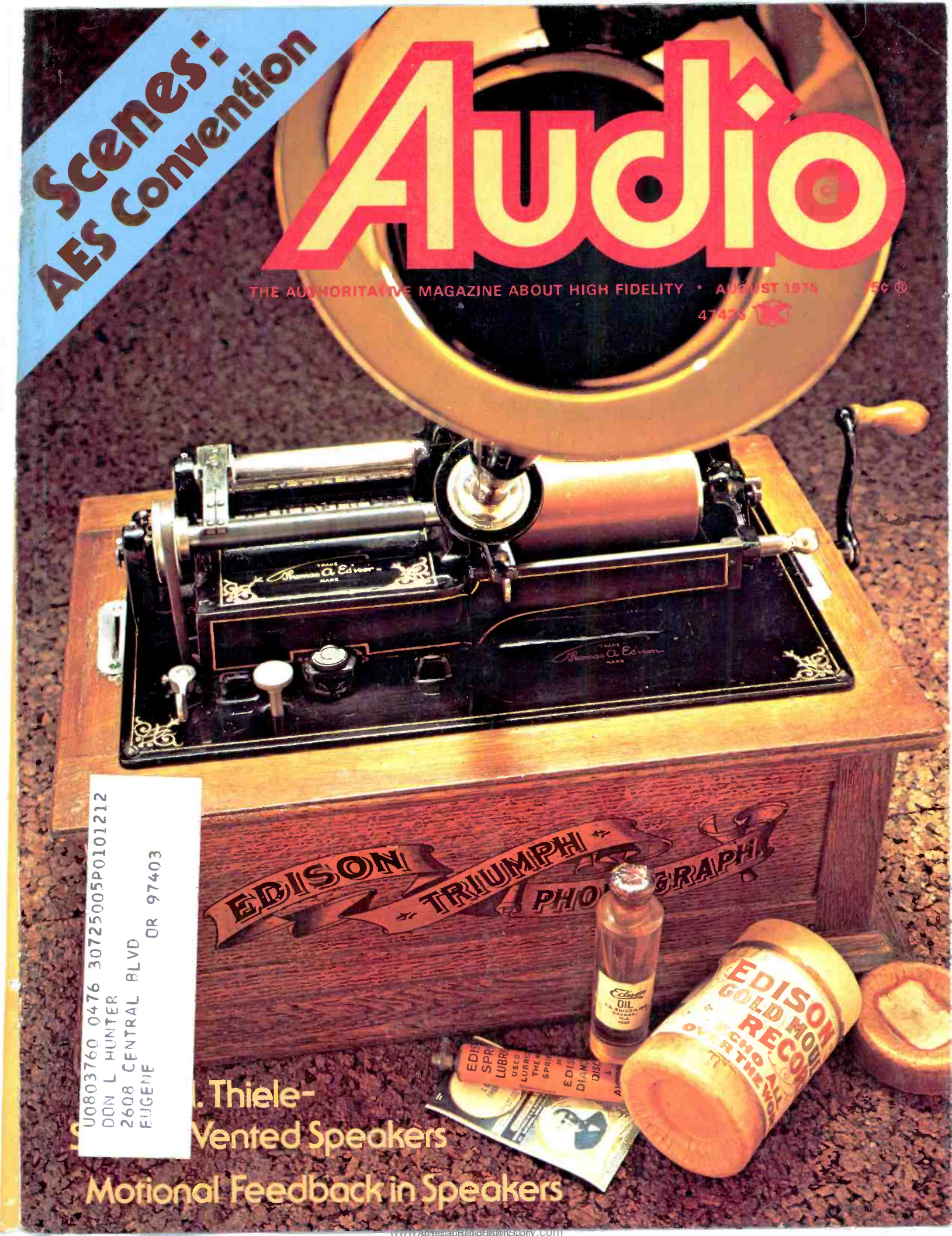

best of each

RT-1050

4-track units. With three motors and three heads, it has virtually every professional feature you'd want. Yet it's extremely simple to use. In addition to stereo record/playback, it also highlights 4-channel playback. The RT-1020H (15, 7½ ips) is the high speed counterpart of the RT-1020L. While the RT-1011L shares most of the features of the RT-1020 series, it does not include 4-channel playback. The complete extent of their capabilities becomes apparent only after you've worked with them. Then you'll recognize the magnitude of Pioneer's accomplishment.

