & Kaminsky.)

(Kindly Editor's Note: Sure, W.J.J., my pleasure, particularly since my personal favorite line, Baranek's Law, is used later in your paper.) One problem with many active crossovers is transient intermodulation distortion (TIM). The author's preamp and power amps are old TIM-free valve units. Previous attempts to build the filters using monolithic IC amps resulted in very bad "transistor sound." These filters were redesigned using transistor emitter-follower circuits which were TIM-free.

Standard 5% tolerances for the resistors and capacitors are tight enough for a crossover such as this one.

The Results

The prototype enclosure was assembled, and the CTS 15W38C was installed. The frequency response was measured using Keele's nearfield soundpressure method. The response is shown in Figs. 8 and 9. The response of the complete system (Fig. 9) is down 3 dB at 20 Hz which is as theory predicted. The equipment set up used in this measurement is shown in Figs. 10 and 11.

The system distortion was measured using Klipsch's method with the test set diagrammed in Fig. 11. Figure 12 is the plot from the spectrum analyzer. The loudspeaker was radiating two frequencies—f1 of 27.5 Hz (A0) and f2 of 82.6 Hz (E1)—each at a SPL of 95 dB re20 μ Pa measured at 1 m. The

Fig. 9—Microphone placement for Keele's method of measuring nearfield sound pressure.

Fig. 10—Nearfield pressure test set.

Fig. 11—Distortion test set.
Avid makes the differences in speakers clear.

If you're a real stereo buff, you know that flat frequency response means flat, uncolored sound.

Like several other manufacturers, we too try to build the flattest, most linear frequency response we can into our speakers.

But we don't stop there. Because we know that great sound depends on more than just frequency response.

Transient response, for instance.

It's all in your head

To understand transient response, it's important to understand how you hear.

You see, you don't really hear with your ears. You hear with your brain.

For instance, it's the brain that helps you identify what you're listening to. The direction it's coming from. And that re-creates that illusion of "being there."

The thing is, every musical note is really a complex tone. A basic tone—the fundamental—plus subtle musical overtones—harm.

This basic tone, together with all those changing harmonics, is called a transient. The brain takes all of them into account in interpreting any sound the ear receives.

On making things imperfectly clear

It's when a speaker can't react quickly or accurately enough to all those changing musical notes, all those transients, that distortion can occur.

And distortion means muddy-sounding music. With little definition or clarity.

A bad situation made worse when a speaker over-reacts to all those changing tones. The speaker actually adds tones of its own. And that's bad.

Most experts feel the best way to measure transient response is with tone bursts. Pure tones of various frequencies are rapidly switched on and off to simulate the transient nature of voice and instrument signals.

In Pattern A, the speaker hasn't reproduced accurately. It's completely over- or under-reacted to all those changing harmonics. The speaker actually adds tones of its own. And that's bad.

The proof is in the hearing

Now you know there's a lot more to a speaker than just flat frequency response. Like good transient response.

But even the best, most accurate transient response in the world isn't the be-all and end-all of a superb speaker. There's more.

The point is, we're a company that is committed to one thing and one thing only. The design and construction of the clearest, best-sounding stereo speaker systems in their price range.

But you've got to hear for yourself. So go to your hi-fi store and listen to an Avid.

Then some other speaker in the same price category.

Then decide. We don't think you're going to have any trouble at all.

Not only that, musical notes are constantly starting and stopping. When they do, the number and intensity of the harmonics change.

Check No. 5 on Reader Service Card
**ALIGNMENT TABLE**

<table>
<thead>
<tr>
<th>Driver</th>
<th>$f_S$ (Hz)</th>
<th>$Q_{TS}$</th>
<th>$V_{AS}$ (litres)</th>
<th>$f_B$ (Hz)</th>
<th>$l_p$ (in)</th>
<th>$F_3$ (Hz)</th>
<th>$R_s$ ($\Omega$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altec 416-8A</td>
<td>22</td>
<td>0.25</td>
<td>840</td>
<td>22</td>
<td>9.5</td>
<td>22</td>
<td>3.6</td>
</tr>
<tr>
<td>CTS 15W54C</td>
<td>20</td>
<td>0.39</td>
<td>840</td>
<td>20</td>
<td>11.5</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>JBL 2205A</td>
<td>22</td>
<td>0.22</td>
<td>620</td>
<td>19</td>
<td>11.5</td>
<td>20</td>
<td>4.7</td>
</tr>
</tbody>
</table>

$f_S$ is resonance frequency of the driver, $Q_{TS}$ is the total Q of the driver, $V_{AS}$ is the compliance equivalent volume, $f_B$ is the resonance frequency of the enclosure, $l_p$ is the length of the port, $F_3$ is the low frequency cut off, and $R_s$ is the value of the series resistor needed to trim the system.

40 **Conclusions**

The measured response of the system is in reasonable agreement with what theory predicted. So, from that point of view, the project was successful.

Was it worth the trouble? The answer must be a qualified yes. On most program material it is not possible to hear any benefit from the sub-woofer. In this case it is not used, and the smaller main system handles everything.

In the case of electronic music the sub-woofer is, for the author, worthwhile. **Switched-On Bach** and other albums have a wealth of program material in the range of the sub-woofer. Of course, the author may be suffering from the effects of Beranek’s Law:

“...It has been remarked that if one selects his own components, builds his own enclosure, and is convinced that he has made a wise choice of design, then his own loudspeaker sounds better to him than does anyone else's loudspeaker. In this case, the frequency response of the loudspeaker seems to play only a minor part in forming a person’s opinion...” — L. L. Beranek, Acoustics, McGraw-Hill, 1954, p. 208.

**Acknowledgements**

The author would like to thank Mr. Ken Bohleber of CTS of Paducah for his kind assistance in assembling the prototype system and toierating a 600-litre box taking up space in the office/lab which he shares with the author.

Is 20 Hz low enough? How about 12 Hz? The author has designed a system using the same basic enclosure, with a different vent, and a CTS 18W54C. The system has an $f_s$ of 12 Hz. Thrill to the feel of 64-ft. organ pipes, thuder, earthquakes, and other natural disasters! For details, contact the author.

**References**


**Fig. 12**—Plot from the spectrum analyzer.
The ultimate distortion of the T-100's FM section was unequivocally the lowest we have ever measured. To this can be added a really first-rate AM tuner section, the likes of which we have never before encountered in a product of this type."

"There is no doubt that its stereo channel separation and distortion characteristics surpass anything in our previous experience. Its AM frequency response was not only, by far, the flattest and widest we have ever measured on an AM tuner, it is sufficiently free of distortion and noise to make it a truly useful program source even for high fidelity listening."*

Spending more won't buy a better tuner.

The uncompromising quality of Accuphase makes the T-100 AM/FM Stereo Tuner one of the finest available. At any price. No qualifications.

From its unprecedented excellence in performance to its unusually effective multipath meter, the T-100 is truly superb.

Prove it yourself. We've assembled a free 36-page booklet of independent laboratory reports attesting to the superior performance of Accuphase. It's very convincing. But the best way to be convinced is to audition the T-100 yourself. Then you'll understand why the critical acclaim has been as impressive as the product itself.

Accuphase

write: TEAC Corporation of America, 7733 Telegraph Road, Montebello, CA 90640
Doppler Distortion in Loudspeakers

James Moir*

Of the many distortions produced by loudspeakers, the most controversial is probably Doppler distortion, some experts claiming that it does not exist, while others, notably Paul Klipsch and this writer, believe it to be the predominant residual distortion in cone-type systems.

Researchers may theorize for years over the subject of its existence and significance, but actual measurements of the distortion should short circuit much of the discussion, particularly when the argument against its importance is based on unsupported assumptions. This contribution includes such measurements on a variety of loudspeaker systems, many of the measured values having the great additional merit of being taken on the speakers while they are reproducing normal program material, speech and music. In minimizing the use of the standard sinusoidal test signal, it is believed that they set a new approach to the measurement of distortion. A little of the basic theory is perhaps a good start to the subject.

Frequency Intermodulation Distortion

Consider a loudspeaker reproducing two tones having frequencies \( f_1 \) and \( f_2 \) with a frequency ratio of 20 to one, then while the loudspeaker cone is moving towards the listener to reproduce one half cycle of the lower frequency, \( f_1 \), it will simultaneously reproduce 10 complete cycles of the higher frequency, \( f_2 \). While the cone is moving away from the listener on the reverse half cycle of the lower frequency, it will reproduce the second 10 cycles of the higher frequency. This is the classical Doppler situation, the pitch of the higher frequency as heard by the listener being increased as the source moves towards the listener, and decreased as the source moves away from the listener.

An observer listening to a signal frequency, \( f_0 \), from a source moving towards him with a velocity, \( v \), hears the resultant note with a frequency, \( f'_2 \), where,

\[
f'_2 = f_2 \left( \frac{c+v}{c} \right)
\]

and \( c = \) velocity of sound in air. When the source is moving away from him he hears the note as having a frequency,

\[
f''_2 = f_2 \left( \frac{c-v}{c} \right)
\]

The velocity of sound in air is around 1125 ft./s and the velocity of the speaker cone generally below 10 ft./s but dependent, of course, on the frequency and amplitude of the lower frequency. Thus, the maximum change in pitch (frequency) due to the Doppler effect is in the region below 1%. In FM transmission parlance, the Modulation Index (defined as Carrier Frequency Deviation \( \div \) Modulation Frequency) is very low.

When the moving source is a loudspeaker diaphragm executing a sinusoidal motion at the lower frequency while reproducing a high frequency tone, the pitch of the high frequency tone as heard by the listener will vary cyclically between the two limit frequencies quoted above at the frequency \( f_1 \) of modulation, a simple example of frequency modulation. The mathematics of this are well understood, the known result being the appearance of two sidebands, symmetrically disposed about the carrier frequency, \( f_0 \), at frequencies \( f_2 \pm f_1 \) and having amplitudes that are an indication of the extent of the Doppler distortion. It is necessary to differentiate between the value of the carrier frequency shift, \( \Delta f_1 \), measured in Hertz, and the frequency at which the sidebands due to this shift appear. The carrier shift is an indication of the extent of the Doppler distortion, and it is at its acceptable limit when it is only 20 to 30 Hz. The sidebands are always spaced from the carrier at the frequency of the low frequency modulation, \( f_1 \), irrespective of the amount of Doppler distortion, because the carrier frequency deviation is cyclic at this modulating frequency. Measurements of the Doppler distortion are made rather difficult because there is a second form of distortion that produces sidebands at exactly the same frequency as the Doppler mechanism.

Amplitude Intermodulation Distortion

These similar distortions appear when the same two frequency test signal is applied to any device that has a non-linear input/output characteristic. If two sinusoidal voltages, \( V_1 = V \sin (2\pi f_1 t) \) and \( V_2 = \sin (2\pi f_2 t) \), are simultaneously applied to a device having a transfer characteristic represented by the power series,

\[
V_{\text{out}} = a_0 V + a_1 V^2 + a_2 V^3 + \cdots
\]

the output will include in addition to the harmonics of the two test tones, \( f_1 \) and \( f_2 \), two sidebands having frequencies \( (f_1 + f_2) \) and \( (f_1 - f_2) \) with amplitudes in proportion to the coefficients \( a_1 \) and \( a_2 \), etc., in Equation 3. It will be seen that the frequencies of these two sidebands are identical to those produced by Doppler frequency intermodulation but the amplitude of the two sidebands is determined by an entirely different factor, the degree of amplitude non-linearity in the device. The extent of this non-linearity is indicated by the value of the coefficients \( a_1 \) and \( a_2 \) in the power series of Equation 3. The sideband frequencies produced by this amplitude dependent intermodulation are subsequently referred to as the A.I.M. sidebands. These A.I.M. sidebands are produced in loudspeakers by non-linearities in the suspension, non-uniform distribution of the magnetic field in the gap, and at higher frequencies by non-linearities in the cone material and in the magnetic system.

The distortion spectrum that results from applying two separate test frequencies is in the simplest example like that shown in Fig. 1. The two sidebands, \( f_1 \pm f_2 \), have amplitudes that are

the sum of the Doppler and amplitude modulation components, whereas the $f_i \pm 2f_i$ are almost invariably due to amplitude intermodulation alone. The remaining two distortion components are the first two harmonics of the two test frequencies $f_1$ and $f_2$.

It should be remembered that the presence of the amplitude dependent sidebands implies the simultaneous presence of the ordinary harmonic distortion components having frequencies of $2f_i$, $3f_i$, $2f_1$, $3f_2$, etc. These have no equivalent in the frequency intermodulation case, so for equal amounts of distortion power in the Doppler and A.I.M. sidebands, the total distortion power due to the amplitude dependent distortions, the harmonics and amplitude intermodulation components, will usually be much greater than the total distortion power in the Doppler sidebands. The first order intermodulation sidebands having frequencies of $f_i \pm f_1$, due either to Doppler or amplitude intermodulation, are seen to form only a small part of the total distortion power, but their effect in degrading the quality of the sound is not indicated by merely comparing the total power in the amplitude distortion components to the power in the Doppler distortion components. Critics have sometimes based their estimation of the importance of Doppler distortion on a comparison of the respective powers in the distortion products and on this basis come to the conclusion that Doppler distortion is not significant, but this cannot be justified.

It has generally been considered that the amplitude dependent distortions were the prime cause of much of the residual distortion in loudspeakers. Perhaps it should be remembered that it has never been conclusively demonstrated that the addition of the lower order harmonics alone results in any significant loss in sound quality. Thus, violins of unquestionable tonal quality differ markedly in their harmonic structure. The quality deterioration that is evident when harmonic distortion is present in an amplifier or loudspeaker is more reasonably assumed to be due to the sidebands components $(f_i \pm f_1)$, $(f_i \pm 2f_1)$, etc., that inevitably accompany harmonic distortion in a loudspeaker, but do not accompany the harmonics in musical instruments.

**Measurement Technique**

Separate determination of the amplitudes of the amplitude inter-

**Fig. 1—Spectrum of Doppler distortion on a 7-in. loudspeaker.**

**Fig. 2—Block diagram of the two-tone test equipment.**

**Fig. 3—Block diagram of the modified “on program” test equipment.**
modulation and Doppler sidebands has evidently proved difficult if judged by the complexity of some of the techniques that have been used. The technique to be described provides a simple method that not only separates the two sets of sidebands from each other even though they have the same frequencies, but allows the Doppler sidebands produced by the loudspeaker to be separated from the music being reproduced by the same loudspeaker.

Our technique is to insert an amplitude limiter and FM discriminator designed for a carrier frequency of 3 kHz into the measuring system. This particular carrier frequency was chosen as it allows the data obtained to be compared with that obtained by other investigators when assessing the subjective effect of wow and flutter, a very similar form of frequency intermodulation distortion.

The arrangement of the test equipment is shown in the block diagram of Fig. 2. Test signals are provided by two Bruel & Kjaer type 1014 signal generators, adequately decoupled and fed via a Quad type 303 50-watt amplifier to the loudspeaker under test mounted in the open air. The output signal from the loudspeaker is picked up by a Bruel & Kjaer type 4131 microphone mounted on the axis of the speaker at a distance of 1 meter, amplified and then fed in parallel to the 3-kHz limiter and discriminator and to a Marconi type 2330 narrow-band analyzer. Meter $M_1$ checks the amplitude of the two separate input signal components $f_1$ and $f_2$ and the total amplitude of the combined signals, while Meter $M_2$ indicates the amplitude of each of the individual components of the speaker output signal spectrum. The reading of $M_2$ is proportional to the frequency deviation of the carrier $f_1$. This is related to the modulation index, $M$, by the simple relation,

$$ M = \frac{(\Delta f_2 \times f_2)}{f_1} $$

With the narrow band analyzer switched to the output of the microphone amplifier, it will read the rms sum of the amplitude intermodulation and frequency intermodulation components at that particular frequency. When switched to the output of the discriminator, it will read the amplitude of the FM component only. The amplitude of the AM component can be determined by subtracting the FM component from the total. In the first test to be described two sinusoidal tones were used for the investigation, a low frequency signal around 70 to 90 Hz with a high frequency signal of 3 kHz being employed.

**Test Samples**

Three speakers of different sizes were used for the preliminary investigation but the data is typical of many other speakers tested. The choice was biased towards demonstrating the effect of radiator size on the AM and Doppler distortions.

The first unit tested was a 12 in. (30.4 cm) cone speaker covering the full audio range mounted in a ported enclosure having a volume of 3,200 cu. in. The second was an enclosure of 1496 cu. in., using a single 7 in. (17.7 cm) diameter unit to cover the full range. The third was a 4 in. (10.1 cm) diameter unit in an enclosure of 400 cu. in.

All three systems were operated at an on-axis sound pressure level of 85 dB at the modulating frequency $f_1$ of 90 Hz. It is appreciated that this may be a little below the sound level at which the hi-fi enthusiast may operate his system but it enables the perform-

---

**Fig. 4—Doppler distortion on two loudspeakers:**

- 4A (top) with a 4-in. (10.1 cm) and, 4B (bottom) a 7-in. (17.7 cm) speaker.
They wrap the sound around you.

Most unusual speakers. You can listen anywhere in the room and hear the same stereo image. No other speakers to our knowledge, can do that for you.

With conventional speakers you have one "ideal" position from which to hear maximum stereo imaging. Move out of that position and the stereo image changes: the music sounds different.

Not so with B.E.S. Geostatic™ speakers. Because they're omnipolar there is no "beaming", they spread all frequencies in all directions. So no matter where you are in a normal reflective room you hear the identical stereo imaging: the illusion of "live" three-dimensional depth.

How is it done? The new Bertagni technology -- 22 U.S. and world patents eliminate directional cone drivers and bulky enclosures. (B.E.S. speakers are only 3½ inches thin.)

You must hear them. Wrap your arms around a pair of Geostatic speakers and take them home (any B.E.S. dealer will let you). Listen in your own room.

Then hear what happens.

The New B.E.S. Geostatic Speakers

You've never heard omnipolar sound before.
10 sound reasons to buy our new receiver.

Plus its sound.

Sony's new, more powerful STR-6800SD receiver should get a warm reception. Because it not only looks different from other receivers, it is different. It has some features found in more expensive separate components—and other features found nowhere else at all.

1. The most-used controls all in one place. Electronically, it would have been convenient for us to scatter the level control, tuning knobs and input and tape selectors all over our receiver. Instead we grouped them in the upper right-hand corner—so they're convenient for you.

2. A dial pointer that doubles in length when it's close to a station. Together with the signal strength meter and the center channel meter, this Sony innovation constitutes a system that helps you tune faster and more accurately.

3. A muting switch—great if the phone rings. Flick it down and volume drops. Flick it back up and volume goes back up to where it was. And this muting switch is right where it should be—right next to the level control.

4. A stepped level control to keep both channels equal. It guarantees unprecedented accuracy—to within 1/2 db instead of 1 db. And it guarantees it over the whole volume range instead of just in mid-volume.

5. MOS FET front end electronics unitized tuning. The 4-gang tuning section and all its associated electronic parts are mounted on one sub-assembly. So temperature differences don't affect these circuits—the receiver tunes the same whether it's cold or warmed up. And, with MOS-FET, the receiver has a very wide dynamic range.

6. Dolby noise reduction system. As more and more stations broadcast in Dolby, you can really use a Dolby system. And ours has a definite advantage: Instead of being an optional extra, it's built in—operated from the front panel.

7. Phase locked loop. It gives you greater stereo separation and less distortion.
LEC (low emitter concentration) transistor. This piece of advanced design in the preamp phono stage assures you tight RIAA equalization plus low noise, low distortion and a wide dynamic range. It's a Sony exclusive.

An acoustic compensator for easy control of highs, lows and middles. A conventional loudness control only lets you boost bass. Our acoustic compensator has three positions: For true loudness compensation, for bass boost and for mid-range presence.

Sony's most powerful receiver. It delivers 80 watts minimum RMS continuous power per channel at 8 ohms from 20 Hz to 20,000 Hz with no more than 0.15% total harmonic distortion. It has a direct-coupled power amplifier with true complementary symmetry output stages.

And more. To these specifications (remember we state them conservatively), add Sony's proven reliability. And you get a receiver that produces a sound that'll make you understand why you have ears.

That's the STR-6800SD at $500. Or, for less power and a few less features— but no loss of fidelity—the STR-5800SD at $400 and the STR-4800SD at $400 (all suggested retail prices).

A sound investment.
ance of the three systems to be compared at the same sound level without grossly overloading the smaller units. In all cases the level of the lower frequency, \( f_0 \), was varied over a range sufficient to confirm the expected relation between sound pressure level and distortion.

**Test Data**

The 4-in. diameter unit happened to be the first to be measured, and the result was rather surprising for the calculated values of Doppler distortion agreed almost exactly with the values measured by the analyzer, the sideband amplitudes being the same when the analyzer was connected either to the output of the microphone amplifier or to the output of the discriminator. This implies that all the \((f_0 \pm f_s)\) sidebands were due to Doppler distortion and that the amplitude intermodulation contributed little to the total amplitude of the sidebands. Our initial surprise led to some very careful rechecking of the whole measuring system and of other speakers, and we gradually came round to the obvious conclusion that practically all the intermodulation distortion in small units was due to Doppler.

Data on three systems is contained in Table 1 from which it will be seen that when using a speaker with a cone diameter of seven inches, the Doppler intermodulation distortions exceeded the amplitude intermodulation distortions at the same frequencies by 16 dB, confirming the theoretical prediction that when operated at the same acoustic power level small speakers produce more distortion than do large speakers. The oft repeated claim that a small cone performing a large excursion is just as good as a large cone executing a small excursion is seen to be an oversimplification of the situation. The acoustic signal “knows” whether it has been radiated by a small loudspeaker or a large loudspeaker. It should be emphasized that the use of “long throw” units with very flexible linear surrounds is no solution to the Doppler distortion problem, though their use does minimize the amplitude dependent intermodulation distortions.

It will also be seen that in typical units having cone diameters less than about 12 inches, the Doppler distortion sidebands greatly exceed the amplitude intermodulation sidebands. As the previous discussion shows that these Doppler distortion components have the same frequency as the distortion components due to amplitude intermodulation, it is apparent that in the typical units tested Doppler distortion is a more serious cause of sound quality degradation than is amplitude intermodulation, quite contradicting the generally held view.

However, the interesting aspect is the possibility of measuring the Doppler distortion while the loudspeaker is reproducing program material. Two-tone testing, using sine wave signals, produces accurate data that applies in the test conditions, but it requires a semi-arbitrary choice of the test tone frequencies and their relative amplitudes. Even with this infor-

![Image 5](Image)

**Fig. 5**—Doppler distortion comparisons between 5A (top) a 12-in. loudspeaker and, 5B (bottom) an electrostatic speaker.

---

### Table 1—Intermodulation Distortion in Typical Speaker Systems.

<table>
<thead>
<tr>
<th>Cone Diameter (in.)</th>
<th>Amplitude (dB)</th>
<th>Frequency (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-40</td>
<td>-16</td>
</tr>
<tr>
<td>7</td>
<td>-41</td>
<td>-25</td>
</tr>
<tr>
<td>12</td>
<td>-43</td>
<td>-41</td>
</tr>
</tbody>
</table>

---

*AmericanRadioHistory.Com*
Micro-Acoustics 2002-e cartridge.
Because good tracking isn't enough.