The RT-1050 is a 2-track, 2-speed (15, 7½ ips) 3-head deck which, like all all Pioneer models, can handle professional 10½-inch tape reels. Its unique combination of bias and equalization switching controls give 12 different settings to optimize the performance of any tape on the market.

12 Bias & Equallzation settings optimize performance.

The RT-1050's 3-motor transport system is activated electronically by full logic, solid state circuitry, triggered by feather touch pushbutton controls. Its transport is completely jam- and spill-proof, permitting you to switch from Fast Forward to Fast Rewind, bypassing the Stop button.

The RT-1050 was specifically designed for easy operation with a wide combination of professional features like extended linearity VU meters with adjustable sensitivity, mic/line mixing, pushbutton speed selection and reel tension adjustment buttons. There's also an exclusively designed pause control, and independent control of left and right recording tracks.

The same 2-track recording system studios use for better signal-to-noise ratios and higher dynamic range is incorporated into the RT-1050. Yet it can be easily converted to 4-track use with an optional plug-in head assembly. Everything considered, it's the most versatile open-reel deck you can buy. Professionals prefer it for its studio-quality performance. Everyone appreciates its completely simple operation.

Pioneer open-reel and cassette decks are built with the same outstanding quality, precision and performance of all Pioneer high fidelity components. That's why, whichever you choose, you know it's completely professional and indisputably the finest value ever in a studio-quality tape deck.

U.S. Pioneer Electronics Corp.,
75 Oxford Drive, Moonachie,
New Jersey 07074.
West: 13300 S. Estrella, Los Angeles 90248 / Midwest: 1500 Greenleaf, Elk Grove Village, Ill. 60007/ Canada: S. H. Parker Co.

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when you want something better

CT-7171

Pick The Cassette Features You Need

Model	Dolby	Memory Rewind	Frequency Response (Chrome tape)	Peak Indicator	Level Limiter	S/N (with Dolby)	Wow & Flutter (%-WRMS)	Price ‡
CT-9191*	Yes	Yes**	20-17kHz	Yes	Yes	62dB	0.07	$449.95
CT-7171*	Yes	Yes	30-16kHz	Yes	Yes	58dB	0.10	$369.95
CT-6161*†	Yes	Yes	30-16kHz	No	No	58dB	0.12	$299.95
CT-5151	Yes	Yes	30-16kHz	Yes	Yes	58dB	0.12	$269.95
CT-4141A	Yes	No	30-15kHz	No	No	58dB	0.13	$239.95
CT-2121*	Yes	No	30-16kHz	No	No	58dB	0.12	$199.95††

*Front loading ††Less cabinet **Plus Rec/Play auto start †Not shown

Pick The Open-Reel Features You Need

Model	Speeds (ips)	Frequency Response (± 3dB)	Tape Bias/ Equalization Positions	Wow & Flutter (% at highest speed)	S/N	Mic/Line Mixing	4-Ch. Play	Price ‡
RT-1050	15, 7½	30-22kHz	3/4	0.06	57dB	Yes	No	$699.95
RT-1020H†	15, 7½	30-22kHz	3/2	0.06	55dB	Yes	Yes	$649.95
RT-1020L	7½, 3¾	40-20kHz	3/2	0.10	55dB	Yes	Yes	$649.95
RT-1011L	7½, 3¾	40-20kHz	2/2	0.10	55dB	Yes	No	$599.95

†Not shown

*Dolby is a trademark of Dolby Labs., Inc.

‡Prices listed above are manufacturer's suggested resale prices only. Actual resale prices will be set by the individual Pioneer dealer at his own option.

Bringing you the b is up to us.

High fidelity is important to us at Pioneer. It's all we do and it's all we care about. We are excited that cassette tape decks have reached a level of performance that meet the highest standards. We are excited because we know that it means more enjoyment for you from your high fidelity system. We also know that you can now get more versatility and value out of your high fidelity system than ever before.