Tracking is just the beginning.
While good tracking ability is vital, it's only an indication of how well the stylus keeps contact with record grooves on louder, harder-to-follow passages, at stylus pressures low enough to minimize wear. But surprisingly, tracking ability tells almost nothing about how well a cartridge reproduces most musical sounds.

Transient ability is just as important.
After all, transients are what music is made of: sudden start-and-stop bursts of sound at all frequencies. From the attack of a low organ note to the bite of a plucked string. Transient information is essential to differentiate the sound of one instrument from another, and in stereo, to localize instruments in space. That's why, without good transient ability, no cartridge can reproduce music with really lifelike clarity.

Until now, it was simply one or the other.
Tracking or transient ability. Popular high-compliance cartridges, on the one hand, offered good tracking ability and low record/stylus wear, but sacrificed transient ability. And low-compliance cartridges provided good transient ability at the expense of tracking ability and increased wear.

A new technology.
Micro-Acoustics, the world's leading manufacturer of record-mastering styli, has combined for the first time superb transient and tracking ability. In the radical design of the 2002-e (patent pending), direct-coupled electrets and critical damping provide optimized transient ability as shown in the graph. While an ultra-low-mass beryllium stylus bar and high-compliance dual-bearing suspension provide maximum tracking ability at 1 gram, for lowest possible record and stylus wear.

Transient ability best defines how accurately a cartridge can reproduce a musical burst at different frequencies. (Note that the 2002-e’s results are independent of cable capacity!)

A simple way to convince yourself.
Micro-Acoustics has prepared a unique demonstration record to help you evaluate and compare cartridge transient and tracking ability. Just send $3.50, and we'll mail you a record postpaid. For free information and the name of your nearest dealer, just complete and return the coupon.
mation, it is necessary to decide whether these conditions are relevant when reproducing music. It occurred to this writer that it should be possible to measure the extent of the Doppler distortion while the loudspeaker was actually reproducing music, the technique being as follows:

The block circuit diagram is shown in Fig. 3, a modified form of the current shown in Fig. 2. A flutter-free, 3-kHz test signal is inserted in the music program by inserting a notch filter tuned to 3 kHz into a suitable point in the output of the tape recorder to attenuate the 3-kHz components of the music, and replacing these with a 3-kHz, flutter-free tone from a suitable signal generator. The amplitude of this test tone is held constant at some suitable value.

When the music is being reproduced, the tone excursion due to the low frequency components of the music Doppler modulate the 3-kHz test signal in just the same manner as they modulate any high frequency component of the music. The loudspeaker output signal derived from the microphone is then passed through a band-pass filter that eliminates all the frequencies except those in a narrow band centered on 3 kHz and including the Doppler modulated 3-kHz test signal. This narrow band is then passed through the 3-kHz demodulator and the amplitude measured by a suitable meter and chart recorder.

To obtain simultaneous recordings of the signal and the consequent distortion, the chart recorder was switched to the output of the microphone and a standard piece of music replayed from a professional 15 ips tape recorder. This produced the top trace on the charts, as shown. The chart and tape were then rewound and the music repeated with the chart recorder connected to the FM discriminator output. This produced the lower trace showing the variation in the Doppler distortion as the signal amplitude varied.

Figures 4, 5, and 6 illustrate some of the information obtained on several speaker systems including several very expensive enclosures. The curves of Figs. 4A and 5A illustrate the results obtained using 4-in. and 12-in. diameter units in suitable enclosures, and it will be seen that Doppler distortion in the smaller unit is about five times higher than the 12-in. unit.

No self-respecting designer would rely today on a single unit to cover the whole audio band, and two, three, and four unit assemblies are the common solution to the problem of obtaining a wide overall frequency response. It is often claimed that this division of responsibilities is also a solution to the Doppler distortion problem, but the curves of Fig. 6 show that this is not necessarily true.

Figure 6B is an indication of the performance of an expensive three unit system with a sub-optimum choice of changeover frequencies and crossover network design. It will be seen that the performance is little better than that of a single 12-in. unit, at least in respect of Doppler distortion, the Doppler distortions being some 30 dB below the level of the 3-kHz test tone. That a multiple unit system can be a solution is indicated by the curves of Fig. 5B taken on a well-known, wide-range electrostatic speaker system. The Doppler distortions are seen to be about 45 dB below the test tone level, some 15 dB better than the expensive 3 unit system of Fig. 6B.

Significance of Doppler Distortion
That Doppler distortion does occur can hardly be disputed in view of these and similar results published by
PART TWO:  THE END OF THE DOUBLE STANDARD.

In the frequency range where you find most music, our least expensive speaker offers virtually the same flat frequency response and freedom from distortion as our most expensive speaker.

Until recently, you could consider the selection of speakers an act of faith. Because of the lack of industry standards and the resulting confusion in the marketplace, the speaker buyer had to depend almost totally on personal taste and subjective evaluation.

But no longer. At Yamaha, before we designed a new line of speakers that would equal the revolutionary standard of our electronic components, we first defined its frequency response.

High accuracy across the musical spectrum. One of the few objective criteria for rating speaker performance. Then we proceeded to make all Yamaha speakers to a single revolutionary standard of accuracy:

A frequency response curve that varies by no more than ±3dB from 100 Hz to 15,000 Hz. With typically no more than 1% harmonic distortion.

But in the frequency range of all our speakers extends well below 60 Hz to beyond 15,000 Hz, why do we even bother mentioning this fact?

Because, with the exception of the very deepest rumblings of a pipe organ, all music is produced within this range. In fact, few if any commercially available stereo pressings have frequencies below 100 Hz and above 15,000 Hz.

Yamaha's success in achieving a single standard of accuracy in all our speakers is confirmed in the chart above.

Unlike the frequency response curves of other speaker manufacturers which indicate unnatural booming in the bass, added sparkle in the treble, and extreme loudness level variations of as much as 10 dB, Yamaha's response curves show a relatively straight line, which indicates uncolored, natural sound.

Yamaha's musical heritage.

Yet, in spite of Yamaha's objectivity in design, the perception of sound remains subjective.

That's why Yamaha speakers aren't designed to meet objective standards alone, but to meet a higher standard: the ears of the people who make Yamaha's world famed musical instruments. 

Yamaha's frequency response curves were taken over this range where you find most music, our least expensive speaker offers virtually the same flat frequency response and freedom from distortion as our most expensive speaker.

Since 1987, Yamaha has been making some of the finest musical instruments in the world. Pianos, organs, woodwinds, guitars, and brass.

With our musical instruments, we've defined the standard in the production of fine sound. And now, with our entire line of speakers and electronic components, we've utilized not only our studio engineers, but also our musical instrument designers to define the standard of music reproduction.

It's called Natural Sound. And it's totally unique to Yamaha.

Five different speakers, built to one standard.

Yamaha offers five different speaker models, ranging in price from $1,350 a pair down to $200 a pair.

At the top, the revolutionary beryllium dome NS-1000 Series, offering the ultimate in state of the art performance. Following the NS-1000 are our other three way types: the NS-690, NS-670, and NS-3. Our least expensive, but still highly accurate, is the two-way, NS-2.

Since each is built to the same high quality standard, you're probably wondering what those extra dollars are buying.

It's very simple. To satisfy the most demanding audiophiles, those extra dollars buy extended response at the frequency extremes. Higher sound levels with equal or lower distortion. More power handling capability. More tone controls to contour the tonal balance of the speakers with the characteristics of the room.

More specifically, on our model NS-670 and above, Yamaha offers die-cast speaker frame baskets to eliminate potential resonance. Luxurious wood enclosures (even rare ebony wood!). Tangential-edge suspension for midrange and tweeter domes to provide smooth response. Acoustic equalizers on tweeters to flatten frequency response and enhance dispersion. Diagonally edge wound voice coils for greater diaphragm control and increased transient response. Plus thick felt lining inside the cabinet to isolate rear sound waves for distortion-free bass response.

But regardless of how much you pay, every Yamaha speaker is built to the same essential construction criteria and tonal accuracy.

Proven acoustic suspension design. Dome drivers for better high frequency dispersion. Carefully matched crossover networks. And heavily reinforced, extremely rigid enclosures.

The End of the Double Standard.

The single standard of performance found throughout the entire line of Yamaha speakers is a demonstration of product integrity that no other manufacturer can claim.

But in the final analysis, only your ears can be the judge.

That's why we invite you to visit your Yamaha audio dealer soon. His knowledgeable salesmen and extensive demonstration facilities can save you time and trouble in selecting the speaker that's right for your budget. And right for your ears.
Klipsch, but it is more difficult to decide on the significance of the distortion when it occurs in a loudspeaker. It is clearly unreasonable to claim that it is less important than amplitude intermodulation distortion where the measurements show that the intermodulation sidebands produced by Doppler are of greater amplitude than the amplitude intermodulation sidebands at the same frequency that results from non-linearity in the loudspeaker.

We attempted a separate assessment with a small listening crew. The Doppler sidebands in the 3-kHz region were removed from a recording by suitable filters and tape recorded. Amplitude dependent sidebands in the same frequency band were similarly obtained by filtering the output of a slightly overloaded amplifier playing the same piece of music. The two sets of recorded side bands were then compared while being replayed at the same loudness level. Both observers were agreed that the Doppler sidebands were more annoying than an equal percentage of the amplitude intermodulation sidebands. That they should be more annoying than an equal percentage of amplitude intermodulation distortion is rather surprising and no explanation is offered, but the result is recorded for later consideration.

Some lower key confirmation was provided by a review of some earlier tests. Several months before the commencement of the investigation, three good loudspeaker systems had been subjectively compared and ranked by two observers. Some months later when the Doppler measuring equipment had been assembled, the three systems were objectively assessed. It was then found that the earlier subjective ranking in respect to "roughness" agreed exactly with the later objective ranking in respect of Doppler distortion. By that time both observers had considerable experience in recognizing Doppler distortion in a loudspeaker and they agreed that the "roughness" commented on many months earlier was indeed due to Doppler.

Though we have not had an opportunity of objectively assessing the Doppler distortion content of a good horn-type loudspeaker, we believe from simple listening tests that their characteristic clarity is largely due to the absence of Doppler distortion. The same comment can be made about the performance of the wide-range electrostatic loudspeaker.

Bibliography


The writer's interest in the subject was aroused in 1947 when investigating the performance of horn loudspeakers for use in cinemas. In January, 1967, Hi-Fi News published a series of test results on typical loudspeakers, and in 1970 the author presented a paper at the AES Convention in New York describing the technique for measuring Doppler distortion in loudspeakers while the speaker was reproducing music and speech. This was updated in a contribution to Wireless World for April, 1974, and is again up-dated by the present paper.

Anatomy of a ¼" tape recorder

Automatic shut-off

Hysteresis three-motor drive

Electro-magnetic braking prevents tape spillage

Rugged Neoprene head mount for good alignment

Heavy, 3/16" plate for good alignment

Pressure brush improves contact

Plug-in electronics Remote record for no-thump recording

10" NAB reels (or 5" or 7" standard)

Only seven moving parts

One-piece, 4½ pound flywheel-and-capstan

Computer logic permits any command sequence

Remotable

Two channel record/playback capability. (Other models with four, two or one channels; ¼, ½ or full track; playback only. Extra performance options available.)

Compare all the features of the Crown CX-824 with any other reel-to-reel recorder you may be considering. And then compare the price. Crown represents the real value.

Fast playback coupon Send directly to Crown for specifications on Crown tape recorders.

When listening becomes an art,

CROWN

Box 1000, Elkhart IN 46514

Check No. 9 on Reader Service Card

A-5
Not everyone can sell you a receiver that looks as good as this.

The RS4744 is the top stereo receiver in our line. And we think it looks good from any angle—value, performance and specs.

Audio magazine said ‘...we note that most receivers in this price range offer less power (usually 50 or fewer watts per channel) and don’t have as many control features as this top-of-the-line entry from Sylvania.’

But, don’t just take other people’s word for it, check the specs out for yourself.

Power output of 60 Watts min. RMS per channel at 8 ohms from 20 Hz to 20 kHz with no more than 0.25% total harmonic distortion.

Three wide-range tone controls that let you tailor bass, mid-range and treble response to your speakers, room and ears.

Active high- and low-cut filters that have a sharp 12 dB/octave slope to reduce noise and rumble with minimum effect on music.

In the tuner section, you’ll find features such as a phase-locked loop for long-term stability. An IHF sensitivity of 1.8 µV and a 3.0 µV level for 50 dB quieting.

And the front panel doesn’t get by on just its good looks alone. Its functionally designed pushbutton bank puts a wide range of control capabilities right at your fingertips for mode selection, scratch and rumble filters, three-stage FM muting and loudness control.

Listen to the RS 4744 at your Sylvania dealer’s today. You’ll find its specs sound every bit as good as they look.

GTE SYLVANIA

Check No. 15 on Reader Service Card
McKay Dymek AM-5 AM Tuner and DA-5 AM Antenna

MANUFACTURER'S SPECIFICATIONS

AM-5 Tuner

Sensitivity: 3 µV for 10 dB S/N.

AGC Characteristics: Less than 6 dB output variation from 10 µV to 10 mV r.f. input level. R.F. Bandwidth –3 dB: Narrow, 6 kHz; Wide, 20 kHz. Image Rejection: 70 dB.

Adjacent Channel Rejection: 70 dB.

I.F. Rejection: 45 dB.

Frequency Response: Wide, 15 Hz to 9 kHz, –3 dB.

THD, 1 kHz Modulation: 0.5% at 30% mod.; 1.0% at 50% mod.; 1.5% at 80% mod.

Audio Output: 1 V rms, (5000 Ohm output). Power Requirements: 110-120/220-240 V/a.c., 50/60 Hz, 30 watts. Net Weight: 8 lbs. (3.97 kg). Dimensions: 17 in. (44.5 cm) W x 3 3/4 in. (8.9 cm) H x 10 in. (25.4 cm) D. Suggested Retail Price: $295.00. (Also available with balanced 150-600 Ohm output at extra cost. Supplied with wood ends or 19-in. rack mount.)

DA-5 Antenna

Frequency Range: 540 to 1600 kHz.

Output Impedance: 50 Ohms.

Sensitivity Adjustment Range: 40 dB.

Type: Tuned preamplifier with shielded ferrite loop.

Ferrite Rod Dimensions: 12 in. (30.5 cm) L x 3 3/4 in. (1.9 cm) diameter.

Overall Dimensions: 13 3/8 in. (34 cm) W x 9 1/16 in. (23.3 cm) D x 11 in. (28 cm) H.

Weight: 6 3/4 lbs. (3.06 kg).

Suggested Retail Price: $175.00.

Before everyone experiences a collective deja vu, let me reassure you all that, yes, you have seen a pair of similarly configured McKay Dymek products in Audio magazine before. The McKay Dymek AM-3 tuner and DA-3 antenna were tested and reported on in the December, 1974 issue of this publication. While we do not know what ever happened to (or if there ever were) AM-4 and DA-4 McKay Dymek models, we can attest to the fact that the AM-5 and DA-5 units tested here represent more than just a cosmetic change and a price increase (the AM-3 used to sell for $255.00, while the antenna sold for $155 in its earlier version). As impressed as we were with the old AM-3, we are happy to advise all you AM fanciers that the AM-5 is even better. Specifically, the AGC circuit is “tighter” and frequency response is actually somewhat more extended than before. But perhaps we’re getting ahead of ourselves (particularly for newer readers of Audio who may have missed the earlier reports). Countering the trend towards mediocre AM circuitry normally found in high fidelity components, George McKay of Pomona, California introduced the Dymek tuner (originally built overseas) to the AM-DX buffs of

AmericanRadioHistory.Com
America a few years ago. They welcomed it enthusiastically, confirming what they had long suspected: that AM radio can be hi-fi if a proper receiver is used and if AM radio stations take the trouble to lease high-fidelity telephone lines between studio and transmitter. Inspired by this early success, McKay now manufactures the latest version of the tuner (the currently tested AM-5) and the unusual DA-5 AM indoor antenna in the United States.

The newest version of the tuner looks very much like the high fidelity component it is. The black metal panel, framed at each end by attractive teak wood end panels, has a long, well-calibrated (if dimly illuminated) dial scale, large tuning knob, and signal strength “S” meter along its upper half. The lower left section of the panel has five rectangularly shaped metal push-buttons which turn power On and Off as well as select distant or local reception (in the local position, 30 dB of attenuation is inserted in the antenna input circuitry) and between wideband or narrow band operation of the i.f. filter.

The back panel of the AM-5 has a single output jack (Yes, Virginia, AM is still mono.), a phono-jack type AM antenna connector (for connecting a coaxial type “lead-in” wire), a pair of screw terminals for single wire antenna and ground connection, an output level control, and a pair of convenience a.c. receptacles. A slide switch permits changeover from 120- to 220-V power lines, and a line fuseholder is also located on the rear panel. The “covered over” area seen in Fig. 1 obscures the area which would contain the 150-600 Ohm balanced output option.

Construction and Circuitry

Figure 2 shows the internal layout of the AM-5 chassis. Five separate circuit board modules are used (r.f., i.f., power supply, antenna, and function selection), with a sixth added for the balanced output option (not present in our sample). A block diagram of the circuit is reproduced in Fig. 3. Following the antenna input is a dual element band reject filter to eliminate any incoming 455 kHz (i.f. signal). The switchable 30-dB attenuator (for “local” reception) comes next. A three-gang tuning capacitor is used, as are junction field effect transistors in the entire r.f. section. Cascade JFETs are used in the i.f. section, as are two ceramic ladder filters used to provide the switchable selectivity (wide and narrow bandwidth). Two double-tuned i.f. transformers also aid in establishing desired i.f. response. Separate detectors are used for audio and AGC circuits, with the former circuit employing a hot carrier diode detector. AGC voltage is derived through envelope detection and is carefully filtered before application to preceding stages. A sharp 10-kHz notch filter is included within the feedback loop of a pair of ICs in the audio section to provide 30 dB of rejection of heterodyne beats that might be caused by adjacent carrier signals. Dual polarity supply voltages are regulated by an IC.

Laboratory Performance Measurements

While existing HF measurements standards do not recognize the “10 dB S/N” sensitivity figure published by McKay Dymek, we confirmed this measurement, obtaining 10 dB of S/N for only 2.7 µV of signal applied. Using the more conventional sensitivity measurement technique, an input signal of 14 µV (at 30% modulation) was required for a 20 dB S/N + THD ratio. Ultimate S/N with strong signals was better than 53 dB. Audio output level was extremely uniform at all signal strengths above 100 µV and was “down” only 5 dB at 10 µV input signal strength, a measure of the outstanding AGC characteristic of the AM-5. It should be noted that the sensitivity measurement was made with the “narrow” set-mode.

Fig. 1—Back view of the AM-5 tuner.

Fig. 2—Internal layout of the tuner.

Fig. 3—AM-5 block diagram.

AUGUST, 1976
Fig. 4—Frequency with tuner set to "wide" bandwidth.

Fig. 5—Linear sweep from 7.5 kHz to 12.5 kHz shows steep rejection capability of 10 kHz "whistle" filter.

Fig. 6—Frequency response with tuner set to "narrow" bandwidth position.

ting of the i.f. section. In the wide setting, sensitivity is understandably somewhat lower. I.f. rejection measured exactly 45 dB as claimed, while image rejection was better than claimed, measuring 83 dB. Distortion, though a bit higher than claimed at the 30% modulation level (0.7% as opposed to 0.5%), behaved nicely at higher modulation levels, with 1.1% THD at 50% modulation and 1.6% at 80% modulation levels.

Perhaps the most outstanding feature of the AM-5 is its uniform frequency response all the way out to 9 kHz (in the "wide" position of bandwidth). This capability is best illustrated in the spectrum analysis 'scope photo of Fig. 4. Note the action of the 10-kHz "whistle filter" in this trace. The filter's notch is not properly or adequately depicted in this trace because of the relatively fast sweep rate and the logarithmic sweep used for frequency response plots on the analyzer. By slowing down the sweep and altering it to a linear sweep covering only the range from 7500 Hz to 12,500 Hz (500 Hz per division, horizontally), we were able to obtain the photo shown in Fig. 5 which shows some 40+ dB notch capability of the steep notch filter at 10 kHz.

An additional response measurement was made in the Narrow bandwidth mode of the tuner, and results are presented in Fig. 6. Even at this reduced bandwidth setting, response is still quite flat to beyond 5 kHz (probably better than that obtained on typical AM sections of most stereo receivers and tuners). As reported in our earlier test of a McKay Dymek tuner, our local full-fidelity AM station is still pumping out wide-range audio programming—a fact that we could only appreciate by listening to it with a tuner such as this McKay AM-5. If you are fortunate enough to be near an AM station that also broadcasts wide frequency response (or even if you are relatively far from one, since the AM-5 will receive stations that are further away than you would believe), the AM-5 may shed a whole new light on the capabilities of AM broadcasting. I know you will find this hard to believe, but a newsletter sent out by the McKay Dymek company contained a letter from an AM-DX'er who actually claims to have picked up the broadcast band transmissions of Radio-France Inter (not short wave, broadcast band) at 1554 kHz on his receiver, using an older version of the McKay Dymek antenna (the previously reviewed DA-3), so let's go on to discuss this second product from McKay Dymek.

The DA-5 from McKay Dymek seems to have undergone fewer changes than the AM tuner just discussed. It still has the rotatable ferrite shielded loop on top and the small box below containing a two-stage FET preamplifier which is tunable by means of a calibrated dial over the standard AM broadcast range of frequencies. A sensitivity control varies the gain of the system and a power On/Off switch (which also makes a direct-through connection to your existing outdoor AM antenna if you have one connected to your AM set) are the only other controls provided on the DA-5. Since it does contain amplifying components, it needs to be connected to a power source (either 120 or 220 volts a.c., 50/60 Hz) but consumes a mere 2 watts in use. Choice of power source voltage is made by means of a small switch on the rear panel.

Obviously, the DA-5 can be used with any AM tuner or receiver that has a terminal for connection of an external AM antenna. Equally obvious is the fact that this device cannot improve the fidelity of your present AM equipment but it certainly can and does improve overall sensitivity as well as selectivity (because of the extra stages of tuning provided ahead of your normal antenna input). Because the ferrite rod can be rotated or tilted in almost any direction, you will
The Beogram 4002. If music in your home is important to you, it should begin here. The Beogram 4002 is a fully automatic turntable which exhibits a level of creativity and engineering skill unequalled in the field of audio components. Its tangential tracking permits the record to be played back in exactly the same manner that the master disc was cut. Electronic logic circuits, activated by a single light touch on the control panel, automatically select the record size and correct speed, cue the stylus, and turn off the unit when the selection is finished. Furnished with Bang & Olufsen's finest cartridge, in itself an acknowledged masterpiece of audio engineering. A full color brochure presenting all of Bang & Olufsen's audio components is available upon request.

Rarely has technology served music so well.

Bang & Olufsen

Bang & Olufsen of America, Inc., 515 Busse Road, Elk Grove Village, Illinois 60007

Check No. 6 on Reader Service Card
probably find (as we did) that man-made noise can be substantially reduced when listening to AM. We were not able to make specific measurements of the "gain" of the DA-5 system, since that would have required a calibrated, known field of microvolts per meter. We are, however, reproducing a curve provided by the McKay Dymek people (Fig. 7) which represents the output delivered by the DA-5 to a 50-Ohm load over the entire broadcast band of frequencies when in the presence of a 1000 microvolt-per-meter field strength. Used in conjunction with the AM-5 tuner, this pair of products will provide you with AM reception second to none. Perhaps the most fitting way in which to summarize this report might be to quote, verbatim, the final paragraph of our earlier, 1974 test report concerning the antecedents of this current pair. The words fit even better, now.

"Certainly, the limitations imposed by AM broadcasting techniques in general may discourage a great many audio buffs from rushing right out to spend $295.00 (sic) for the AM-5 (sic) or even $470 (sic) for the combination of DA-5 and AM-5 (sic). For those who enjoy AM-DX'ing, and for those fortunate enough to be served by an AM station that does broadcast wide response audio (a phone call to your favorite station's chief engineer should provide you with the needed information), here at last is a pair of products that successfully concentrates on good AM performance."

Incidentally, McKay Dymek products are sold through mail order only. You can call a toll-free number (800-854-7769 nationwide, 800-472-1783 in California) or write directly to McKay Dymek Co., North Park Avenue, Pomona, CA 91766 if you are interested in obtaining further information about these unusual products.

Leonard Feldman

Check No. 90 on Reader Service Card

Audio Classified Ads

Want to buy, trade or sell components? Want to offer or buy a service? Want a job in the audio field? Your ad belongs in Audio. Rates are low—results high.

RATES: Commercial, 60¢ per word; situation wanted or non-commercial, 35¢ per word. We reserve the right to determine classification as commercial or non-commercial. Payment must accompany all orders.

Place your ad today!

Send copy to:
Audio Magazine
401 N. Broad Street,
Philadelphia, PA 19108
Attn: Classified Dept.
Reintroducing A World Standard...

CBS Laboratories' STR Professional Test Records

For over ten years, the original series of these high-precision test records has set a standard for the audio industry. Now the new series sets an even higher standard. It's been revised, recut and expanded.

The new series consists of eight records for professionals and one for non-professional audiophiles.

Each record contains a complete series of easy-to-use tests to help you rapidly and accurately evaluate components and systems. Even one of these records can eliminate the need for costly, additional equipment. Each will find productive use and save you hours in the laboratory, on the production line and in field testing.

Take a look at what this essential testing series contains:

SEVEN STEPS TO BETTER LISTENING—For only $6.98, you can improve your system with CBS Laboratories' "Seven Steps to Better Listening." This high-precision test record equips you for years of use. Included is a detailed 16-page booklet by Audio's Edward Tatnall Canby explaining how to use the record to improve the performance of your system. With the record you can perform the following "ears alone" tests: left-right identification, phasing, loudspeaker balance, tone control setting, alternate phasing, buzz and rattle elimination, lateral tracking, and vertical tracking.

★STEREOPHONIC FREQUENCY TEST RECORD STR 100 Designed for the evaluation of pickups and systems. Provides a constant amplitude, characteristic below 500 Hz and a constant velocity characteristic above 500 Hz. Tests include: Sweep Frequency—w/ a graphic level recorder, Spot Frequency—w/ voice announcements; Channel Separation: Wavelength Loss and Stylus Wear—to pinpoint oversize or worn-out stylus, and excessive pickup tracking force; Compliance; Phasing; Vertical and Lateral Tracking: Tone Arm Resonance—to check system performance at low and subaudible frequencies and thus reveal undamped resonance which may cause equipment overloading.

★SQUARE WAVE, TRACKING AND INTERMODULATION TEST RECORD STR 112 Enables detailed study of tracking capabilities of stereophonic phonograph pickups. The square wave modulation allows a rapid appraisal of stylus-tip mass, damping, and tracking. Low frequency compliance and tracking are determined by means of 300-Hz bands of progressively increasing amplitude. Intermodulation distortion measurements are made possible by graduated 200-Hz intermodulation test bands. The Str 112 has been cut with vertical angle approximating 15°, which is representative of current recording practice.

★BROADCAST TEST RECORD STR 151 Developed especially to meet the needs of broadcast engineers, audiophiles, and other professionals seeking a convenient signal source for the testing and adjustment of broadcast audio equipment. Tests include: phonograph pickup response and sensitivity, surface noise at 33 1/3, 45 RPM, wow and flutter, rumble and hum detection, ballistic test of V.U. meters and many others.

★RIAA FREQUENCY RESPONSE TEST RECORD STR 130 Provides RIAA frequency characteristics for the calibration of professional recording equipment and for testing the response of professional and consumer record reproduction equipment. This record is suitable for use with a graphic level recorder to provide permanent, visible records for precise evaluation. Spot frequency bands for use without automatic equipment are included.

★RIAA PINK NOISE ACOUSTICAL TEST RECORD STR 140 Designed for acoustical testing of systems and loudspeakers and for psychoacoustic tests on reproduction equipment. With the STR 140 it becomes possible to test loudspeakers in the room in which they will be used. Spot frequency tones with voice announcements facilitate the testing procedure. Continuous glide-tones in oversize bands of frequency range from 30 to 15,000 Hz and are synchronized with a graphic level recorder.

The original series has been unavailable for many years. Quantities of the new and improved series are also limited. So make sure you have perfect copies on hand for years to come by ordering duplicates. Fill out and mail the coupon now for immediate action.

Only a limited quantity are available. Be sure to order enough for many years of use.

Send me the following test records:

☐ Seven Steps to Better Listening (STR 101) $6.98 each. Quantity

☐ Stereophonic Frequency (STR 100) $10.00 each. Quantity

☐ Square Wave, Tracking and Intermodulation (STR 112) $15.00 each. Quantity

☐ Wide Range Pickup Response (STR 120) $15.00 each. Quantity

☐ RIAA Frequency Response (STR 130) $15.00 each. Quantity

☐ RIAA Pink Noise Acoustical (STR 140) $15.00 each. Quantity

☐ Broadcast test (STR 151) $15.00 each. Quantity

☐ 318 Microsecond Frequency Response (STR 170) $15.00 each. Quantity

☐ Quadraphonic Test (SOT 1100) $15.00 each. Quantity

SEND TO:
AUDIO TEST RECORDS
401 N. Broad Street
Philadelphia, Pa. 19108

Amount Enclosed $ (Payment must accompany order)

Name ________________________________

Address ________________________________

City ____________________________ State ______ Zip ______

AU 8/76
The Duntech DL-15 is a three-way loudspeaker system. It is heavy (47.63 kg), and it is big (82 cm high, 59 cm wide, and 45 cm deep). It is one of those loudspeakers whose reproducing position in your home you should try to determine before you take delivery. The intent of this loudspeaker system is producing extremely high quality sound with no sacrifice of performance for ease of handling.

The enclosure is walnut finished and has black grille accenting the front and upper sides. A 381 mm (15 in.) woofer is used to cover the frequencies from below 40 Hz to a crossover of 350 Hz. A 127 mm (5 in.) midrange speaker covers the range from 350 Hz to 4 kHz, and a 445 mm (1 ¾ in.) tweeter takes over for frequencies above 4 kHz.

Speaker connection is made to well-marked terminals placed in a recessed cavity on the rear of the enclosure. Also mounted in this cavity is a system fuse holder for overload protection and a tweeter balance L-pad. A red dot is placed on the tweeter control place to indicate the position for flatest response, each speaker being individually calibrated.

Plastic angle brackets hold the upper grille in place and serve as edge trim on the upper front and sides. These brackets are cut off flat, leaving edges at the corners. In typical Laurel and Hardy fashion, I cut myself on one of the brackets when I grasped the enclosure to move it. My lack of grace notwithstanding, I hope that Duntech will smooth or remove these edges on subsequent units.

Duntech supplies a very thorough and readable instruction manual with each speaker. This covers both technical details and helpful suggestions on room placement for best sound. The DL-15 loudspeaker system carries a five-year, transferrable, full warranty against manufacturing defects.

Technical Measurements

The measured magnitude of loudspeaker impedance is shown in Fig. 1, and the corresponding complex plot is given in Fig. 2. The rear-mounted tweeter control was left in the factory preset flat position for both of these measurements. Impedance variations are quite small and remain predominantly resistive for frequencies above the characteristic bass resonance peak. This speaker should present no load problems to any quality power amplifier.

The one-meter axial anechoic frequency response at one-watt average drive is shown in Fig. 3 for the amplitude of the sound pressure and in Fig. 4 for the phase. The tweeter control was set to the indicated flat position for these measurements. Bass response extends down to around 45 Hz, then rolls off smoothly. The unusual dip in response at 5 kHz, and its attendant phase change, warrants some discussion, particularly in view of the fact that Duntech measures the frequency response of each unit prior to shipment. Duntech's claim for their low frequency response is based on using a
Compiled from Recording Institute of America's interviews with key executives and "hit-makers", plus Reference Directory and Dialogue's Viewpoints of industry "stars".

Listen to the industry "pros" describe the workings of the Music Business. Hear the most respected attorneys of the entertainment field define and discuss the legal terminology of Recording Contracts, Songwriter Contracts, Professional Management Contracts. Over 3½ hours of professional reference... could be the most important 200 minutes of your life!

Plus... RIA Reference Directory, including sample songwriter affiliation forms, sample artist contracts, writer contracts, etc., in addition to a Directory of Record Manufacturers, Music Publishers, Personal Managers, Producers and Booking Agents. Also Record World's "Dialogues" with over 50 candid interviews from Record World magazine, and a cross-section of "star" personality interviews.

You get all the above (regularly $49.95) for only $39.95 for AUDIO readers.

10 DAYS FREE APPROVAL—MAIL TODAY

Book and Learning Systems Division
NORTH AMERICAN PUBLISHING COMPANY
401 N. Broad Street, Philadelphia, Pa. 19108

Please send [ ] copies of "Music Industry Cassette Library" at $19.95 each

Please send [ ] copies of "Home Recording Techniques" at $17.95 each

Please Print

Name______________________________Signature______________________________
Address______________________________
City________________________State__Zip______________________________

Total Amount_________________________Check/Money Order for $__________

☐ SAVE MONEY. My payment is enclosed. Publisher pays all postage and handling. Same money-back return privilege.
two-boundary measuring condition (wall and floor), which they believe more nearly approximates normal home listening conditions. Audio measures the response directly on the geometric center line of the speakers, with no "preferred" positions, and everybody gets the same treatment. It just happens that this is about the worst position for the Duntech. Moving the microphone a bit up to be aligned with the tweeter or down to be in front of the woofer substantially smooths the measured response, but the response shown in Figs. 3 and 4 is what the center-line measurement yields.

The acoustic transition between midrange and tweeter accounts for the dip in response at 4 to 5 kHz and nearly 360 degree shift in phase. The phase measurement was made with a time delay offset corresponding to the air path delay from midrange driver to microphone. The phase shift below 600 Hz is due to the woofer, which has an acoustic position behind the midrange driver and hence a longer time delay. With the exception of the phase changes around 600 Hz and 5 kHz, the Duntech DL-15 is principally minimum phase.

Figure 5 shows the measured three-meter room response. The DL-15 was placed on a carpeted floor and against a wall, as recommended by Duntech. A microphone position three meters from the front of the enclosure and one meter above the floor is used to simulate a normal listening position. The tweeter control was set to its indicated flat position. Two measurements are shown, one directly in front of the enclosure and the other angled 30 degrees for the Duntech in a normal left-channel stereo position; the plots are displaced 10 dB for clarity. The response is quite smooth throughout the frequency range but begins to drop above 7 kHz, though it extends smoothly to 18 kHz. (Editor's note: This high end drop, says Duntech, with distance was intentional. It is based on their contention that the same drop is evident with most musical instruments and the human voice due to a reduction in angular dispersion at frequencies higher than about 4 or 5 kHz.)

In order to check the top end drop, the measurement was rerun with the tweeter control in its maximum position, with the results shown in Fig. 6. It appears that the tweeter control should be left in its flat position as a 6-kHz peak occurs when the control is placed in its maximum position.

If you want to pull the top end up for a more uniform direct source sound, an equalizer should be used which emphasizes the frequencies above 5 kHz. An octave band equalizer may do it, but a normal pre-amplifier tone control will not and should be left in the flat position.

The polar energy response is shown in Fig. 7 for horizontal dispersion and in Fig. 8 for vertical dispersion. This is a measurement of the total sound energy density for all frequencies equally weighted from 20 Hz to 20 kHz. The three curves are for the rear-mounted tweeter control in its minimum, flat, and maximum position.

The horizontal polar pattern is quite symmetric with almost no left or right dominance of sound. The vertical polar pattern, particularly in the flat position, shows a mild upward dominance of launch angle for sound with a minor notch on axis. This verifies the axial frequency response measurement difficulty we encountered in the anechoic test. The room tests, shown in Figs. 5 and 6, have a microphone position above the enclosure's geometric axis and thus are made in the major vertical lobe of Fig. 8. This is why the 5-kHz notch did not show for an average room listening position. (Editor's note: Duntech points out that the smoothness of the polar plots is, in large part, due to the use of foam around the midrange and tweeter units. Used in this manner, says Duntech, the foam also prevents diffraction effects which take their toll on the sharpness of transients.)

**Fig. 3**—Anechoic one-meter axial sound pressure level for one-watt average drive.

**Fig. 4**—Anechoic one-meter axial phase response.

**Fig. 5**—Three-meter room test, tweeter set flat.

**Fig. 6**—Three-meter room test, tweeter set to maximum.

**Fig. 7**—Polar responses for three-meter room test, tweeter set flat.
Fig. 7—Horizontal polar energy.

Fig. 8—Vertical polar energy.

Fig. 9—Harmonic distortion for musical tones E1 (41.2 Hz), A2 (110 Hz), and A4 (440 Hz).

Fig. 10—Harmonic distortion for the tones of 1 kHz and 2.4 kHz.

AUDIO • AUGUST, 1976
The success they achieved can be judged from the sharp peak in the energy-time plot shown in Fig. 12.)

Harmonic distortion for the musical tones E1 or 41 Hz, A2 or 110 Hz, and A4 or 440 Hz is shown in Fig. 9. The low bass (41 Hz) distortion, usually where most distortion occurs, is quite low, right up to the 100-watt level, where it is just reaching 2 per cent.

During the earlier listening test, it seemed to this reviewer that the upper midrange frequencies, particularly around 3 kHz, were reproduced with a mildly strained quality suggestive of nonlinear distortion. During later measurements on these speakers, we went looking for it with the aid of a spectrum analyzer and found that the midrange driver has difficulty handling the spectrum around 2.4 kHz. Figure 10 shows the second and third harmonic distortion for the frequencies of 1 kHz and 2.4 kHz. The fourth and higher order harmonics lie well below these levels.

The Duntech woover crosses over at 350 Hz, which is approximately F above middle C. In order to check for woofer intermodulation, we used E1 or 41.2 Hz and middle C, 262 Hz, approximately one-half octave below the crossover frequency. These were mixed in equal ratio and the crossmodulation of C4 by E1 measured and the results are shown in Fig. 11. The nature of this intermodulation is principally amplitude modulation of C4 by E1 up to high levels, then an additional phase modulation occurs at the highest levels. At 40 watts average drive, for example, the peak-to-peak phase modulation is about 10 degrees and the peak-to-peak amplitude modulation is about 5 per cent.

The energy-time response, which is the logarithmic magnitude of the impulse response, is shown in Fig. 12 for the one-meter axial position. The anticipatory peaks at 3.0 and 3.1 millisecond are computer artifacts caused by the rapid phase change of the loudspeaker response at 5 kHz. The actual sound pressure level commences at 3.16 milliseconds and peaks accurately at 3.26 milliseconds, as shown here.

The tweeter and midrange start their separate impulse responses at the same time, but because the tweeter has peaked its arrival energy before the midrange unit, there is a residual response from the midrange driver extending to 3.7 milliseconds. Diffraction peaks occur at around 4.0 and 4.6 milliseconds, but they are minor. The first arrival at 3.26 milliseconds has a spectral dominance at around 8 kHz, and the spectral peak at 3.4 milliseconds is around 18 kHz. The spectral components at 3.6 milliseconds are principally 3 kHz and are due to the midrange driver.

Listening Test

In order to assess the listening quality of the DL-15s, they were mounted exactly as recommended by Duntech, flat against a wall and subtending an angle of 60 degrees relative to the listening position.

My overall impression of the reproduced sound quality is that the response is well balanced and extended, with good high and extreme low frequencies. The extra low bass seemed somewhat prominent, and a mild drop in bass level by preamplifier tone control was felt to help out a bit. I found that I wanted a mild high frequency pre-emphasis for some musical material, particularly vocals and brass.

In my opinion, the only detractor from otherwise superior reproduction is a touch of stridency in the midrange, from 1 kHz to 5 kHz, at high sound levels (above 95 dB SPL), which stands apart from the clear bass and extreme top end. This was particularly noticeable on vocals. In my earlier listening notes I commented that there is some distortion at around 3 kHz, which the technical measurement showed was at 2.4 kHz. I also sensed a moderate peak at 100 to 200 Hz in the response, which may be due to the flush wall placement of the enclosure.

Stereo imagery is good, both for lateralization and a sense of depth. There is, however, a change of timbre with listening position, and this results in a small amount of space wandering of center-positioned stereo images as one moves about the listening area.

I consider that the DL-15 has one of the most accurate reproductions of a piano which this reviewer has heard from commercial speakers thus far. The spectrum up through the octave above middle C is clean and free of audible peaks, and the 100 to 200 Hz "room bump" can be readily softened by tone control equalization.

The low bass is reproduced quite firmly with only the slightest evidence of bass hangover on percussion.

I found the DL-15 totally unforgiving of any substantial sound absorbing object near the front of the enclosure. The area immediately near the front of the enclosure must be clear of objects or the stereo illusion goes to pot.

The Duntechs need a good, big power amplifier if you like your sound loud; a Marantz Model 510 handles them quite well. And you need a good-sized living room to make use of the bass response which the speakers are capable of achieving. If you've got that, and some clean recorded material, you can sit back and enjoy some truly good sound with a pair of DL-15s.

Richard C. Heyser

Check No. 91 on Reader Service Card

AUDIO • AUGUST, 1976
Black 'n' Blue: Rolling Stones
Rolling Stone COC 79104, stereo, $6.98.

Those grand old debauchers of the musical scene are back with another new/old album, and like the last, It's Only Rock 'n' Roll, it's produced (and thereby dominated) by Mick and Keith, known to some as the glimmer twins. Ron Wood is only present as a charter member, having joined the group after a majority of the tracks were cut, and even when he does play, he adapts to the Rolling Stones guitar sound, rather than being his own stark self; Charlie and Bill usually sound the same but don't have much presence and personality on record than the section rhythm section you'd find in L.A. or N.Y. (and which were rumored to have played on several Stones records in the past). So the main thrust of any criticism should be leveled at Jumping Jack Jagger and his henchman Keith.

My criticism is the same as with Goat's Head Soup and most of the post Oldham/Jones albums—there is little excitement, the spirit of fun and fighting has gone, and the records are dominated by a pretentious effort to retain the Stones Sound, yet remain au courant. This record isn't nearly so premeditated as the others, probably due to the extensive use of drugs during the recording—The Rolling Stones have never sounded so much like they'd rather sack out than play. Not only do they sound like they were asleep during the recording of this album but also while they wrote the songs—the only really decent songs on Black 'n' Blue are Hand of Fate and Crazy Mama, neither of which has the sting of Honky Tonk Women, never mind coming close to the punch of Satisfaction.

This is the Stone's R&B album, which means they get away with recording non-songs like Hey Negrita and Hot Stuff, which are basically your typical dumb lyrics repeated over mediocre riffs. They can lay back in their chairs on Melody and let Arif Mardin's horn arrangements pick up the slack, they can fall on their faces with Fool To Cry and claim it's the next Angie. They've done a nice job on a traditional reggae tune Cherry Oh Baby but it's nothing spectacular, and people might say that Memory Hotel is the next Till The Last Goodbye. But that's using a rather lame song as the basis of a critical analysis, and the truth is, Black 'n' Blue is far more vacuous than the pleasant-but-innocuous It's Only Rock 'n' Roll. The Rolling Stones should either start taking more care with the making and creation of their records, at least as from a historical point of view but is also the best collection of Rolling Stones songs released in the U.S. in seven years. Behind a statement like that lie some fairly meaty arguments (often challenged by today's Stones fans), so explanation is in order.

One must ask who the Rolling Stones are, to determine if they are better today than they were yesterday (or more importantly, whether they are more Rolling Stonesish today than before or less so). The Stones were a combination of four ingredients: Mick Jagger (lead singer/songwriter), Keith Richards (lead songwriter/guitarist), Brian Jones (lead artist/multi-instrumentalist), and Andrew Oldham (producer/lead puppeteer, mastermind). The interaction of these four distinct personalities made the Stones different from every other rock/r&b group around, a difference which kept them on top of the rock (with competition only from the Beatles) as long as the group was intact. Andrew Oldham was the first Stone to roll on (right after the Dandelion/We Love You single)—for several personal and musical reasons. The group was significantly weakened, but with the three left there was enough room to produce a decent album, Beggar's Banquet, although it couldn't begin to compare with their earlier albums except as it projected Mick Jagger as a

Metamorphosis: Rolling Stones
Abkco/London ANA 1, stereo, $6.98.
Made In The Shade: Rolling Stones/Atlantic COC 79102, stereo, $6.98.

Both of these albums purport to be definitive statements of what the Rolling Stones are/were during a particular period, and serve to show to all the world the Rolling Stones' singles (Made in the Shade) and their early closet tracks (Metamorphosis). However, Made in the Shade is utterly useless, while Metamorphosis is not only the most interesting Stones record before or less so). The Stones were a combination of four ingredients: Mick Jagger (lead singer/songwriter), Keith Richards (lead songwriter/guitarist), Brian Jones (lead artist/multi-instrumentalist), and Andrew Oldham (producer/lead puppeteer, mastermind). The interaction of these four distinct personalities made the Stones different from every other rock/r&b group around, a difference which kept them on top of the rock (with competition only from the Beatles) as long as the group was intact. Andrew Oldham was the first Stone to roll on (right after the Dandelion/We Love You single)—for several personal and musical reasons. The group was significantly weakened, but with the three left there was enough room to produce a decent album, Beggar's Banquet, although it couldn't begin to compare with their earlier albums except as it projected Mick Jagger as a

Sound: B — Performance: C —
fast-jiving Satan, which readily appealed to the American sense of bloodlust. But when Brian Jones left the band (and the world of the living) the Rolling Stones were no more. Though the Jagger and Richards team could superficially claim to being responsible for the Stones sound, the soul of the Rolling Stones belonged to Brian and Andrew. The result has been a series of albums which were not only dull, moronic, and empty, but which have been promoted to the point where many people actually believe that the Rolling Stones are the greatest rock 'n' roll band in the world. This came about from hypes performed by their management, and their sharing the same moniker as America's number one rock magazine. It's amazing what a good publicist can do when the music has run out.