The great advances in cassette technology have had impact on the reel-to-reel tape deck concept as well. We believe that the era of the small, inexpensive 7-inch reel tape deck is past. Neither its convenience nor its performance make it a good value compared to the new cassette technology. And it is now possible for Pioneer to offer you a professional, studio-quality 10½-inch reel deck at prices that compare favorably with what you might expect from old fashioned 7-inch reel units. In our judgment the old ideas must move aside for the new ideas. And Pioneer has some very intelligent new ideas in tape for you.

The convenience of cassette. The performance of open-reel.

The new CT-9191, with built-in Dolby* establishes a new and incomparable level for cassette deck performance and features. Designed with up-front controls and cassette loading, you can stack other components above it or under it.

Performance features stack up, too. Bias and equalization switches insure optimum recording and playback for every type of cassette tape made. There's even automatic bias/equalization switching when the new type CrO_2 cassette, equipped with the special identifying notch, is inserted. A front panel indicator light signals this automatic operation.

Simple vertical cassette insertion visible at all times.

Distortion- and interference-free recordings are consistently produced, thanks to a combination of wide-scale range VU level meters (-40dB to+5dB), an LED peak level indicator light, a selectable level limiter circuit, and an FM multiplex filter switch.

Locating a desired program point in a cassette is simple with the new CT-9191. A specially designed memory rewind switch (including record/play automatic re-start) and 3-digit tape counter, make precision cueing a breeze.

Operation is further simplified with automatic tape-end stop, dual concentric rotary mic and line input controls — for mic and line mixing — and separate rotary output level controls, all with adjustable memory index markers. In addition, there are soft-touch solenoid operated transport controls. This combination makes the 9191 the recording studio that fits on a shelf.

Two independent drive motors, plus solid ferrite record/playback heads combine to provide a new low in wow and flutter (0.07% WRMS) and a new high in

Memory rewind with record/play automatic re-start.

frequency response (20 to 17,000 Hz; CrO_2 tape).

Whether you choose the ultra sophistication of the CT-9191 or Pioneer's other front loaders — CT-7171, CT-6161, CT-2121, or the top loading CT-5151 and CT-4141A, which snare many of its features, you're assured optimum performance and maximum value in their respective price ranges. One tradition that never changes at Pioneer.

Open-reel. A professional recording studio in your home.

Professionalism comes with all four studio-quality open-reel models. The RT-1020L (7½, 3¾ ips) is unequalled in

CT-9191

Whether you use a cassette or open reel deck is up to you.

Audio

August, 1975 *"Succesor to RADIO Est. 1917"* **Vol. 60, No. 7**

Feature Articles

Equipment Profiles

Record & Tape Reviews

Audio in General

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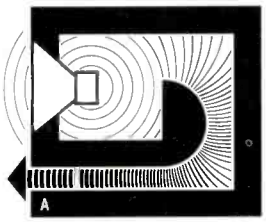
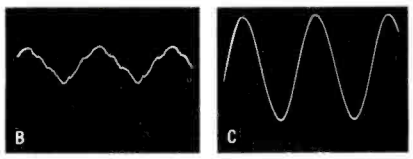
These four major developments make the B·I·C VENTURI™ speakers totally unlike all others...and better.

B·I·C VENTURI Principle Bass Section (pat. pend.) transforms the magnitude of air mass and energy in a way never before applied to acoustics. (Fig. A) The result is bass response hundreds percent more efficient and substantially purer in quality than is possible from any other speaker of comparable size.





B — Shows output of low frequency driver when driven at a freq. of 22 Hz. Sound pressure reading, 90 dB. Note poor waveform.

C — Output of B·I·C VENTURI coupled duct, (under the same conditions as Fig. B) Sound pressure reading 111.5 dB (140 times more output than Fig. B) Note non-distorted appearance.

Biconex™ Pyramidal Dispersion Horn (pat. pend.) was developed to match the demanding capabilities of the B·I·C VENTURI bass section. It is far more efficient, can handle more power and covers a wider, uninterrupted frequency range than cones and domes. And, unlike other horn designs, it can't add metallic sound coloration and has truly wide angle dispersion in both the horizontal and vertical planes, for unrestricted system positioning.

Biconex horn

Dynamic Tonal Balance Compensation (pat. pend.) adjusts speaker performance automatically (when desired) to provide aurally "flat" response at all listening levels in accordance with the Fletcher-Munsen hearing characteristics. This is accomplished in a manner which cannot be achieved by amplifier loudness or contour controls.