**Made in the Shade** is a tight, polished document of the past five years of Rolling Stones music—blunt blues progressions with semi-decadent lyrics, weepy ballads, and a hit single or two. Very tedious stuff that we've all heard a thousand times before.

**Metamorphosis**, on the other hand, is the meat of the Rolling Stones. Because what this album is a collection of the songs which the Rolling Stones decided not to release for various reasons: some too openly expose their bisexuality, some are too pop-oriented, and a few are blatant steals from other songs. Just a partial picture of what's hidden in the vaults of the Rolling Stones, taken out of the garage years after the fact by ex-manager/producer Andrew Oldham and brought back into the studio for an overdub or two. Yes, the original masters were slightly tampered with (rather obvious to any listener), but the post-mortems were done with the same purpose as the original recordings: *let's have some fun!* Side one is material originally recorded with Andrew at the knobs between 1963 and 66 (so they say) and side two is a bunch of tracks cut when Jimmy Miller was producing them, all mixed and remixed by Oldham over the past few years. A track-by-track analysis is in order. Out of Time was originally on the Flowers album in America (recorded around the time of Aftermath), but this is a different take, full of grand orchestration. In fact, it was originally recorded as the backing track for the single by Chris Farlowe (a hit in England) and I'd guess that Jagger's vocal was merely put on as a reference for Farlowe to follow. One of the best Jagger/Richards compositions ever, this version features an offhand and classic vocal by Jagger, who seems less self-conscious than usual, probably because he figured it'd never see the light of day. *Don't Lie To Me* is a Chuck Berry song (at least that's the song credited to Chuck which appeared on *Berry's Golden Decade Vol. 2*) probably recorded about the same time as *The Rolling Stones Now* (a great bass line, guys). *Each & Every Day of the Year* is a demo the Stones did for another group produced/managed by Oldham and released as a single, a very pretty song with a mildly off-key but charming vocal. The only throwaway on side one is a rather tepid rendition of *Heart of Stone* featuring crummy drumming and a raunchy solo by a young Jimmy Page—Pagey sounds like he just got through with a Kinks session and left his chops at home. However, the next track is an absolute winner written by Oldham/Richards on an Australian beach, a hilarious little gem titled *I'd Much Rather Be With the Boys* featuring Andrew Oldham on lead production and Mick Jagger on out-of-tune vocals. The next track is a killer as well, a very un-Stonesy (I'd suspect it's another demo) and seemingly Spectorific (cute lyrics, too). It's *Walking Thru the Sleepy City*, a good one. The last on side one is *Try A Little Harder*. It's an *Aftermath* outtake that's OK even if it sounds a little bit too much like an R&B song (whose title escapes me). All in all, a fine assortment of tunes—more worthwhile stuff than you'll find on *Made in the Shade*, hands down.

Side two was recorded later (1969?) and by now their writing talents had dissipated more than just a little bit. The songs are less than classics, I regret to report, but they're still darn good. *I Don't Know Why* (written by Stevie Wonder) is listed as featuring Mick Taylor, but it doesn't sound like him to me. Andrew Oldham's post-production on this one is terrific. As a matter of fact, the man deserves a special award for his major surgery on most of these tracks because, from what I've been told, the original tapes were all but unlistenable. If You Let Me sounds like it was recorded during *Beggar's Banquet* (shades of Factory Girl) but written earlier (*Sittin' on a Fence* comparisons are obvious). *Livin' Sister Fanny* is a Keith Richards Special—the vocal by Jagger is mostly off-the-cuff, and the music is straight Rock 'n' Roll. Bill Wyman gets his first composing credit since *In Another Land on Downtown Suzie*, a rather drunken ramble full of groans and strange noises. Mick parades his decedence on *Family*, not one of the
stronger tunes on the album but interesting (great enunciation, Mick). Memo From Turner is a throwaway, far inferior to the Ry Cooderized version which appears in the Performance movie, and is useful only for its lyrics. The final word on the album is I'm Going Down, a strong rocker from the Jagger/Richards/Taylor pen with unintelligible lyrics, I'm happy to report. There's nothing so embarrassing as Mick Jagger with nothing to say, trying to verbalize his thoughts.

Anyhow, if you're any kind of Rolling Stones fan you will have no use for Made in the Shade, as you've probably got all the songs already, and they're not so good anyhow. Metamorphosis, though, will at the very least intrigue, and probably will excite you. If you gave up on the Rolling Stones when they left the 60s, pick up on Metamorphosis. It'll let you know why they were what they were, and why they aren't anymore. Jon Tiven

Shade Sound: B Performance: C-
Meta. Sound: A Performance: A

Sunburst Finish, BeBop Deluxe
Capitol ST-11478, stereo, $6.98.

Bill Nelson is an extremely able guitarist and he knows it—he intimates it in his lyrics, he brings his guitar right up front in his mix of his albums, and he'd have to be deaf not to realize that simple fact. But if that was all he could do, BeBop Deluxe's albums might be as boring as, say, David Bowie's. However, Nelson is not infatuated with his guitar wizardry, though he is arrogant with his axe and anxious to show off his wizardry; no, Nelson is a highly intelligent, articulate, and well-heeled guitarist who doesn't preach with his albums but asks questions, who doesn't walk blindly into each album but proceeds cautiously, taking just the number of steps he can without tripping over his own feet. Sunburst Finish, the third album by Bill Nelson's BeBop Deluxe—and it's fairly obvious whose group this is—is coproduced by Bill, features several songs written by him, and will obviously be compared to Queen (because of the guitar

The only thing better than being there is being there again

Music. Record it right. On the only premium blank tape good enough to wear the name—The Music Tape by Capitol! It's designed specifically to record music with wide frequency response, low noise and low distortion. Nobody knows music better than Capitol... knows the subtle colors of treble, bass and mid-range. Listen. Record. Listen. The Music Tape by Capitol takes you there again and again and again.

Check No. 8 on Reader Service Card
Try Audio's Classifieds—They Pull!

AM Comes Alive

The McKay Dymek DA5 shielded ferrite loop AM antenna has a solid state preamp with tuning and sensitivity controls.

Overcomes the two most common AM reception problems: strong local stations "hiding" weaker distant stations close on the dial, and interference from TV and electrical sources.

Improves inherent long range capabilities of AM—programs listenable from hundreds of miles.

Increases signal strength 4 to 8 times—really sharpens up AM performance in typical hi-fi receivers and tuners.

Factory direct, ten day money back guarantee. Rental plan, Bank-America and Master Charge welcome. For more information or to place your order, call toll free:

Nationwide 800/854-7769
California 800/472-1783

McKay Dymek Co.
675 North Park Ave.
Pomona, CA 91766

Sound: A — Performance: A —

Ba-Fa: The Hudson Brothers
Rocket PIG-2169, stereo, $6.98.

Some of my colleagues have argued that The Hudsons could be the next Beatles with their clean look, clean sound, and clean image. I don't even think these guys could be the next Badfinger, never mind the next Beatles. This reviewer was unfortunate enough to catch The Hudsons at the Bottom Line in N.Y.C., and their act has got to be the crassest, most artificial, and the least lifelike show in the world. They've got about as much rock 'n' roll spirit as Percy Faith.

I do believe they've studied their Beatles chord progressions very hard,
David Courtney's First Day: David Courtney
United Artists UALA553G, stereo, $6.98.

The premise behind the making of this album was a sound one. Leo Sayer has become a successful star and a hot talent in songwriting as well. It so happens that Leo writes only the lyrics to Courtney's songs, who in turn provided the music until recently. Courtney split, Sayer found a new music composer, and the quality of Sayer's songs fell drastically; it was only natural that someone would scoop up Courtney as a talent unto himself.

However, it was foolish to assume that Courtney alone would be as much of a find as Sayer. Sayer's voice is extraordinary, while Courtney's is at best fairly good and at worst mannered and misapplied. What's more, Sayer's lyrics provided structure, focus, and proper rhythms for Courtney's melodies and chord progressions, and the value of this should not be easily cast aside. Lyrics are not just words in rock 'n' roll, they key the beat of the song, and Courtney is simply not as competent as Leo. Courtney is forced where Sayer was free and flowing, and his lyrical ideas can't match Leo's—the best explanation for Courtney's flaws is that he's young, very early in the development of his abilities as a self-contained artist. His voice has all the flaws of someone not used to singing, and his lyrics sound like the lyrics someone would write when he was just beginning. Courtney may some day develop into a major rock artist, but right now his career seems premature.

There are a few delightful moments on his debut album—Don't Look Now and My Mind the most obvious—but he seems a more capable singles artist than an album man at present.

Jon Tiven

Sound: B Performance: B–

David Courtney's First Day: David Courtney
United Artists UALA553G, stereo, $6.98.

The premise behind the making of this album was a sound one. Leo Sayer has become a successful star and a hot talent in songwriting as well. It so happens that Leo writes only the lyrics to Courtney's songs, who in turn provided the music until recently. Courtney split, Sayer found a new music composer, and the quality of Sayer's songs fell drastically; it was only natural that someone would scoop up Courtney as a talent unto himself.

However, it was foolish to assume that Courtney alone would be as much of a find as Sayer. Sayer's voice is extraordinary, while Courtney's is at best fairly good and at worst mannered and misapplied. What's more, Sayer's lyrics provided structure, focus, and proper rhythms for Courtney's melodies and chord progressions, and the value of this should not be easily cast aside. Lyrics are not just words in rock 'n' roll, they key the beat of the song, and Courtney is simply not as competent as Leo. Courtney is forced where Sayer was free and flowing, and his lyrical ideas can't match Leo's—the best explanation for Courtney's flaws is that he's young, very early in the development of his abilities as a self-contained artist. His voice has all the flaws of someone not used to singing, and his lyrics sound like the lyrics someone would write when he was just beginning. Courtney may some day develop into a major rock artist, but right now his career seems premature.

There are a few delightful moments on his debut album—Don't Look Now and My Mind the most obvious—but he seems a more capable singles artist than an album man at present.

Jon Tiven

Sound: B Performance: B–

For the first time in tape history, you can record live music on your audiophile recorder and achieve better signal-to-noise performance than professional studio recorders.

The new dbx 120 tape noise reduction system provides about 40 dB noise reduction with reel-to-reel, cartridge or cassette recorders. For live recordings, tape hiss and background noise are completely eliminated. For taping off-the-air or dubbing from records or tapes, no noise is added beyond the noise content of the material being copied. (We do not attempt to remove noise present in the original input signal, however.)

dbx 120 units also decode the newly released dbx encoded "noiseless" discs which offer over 100 dB dynamic range with no audible surface noise at any listening level.

Model 122 is a two-channel tape noise reduction system, switchable to record or play, with a dbx disc decode feature, priced at $259.00.

Model 124 is a four-channel tape noise reduction system, switchable to record or play, which will also provide simultaneous record and play for two-channel recording, with a dbx disc decode feature, priced at $379.00.

Words cannot adequately describe the experience of listening to recorded music with over 100 dB dynamic range. We don't expect you to believe it possible until you hear it for yourself.

For the most dramatic recorded music demonstration of your life, hear the dbx encoded "noiseless" disc at your demonstrating dbx dealer.

For complete product information and dealer list, circle reader service number or write to:

dbx Incorporated, 296 Newton Street
Waltham, Massachusetts 02154

Check No. 11 on Reader Service Card
# Advertising Index

<table>
<thead>
<tr>
<th>ADVERTISER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustic Research</td>
<td>13</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>13</td>
</tr>
<tr>
<td>Check No. 1 on Reader Service Card</td>
<td>13</td>
</tr>
<tr>
<td>Airav America, Ltd.</td>
<td>23</td>
</tr>
<tr>
<td>Cassette Decks</td>
<td>23</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>23</td>
</tr>
<tr>
<td>AKG Headphones</td>
<td>6</td>
</tr>
<tr>
<td>Check No. 2 on Reader Service Card</td>
<td>6</td>
</tr>
<tr>
<td>Analog &amp; Digital Systems, Inc.</td>
<td>37</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>37</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>37</td>
</tr>
<tr>
<td>Audio Analyst</td>
<td>80</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>80</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>80</td>
</tr>
<tr>
<td>Audio-technica</td>
<td>32</td>
</tr>
<tr>
<td>Phono Cartridges</td>
<td>32</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>32</td>
</tr>
<tr>
<td>Avid Corp.</td>
<td>39</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>39</td>
</tr>
<tr>
<td>Check No. 5 on Reader Service Card</td>
<td>39</td>
</tr>
<tr>
<td>Bang &amp; Olufsen</td>
<td>57</td>
</tr>
<tr>
<td>Turntables</td>
<td>57</td>
</tr>
<tr>
<td>Check No. 6 on Reader Service Card</td>
<td>57</td>
</tr>
<tr>
<td>B.L.S. Loudspeaker Systems</td>
<td>45</td>
</tr>
<tr>
<td>Check No. 7 on Reader Service Card</td>
<td>45</td>
</tr>
<tr>
<td>Bose</td>
<td>19</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>19</td>
</tr>
<tr>
<td>BSR Equalizer</td>
<td>78</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>78</td>
</tr>
<tr>
<td>Capitol Magnetic Products</td>
<td>67</td>
</tr>
<tr>
<td>Magnetic Tapes</td>
<td>67</td>
</tr>
<tr>
<td>Check No. 8 on Reader Service Card</td>
<td>67</td>
</tr>
<tr>
<td>Crown International</td>
<td>52</td>
</tr>
<tr>
<td>Tape Recorder</td>
<td>52</td>
</tr>
<tr>
<td>Check No. 9 on Reader Service Card</td>
<td>52</td>
</tr>
<tr>
<td>Dayton Wright</td>
<td>77</td>
</tr>
<tr>
<td>Amplifier</td>
<td>77</td>
</tr>
<tr>
<td>Check No. 10 on Reader Service Card</td>
<td>77</td>
</tr>
<tr>
<td>dbx, Inc.</td>
<td>69</td>
</tr>
<tr>
<td>Noise Reduction Systems</td>
<td>69</td>
</tr>
<tr>
<td>Check No. 11 on Reader Service Card</td>
<td>69</td>
</tr>
<tr>
<td>Designators</td>
<td>91</td>
</tr>
<tr>
<td>Stereo Equipment</td>
<td>91</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>91</td>
</tr>
<tr>
<td>Discount Music Club</td>
<td>89</td>
</tr>
<tr>
<td>Record Club</td>
<td>89</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>89</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>2</td>
</tr>
<tr>
<td>Connector Cables</td>
<td>2</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>2</td>
</tr>
<tr>
<td>Dual (Unified Audio)</td>
<td>3</td>
</tr>
<tr>
<td>Turntables</td>
<td>3</td>
</tr>
<tr>
<td>Check No. 13 on Reader Service Card</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADVERTISER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epicure Products</td>
<td>33</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>33</td>
</tr>
<tr>
<td>Check No. 14 on Reader Service Card</td>
<td>33</td>
</tr>
<tr>
<td>Frazier, Inc.</td>
<td>66</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>66</td>
</tr>
<tr>
<td>Check No. 36 on Reader Service Card</td>
<td>66</td>
</tr>
<tr>
<td>GTE Sylvania-Entertainment Products</td>
<td>53</td>
</tr>
<tr>
<td>Receivers</td>
<td>53</td>
</tr>
<tr>
<td>Check No. 15 on Reader Service Card</td>
<td>53</td>
</tr>
<tr>
<td>Hartley Products Corp.</td>
<td>20</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>20</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>20</td>
</tr>
<tr>
<td>Innotech, Inc.</td>
<td>14</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>14</td>
</tr>
<tr>
<td>Check No. 16 on Reader Service Card</td>
<td>14</td>
</tr>
<tr>
<td>JVC America, Inc.</td>
<td>27</td>
</tr>
<tr>
<td>Receiver</td>
<td>27</td>
</tr>
<tr>
<td>Check No. 17 on Reader Service Card</td>
<td>27</td>
</tr>
<tr>
<td>Kenwood</td>
<td>7</td>
</tr>
<tr>
<td>Tuner and Amplifier</td>
<td>7</td>
</tr>
<tr>
<td>Check No. 18 on Reader Service Card</td>
<td>7</td>
</tr>
<tr>
<td>Lamb Laboratories</td>
<td>81</td>
</tr>
<tr>
<td>Loud Speaker Systems</td>
<td>81</td>
</tr>
<tr>
<td>Check No. 19 on Reader Service Card</td>
<td>81</td>
</tr>
<tr>
<td>Lux Audio of America, Ltd.</td>
<td>31</td>
</tr>
<tr>
<td>Amplifiers</td>
<td>31</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>31</td>
</tr>
<tr>
<td>Marantz</td>
<td>94, Cover III</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>94, Cover III</td>
</tr>
<tr>
<td>Check No. 20 on Reader Service Card</td>
<td>94, Cover III</td>
</tr>
<tr>
<td>Martin Speakers</td>
<td>93</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>93</td>
</tr>
<tr>
<td>Check No. 38 on Reader Service Card</td>
<td>93</td>
</tr>
<tr>
<td>Maxell</td>
<td>17</td>
</tr>
<tr>
<td>Magnetic Tapes</td>
<td>17</td>
</tr>
<tr>
<td>Check No. 19 on Reader Service Card</td>
<td>17</td>
</tr>
<tr>
<td>McIntosh Labs</td>
<td>83</td>
</tr>
<tr>
<td>Catalog</td>
<td>83</td>
</tr>
<tr>
<td>Check No. 20 on Reader Service Card</td>
<td>83</td>
</tr>
<tr>
<td>McKay Dymek</td>
<td>68</td>
</tr>
<tr>
<td>Antenna</td>
<td>68</td>
</tr>
<tr>
<td>Check No. 37 on Reader Service Card</td>
<td>68</td>
</tr>
<tr>
<td>Micro-Acoustics</td>
<td>49</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>49</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>49</td>
</tr>
<tr>
<td>PAIA</td>
<td>58</td>
</tr>
<tr>
<td>Synthesizer</td>
<td>58</td>
</tr>
<tr>
<td>Check No. 21 on Reader Service Card</td>
<td>58</td>
</tr>
<tr>
<td>Phase Linear Corp.</td>
<td>12</td>
</tr>
<tr>
<td>Amplifier</td>
<td>12</td>
</tr>
<tr>
<td>Check No. 22 on Reader Service Card</td>
<td>12</td>
</tr>
<tr>
<td>Pickering</td>
<td>79</td>
</tr>
<tr>
<td>Phono Cartridges</td>
<td>79</td>
</tr>
<tr>
<td>Check No. 23 on Reader Service Card</td>
<td>79</td>
</tr>
<tr>
<td>Pioneer</td>
<td>Cover I, Pg. 1</td>
</tr>
<tr>
<td>Hi-Fi Components</td>
<td>Cover I, Pg. 1</td>
</tr>
<tr>
<td>Check No. 24 on Reader Service Card</td>
<td>Cover I, Pg. 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADVERTISER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polk Audio</td>
<td>83</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>83</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>83</td>
</tr>
<tr>
<td>Primo Co., Ltd.</td>
<td>68</td>
</tr>
<tr>
<td>Microphones</td>
<td>68</td>
</tr>
<tr>
<td>Check No. 25 on Reader Service Card</td>
<td>68</td>
</tr>
<tr>
<td>Quam-Nichols Co.</td>
<td>76</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>76</td>
</tr>
<tr>
<td>Check No. 26 on Reader Service Card</td>
<td>76</td>
</tr>
<tr>
<td>Radio Shack</td>
<td>81, 82</td>
</tr>
<tr>
<td>Receiver</td>
<td>81, 82</td>
</tr>
<tr>
<td>SRA</td>
<td>90</td>
</tr>
<tr>
<td>Rhoades</td>
<td>90</td>
</tr>
<tr>
<td>Telelapser TV Sound Tuner</td>
<td>90</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>90</td>
</tr>
<tr>
<td>Roeckel</td>
<td>29</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>29</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>29</td>
</tr>
<tr>
<td>SAE</td>
<td>4</td>
</tr>
<tr>
<td>Amplifiers</td>
<td>4</td>
</tr>
<tr>
<td>Check No. 28 on Reader Service Card</td>
<td>4</td>
</tr>
<tr>
<td>Sansui Electronics</td>
<td>5</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>5</td>
</tr>
<tr>
<td>Check No. 29 on Reader Service Card</td>
<td>5</td>
</tr>
<tr>
<td>Saxtone</td>
<td>87</td>
</tr>
<tr>
<td>Tapes</td>
<td>87</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>87</td>
</tr>
<tr>
<td>Share Bros.</td>
<td>15</td>
</tr>
<tr>
<td>Phono Cartridges</td>
<td>15</td>
</tr>
<tr>
<td>Check No. 39 on Reader Service Card</td>
<td>15</td>
</tr>
<tr>
<td>Sony Corp. of America</td>
<td>46, 47</td>
</tr>
<tr>
<td>Hi-Fi Components</td>
<td>46, 47</td>
</tr>
<tr>
<td>Check No. 31 on Reader Service Card</td>
<td>46, 47</td>
</tr>
<tr>
<td>Speakerlab</td>
<td>82, 88</td>
</tr>
<tr>
<td>Speaker Kits</td>
<td>82, 88</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>82, 88</td>
</tr>
<tr>
<td>Spectro-Acoustics</td>
<td>18</td>
</tr>
<tr>
<td>Equalizer</td>
<td>18</td>
</tr>
<tr>
<td>Check No. 32 on Reader Service Card</td>
<td>18</td>
</tr>
<tr>
<td>TDK Electronics</td>
<td>11</td>
</tr>
<tr>
<td>Cassettes</td>
<td>11</td>
</tr>
<tr>
<td>Check No. 33 on Reader Service Card</td>
<td>11</td>
</tr>
<tr>
<td>Teac Corp. of America</td>
<td>8, 9, 41</td>
</tr>
<tr>
<td>Cassettes</td>
<td>8, 9, 41</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>8, 9, 41</td>
</tr>
<tr>
<td>Tuner</td>
<td>8, 9, 41</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>8, 9, 41</td>
</tr>
<tr>
<td>Technics by Panasonic</td>
<td>Cover IV</td>
</tr>
<tr>
<td>Receiver</td>
<td>Cover IV</td>
</tr>
<tr>
<td>Check No. 34 on Reader Service Card</td>
<td>Cover IV</td>
</tr>
<tr>
<td>Tripod Audio</td>
<td>86</td>
</tr>
<tr>
<td>Audio Store</td>
<td>86</td>
</tr>
<tr>
<td>Write Direct to Advertiser</td>
<td>86</td>
</tr>
<tr>
<td>Yamaha</td>
<td>51</td>
</tr>
<tr>
<td>Loudspeaker Systems</td>
<td>51</td>
</tr>
<tr>
<td>Check No. 35 on Reader Service Card</td>
<td>51</td>
</tr>
</tbody>
</table>

---

AmericanRadioHistory.Com
**Westchester Symphony,** The (Kleine Dreigroschenemusik). *Kurka: Sofia Nat. Opera, Obretenov Svetoslav Chorus, Robev. Monitor HS 90104, 4 discs, stereo, $27.94.*

Monitor has a winner in this huge 5-act opera recording out of Bulgaria even if it is the sweetened-up Rimsky version. (M. himself finished only a vocal score; R.K. orchestrated it, removing the “barbarisms” that were the best part.) Such gorgeous solo singing, huge big voices—such powerful chorus music, omnipresent! And such a very real intensity and musicianship. Nothing jet-international about this opera making, and it’s the better for it. Beautifully recorded, too. By the Russians, I presume.

**Brahms: Sonata No. 3 in F Minor; Rhapsody in G Minor.** Bruno-Leonardo Gelber, piano. *Connoisseur CSQ 2084, stereo/quadraphonic, $6.98.*

This EMI import, unlike those from Klavier is marked SQ, a single-inventory quadraphonic release. (Question: are Klavier’s EMI discs SQ unannounced? The EMI originals definitely are, in the British release form.) Gelber is again a first line Romantic pianist, really communicating this big, splathy, noisy youthful Brahms without overdoing it. Odd—a trace of edginess (says my stylus . . .) in the main recording, a cleaner, more solid sound in the added Rhapsody, last of side 2. Wot happened?

**Ingus Naruns, cellist. (Bruch, Medins, R. Strauss.) Anatols Berzkalns, pf. Kaibala 60F01, stereo, $6.98.**

The Kaibala label is predominantly Latvian-American and this cello/piano team is excellent, their biggest problem being the Latvian language which, like Czech, is plastered with sprouting accent marks. (We omit them—printers never heard of them.) Naruns is a fine cellist, playing warmly a really beautiful, clear melodic line, in tune; Good piano, too, if microphoned a bit in the background (he is unwisely listed as “accompanist”). Extremely quiet surfaces, totally minus rumble—a phenomenon!


Maybe all Chinamen once looked alike to us Westerners, but no longer the sound of Indian music (!) though the format is always superficially the same, slow introductory improvising, a gradual rhythmic speeding and thickening on an easily audible scale (mode) and a tricky longish pattern of repeated beat-groupings. Two shorter pieces here (arbitrarily boiled down?) seem too short, get there too fast; the single long one on side 1 has the right hypnotic cumulation of effect, I’d say.


It’s always a pleasure to hear the Little Three Penny Music suite, out of the famed 1920s opera about Mack the Knife, et al., so charmingly authentic in its 1920s plunks and blats and grunting saxes. Landau’s Westchester players don’t try to exaggerate—good. Too many do. The much later (1956) Kurka, on a related post-WW1 theme, is rather more out of Shostakovich plus American Academic, smoothly pro and facile at too much length. I’ll take Weill.


The world’s finest choir (my vote!), in contemporary music, impeccably Englished and Oxford, yet marvelously expressive. If you ask me, a lot better than the same works under their respective composers themselves. It can happen.
Mahler: Symphony No. 2 "Resurrection." Fassbaender, Price, London Symphony Orch. and Chorus, Stokowski.

RCA ARD2 0852, CD-4 quadraphonic, $13.96.

First, Schwann lists RCA's CD-4 quadraphonic at the same price as the alternative stereo, a halfway sort of "single" inventory. Check your dealer. Eventually, we can hope for one release, stereo/quadraphonic, to bear out the RCA label saying "compatible stereo/4-channel" on the front of this and all CD-4 RCA releases. That remains the necessary future for the new medium if it is to survive on discs.

Second—this one is GOOD. I do not know whether it is cut via the new Quadulator equipment, which was to have gone into practical use by early this year, but I can say that the playing of this version in CD-4 offered no problems, not even in the loudest parts; the sound—listening as music—was excellent with an ambience that I do feel is unique to the best CD-4; the levels, still a good deal lower than average stereo (and SQ/QS), seemed to me to run a bit higher than similar CD-4 classicals in the recent past, high enough to avoid background noise of any noticeable severity. I did not note undue compressions or other overt audio disruptions—expectable in view of CD-4's inherent complexity in the cutting. All in all, I'd say—good progress.

Two discs, yes; but all the other versions require the same and my only reservation was the ungainly break in the long last movement, which just won't go onto a single side.

There are many big versions of this symphony with chorus and solo voices—I can only say that I found it to be the very best of late by Stokowski, one of his "pure" interpretations, minus overt eccentricities. Beneath his often hammy exterior, this ancient conductor has always reserved a virgin pure asceticism of interpretation for the really great works that deserve, as he surely feels, his humble best; the recent Beethoven Eroica was one and this is another. (If the strings slide up a bit now and then, I expect it was overzealousness, to please the old man, and misguided in this music; if there are inaccuracies, we can surely chalk up the lack of enough rehearsal to human frailty—at 94 years.) Like few conductors now alive, Stokowski knows how to maintain the tension and drama of a huge work such as this while at the same time playing it relatively sparsely, minus extra heroics. Other versions notwithstanding, this one is definitely worth anybody's study in depth.


London OS 26431, stereo, $6.98.

Tape editing has come to the oldest...
extant written-down Western music! And not with the happy results you might hope for.

I hadn't heard the Solesmes monks for quite some time, though this is only the latest in a series from London. The monks have been recording since '78 days, when I first ran into their memorable music—for it was at Solesmes, in the 19th century, that Gregorian chant was restored from a state of "modernized" debasement to its original form, both in the published special notation (the collection adopted officially by the church at the turn of the century) and, even more important, in the manner of performance—once again without anachronistic accompaniment, pure melody for voices. These monks, then, carry on a tradition already a century old, in music that was first brought together in the 17th century.

The tape editing is unfortunate, if reasonable. Church services in a Catholic monastery are not hurried and especially not at Solesmes, where this music is a life preoccupation. How to boil down a very long service in the original chant for an LP edition? Obviously, reduce it to the essentials, remove long pauses, spoken liturgy, combine into one flow the music of different occasions—and, inevitably, edit different "takes" into one piece. It's all in the standard procedure today. In thousands of musical situations this sort of editing is the life blood of the viable LP recording, in spite of strenuous objections from musicians galore. The medium demands it and the technique "works" to perfection, all things considered.

But editing is tricky and a bad edit is worse than a good mistake. Even orchestras play out of tune with themselves; weather does weird things to halls, moods and feelings change uneventfully and will not join together. Bad enough. Much worse things happen in the unaccompanied form of vocal music. There is no fixed mechanical pitch reference; it is all in the mind and the ear. Given the natural sequence of events, in real time, singers who know can do a splendid job of maintaining a viable feeling of pitch and key, unaccompanied. This would be the case at Solesmes, live, even though there are small aberrations in pitch when a forced A-B comparison is made.

That's the rub! Editing is by nature an A-B comparison, of pitches never intended to rub noses, so to speak. As a conductor and recorder of my own (non-Gregorian) unaccompanied singers, I am aware of the dangers in this sort of editing. Hair-raising. For as we all know, the closer are two differing pitches, the higher the numerical ratio, the more startling is the dissonance. There is no almost. Pitch must be exact, or no edit.

Moreover, Gregorian falls into modes, each a distinct and easily heard scale pattern, clearly set forth as each piece is sung. But a sudden transition from one mode to another is anathema—and always avoided in practice. Live, that is.

Alas, London's editors have not had ears for all these things. The music is indeed boiled down and nicely articulated, with normal LP pauses between items and a continuing flow of material in economical form, to fit. BUT (a) there are infinitesimal pitch lapses which are painful in the edited result and (b) musical numbers, which surely were isolated in the living rendition, are put cheek to jowl, wrenching one mode into another, most un-

Continued... the Basic Black Series ... through properly defining the functions required of each discreet block in the system, and careful determination of controls and interfaces; both exceptional performance and high reliability far in advance of other so-called systems can be attained — and maintained.

Continued.... Another State of The Art Product

THE XEC-1000 STEREO POWER AMPLIFIER
The first stereo power amplifier employing error correction techniques (outside the feedback loop) together with low levels of negative feedback to achieve exceptionally small amounts of THD, without compromising the unusually low levels of Harmonic Intermodulation or Cross-Modulation Distortion... the ideal compliment to the superlative XG-5 Mx3 Series 2 Full Range Electrostatic Loudspeakers... the only 4th Generation Electrostatics in the World.

DAYTON WRIGHT associates limited
PO. Box 419, Thornhill, Ontario Canada L3T 4A2
wright for specifications and the name of your nearest dealer

*Specs... 500 watts/channel into 8 ohms, 20-20,000 Hz, 0.2% max harmonic distortion, both channels driven, per FTC pre-conditioning

Check No. 10 on Reader Service Card
You can own the finest component system and still be getting inferior sound.

Because unless you happen to have an acoustically perfect listening room, your system and space probably don't match. Hard walls, soft carpets, glass tables, even the size of a room can change sounds.

So ADC developed the new ADC 500 Sound Shaper Frequency Equalizer.

By adjusting the twelve frequency levels you can actually shape your sound to fit the shape of the room, and compensate for spaces and textures that interfere with sound. You can even tinker with the sound just for the fun of it: bring up a singer, lose a violin, actually re-mix your recording.

The new ADC 500 Sound Shaper can get your system into great shape.

The Sound Shaper

Because all rooms are not created equal.
**Violinspiration:** Stephane Grappelli & the Diz Disley Trio.

**Musicians:** Grappelli, violin; Disley, Ike Isaacs, guitars; Isla Eckinger, bass.

**Songs:** Lover Come Back To Me, Sweet Lorraine, Shine, Solitude, Ain't Misbehavin', Souvenir de Villingen, Hot Lips, My Heart Stood Still, The Nearness of You, Joy, A Nightingale Sang in Berkeley Square, Cherokee, Lover Man.

*BASF MC 22745, stereo, $6.98.*

Among the many current recordings by the great French violinist, this one most closely recalls the peculiar charms of the Quintette du Hot Club de France with which he made his reputation in the 1930s.

There is no Django Reinhardt here, of course, but the two rhythm guitars and the bass, the absence of piano and drums, and a program including several pieces from the old repertory add up to music that is both delightfully nostalgic and fresh.

Grappelli is buoyed by the chugging yet swinging rhythm trio and pretty much has the show to himself, occasional short guitar bits (and a fine bass solo by Eckinger, a distinguished Swiss jazzman, on Solitude) notwithstanding. In his late 60s now, Grappelli has never played better. His command of the instrument is unequalled among jazz practitioners, and in a league with the best classicists (as witness his collaborations with Mennhin). His ear is impeccable, and so is his taste, and there is a joyous feeling to his playing that communicates to all lovers of music.

On Villingen, Grappelli accompanies himself on electric piano via overdubbing. It makes for a pleasant change of pace. *Dan Morgenstern*  

*Whatever Happened To Johnny Bothwell?* Johnny Bothwell  

*Bob Thiele Music BBMI-0741, mono, $5.95.*

Indeed, what did happen to Johnny Bothwell, an excellent jazz musician, and one of the best lead altos in the band business? According to Dan Morgenstern, who did the liner text on this excellent album, Bothwell is working in Florida as an industrial photographer; another fine musical career down the drain because of a shift in popular taste from the band era to the trash pop of the late 40s and early 50s, and finally to the ultimate low, the crude amateurism of early rock.

Bothwell played with Tommy Dorsey, Gene Krupa and Woody Herman, but began to draw attention in jazz circles around 1945-46 when he joined Boyd Raeburn's experimental, progressive jazz band. With Rae-
burn’s men he cut a number of studio sessions for Bob Thiele’s Signature label; most of them are included on this LP. Bothwell, like other alto men of the period, was indebted to Ellington’s Johnny Hodges for his sound. The sweep and tone of Bothwell’s performance here, while undoubtedly drawn from Hodges, has a cutting edge all of its own, and it comes through with tremendous authority on such standards as Harold Arlen’s Ill Wind, Billy Strayhorn’s Chelsea Bridge, and Johnny Hodges’ Cover the Waterfront. The first chorus on each of these exuberant selections are handled ballad style, then the back-up Raeburn band jumps like mad.

The remastering job by Thiele is commendable; the original monaural sound is both crisp and clear.  

John Lissner

Sound: A- Performance: A

On The River: The New Black Eagle Jazz Band
Dirty Shame 2002, stereo, $5.95.

The new Black Eagle Jazz Band is a Boston-based group made up of part-time musicians, business and professional men who play regular weekend dates at the Sticky Wicket Pub in Hopkinson, Massachusetts. This is not one of these traditionalists bands rehashing When the Saints Go Marching In . . . Just One More Time. One of the new Black Eagle Jazz Band’s strongest points is its interesting repertoire, which it plays with gusto and grit. This collection consists of a mix of Armstrong and Johnny Dodds material and post 1930, pre-1950 Tin Pan Alley pop tunes, all played in the New Orleans style.

Noteworthy is cornetist Tony Pringle’s driving lead in the ensembles, Stan Vincent’s brash, bristling trombone, and Stan McDonald’s superb clarinet and soprano sax on uptempo numbers like Oriental Man and When I Grow Too Old To Dream. McDonald, incidentally, could hold his own in any top-notch professional band. The New Black Eagle Jazz Band is one of the best revivalist groups around; they bring a bouncy spirit, warmth, and good musicianship to everything they play. The album is well recorded and available only by mail order; write: Dirty Shame Records, Box 5217, Hannegan Station, St. Louis, Missouri. 63139.  

John Lissner

Sound: A Performance: B+

Summer Solstice: Azar Lawrence
Musicians: Lawrence, soprano and tenor sax; Raul De Souza, trombone; Gerald Hayes, flute; Amaury Tristao, acoustic guitar; Dom Salvador, piano; Ron Carter, bass; Albert Dailey, piano; Guillerme Franco, drums, percussion; Billy Hart, drums.

Songs: From the Point of Love, Novo Ano, From the Point of Light; Summer Solstice, Highway.

Prestige P-10097, stereo, $6.98.

Two of the most powerful and increasingly important saxophone voices, Sonny Fortune and Azar Lawrence, have matured and developed individual styles within the musical continuum of McCoy Tyner’s groups, just as Tyner’s talents began to crystallize within the Coltrane realm. Now these two saxophonists have stepped out on their own, and in their respective solo albums, they successfully reflect the lessons and directions of Tyner and a strong balance of the further avenues they intend to pursue.

Lawrence is Tyner’s current reed man. On Summer Solstice he continues to develop the audibly evident musical concepts of Bridge Into The New Age (Prestige P-10066), his first LP. Bridge, which included fellow
group members bassist Joonie Booth and drummer Billy Hart, consequently bore a somewhat greater degree of Tyner influence than this LP. The album remains a solid, truthful testament to Lawrence's musical requisites and abilities. Familiarity and understanding between personnel on Bridge may have helped ease Lawrence's transition to leader. The obvious musical successes of Solstice make it quite evident that Lawrence, as a sensitive professional, is most adaptable to changes in personnel without the worry of personal frictions. Musical and spiritual rapport abound.

The more intense Brazilian flavor of Solstice is traced directly to the increase of Brazilian musicians. Highway, a festive samba, features a carnival of Brazilians, including trombonist Raul de Souza, composer Amaury Tristan on acoustic guitar, and pianist Dom Salvador, in a most convincing, melodically swaying piano solo.

Novo Ano, another super samba, is from the same session as Highway, obviously. The colorful harmonies of Lawrence's soprano and Tristan's voice are outstanding. Indicative of Wayne Shorter's Native Dancer, Novo has much more fire and drive and much less subtlety—all functions of the contrasts between Shorter's introverted approach, and Lawrence's extroverted playing and outgoing personality. Guilherme Franco, percussionist and drummer here, contributes his musical share in brushwork, and I mean Brazilian brushwork, paralleled only by fellow countryman Airto (with Return to Forever).

Point of Light is from the additional taping for this album and features such luminaries as Ron Carter, and Tyneresque Al Dailey. What a big sound these guys produce. Al Dailey plays so much piano. Of course, it's the rhythmic and melodic genius of one Ron Carter that supplies the life foundation to this energy laden composition. Carter's role in this most progressive situation is ideally comparable to his role in Trident (Milestone 9063, an unequalled trio album in 1975; mixing the talents of Elvin Jones, Tyner, Carter). In both cases he is free of the harness he wears at CTI, where sweet, overproduced commercialized jazz has practically overtaken the firm's adventurous progressive beginnings.

Lawrence knows his axe. He knows harmony, melody and the works. Solid direction and a potent sound crystallize his efforts into a musically and
Who's #1 in audio equipment?

Three famous national component brands, each with fine equipment at all the traditional price points, each with fine magazine ratings and lots of customers. Naturally we at Radio Shack like to think Realistic is top dog. Our reasoning goes like this: Realistic has over 4600 stores — the entire worldwide Radio Shack system — and 21 years of manufacturing experience. Realistic has exclusive Glide-Path* and Auto-Magic* controls. An audio consultant named Arthur Fiedler. Service like no tomorrow. And prices like yesterday.

Maybe a better question is who's #2?

Radio Shack

A Tandy Company

Great sound since 1921

Over 4600 Stores - Dealers - USA, Canada, England, Australia, Belgium, Germany, Holland, France, Japan

*Registered Trademark

Free Speaker Catalog

A 36-page compendium of stereo speaker kits, raw speakers, accessories and tips on how to build high quality speakers in the privacy of your own home.

Practically a manual on speaker building, our catalog features two, three, four-element and folded-horn speaker designs in forms ranging from parts only to completely assembled.

Over half the catalog is devoted to the person who wants to build his own speakers totally from scratch using our extensive array of tweeters, midranges and woofers, including exponential horn/drivers.

Send for it today with the coupon or by calling our toll-free number, 8 am - 3 pm, Pacific Time, Mon-Fri.

I'm interested. Send me your free catalog.

NAME
ADDRESS
CITY STATE ZIP

Realistic STA-84 Stereo Receiver
About $300

Pioneer? Marantz?

technically brilliant performance. While he has learned from Trane, his exploration of different ground is revealed, upon closer inspection. If I could pick only a handful of artists to listen to, you can believe Lawrence (Summer Solstice) would be one.

Eric Henry

Performance: A
Sound: B+

The Tommy Flanagan Tokyo Recital:
Tommy Flanagan
Pablo 2310-724, stereo, $6.95.

I understand that, to date, sales of this splendid album stand at a paltry 6,000 copies—so much for the taste level of the mass record consumer. Alas, Tommy Flanagan isn’t going to appeal to the shop girls, secretaries, and students who frequent the discos and buy millions of Elton John, Diana Ross, and Earth, Wind & Fire recordings.

Flanagan is also unknown to the ‘crossover’ audience, those quasijazz fans who boogie ecstatically to the latest sounds of Herbie Hancock and Chick Corea. It is a handful of buffs that provide the meager support for artists like Tommy Flanagan, and that’s why he has submerged himself in his role as ace accompanist to popular singers. In the 60s he worked with Tony Bennett, and for the past six or seven years he has supported Ella Fitzgerald who, these days, needs all the help she can get.

During the periods when Ella isn’t working, Flanagan gets a chance to do his own thing (Ella rarely gives him a solo); he works occasional gigs at Bradley’s, an excellent piano room in NYC’s Greenwich Village, and last year he joined Norman Granz at the Tokyo Jazz Fair where Granz was astute enough to record this superb set of Ellington/Billy Strayhorn tunes.

Flanagan, one of the finest interpreters of Bud Powell’s bop piano innovations, is a soloist of impressive rhythmic and melodic gifts; I’ve never heard him when he doesn’t play with taste and a supple flow of invention. On this recording, his keyboard agility is a dazzling display on numbers like Caravan, Mainstem, and Take The A Train, all crisp, precise performances performed with a light, driving swing. Flanagan gets fine support from drummer Bobby Durham and particularly bassist Peter Betts, a powerful accompanist whose brawny style provides excellent little fills when a space opens up. On the Ellington/Strayhorn ballads, the two rhythm men respond beautifully to Flanagan’s changes in mood, tempo, and feeling. Their rap-
Sound: B  Performance: A+


When Mercer Ellington took over the helm of his father's band the day after Duke's funeral to honor a commitment in Bermuda, he had, to put it mildly, severe personnel problems. Of course, the "pianist" had to be replaced; indeed, the bodies of two Ellington stalwarts, Duke's tenor man of 20 years, Paul Gonsalves, and Ellington's long-time vibest and trombonist Tyree Glenn were both lying in the same funeral home along with the maestro.

Mercer Ellington still had two of the greatest Ellington veterans, baritone Harry Carney, the rock on which the band was built for almost 50 years, and trumpeter Cootie Williams. Sadly, Carney was to pass away in the next few months though fortunately not until he recorded two cuts on this album, Blue Serge and Drop Me Off In Harlem, where his authoritative, robust sound makes its presence felt. Carney's replacement, Joe Temperley, makes a good stab at the baritonist's tone and phrasing on a tribute piece called Carney. Mercer Ellington's replacement for his father on piano is one Lloyd Mayers who utilizes the Duke's florid, flowing inflections, spare chordings, and dazzling arpeggios. New tenor sax man Ricky Ford is an admirable addition to the Ellington ranks and does a standout job on Happy Go Lucky Local. But overall, since these sides were made in 1974 and early '75, the ensemble sounds tentative; the rhythm section doesn't always kick. I understand that in the past year, the band's performances have greatly improved; if Mercer can hold the group together and the musicians get a bit more adrenalin into their playing, perhaps the spirit and music of Duke Ellington can be preserved.

John Lissner

Sound: A  Performance: B

An Excellent Loudspeaker Needn't Cost A Fortune.

The Polk Audio Monitor Series.

These three loudspeakers cost $99, $129, and $189 each. They sound remarkably similar to each other. They also sound remarkably similar to speakers which sell for three, four, or five times as much.

The Polk Audio Monitor Series all incorporate a one-inch soft-dome high-frequency unit, a phase-coherent crossover using large air core coils, six-inch ultra-low mass plasticized upper bass-midrange drivers, and fluid-coupled low-resonance sub-bass radiators. The sound is natural, boxless, and of consistent high definition.

We invite you to visit the finest audio salons to compare our speakers with the best made (costing up to $4000 a pair). Be ready for an earopener.

Write us to find out where.

polkaudio
4900 Wetheredsville Road
Baltimore, Maryland 21207

FREE McIntosh CATALOG
and FM DIRECTORY

Get all the newest and latest information on the new McIntosh Solid State equipment in the McIntosh catalog. In addition you will receive an FM station directory that covers all of North America.

MX 113
FM/FM STEREO - AM TUNER AND PREAMPLIFIER

SEND TODAY!

McIntosh Laboratory, Inc.
East Side Station P. O. Box 96
Binghamton, N. Y. 13904
Dept. 1

NAME

ADDRESS

CITY    STATE    ZIP

If you are in a rush for your catalog please send the coupon to McIntosh.
For non rush service send the Reader Service Card to the magazine.

Check No. 20 on Reader Service Card

Audio • August, 1976
FOR SALE

ANTI-SKATING for AR TURNTABLES!! Proven counterweight design of nickel steel & aluminum construction. In-stall yourself in minutes. $7.00 postpaid. (Dealer inquiries invited.) AUDIO INNOVATIONAL PRODUCTS, P.O. Box 1607, Portsmouth, N.H. 03801

SUPEX — ORTFON — OTHER MOVING COIL CART-RIDGE OWNERS; Send for free literature on our Micro-Preamp Superb performance at $89.95. Huntington Electronics, Box 2009-A. Huntington, Conn. 06484

ELECTRONIC CROSSOVERS—ALL TYPES. Updated definitive brochure describes applications, how to improve speaker systems; $5.00 postpaid, credited to first purchase. Huntington Electronics, Box 2909-A. Huntington, Conn. 06484.