Extended Musical Dynamic Range results from the unique combination of high efficiency and high-power handling capability. Even our smallest model, the new Formula 1 can be used with amplifiers rated up to 50 watts RMS per channel. The Formula 2 will handle 75 watts; the Formula 4, 100 watts; the Formula 6 can take 125 watts. Yet any of these can make Titans of low-powered amplifiers.

A 4-page color brochure is needed, at the very least, to properly describe what makes these B·I·C VENTURI speaker systems so different, and we think you'll agree, better. So this is what we will send you, upon request. Or better still, visit your B·I·C VENTURI dealer, and hear for yourself.

B·I·C VENTURI™

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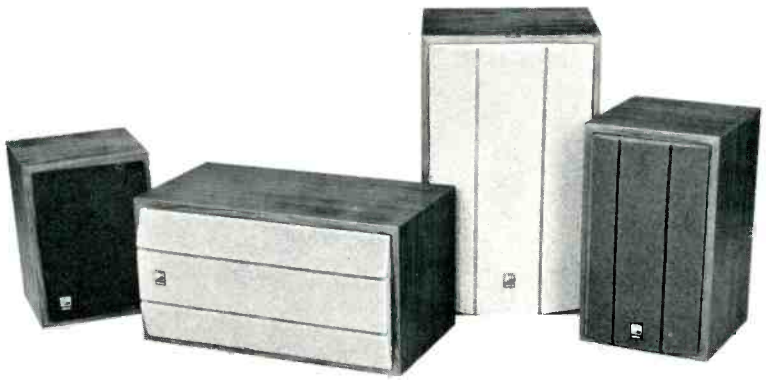

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MUTING

Our new series is so advanced, we expect our first customers to be Audio Research & Crown.

They'll haul it back to their labs. And play it. And play with it. And in general, examine it to pieces to find out How We Did It.

Sony's Vertical Field Effect Transistors: What our competitors are eating their hearts out about.

It's a shame the term "state of the art" has been worn ragged in dozens of "This is It, this is finally and really It" stereo ads. Because anyone in the business will tell you that V-FET's are the biggest thing since the invention of the vacuum tube. V-FET's combine all of the advantages of both triode vacuum tubes and conventional transistors. With none of their disadvantages.

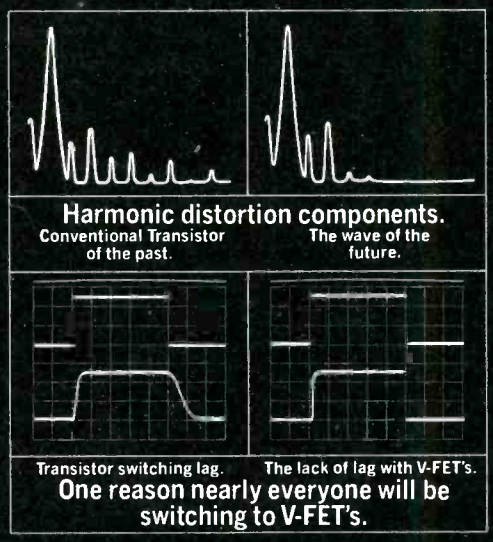
But nobody else can take advantage of these advantages yet. Ask anybody else how their V-FET's are coming. The responses will range from a forthright and candid "we're working on it," to an equally forthright and candid "buzz off." Sony is the first company in the world making commercially available equipment with V-FET's. A power-amp and integrated amp.

Herewith a partial and oversimplified explanation of just what in the world we're talking about.

Triode vacuum tubes: Pros and cons.

To belabor the obvious for a moment, in amplifiers, the name of the game is distortion. And until now triode vacuum tubes have yielded the lowest levels around. That's because of their non-saturating voltage versus current characteristics. Also, they do not suffer from carrier storage effect (which is standard equipment with regular transistors, and causes notch distortion and deterioration in transient response).

So much for the good points of tubes. They also tend to be inefficient, begin to deteriorate as soon as you use them, and wear out. Their high impedance characteristics generally require an output transformer to drive the speakers. And there's no way you can set up a true complementary circuit with vacuum tubes, so there's no way you can get true wave form symmetry.



Harmonic distortion components.
Conventional Transistor of the past. The wave of the future.