LOWEST DISCOUNT PRICES ANYWHERE on audio equipment. All major brands discounted. Write for quotes. K&L Sound Services, 75 N. Beacon St., Watertown, Mass. 02172

WESTCHESTER AND FAIRFIELD COUNTY AUDIOPHILES TAKE NOTE! THE AUDIOPHILE, 201 Bedford Street, Stamford, Conn., carries pre-press equipment for the connoisseur: G.A.S. Kess Model One, ADC Crown, Dahlquist, Dyna, Epiphany, Infinity, Philips, SAE SME, Stax, TEAC, Technics, Thorens, Soundcraftsmen, Denon, Sonus and many more. (203) 348-3551 (Closed Mondays)

ATTENTION DYNAVOX OWNERS. Our Dyna Double 4000 modification with 16 output transistors, front end bypass, and 80 000 mild power supply is twice as fast and twice as strong as a stock ST-400. Our Super-PAT-5 has lightning fast ICS and improved high gain phon section. With a Denon DL103S straight in, these Super Dynakits show you just how great our Fulson /s and Magneplanes will play. JENSENS STEREO SHIP, where State of the Art is affordable. 2202 River Hills Drive, Burnsville, Minnesota 55337 612-890-3517

ATTENTION DYNAPACK COMPONENTS AT TREMENDOUS DISCOUNTS! Write En Joy Sales, Horleyway, Ontario.


DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF FT. WALTON BEACH 652-0 BEAL PKWY. N.W., FT WALTON BEACH, FL 32548

JBL SA-650 integrated amp 70/70W $225. Micro Acoustics DDC-1 elecctret cartridge brand new w/warranty card $75. Mark Levinson JC-1 pre-amp $100. call (213) 392-1466-1466

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF ATLANTA 6, 7, 8 BELVEDERE PLAZA SHOPPING CENTER, 1203 COLUMBIA DRIVE, DECATUR, GA 30032

D I L L O N S D E P T. for all your professional audio requirements. Bottom line oriented. F.T.C. Brewer Company, P.O. Box 8057, Pensacola, Florida 32505

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF SARASOTA 6546 GAY TAKE AVENUE, SARASOTA, FLORIDA 33581

BUILD YOUR OWN SPEAKERS AND SAVE UP TO 50% You can assemble your own high quality, multi-element stereo speakers in a few hours and save up to half the cost of comparable speakers. Send for our free 32-page catalog of speaker kits, raw speakers and accessories. SPEAKERLAB, Dept. AZ. 5500 — 35th N.E. Seattle, WA 98105

ADDITIONAL WESTERN NEW YORK AUDIOPHILES The word is getting around!! Our personalized, hon. at service and quality equipment make a winning combination. In addition to the incomparable AUDIO RESEARCH line (T-15's black/natural in stock), we carry AMPZILLA, SAE I base Linear, Yamaha, Quinnesence, LEVYNSON, B&O, IMF, MAGNE-PAN, MAK Subwoofers, Hegemon, infinity, RTR. ESS, DAHL-DIQUIST, Fulton Music, QUATRE, Deoxy, Connexions, Technics, Thorens, Dynaco, Transistors, Cerwin Vega. Soundcraftsmen. Supex, Ortofon, ADC, Micro-Acoustics, Damped SME, Linn Sandek, KMAL, Naim Audio, etc. The Stereo Emporium, 3407 Delaware Ave., Buffalo, N.Y. 14217 (716) 874-3372

DKL SOUND LAB DKL SOUND LAB DKL SOUND LAB

A COMPLETELY NEW APPROACH TO LONG DISTANCE/MAIL ORDER SALES OF PERFECTIONIST AUDIO COMPONENTS. FEATURING:
A) A CONTINUOUS EVALUATION PROGRAM OF NEW PRODUCTS TO MAINTAIN A SELECTION OF ONLY THE FINEST AUDIO COMPONENTS AT SEVERAL PRICE LEVELS
B) AT YOUR REQUEST, A COMPLETE WRITTEN LABORATORY CHECK-OUT AND LISTENING TESTS PERFORMED ON YOUR COMPONENT PURCHASE BY THE DKL LABORATORY, INCORPORATED
C) ALL ITEMS IN STOCK FOR IMMEDIATE SHIPMENT. PRICES INCLUDE SHIPPING INSURANCE BY SURFACE TO ANYWHERE IN CONTINENTAL UNITED STATES. AIR FREIGHT AND FOREIGN SHIPMENTS ALSO AVAILABLE
D) A WIDE SELECTION OF GOODS CONSIDERED "STATE-OF-THE-ART" BY LEADING AUDIOPHILE AUTHORITIES PLUS COMPONENTS JUGGED "BEST SOUND PER DOLLAR" INCLUDING AUDIO RESEARCH DBX IMF (FRIED) MAGNEPAN STAX

REVOX KEITH MONKS (KMAL) DYNACO DKL CUSTOM PRODUCTS LUX AUDIO (LUKMAN) QUATRE

DUNNOU B&O, IMF, LUXON DYNAMO DKL CUSTOM RABCO AMBIPHON

BROWSE PG-10 CUSTOM SOUNDFIELD LABS DYNAMO

480 WASHINGTON STREET SOUNDBRAINAME M&K SOUND (BOTTOM END) TANNY

SUPER SONIC RESEARCH (GENUS)

RTR INDUSTRIES MAKE YOUR MUSIC COME ALIVE THE DKL SOUND LAB SPECIALIZES IN COMPATIBLE COMPONENT COMBINATIONS OF EVERY DESCRIPTION DESIGNED TO MAXIMIZE THE SONIC POTENTIAL OF YOUR SOUND SYSTEM CALL OR WRITE OUR SOUND ENGINEERS FOR AUTHORTATIVE RECOMMENDATIONS TO INCREASE THE DEFINITION AND DETAIL OF YOUR PRESENT SYSTEM

DKL SOUND LAB 943 BONIFANT ST. SILVER SPRING, MARYLAND 20910 (301) 586-6257

SHOWROOM HOURS: DAILY & SATURDAY 10AM-6PM CLOSED SUNDAYS "WE MAKE YOUR MUSIC COME ALIVE"

AUDIO • AUGUST, 1976
FOR SALE

BATTERY OPERATED, HANDHELD AUDIO OS- CALATOR, 30 Hz, 400 Hz, 1 kHz, 15 kHz, with balanced output. Ideal for testing, alignment, trouble shooting. Use to check frequency response, distortion, gain, crosstalk, noise—$58.95 postpaid. TIMEKEEPER, P.O. Box 35, Great Neck, N.Y. 11021

INFINITY 200DA speakers - $350 pr., SAE 318 amp - $140. Excel cond. R. Johnson, 726 Avon Fields Ln., Cincinnati, Ohio 45229 (513) 861 4318

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF TALLAHASSEE 118 APALACHEE PARKWAY, PARKWAY SHOPPING CENTER, TALLAHASSEE, FLORIDA 32301

AMPEX TAPE - NEW 1880' on 7 reel 12 for $18 POST-Paid; 1200' 12 for $13 POSTPAID - free list — WIDE RESPONSE, 6114A SANTA MONICA BLVD., HOLLYWOOD, CA 90036

FREE SAMPLE! World's only audiophile's classified news letter. AUDIOMART, Box 821, Stratford, Connecticut 06497 SUBSCRIBE! $5/12 issues

HEATHKIT AR15 Receiver, $150. Tel. 513-549-2957 Moyer.

MINNEAPOLIS
— Dedicated To The Reproduction Of The Original Sound — Audio Research, Bang & Olufsen, Klipsch, Audionics, Radford, Revox, Linn, Sansuk, Crown, dbx, SeQuerra and others...

THE SOUND ENVIRONMENT
Butler Square, Suite 114, 100 North Sixth Street, Minneapolis, Minn. 55402 (612) 239-1941

SEATTLE, WASHINGTON
Definitive Audio is a group of engineers and audiophiles whose primary goal is to provide the discriminating listener with the finest sound reproduction that current technology can produce. We are currently recommending the following products: Audio Research, Mark Levinson, Dynaco (modified), Dunlop Clarke, Magneplaner, Quad, Yamaha, Audiophiles, Pana, Radford, Denon, Nakamichi, Sansuk, Quad, Linn, Sansuk, DBX, Oryx.

DEFINITIVE AUDIO
3414 N.E. 55th
Seattle, Washington
98105
(206) 524-5633

DYNAMICS, Ace Audio. Philips Drivers. Lowest quotes. All Kits, Box 864, Dayton, Ohio 45405

FOR SALE

NOW ALMOST 14 YEARS OLD, STEREOPHILE has become the most widely copied audio publication of them all. It should be. We pioneered subjective testing (by ear), devised a unique vocabulary for describing nuances of reproduced sound, proved that a subscriber-supported magazine could be blunt without being crass, and led the industry by demanding higher standards of reproduction fidelity than it could provide. STEREOPHILE is not for the neurotic competitive who must own the Best On the Block, but for the listener who wants the most natural possible reproduction of music. Only 57 for 4 issues, or write to STEREOPHILE, Box 48S, El- wyn, Pa. 19026 for details.

TAPE ClSDESED dozen reals. 1200 $800 postpaid guaranteed Mitchell. Box 132A, Flushing, N.Y. 11367

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF ST. PETERSBURG, 1915 Park Boulevard, North Safety, Florida.

MAGNAPAN, B&O, Phase Linear, Klipsch, Barkey cabinets, and many more. INTERMEDIATE PLUS AUDIO, 30 Bay, N. Fed Hwy., Ft. LAUDERDALE, FLORIDA 33306. (305) 556-3511

STEREO ONE FAIRFIELD, CONN.

Fried the exceptional listener who demands purity and fidelity of sound, we have carefully evaluated and offered:

MARK LEVINSON

STEREOTECH

MCTVISION

ROITZ

BEZOUT

DAHUOST

NAMAKICHI

LINS SODER

MKANS/BRAUN

AKG

YAMAHA

STAX

BANG & OLUFSEN

TDK

DENON

MAXELL

SUPEK GRACE

PHASE LINEAR

DORTOFON

M.K. BOTTOM END

WE PAY FREIGHT.

STEREO ONE INC.

1229 POST RD.

FAIRFIELD, CONN. 05430

PHONE 203-255-5939


DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BIRMINGHAM # 2, 203 SOUTH 18TH STREET, BIRMINGHAM, ALABAMA 35223

HIGHEST QUALITY EQUIPMENT USED: IMF Studio B, $300 ea; IMF AL40A, $250 ea. All PTF, (2 new). $250 ea. IMF 4070 deck, $1250, JBL-SB system in enclosure $750 ea. JVC PST-1000 pre-amp, $200; Crown DC000A $500, Sony 2000 pre-amp, $350, Tandberg 9000X deck, $350; Sony IT5-3000A w/Vestigial arm, $250; McIntosh MR55 tuner; $150; Marantz 3300 pre-amp, $280; Marantz 250 amp, $500; Marantz 500 amp subwoofer; Citation A pre-amp, $15. Transistors, Skeleton turntable w/arm, $250; Decca Leen- don ribbon tweeters, $50 ea. Marantz 20B tuner, $550. H 1000 deck, $250; McIntosh MC12 spks. $425 ea; Thorens T0125 w/SMC, $325; Four (4) Dayton-Wright XDB CYP w/power supply, $200. All guaranteed 90 days parts & la- bor. Audio Consultants, Inc. 517 Davis St. Evanston, Ill. 60201. (312) 864-9555

 został identyfikowany z obrazkiem:
FOR SALE

massachusetts

tripod audio offers you advice on & demonstrations of the finest equipment available. Our emphasis is on giving you the best sound/dollar value we can. Our suppliers include... ampulla • dahliquist • bang & olufsen • thadra allison • yamaha • A.D.S. • nakamichi • advent • star techics • denon • revò • quintessence • kenwood • avid • audio pulse • docca

tripod audio
219 main northampton
(413) 587-6988

WELL CARED FOR—ampulla S550, ARC WA Bass panels S600, ARC EC-3A crossover S500, 18" Hartley woofer. $150. Citation Twelve S175, Backyard design 10 cabinet $150, React ESP & headphones $90. Pioneer 3-way crossover S65. These little used cartridges. Denon 100S $95, Spx 901 and RB pre-amp $175, DBP 15 $50. Supercap switchable transformer $30 Doug Robinson. Waterlou, New Brunswick 28-2589.

AN INTRODUCTION TO MUSIC through practical, reliable design Speakers from $230 to $800 per employing amplitude-phase compensated crossovers. All Class A differential input Pre-Amplifier with only 23db of feedback, unparalleled construction. 2/70. Write us for dealer nearest you. Delmar & Regine invites invite SEL Inc. 315 S. Fourth St. Manhattan, Kansas 66502.

DON'T PAY THE HIGH MAIL ORDER PRICES. THEIVES WAREHOUSE OF JACKSONVILLE, 6078 OLD ST. AUGUSTINE ROAD, JACKSONVILLE, FLORIDA 32217.


NORTHEAST AUDIOPHILES THE FINEST IN AUDIO COMPONENTS—Audio Research, Audiosonics, Belcrunder, Cambridge, Canton, Dahl- iquist, Dayton Wright, Decca, Dense, Dunlap Clarke, Dynaco, Fidelity Research, Fulton, Formula 4, Gale, grace, Hartley, Linn Sandel, Magneplan, Mark Levinson, Nakamichi, Ortofon, Polk, Quad, Quatre, Quintessence, Raydor, Soundscanners, Share, Speaker, Stax, Supex, Tandberg, Technics, Yamaha and Custom Designed Superwoofers. HARTLEY ELECTRONICS AND THE TIN EAR STEREO CENTER, 1502 BUTTER- NUT, RICHMOND, WA 98352 (509) 946-4658 until 6:00 pm, then 946-1529.

AN IMPORTANT ANNOUNCEMENT Parnassus Audio is now producing a full Class A (not AB) stereo power amplifier capable of relatively high output power. The amplifier additionally satisfies the theoretical criteria for completely eliminating transient intermodulation distortion. The difference in sound quality between this amplifier and conventional amplifiers is easily audible, even to the inexperienced. We welcome requests for a descriptive brochure. Dealerships will be limited. Address all inquiries to: PARNASSUS AUDIO, INC. 2918 Harper Street, Berkeley, California.

DON'T PAY THE HIGH MAIL ORDER PRICES. THEIVES WAREHOUSE OF KNOXVILLE 5710 KINGSTON PIKE KNOXVILLE, TN 37919.
SAXITONE
Bicentennial Tape Shoppe
1776 Columbus Rd NW Wash, D.C. 20009

INFINITY SERVO-STATIK k: rosewood: completely factory restored, shipped from factory in sealed cartons $1400
Write J. Greggs P.O. Box 364, Vailcana, Hawaii 96785


HIGHEST QUALITY vacuum tubes for audio. We carry low noise 12AX7's, 128LS 's and all others in the major imported: Domestic brands. Tendertron Electronics Ltd. 138 69 Francis Louis Blvd Rosedale, N.Y. 11422. Tel. (212) 978-5896

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BETHESDA. P.O. Box 34251. WEST BETHESDA, MD 20034

PERFECTIONISTS DYNASTY Before You Purchase You Owe It To Yourself. Our Free Catalogue. II 971 Fronebisher Johnstown, Pa. 15902


AUDIO BREAKTHROUGHS 1081 Northern Boulevard, Manhasset, New York 11030 (516) 627-7333

QUALITY AUDIO MONITOR SERIES AUDIO BREAKTHROUGHS new has an demonstration the remarkable new Polk loudspeakers. Compare them to the finest loudspeakers in the world. Both the Seven ($129.00 ea.) and the Ten ($189.00 ea.) utilize high definition polymer laminate bass-midrange drivers, wide dispersion soft dome tweeters and fluid coupled sub-bass radiators. They are capable of reproducing a highly defined phase accurate three dimensional sonic image which rivals the thousand dollar super speakers. They sound great with a small receiver, yet reveal the fine subtleties of state of the art electronic devices like Le- vinson and G.A.S. Shipped free in U.S. Send for free bro- chures on Polk or our other line. ADDRESS: AUDIO BREAKTHROUGHS, 1651 Northern Blvd. Manhasset, L.I., N.Y. 11030 516-627-7333

PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c.

INFINITY SERVO-STATIK k: rosewood: completely factory restored, shipped from factory in sealed cartons $1400
Write J. Greggs P.O. Box 364, Vailcana, Hawaii 96785


HIGHEST QUALITY vacuum tubes for audio. We carry low noise 12AX7's, 128LS 's and all others in the major imported: Domestic brands. Tendertron Electronics Ltd. 138 69 Francis Louis Blvd Rosedale, N.Y. 11422. Tel. (212) 978-5896

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BETHESDA. P.O. Box 34251. WEST BETHESDA, MD 20034

PERFECTIONISTS DYNASTY Before You Purchase You Owe It To Yourself. Our Free Catalogue. II 971 Fronebisher Johnstown, Pa. 15902


AUDIO BREAKTHROUGHS 1081 Northern Boulevard, Manhasset, New York 11030 (516) 627-7333

QUALITY AUDIO MONITOR SERIES AUDIO BREAKTHROUGHS new has an demonstration the remarkable new Polk loudspeakers. Compare them to the finest loudspeakers in the world. Both the Seven ($129.00 ea.) and the Ten ($189.00 ea.) utilize high definition polymer laminate bass-midrange drivers, wide dispersion soft dome tweeters and fluid coupled sub-bass radiators. They are capable of reproducing a highly defined phase accurate three dimensional sonic image which rivals the thousand dollar super speakers. They sound great with a small receiver, yet reveal the fine subtleties of state of the art electronic devices like Le- vinson and G.A.S. Shipped free in U.S. Send for free bro- chures on Polk or our other line. ADDRESS: AUDIO BREAKTHROUGHS, 1651 Northern Blvd. Manhasset, L.I., N.Y. 11030 516-627-7333

PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c.

INFINITY SERVO-STATIK k: rosewood: completely factory restored, shipped from factory in sealed cartons $1400
Write J. Greggs P.O. Box 364, Vailcana, Hawaii 96785


HIGHEST QUALITY vacuum tubes for audio. We carry low noise 12AX7's, 128LS 's and all others in the major imported: Domestic brands. Tendertron Electronics Ltd. 138 69 Francis Louis Blvd Rosedale, N.Y. 11422. Tel. (212) 978-5896

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BETHESDA. P.O. Box 34251. WEST BETHESDA, MD 20034

PERFECTIONISTS DYNASTY Before You Purchase You Owe It To Yourself. Our Free Catalogue. II 971 Fronebisher Johnstown, Pa. 15902


AUDIO BREAKTHROUGHS 1081 Northern Boulevard, Manhasset, New York 11030 (516) 627-7333

QUALITY AUDIO MONITOR SERIES AUDIO BREAKTHROUGHS new has an demonstration the remarkable new Polk loudspeakers. Compare them to the finest loudspeakers in the world. Both the Seven ($129.00 ea.) and the Ten ($189.00 ea.) utilize high definition polymer laminate bass-midrange drivers, wide dispersion soft dome tweeters and fluid coupled sub-bass radiators. They are capable of reproducing a highly defined phase accurate three dimensional sonic image which rivals the thousand dollar super speakers. They sound great with a small receiver, yet reveal the fine subtleties of state of the art electronic devices like Le- vinson and G.A.S. Shipped free in U.S. Send for free bro- chures on Polk or our other line. ADDRESS: AUDIO BREAKTHROUGHS, 1651 Northern Blvd. Manhasset, L.I., N.Y. 11030 516-627-7333

PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c. PROTECT YOUR LPS. Poly sleeves for jackets 50c round bottom. Inner sleeves 7c Poly lined paper sleeves 15c White jackets 25c.
FOR SALE
BUILD YOUR OWN SPEAKERS AND SAVE UP TO 50%

For more information write for your free high quality multi-page stereo speakers catalog. It’s a true money-saver and brings you to the top of the hi-fi hobbyists’ league. Send 25¢ for your 30-page catalog of speaker kits, raw components and accessories.

SPEAKERLAB
Dept. A, 13350-Burnt Rd
Seattle, Washington 98105

WESTCHESTER, FAIRFIELD COUNTY
THE LISTENING ROOM INC.
590 Central Park Avenue
New Rochelle, N.Y. 10803
(914) 472-4538

Cordially invites you to audition the fine line of equipment.

P.O. and inquiries
SOUNDSCRAMS
THEADRA
AMPZILLA
Cordially invites components. Components Center,
(413) 773-3505
Offer. Roger Weld, 163 Davis th”, 1”

We ship
JANIS
available.

megohms for 31hc

THIEVES WAREHOUSE
CARTRIDGES AND STYLUS REPLACEMENTS

2”

THIEVES WAREHOUSE
Resistors

-1/4W,

from

10038
10-4.7
19108.

Other

1915

1915-1/2

Ave., Absecon, N.J.

462-0984

PAY THE HIGH

1

Box

683

683

Box

919-449-

919-449-

FOR SALE
SUB WOOFERS
+ FREE PASSIVE X-OVER DESIGN W/PURCHASE +

ENGINEERED ENCLOSURE & CROSSOVER DES-
Signs — free w/our purchase of professional series J.B., Atco, Comm-

city & Guess raw drivers + radial horn/diffraction lenses. Some Engineering Labs, 114 Old York Rd, Willow Grove, Pa 19090 (215) 669-9251

+ LOUDSPEAKER RECONSTRUCTION +

DYNACO STEREO 120 Cabinets, with VU meters. Literature
? Geometria, Box 612, Mexico, Mo. 65205

ATTENTION AUDIOPHILES
Ampeg, Burven, Daughstt. Decca, Denca, Dynaco (Medi-

fied), Ferrograph, Fulton E and J Subwoofers, Grace, IMF, Kiss Speaker, Lecon, Lux, Magnepan, Mark Levinson, Fons, M & K, Quad. Quinmestence, Quatre, Sarx, Sain, Stanas, Tech-

nicians, Transcript, and many others. All equipment precision and guaranteed to meet specifications, and shipped prepaid and insured in continental U.S. AUDIOPHILES' SOUND STU-

DIO 7459 Elmwood Ave., Middleton (Madison), Wisconsin 53562 Phone 608-830-3007

FAIRFAK TOP RATED FX360 SPEAKERS superb line

and advances.

Our...

GRACE

SALE — NOISE

OF

KEF

SPEAKERS AND

FILTERS.

SPEAKERS

or

mail.

20910. (301) 585-1118.

MAIL

MAIL

Central Park Avenue

2

Seattle, Washington 98105

5500351n

SAN FRANCISCO BAY AREA, Greenwood Sound Inc. has

moved to Talo Alto Ca. Call Talo Alto information for number or write Greenwood Sound. P.O. Box 3698, Stanford Ca

94305

ILLINOIS AND INDIANA audiophiles. Audition the ex-

traordinary ALLISON ONE and TWD at the SOUND SHOP.

Champaign. 217-359-3774

DON'T PAY THE HIGH MAIL ORDER PRICES.
THIEVES WAREHOUSE OF PENSACOLA
2769 LAKEWOOD AVE. S.W., ATLANTA, GEORGIA 30315

DEALERS: We will buy your excess stock. ALL lines, no quantity too large or small. Cash paid immediately. Call Lou 617-924-0561

SUPERIOR PRODUCTS AT LOWER PRICES.
B&W, Decca, IMT, Leak, KML, Naim, Quad, Linn Soundek, Stax, many others.

THE SOUND AFFAIR, 364 Mission Court, St. Louis, Mo. 63130 (314) 863-6037

DON'T PAY THE HIGH MAIL ORDER PRICES.
THIEVES WAREHOUSE OF ATLANTA
3164 PEACH TREE RD. N.E., ATLANTA, GEORGIA 30303

CROWN SX-724 30 Hrs. New Warranty Walnut Case $900

Thomas Guyette
2508 E, Milikane Pl # 3

Milwaukee, Wisc. 53211

414-332-6813

DON'T PAY THE HIGH MAIL ORDER PRICES.
THIEVES WAREHOUSE OF ATLANTA
4166 BUFORD HIGHWAY, N.E., ATLANTA, GEORGIA 30345

DON'T PAY THE HIGH MAIL ORDER PRICES.
THIEVES WAREHOUSE OF ATLANTA
1030 3 CHEROKEE ROAD, Smyrna Georgia 30080

HEWLETT-PACKARD 333A distortion analyzer. Never used
513-267-2395

AUDIO RESEARCH D015 amp. Linn Sondek and Sony TTS
3000 turntables, transformers arm with - Super XD-300 cartridge, mint condition. Walker 201-746-2794

MAGNEPLANAR Tyman II's. Black, good condition, S575.
Audio Research SP3A-1, mint, S500. Bath with war-

ranty transfer 415-282-7275

SIEMENS LOW-NOISE vacuum tubes Available. For price or type contact Jim Wallace, at 201 McMahons Drive, Mon-

treal, P.Q. 15146 (412) 373-2602

DUNLAP CLARKE ANALOG ENGINEERING
SPECTRE-Acoustics GRADE-PRODUCTS
Where in the MG-DC area do you audition these products?
Only at BEETTER SOUND INC. Also listen to the NEW EZE-
KIEL LOUDSPEAKERS using aluminum dome tweeter and
cage drivers, offering the high definition of electrostatics with wider dynamic range and FLAT FREQUENCY response from 100 Hz.

Call or Write
2710 George Rd Silver Spring M.d. 20910
301-587-7877

FOR SALE
919-449-4132

DON'T PAY THE HIGH MAIL ORDER PRICES.
THIEVES WAREHOUSE OF PENSACOLA, 2. 3820 NORTH 8TH AVENUE, PENSACOLA, FLORIDA 32503

DISCOUNT PRICES on stereo components. All major brands. Write for quote. Seabase Stereo Sales, 204 Woodcrest Ave., Aberdeen, N.J. 07720

-DCATALOG SPEAKER CATALOG

Up to date. Top quality drivers. Hop-up the speakers you have or build new ones. Transmission line speaker plans S5.00-Foam damping material. E & E Audio, 1861 Church Ave., Brooklyn, N.Y. 11226 (212) 462-0364

CROSSTOWN—Custom designed, fully tested, guaranteed quality. Free Brochure. Write Networks, Box 458, Placentia, Ca. 92670

MODIFICATION KITS
MODIFICATION KITS
MODIFICATION KITS

The DLK Laboratory. Incorporate proudly announces the new kit versions of their now famous modifications for

DYNAPAS(I) PRE-AMP
STEREO 70 AMPLIFIER
INFINITY 2000A SPEAKERS

Offering Tighter Bass, More Transparent MID- RANGE, Much Lower Distortion & Increased Definition, the new DLK Mod Kits greatly improve sound performance at a reasonable price.

For details, contact
DLK LABORATORY, INCORPORATED
BOX 883
SEVERNA PARK, MARYLAND 21146
(301) 588-6257

DON'T PAY THE HIGH MAIL ORDER PRICES.
THIEVES WAREHOUSE OF ATLANTA, 1416 JONESBORO RD., ZAYRE CENTER, FOREST PARK, GA. 30305

FACTORY SEALLED CARTRIDGES:
SC-102A, 2121, 2117
Sony 189-2, 398-4. TC 177. BA-5000/7000m Geneman 1, 2.
2 Sub Woofer, Sansui CA 3000, BA 5000 Dynasty 150, 300,
400. 400M 410 EMP 40A. AL 50 STUDIO III C, R & N
O. Janzen 412 A 412 HP, 600 a Fairfield WALL OF
Sound. Other gear: Inquire Hal Duvall 4111 W Persh Rd
Chicago, IL 60615. (305) 255-4207 or 325-7352 (Day)

FOR SALE - MARANTZ 1000 amplifier, two months old like new. $1155 Larson Benson Jr. R. 1 Box 368-L. Sardis, Miss. 38666

SP-10 direct drive turntable. Hartley 24" woofers. $191 449-$

DON'T PAY THE HIGH MAIL ORDER PRICES.
THIEVES WAREHOUSE OF MOBILE/VILLAGE SQUARE, 301 SOUTH CRAFT HIGHWAY, MOBILE, ALABAMA

AUDIO • AUGUST, 1976
CUSTOMIZED TUNED ROCK PA's
Expandable high intensity touring/permanent sound systems
including narrow band, large area sensitive response environmental
equalization (+ 1 dB at your ear) room design/measurement/correction, free engineered enclosures
+ 18dB X hundreds of customized professional products
including: fiberglass horns, coaxial comp./lim./
peak limiters, continuously variable electronic crossovers, an-
alog/digital/ acoustic delays, omnispeakers, flangers, reverber.
delay, doubling/tripling, p.a. noise reduction, piezo
transducers, frequency shifters, notch filters, parameters, com-
pander from 18915. Mark Levinson. Allen & Heath, Crestron, Multikan, Orban, etc.

DON'T PAY THE HIGH MAIL ORDER PRICES
THIEVES WAREHOUSE OF CLEARWATER, 15024 Gulf 10 Blvd CLEARWATER, FLORIDA 33755

DON'T PAY THE HIGH MAIL ORDER PRICES
THIEVES WAREHOUSE OF MONTGOMERY 3368 NORMAN BRIDGE RD. MONTGOMERY, AL 36105

REVOX LAMB SOUNDCRAFTSMEN
CROWN SENNERSRE
TANDBERG BAYER AKG
UFER SHURE
SONY ETA
TEAC MB VEGA

WESTERN AUDIO IMPORTS 2213 CAMINO REAL
PALO ALTO, CALIFORNIA 94306 (415) 321-0664

A PAIR OF MAGNAPANS with infinite servo-static bass system
including 100 RMS serve-bass amp./cross-over, super-
mini-amp. condition. 316-684-1584 Price $1100 each for both, speakers list $655, bass system $1400.

CLASSICAL Soundtrack, Stage. Personality Raritys. Huge
29910

SOUND ADVICE MAGAZINE—IN ITS SECOND ISSUE
INTRODUCES TWO EXCITING NEW COMPONENTS.
— THE ELECTRO-RESEARCH — AN UNBELIEVABLE
CLASSIC AMPLIFIER. A. AMPLIFIER THAT WILL CHANGE YOUR THINKING ABOUT AMPLIFIER SOUND, AND THE
PARAGON — A TUBE PREAMP THAT SOUNDS LIKE
NO OTHER TUBE PRODUCT YOU HAVE EVER HEARD.
IT HAS AWESOME BASS AND FLAWLESS HIGHS
COMBINED WITH TUBE SWEETNESS. IMPROVED
EVALUATIONS ARE ALSO CONDUCTED ON PRE-
AMPLIFIERS. AUDIO RESEARCH SP-3A-1, LATEST
LEVISON JC-2, PHASE LINEAR 4000, SONY TAE 4580,
EPICURE FOUR, DYNAPAT 5 AND SOUNDCRAFTSMEN
PE2217. AMPLIFIERS TESTED INCLUDE; AUDIO RE-
SEARCH DUAL 76A, C/M LABORATORIES 912. SAE
2580 AND TECHNIQNS $6990. CARTRIDGES EXAM-
INED ARE ELLIPTICAL (ACG) MARK V DECQA, WIN
LABORATORIES SD1-10, LATEST FIDELITY RESEARCH
FR-1 MARK II, SHURE V.15 AND SPHERICAL DENT
DL-109 (MOVING MAGNET) AND IMPROVED DL
DOLAND FOUR. SOME OTHER GOODIES: A SU-
PER MOVING COIL TRANSFORMER FROM DENON
(AUZ20), LEVISON JC-1AC, GRACE G-707 TONEARM,
LINN SOUNDE KITABLE KEITH MONKS TONESARM
AND I-AD EXANDER OUR FIRST ISSUE WITH RE-
VIEWS OF 19 POWER AMPLIFIERS AND 17 CAR-
TRIDGE IS STILL AVAILABLE COMING SOON — "DI-
RECT DISCO" — A NEW DIRECT TO DISC RECORDING
FEATURED.- TWO DISC ROCK SOUND. (WRITE FOR INFORMATION.) SOUND ADVICE — 4th
SU8S $10 ($12 FIRST CLASS, $13.50 - SENT AIR
MAIL). SOUND ADVICE, 225 Keanry, NO 20UL, SAN
FRANCISCO, CALIF. 94108.

DON'T PAY THE HIGH MAIL ORDER PRICES
THIEVES WAREHOUSE OF MONTGOMERY
3368 NORMAN BRIDGE RD. MONTGOMERY, AL 36105

CUEING FOR AIR TURNtables and others. Precision Ma-
chined. Silent damped. Easily installed. $100., postpaid.
Lyte Trading. 582 Franklin, Cambridge, Mass. 02139

MARANTZ 10-B rack mount. Thoreson TD125B with SME
3099 improved. Shure V111-511 Crown DC300A. Sound-
craftsmen RP2212. All cosmetically fine, functionally ex-
cellent. Bilt 617-846-1398

YELLOW PAGES OF AUDIO $3.95. Comprehensive refer-
ence to professional as well as consumer audio products and manu-
facturers. Free classified advertising information and
copy form available with each issue. Box 94, Colmar, Pa.
18915.

DON'T PAY THE HIGH MAIL ORDER PRICES
THIEVES WAREHOUSE OF NORTH MIAMI BEACH 1807 N E 164TH STREET MIAMI BEACH, FLORIDA 33162

DON'T PAY THE HIGH MAIL ORDER PRICES
THIEVES WAREHOUSE OF PANAMA CITY, $220 W HWY 98
SUITE D. PANAMA CITY, FLA 32401.
FOR SALE

Listen to TELEVISION IN STEREO

The TV/DOODAD EASILY CONNECTS TO ANY TV & STEREO SYSTEM. Using our easy-plugging and taping, listeners take a sizzling, expanded output from the television and deliver lossless audio directly to your home stereo. The TV/DOODAD connectors are small, high-precision metal plugs, each with two contacts for one-way audio and one-way lighting. The TV/DOODAD includes our exclusive ground loop eliminators, too.

HOUSTON AND SOUTHERN U.S.

Lucan, Dahlquist, Magneplan, Kipsch, Dunitech, Phase Linear, Advent, ADS, Citation, Russen, Supex, Denon, etc. In stock and on demonstration. Shipping prepared and insured. Audio Concepts/ Houston 2200 S W Freeway Houston, Texas 77008 713 527-0774.

10" RECORDER SPECIALISTS: fresh new Scotch L/N 3600 ft on new 1/4" metal reel $53.00. New Ampex GRANDMASTER tape on 1/4" metal reel, six $73.00. New 4 channel 8-track blank cassette loaded with 40 minutes Scotch L/N tape, $23.00 per dozen. Re-conditioned NAB metal 1/4" reel, $24.00 per dozen $18.00 on above for postage. Sound investment. P.O. 88338. Darn, woody, Ga 30338.

THIS IS WHAT WE PROMISED

I. SERVICES (free to our clients)

A. 10 Year Extended Warranty Program

Due professionally aligned & calibrated & life tested & equalized & biased & tensioned components are THAT reliable.

B. Continuous Live vs. Recorded Demos

Produced in our 99 working floor anechoic chamber, & using our Wb Bureau of Standards calibrated microphone system.

FINALLY

the ear will judge loudspeaker musical (in) accuracy in reality very interesting.

C. Sub Sonic Power Boosting Filters.

D. Loudspeaker Enclosure & Crossover

Designs, free for your raw transducers.

E. In Home Reverberation Curve & equalization & room design/correction & loudspeaker placements. Our room is neutral, yours isn't.

F. Proprietary Customized Tone Arm

Mods (s. e.g. vestal, Rubco 8-B-E, Loudspeaker Mods, Tape Recorder Mods, etc.), and mod mods and more mods (check our s.

G. Impulsed/Hard Packed cartridges, or factual boxes, microphones, recorders.

II. FACILITIES

Anechoic Chamber — 99 working floor $50,000 acoustical research laboratory Loder Speaker Receiving Lab. P.A. warranty stations.

III. CREDENTIALS

College instructors in Acoustics

Patented Inventions

Degreed Electrical Engineers

Recording & disc mastering engineers

Composers & professional musicans.

IV. MEMBERS

United Inventors & Engineers

Institute of Electrical & Electronic Engineers

Acoustical Society of America

Audio Engineering Society

V. PRODUCTS

If they pass our live vs. recorded tests & in circuit tests, & IF they last at least 10 years, & IF they sound the best, Sonics Engineering Labs, 11 1/2 Old York Rd, Willow Grove, Pa. 19090 (215) 659-9251

— AND IT COSTS NO MORE —

ATTENTION: LATIN AMERICAN AUDIOPHILES

ATTENTION: VACATIONERS VISITING THE MIAMI AREA

ATTENTION: RESIDENTS OF SOUTH FLORIDA

SOUND COMPONENTS, INC. is the place to be for state of the art stereo. Some of our products include:


TAPE RECORDERS: Uher, Otari, Braun, B&O Recorder, Yamaha RECORDINGS: A selection of British French, and German pressings. Also, the foilent, Spherey, and laboratory Audio. All of the above products are in stock and on demonstration in our 1100 sq ft. showroom.

HOURS: 10-6 Monday through Thursday & Saturday 10-9 Friday.

We accept Barcardicam and Mastercharge.

We ship material in continental U.S.

SOUND COMPONENTS, INC.

2710 Ponce de Leon Boulevard

Coral Gables, FL 33146.

Telephone 953.446.1565

TWX 810.848.7672 SUPERB PRODUCTS FOR THE DISCRIMINATING AUDIOPHILE AND MUSIC LOVER.

MILWAUKEE & WISCONSIN'S ONLY AUDIOPIE DEALER

Specialists in components by Dahlquist, Transcriptors, SAE, Nakamuk, Etc. 8-B-E, 4-E, 8-E, etc. Denon, B&O, DBX, Infinity, Revox, RTX, Phase Linear, Quested, Atoll, Vanguard and over 50 others. Wisconsin's first Audio Research dealer with the complete product line on demon- stration. PLUS— one of the truly largest display of tape decks in the entire country. Over 130 machines on display. WACK ELECTRONICS INC. 5722 W. NORTH AVENUE MILWAUKEE 53208. 414.442.3441.

MICHIGAN AUDIOPIE DEALERS:

Win Labs, Denon, Pauli, Ampmple, Transcriptors, Magneplan, Fultes, Linn, Sandek. Available at Equinox Systems, (618) 457, 2117 or Box 333. Grandville, Michigan 49418.

AUDIO RESEARCH 3C 24 N 5745 $800, shipping waiting (base, cover), $119.00; 9200 $250; JVC VLS 854, (new) $850; (base, cover), $119.00.

A FEW COMPARATIVELY priced used Revox A77 and A700 decks available. Completely reconditioned by Revox, virtually indistinguishable from new and then the standard Revox 50 day warranty for rebuilt machines. Satisfaction guaranteed. Example, A77 with Dolby, $675, plus shipping. Write requirements to ESS, Box 854, Waukegan, Illinois 60085 (513) 787-4072. Ask Ken Berger.

MASE: A UNIQUE MOVING COIL PREAMPLIFIER THAT VIRTUALLY WILL NOT ALTER SOUND. VARIABLE IMPEDANCE SWITCH EXACTLY MATCHES YOUR TUNER TO SUPER- EMF ORTOLON- FIDELITY RESEARCH ETC. CARTRIDGE FOR optimum PERFORMANCE. $229.00 DEALER INQUIRIES INVITED. MEL SCHILLING INDEPENDENTS, 7205 PO BOX 16249. CANOGA PARK, CA. 91305 (213) 348-4590.

MODIFY YOUR TUBED AMPLIFIER/ PREAMP/ CROSSOVER YOURSELF! If you can build kits, you can follow these instructions. Booklet permits dramatic improvements from new and then the standard 50 day warranty for rebuilt machines. Satisfaction guaranteed. Example, A77 with Dolby, $675, plus shipping. Write requirements to ESSI, Box 854, Waukegan, Illinois 60085 (513) 787-4072. Ask Ken Berger.

MODIFY YOUR TUBED AMPLIFIER/ PREAMP/ CROSSOVER YOURSELF! If you can build kits, you can follow these instructions. Booklet permits dramatic improvements from new and then the standard 50 day warranty for rebuilt machines. Satisfaction guaranteed. Example, A77 with Dolby, $675, plus shipping. Write requirements to ESSI, Box 854, Waukegan, Illinois 60085 (513) 787-4072. Ask Ken Berger.

AUDIO • AUGUST, 1976
FOR SALE

DYNAMIC SPECIALTIES IS A WEST COAST STORE DEALING PRIMARILY IN USED AUDIO EQUIPMENT

1. We sell and offer service for vintage tube equipment: Marantz, McIntosh, Citation, Quad, Scott, Fischer, Revox, Ampex, etc. Also Audio Research, Futterman.

2. We carry a wide range of used components, vintage and current.

3. We also sell and demonstrate certain new equipment: Fultan, Grace, Seper, F.R., Dahlquist, M&K Subwoofers, Connoiseur, PARADISE AUDIO, ERA.

4. We stock Telefunken, Mollard, Ampex, Genalex, G.E., Symphonic Vacuum Tubes.

5. We are the exclusive dealer for PARADISE AUDIO vacuum tube electronics. Audition the new Model 10 High Gain Wide Band tube preamplifier at our store. Phone for an appointment.

We Buy Sell Trade

DYNAMIC SPECIALTIES
2261 Spring Street
Redwood City, CA 94063
415-364-6634

LONG ISLAND'S NEWEST State of the Art Dealer. Purveyors of Avid, Polk, Luxman, Fultan Jr's & Es & BS's, Koss Electrostats, Quad 405, Quad ESL, IMF International Professional Mark IV monitors. Technics, Decca, Grace, Seper, ADC, Paoli. Hearing is Believing! And you can hear them all. Audio Den Ltd. 1320-34 Stony Brook Rd Stony Brook, NY 11790 516-751-3350

NATURAL SOUNO invites you to hear the FULTON J MODULAR SYSTEM, the musical speaker with phenomenal and highly articulate bass, the BVERIDGE full-range electrostatic speakers with built-in direct coupled tube amplifiers, and the LENTEK MONITORS, a ten foot transmission-line design with incredible imaging. These are three of the world's finest speakers. Hear the BRAVURA, a new state-of-the-art preamp which combines the sonic virtues of tube and transistor electronics, the SON OF AMPHILLA which is simply one of the finest amplifiers available. The Bravura and the Son of Amphilla are both moderately priced.

We hear the new and exciting equipment: Thoeb, Thaedra, DB Systems and Audio General Preamps. Quad 405 and Paoli 60M amplifiers. Armstrong Receivers, the moderately priced Fulton J System. Hear Kef 104s, 103s, and Celestion speakers. The Poli SP3a-1 Modification. Odon. Fidelity Research, and Satin cartridges on Linn Sondek and ERA turntables with Grace, KMAL and Formula 4 arms.

QUALITY PREOWNED EQUIPMENT: ARC SP3a-1, SP3, Tymphany Illa. EC3a crossover, WA bass panels, Classic Marantz System: 10b. 7c. pair of 8bs. Two pair of KLH 9s, EPA Towers. IMF ALS 40s, Dayton Wright SP7 MkII. Quad 33 and 303. Crown 150. Citation 12, and Revox A77 Braun TG1000 tape decks. If you can not visit us, call us at one of our two locations any day between noon and midnight. NATURAL SOUND. 1021 Clarendon Street, Lincoln, Nebraska 68508. (402) 475-3325 and NATURAL SOUND. 401 Worcester Road, Framingham, Mass. 01702 (617) 879-3550

CROWN INTERNATIONAL
Complete repair. Rebuild, and revoicing service for current and early model CROWN tape recorders. Used machines bought and sold. Technics, 8555 Fenton Street, Silver Spring, MD 20910. (301) 585-1118.

FORMULA 4 PROFESSIONAL LABORATORY TONE ARM only viscous pivot damping with low variable effective mass will enable all cartridges to reach their "Linear Region" of optimum performance through the us. Audio Dealers literature. $1 Bill Formula 4. 15 Heather Walk, Edgware, Middlesex, England.

OTARI MX5050 OTK 4ch./4trr Recorder $1400.00 (402) 432-2193.

KEF-B-139 wooler transmission line speaker $52.00 free plans for purchase. R.C. Sound Co. 7961-B-Independence, Mentor, Ohio 44060. (216) 255-5669

SAVE ON SACRED COWS
Bose, JBL, SAE, Thorens, Philips. Over 50 Top Brands - Write for quote - Answered in 24 hrs. SOUTHBOUND SOUND P.O. Box 52508 Atlanta, Georgia 30305

THE ULTIMATE PAS newly developed circuitry converts PAS to steering state-of-the-art contender. For surpasses any other modification service! Confidently confirmed, particularly with SKL LAB's product. Cosmetically outstanding with new anodized face and knobs. $220 for tube amps. $225 with cathode follower for solid state compatibility. $25 extra for walnut case. STEREO MODIFICATION equally unique and spectacular; cathode coupled, internally fan cooled, tailored phase margin. $200 AUDIO TWIN MEASUREMENTS P.O. BOX 16249, SAN DIEGO, CALIFORNIA 92116

DON'T PAY THE HIGH MAIL ORDER PRICES. THE EVES HOUSEWALD OF NOBLE @ 2. 301 SOUTH CRAFT HIGHWAY, CHICKASAW, ALABAMA 36811


ONTARIO QUEBEC MARITIME AUDIOPHILES SPEAKERS: Stax 4A Electrostatic, Speaker BCIII, Monitor Audio, DBW. Dayton Wright XG8 MkII, Quad, Dahlquist, Polk, Magnepan.


Tape: Dia, Reov. Nakamichi. DBX.

OTTAWA STUDIO SOUND LTD.
697 BANK ST
OTTAWA, ONTARIO K1S 5A8 CANADA
1-813-236-1097

AGFA-GAERTNER Professional PEM MASTeRPASteR, the international studio standard available in this country from TECHNARTS. 8555 Fenton Street, Silver Spring, MD 20910 301 585 1118 We accept BankAmericard on mail orders.

AT LAST: The modification that you have been waiting for! We now offer a superb tone arm installation in your B & O 4002 tonearm that allows the use of ANY cartridge. This includes a custom machined anodized tone arm, a single grade 7 minute thrust bearing, hand channeled counterweights. Price: $210.00. Dealers please inquire. Literature on request. M&K Sound, 8719 Wilshire, Beverly Hills, California.

PHASE LINEAR 4000, 700, with cases, like new. $500 and 5550. 607-772-6460

CONTROL 1 - Signal Activated Automatic power shut-off for Component Systems. $49.95. Electrodemia Design Inc. Box 26, Livingston, N.J. 07039

AUDIO RESEARCH Tymphany 3-A complete, new. Dual 76A, EC3-A crossover. 819-449-4132

USED Thaedra, mint, complete, new; Tympani 3-A, complete, new; Audio Research, Futterman. Each $25 with BankAmericard.

MADE IN USA....SACRED COWS S.A.E., Southbound Sound, 1021 Clarendon Street, Lincoln, Nebraska 68508. (402) 475-3325 and NATURAL SOUND, 401 Worcester Road, Framingham, Mass., 01702 (617) 879-3550

BUSINESS OPPORTUNITIES

OUR PORTABLE DISCO SYSTEMS could make you rich! Earn $150 night and more, playing records for parties, bars, weddings. Get in on one of the fastest growing best paying jobs. Free information

American Audio
103 Ohio Ave.
Fremont, Ohio 43420
419-334-3326

MUSICAL INSTRUMENTS

UP TO 60% DISCOUNT: Name brand instruments. Catalog Freeport Music, 114th Mtain St., W. Babylon, N.Y. 11704

S300-$1200 OFF on new pianos & organs. Catalogue. Liberi-

Music, Box 68, E. Weymouth, Mass. 02189

SERVICES

DO BRING YOUR clock radio to AUDIOCLINIC for repair. BRING YOUR receiver, amplifier, tuner, tapedeck or turntable for expert repair or routine maintenance.

MAKE SURE your electronics are delivering what you paid so dearly for!

WE SPECIALIZE in cartridge installation and adjustment using the EMPIRICAL approach.

WE DON'T SELL anything except service. All work fully guaran-

teed. OUR TURNOVER TME on components is typically half that of NYC service centers, so IT PAYS to visit AUDIO-

CLINIC!!!!!

AUTHORIZED Kenwood, Sherwood, Sony, Marantz, Pioneer, Technics, Dual, TRINTRODES and BATAKAM, too!

CALL AUDIOCLINIC (212) 658-6400. Free pick up and de-

livery.


AOC cartridges' sinking cantilevers repaired. Mail protected styles assembly and $4.00. Ron Zeeman, 50-22 186 St, Flushing, NY 11356

MASS PRODUCTION CUSTOM REPRODUCTION - 8-Track cassette & Reel to Reel. We specialize in corporate meetings. Call or write T.S. Recordings c/o T.C. Sharrar. 385 Ocean Blvd., Suite 5C. Long Branch, N.J. 07740 (201) 870-2952

STEREO SOUND LABS Factory specs or better by 10% on all repairs on major brands. Warranty 90 days parts and labor. Ship us your gear properly packed and insured. 4410 John Mart Drive, Annadale, Virginia 22003 (703) 941-5707

COMPLETE CUSTOM RECORDING SERVICE - Record pressing cassette duplication — editing — location recording. Omega Audio, 25520 Graham, Detroit, Mich. 48239
92

SERVICES
HIGH FIDELITY SPEAKERS REPAIRED
AMPHRITE SPEAKERS SERVICE
655 Sixth Avenue, New York, N.Y. 10010
212-412-4812

CANVAS PHOTO TOTE BAG. Your favorite color or BW picture. We'll blow it up in full color on our 12x14 canvas tote bag. Send $2.95 for catalog and price list. Refundable with your first order. Write to: Gierswara Marketing Assn., P.O. Box 4951, Washington, D.C. 20008.

TAPE RECORDER HEADS re-tapped $15.00 ea. Renewed from machine or stack. One day service. E. Mayer, 5 Evans Place, Drinda Calif. 94563

NASHVILLE RECORD PRODUCTIONS will press high quality pure vinyl records from your tapes. Send for SAMPLE RECORD AND PRICE LIST. ALSO FINEST DISC MASTERING 469 Chestnut St., Nashville Tennessee 37203.

INTERNATIONAL HI-FI has low prices and fast service! For the name of your nearest representative in the San Francisco Bay area write to:
INTERNATIONAL HI-FI DIST.
6330 FRANORD AVE
Baltimore, Maryland
21206
or call: (301) 488-9600
The savings on stereo equipment is worth the call.


STEREO MASTERS, RECORDS AND ALBUMS. Check our prices. Newest type high level cutting equipment featuring Neumann VMS 70 Computer control lathe, Parametric Equalization, Dolly, DBX, and the new SKT4 Cutting System by Neumann. Special package prices on pure vinyl album and single record production. 1000 45 RPM stereo singles $199.00 including mastering. 100 LP albums $326.00 including printed jackets. Write or call for brochure. A & R Record Manufacturing Co., 907 N. Industrial Blvd., Dallas, Texas 75207. Toll Free 1-800-527-3260.

PHOTOGRAPHY
12 EXPOSURE Roll Kodacolor Film developed-printed jumbo 90, $1.50. Capri Color, Box 931, Laredo, Texas 78040

RECORDS
WHILE YOU WERE LOOKING for out-of-print records, you should've been looking for 'em DISCONTINUED. 218 N. Rete, Burbank, California 91505.

FILM-STAGE SOUNDTRACKS. Large free list. A. Lutsky, P.O. Box 557342, Miami, Fla. 33155.

DISCOUNTS ON LP's. Tapes, Cassettes, Imports. Huge Catalogs. One Dollar. Record Finder Services NERT, Box 268, Lawrence, Mass. 01843.

RECORD CARE IS IMPORTANT to be left to amateur methods. Supex, the company that elevated phono cartridge technology beyond the "state of the art" as conceived by lesser companies, has produced a complete line of record care products to properly protect and extend the life of your precious records. Available at all knowledgeable audio dealers. Sumiko, Box 5046, Berkeley, CA, 94705 (415) 843-4500.

SOUNDTRACK RECORD ALBUMS—Mail Auction—Free List. Whalen, 2321A Hill, Redondo Beach Calif. 90278.

PONTUN RECORD SALES 56 Washington St. Newburyport, MA 01950. Jazz Records - lowest possible prices - free list

RECORDS
SHOW ALBUMS—Rare, Out of Print LP's. 52 page list. 50c. Broadway-Hollywood Recordings. Georgetown, Conn. 06829.


OLDIES — 45 RPM Original hits Catalog 50c C&S Record Sales. Box 197, Wampsville, N.Y. 13163

RARE '78's. State Category Record Lists, 3238 Stoddard, San Bernardino, CA 92405.

CATALOGS. Broadcasts, soundtracks. Personalities of Thirties, Forties. Box 225, New York, N.Y. 10026

QUADRAPHONIC RECORDS AND TAPES. World's largest selection - all labels, over 1000 titles - at discount prices! For your free illustrated quad catalog, write: SOUNDCONCEPTS, Box 654 C, Peoria, Illinois 61601.

SOUNDTRACKS/DC. JAZZ/PERSONALITY — FREE NEWSLETTER RIAA, 3700 S. Plaza Drive, Bldg F/211, Santa Ana, California 92704

UNACCOMPANIED CELLO — Schuster, Dallapiccola, Crumb, & Hindemith compositions. Roy Christensen, Cellist LP only. 450101, $9.95 prepaid. GASPARCO Co., Box 90574, Nashville, Tenn. 37209.

"DIRECT DISCO" — A new direct to disk recording featuring the current disco-rock sound. Available soon. For information write: Sound Advisor, 225 Kenny Street, Suite 200 DQ, San Francisco, California 94108.

RADIO PROGRAMS
1930-1962 RADIO PROGRAMS, Reels, $1.00 hour! Cassettes, $1.00 hour! Mammuth catalog $1.25. AM TREASURES, Box 162 All, Babylon, New York 11702.

GOLDEN AGE RADIO — your best source for radio tapes. Box 25215-D, Portland, Oregon 97225

RADIO CLASSICS — SUPERIOR QUALITY VINTAGE RADIO UNIQUE OFFERINGS! USUAL SELECTION OF THOUSANDS. HIGH QUALITY LOW COMPETITIVE PRICES CATALOG. 25¢. RADIO CLASSICS, BOX 1649, EVANSTON, ILL. 60204

YESTERDAY'S RADIO PROGRAMS ON TAPE. Reels, Cassettes, Fastest Service. Catalog $1.00 — refundable with first order. ADVENTURES, Box 4822-A, Inglewood, California 90302.


RENT RADIO SHOW. Make your own copies or just listen. Great way to build your collection reasonably. Catalog $1.00 refundable. DTR Rental, Box 1146, Livonia, Michigan 48150

OLD RADIO PROGRAMS. 2 Cassettes. Cassettes $1.50 hour, Reels 4 hours $5.00. Nostalgia Sounds, Box 3584, Santa Susana, Calif. 91303.

OLD RADIO ON TAPE AND CASSETTES. THOUSANDS AVAILABLE. 6 HOURLY $8.00. Immediate Service. Catalogue 50c. Nostalgic Radio, Box 29K, Peoria, Ill 61601

EQUIPMENT WANTED
CASH FOR your unwanted LPs & reel to reel tapes. Records, Box 323, Hollin, New York 10631.

"GE MODEL A1-901 or similar passive record compensator/liner. State price and condition." W. Rawlings, 261100 Oak, Lomita, Calif. 90717

WANTED: MB-8 rack mount for Sony 850, Marantz RA-1 rack assembly. M. Horacek, 332 Newport, Webster Groves, Mo. 63119

EQUIPMENT WANTED

WANTED: SONY TC-654-4 (Quad version of TC-650). Also have Marantz 4100 (W&O) and R.C. to sell or trade. Art Courviet, 68 N. Cedar, Battle Creek, MI 49017 616-868-8651

WANTED: Reel to Reel Tape Deck. Cassette tape deck with speakers and headphones by Soundesign. Write: Hubert Woods, 162 Courier Court, Talladega, Al 35160

TAPE & TAPE RECORDERS
SCOTCH RECORDING TAPE, lowest prices TAPE CENTER Box 439356, Washington, D.C. 20012

BIGGER DISCOUNTS ON RECORDING TAPE. write M.A.D. REPROGRAPHICS, INC. Dept. A, P.O. Box 532, Southfield, Mich. 48075, (313) 6913.

MAXELL RECORDING TAPE. All widths. Lowest prices. N.A.B. Audio, Box 7, Ottawa, Illinois 61350

INTERESTED IN OLDIES BUT GOODIES on reel to reel tape? Write to Theodore Emilny Inc. 40-5K Richman Plaza, Bronx, New York 10453.

TAPE WORLD deals exclusively in tapes and we must give you the lowest possible prices. Save 30-40% on TKD, FUKI, BAF, AMPEX, MAXELL and others. Tape World International, Box 231, Butler, PA 15601

TAPE DUPLICATING. Professional standards. Half Track, Quarter Track Reel. Cassettes. Low Prices. Write for rates. Moonlight Recording. P.O. Box 22635, San Francisco, Calif. 94122


WANTED TO BUY OR TRADE
SONY TC-850 Head Ass'y's 319-889-8721

ONE KENWOOD KR-6170 Jumbo receiver and two realistic OMR-1 Dolby units. Terrence Fraser, R.D. 1, Box 299, New Camberlard, W.Va. 26047.

I WOULD like to trade a Sony TC-377 Reel to Reel 1976 model. Willie McMillon, 11 Almeda - Glenwood, Pittsburgh, PA 15207.

CROWN SX OR CX RECORDER electronics only, new or used, minor malfunctions are acceptable. Also Ampex AG 440, electronics, transistor or tube type, any condition. Robert D. Lombard 548 Ballaviney St., Apt. 4, El Cajon, Ca. 92020

SPORTING GOODS
SPORTING GOODS at Wholesale First Line Name Brands Catalog only. 51 Global Dept. A-3: 7030 Pelican Dr., Buena Park, CA 90620

HIGH FIDELITY
CONTROL L—AUTOMATIC SIGNAL ACTIVATED Shut Off for Hi-Fi components, 349.95. Details, ElectroMedia Design, Inc. Box 26, Livingston, NJ 07039

AUDIO • AUGUST, 1976
INSTRUCTION & EDUCATION

EXTERNAL DEGREE PROGRAM Earn College Degrees. Receive your bachelor, masters or doctorate at home. Many subjects, ministerial studies, high school diploma. Florida State Christian University, P.O. 14576, Fort Lauderdale, Florida 33302.

SYN-AUD-CON 3-Day Sound Engineering Seminar. For more information about the seminar in your area, write Don Davis, Synergetic Audio Concepts, P.O. Box 1134, Tuscon, Ca. 92390 (714) 836-2288.

DEGREE Needed? Send Support Data EML, Box 4277, Ingleswood, CA 90309. Satisfaction Guaranteed.

HELP WANTED

STEREO REPRESENTATIVES NEEDED!! Sell 100 brands!! Lowest Possible Prices!! Krasco 623 Campbell Ave West Haven, Connecticut 06516.

BUSINESS MANAGER/PARTNER needed for small audio products manufacturing company relocating in S.F. Bay area. Should have M.B.A. degree or equivalent expertise as manufacturing mgr. strong sales/marketing skills, and minimum investment capital, potential of $25k. Send resume to address: HAYNES Microelectronics Box 413 623 Post St. S.F., CA 94109.

SPEAKERS

SAVE 50%. Construct speakers and save money. Send for free catalog and instructions SpeakerKit, Box 12A Menomonee, WI 54751.

STATE OF THE ART SPEAKER KITS. Complete kits from $60 to $260 including Cabinets, Drivers, X-Overs. Complete laboratory facility. $40,000 worth of test equipment. All speakers supplied with machine run 1/3 octave response curve. AUDIO-TECH ELECTRONICS, 3803 Steilboom Blvd. S.W. Tacoma, WA 98499 206-584-0332.


SPEAKER KITS, loudspeakers and accessories. We have the best value for your money. Send today for our free catalog. SPEAKER WORLD, Box 1653, Marysville California 93901.

ALTEC 604-8G DRIVER used by more recording studio's than any other driver $286 including crossover. Send $5 for construction plans and 10% discount card for all Altex monitors. Raw Speakers, 14 Leeds Lane N. Babylon N.Y. 11703.

MUSICAL SPEAKERS REPAIRED
ALTEC WARRANTY STATION
Hughes Electronics Service 45 Dunn St., Asheville, N.C. 28806

SPEAKER ENCLOSURES with grill boards · raw speakers · crossover components · S.A.E. for details. The Stereo Workbench 214-C Main Ave New London, Ct. 06320

MISCELLANEOUS

100-CARD BIBLE GAME!!! $1.00. ANYWHERE!! BIBLE-GAMES, 5837 Stewart, Sylvania, Ohio 43560.

AUDIO • AUGUST, 1976

CABINETS

QUALITY WOOD FURNITURE for your components in a wide selection of styles. Finishes, unfinished, and kits. Sold in fine stores and direct. Send $5 for all new full color brochure.

AUDIO ORIGINALS
546 S. Meridian St., Indianapolis, Ind 46225

SHORTWAVE

NEAR POLICE FIRE Dispatchers Catalogs show receivers: exclusive diversities of "confidential" channels. Send 10c stamp. Communications, Box 56AU, Commack, New York 11725.

PLANS & KITS

POWERSFUL indoor antenna for stereo receivers. Pulls in more stations. Increases response. Simple construction, only 30 minutes. Guaranteed. Send $1.00 for plan TIME-LAPSE PRODUCTS, 1209 AA Umatilla, Long Beach, Calif. 90804

BUILD YOUR OWN BASS-REFLEX SPEAKER ENCLOSURES. Send $6 for book containing over 1600 different designs. Parrotco Sound, Box 68365, Portland, Oregon 97206.

CONSTRUCT YOUR OWN speaker enclosure. Send $2.00 for drawing to Crightney Sounds, 140-23 169th Street, Jamaica, N.Y. 11434.

DISCO EQUIP

DON'T MISS THE 'DISCO WAGON'! Excellent complete line of discotheque equipment are available to fulfill your needs. Request your information packet today. Write to D.T.S., Dept. DISCO, P.O. Box 16049, SEATTLE, WA 98116.

RESERVE your dealer territory in time!!!

SITUATION WANTED

FORMER DJ would like to return to radio in a similar position or as a Program Director. Have a third class broadcast license. 2 years college, 2 years experience. Contact: Doug Gallicher, 3907 Angel Place, Jacksonville, Florida. 32210 (904) 771-7386.

AMBITION'S YOUNG MAN seeking position in a quality audio-stereo shop. A.S.S. degree in Electronics Tech. Presently enrolled in S.A.C. Professional Mi-Fi Course. Prefer position in East or Northern Calif. Write: Timothy E. Gifford, Mohonk Mt. House (staff), New Paltz, N.Y. 12561

KNOWLEDGABLE, STABLE, SOUND TECH with 3 yrs. road exp. in audio and 2 yrs. exp. in FilmSound, desires specialization. Am diligent and aggressive. Would prefer non-road related position but will seriously consider all offers. Resume upon request. Michael c/o 50 Hellberg Ave., Chalfont, Pa 18914 or 215-822-2399.

PROFESSIONAL BROADCASTER, with over eight years experience in all phases, seeking full time employment. Would prefer news or production slot on progressive rock announcng, but will consider almost anything. Want to relocate to southwest or west coast. If you are looking for a dedicated professional with years of "hands on" experience, give me a call. Available immediately. 417-369-4028. Write AUDIO Box 686-1. Guaranteed results.

TAPE RECORDINGS

RENT Open Reel or Cassette Prerecorded Tape. All labels. Catalog $1.00. Tape & Time. 8220 Eldenberry St., Anchorage, Alaska 99502

SONAR'S OPEN REEL TAPES. Goped one-to-one from the master. Quad and stereo. 4', 1/2 track. 71/2; 15 ips; 7', 101/2" reels. Highest quality anywhere! Sonar Records Corp., P.O. Box 455A, Kingsbridge Station, Bronx, NY 10463.

If you're going to buy speakers this month, a word of advice.

Not that there aren't fine speakers currently available. But next month, the new Gamma Series from Martin will be introduced to the United States.

Is speaker development still going through a phase? The reason speakers from conventional speaker manufacturer's rarely reproduce sound accurately has been the phase relationships between drivers reproducing fundamental tones and drivers reproducing the associated overtones and harmonics. These overtones are what enable you to distinguish different instuments capable of playing identical notes. Martin's new Gamma Series will "phase out" the competition.

Martin
Eastman Sound Mfg. Co. Inc., Michigan, NJ 08064 USA
Exporter: Teleco Int'l Corp., 1 Dupont St., Plainview, NY 11803

Check No. 38 on Reader Service Card
"Marantz offers—in one speaker—both air suspension and ported design. It's the ultimate in flexibility—and quality."

February, 1976:
Marantz engineers invited audio experts to comment on the new Marantz High Definition Speaker Systems.
The following remarks were taken from that taped discussion:

"It's one thing to design an acoustic air suspension system that will have low distortion. And it's another to design a ported system for high efficiency. But here, in one unit, Marantz offers the audiophile the best of both worlds."

"It's incredible. Marantz calls it Vari-Q*. Pull out the high density acoustic foam plug and the system becomes a tuned port reflex. Push it back in and the port is absolutely sealed and the speaker becomes air suspension."

"It doesn't matter what kind of music the listener is into, either. Air suspension with the plug in is great for full orchestra, because it damps better and doesn't peak the lower frequencies. But when you listen to rock, pull the plug and you increase the low end efficiency. It pumps up the lows at about 75 Hz and really delivers that low end oomph."

*Patent Pending. **Manufacturer's suggested list price. Actual selling price at dealer's discretion. (The enclosures for the HD-88, HD-77 and HD-66 are constructed of particle board, finished in genuine walnut veneer. The enclosures for the HD-55 and HD-44 are finished in walnut grain vinyl.)
Another tremendous feature is the **linear polyester film domes** on the tweeters. The dome shape disperses high frequencies over a much wider area. And because the polyester film is so lightweight, it's more efficient.

It takes less power to do the same job. And they're practically indestructible. And higher efficiency means greater distortion-free accuracy in reproducing high-frequency transients.

We call them High Definition Speaker Systems. You'll call them the ultimate in flexibility and listening excitement. Five models in all (three with Vari-Q) ranging from the bookshelf-sized HD-44 with frequency response from 45 Hz to 18 kHz (±3 dB – all controls set flat) and power handling capacity of 60 Watts – to the super-powerful HD-88 with frequency response from 25 Hz to 25 kHz (±3 dB – all controls set flat) and power handling capacity of 300 Watts. Marantz High Definition Speaker Systems start as low as $89.95**. Experience the professionals' choice today at your Marantz dealer. He's in the Yellow Pages.
Introducing
the world's most powerful receiver.
165 watts per channel.

With the world's least distortion. Only 0.08% THD.*

The Technics SA-5760. More power and less distortion than any other receiver in the world at rated power. And that's just for starters.

The SA-5760 also has the reserve power you need to float through complex musical passages without distortion, clipping or instability. Because we use single-packaged dual transistors in the differential amplifier stage of each channel. Along with high capacitance filtering and a bridged rectifier. There's also direct coupling and heavy power supply regulation. So transient bursts in one channel remain isolated from the other.

And you'll hear your records precisely the way they were recorded. Thanks to "current mirror loading"—a radically new circuit found in the SA-5760's phono pre-amp. The results are an unsurpassed S/N ratio of 78dB. And a frequency response that's accurate to within ±0.2 dB of the ideal RIAA curve.

On FM, the signal being broadcast will be the signal you'll hear because we use flat group delay filters in the SA-5760's tuner section. As well as a Phase Locked Loop IC. So you'll also receive 38dB of stereo separation at 1kHz and 45dB at 1kHz. As well as inaudible distortion and a frequency response that actually exceeds the response of FM broadcasts.

The SA-5760's controls are as sophisticated as its circuitry. Like a 26-step true attenuator click-stop volume control. Negative feedback tone controls with turnover selector. Two-way tape-to-tape dubbing. A truly linear signal-strength tuning meter for AM and FM that works the way other meters don't: accurately. And all the other refinements you'd expect from the world's most powerful receiver.

And to complement the SA-5760, Technics has five other new stereo receivers. All with excellent power. Outstanding performance. Sophisticated circuitry. And all at a good price. The concept is simple. The execution is precise. The performance is outstanding. The name is Technics.

*165 watts per channel, minimum RMS, into 8 ohms from 20Hz to 20kHz with no more than 0.08% THD (total harmonic distortion).

Technics
by Panasonic