Transistor switching lag. The lack of lag with V-FET's.

One reason nearly everyone will be switching to V-FET's.

Conventional Bi-polar transistors: Pros and cons.

The advantages of bi-polar transistors can be dealt with in a sentence. They're very reliable, very efficient and last almost forever. But there are a number of bugs in the ointment.

Bi-polar transistors can become saturated with current. And they all cause switching lag distortion. To obtain acceptably low levels of distortion, plus wide frequency response, you need to pump in a lot of negative feedback. Which can make the amp unstable.

Plus (at no extra charge), as they heat up, bi-polar transistors have a marked tendency toward thermal runaway (which is a fancy way of saying they try to self-destruct).

V-FET's: All pros. And that's no con.

First off, V-FET's are very reliable, very efficient and last almost forever. They also match the highly defined tonal quality previously provided only by vacuum tubes. V-FET's don't become saturated with current. But at the same time, they protect themselves as temperatures build up. So there's no possibility of thermal runaway. Their low impedance characteristics mean no output transformer (the less gizmos in the circuit, the better the sound). The use of V-FET's allows for better control of negative feedback, making the amp more stable. V-FET's don't have carrier storage effect to cause switching lag. And you can use V-FET's to build a true complementary circuit, thus obtaining true wave form symmetry. And isn't that what it's really all about?

One more thing. We'd be less than forthright and candid if we didn't admit that our new amplifiers are a bit pricey. As much as $1300 a piece.

At Sony, we've always maintained that, in the end, the best way to buy equipment is to hear it for yourself. So we're making what's probably the best offer you've ever heard. Have your dealer hook up our new V-FET equipment against *anything* made by *anybody*. If we sound sure of ourselves, we are.

And we're sure your own ears will tell you we've got the best sound you've ever heard.

SONY®

Audioclinic

Joseph Giovanelli

"Stuck" Stylus

Q. After balancing the tonearm, setting the tracking force for 2 grams (required by my cartridge), and setting the anti-skating force for that same 2 grams, and making sure that the cartridge is adjusted properly for overhang, I put on a record. All went well until the arm was about an inch and a quarter into the record, the stylus then gets "stuck." This happens on ALL of my records, new and old. I found that I could move the arm slightly inward, and once again, all goes well for a time. When the arm reaches four and a half inches in, it once again "sticks." I have tried mounting and remounting my cartridge. I've changed the tracking force to 1.5 grams, using both antiskating settings for conical and elliptical. My tonearm still "gets stuck." I know that this is not a problem related to worn or dirty records because it occurs with all of my records.

I hope the problem is that I am doing something wrong and not my turntable. Your advice will surely be of help.—R. Padilla, New York, N.Y.

A. I suggest that you obtain a force gauge. Use it to check the accuracy of your tracking adjustments. Sometimes the calibrations for tracking force are incorrect, and this can only be determined by the use of an independent tracking force gauge. Like the tracking force adjustments, the antiskating force calibrations could be incorrect, so that you are using too much antiskating force. To obtain a reasonably good setting, consider obtaining a blank disc (one having no grooves at all) from a recording studio. Set the antiskating force so that the arm moves neither inward nor outward. Move it to various points on the surface of the disc. You may have to compromise on this adjustment. In some parts of the disc the arm will tend to pull inward slightly; in other parts, it may pull outward by an equal amount.

Your problem also could be the result of defective bearings. They may have so much friction that the arm is not free to be pulled along by the stylus. In that case, the turntable should be returned to your dealer for repair or replacement.

Paralleling Speakers

Q. My receiver puts out 70 watts at 8 ohms and 90 watts at 4 ohms. There is provision for two sets of speakers on this receiver. Does this mean that my resistance is 4 or 8 ohms? I am using four 8-ohm speakers.—Mark Smith, East Hanover, N.J.

A. First you should understand that speakers are rated as to *impedance*, not *resistance*. It's easy to confuse these two related, but different things. The term impedance takes into account both resistance (which is the same regardless of frequency) and inductance (which changes with frequency).

The switch on the front panel of your amplifier selects *Main*, *Remote*, or *both* Main and Remote (together). It is not intended to select the impedance presented to the amplifier. When both the Main and Remote speakers are operated at the same time, the speakers are wired in parallel. Thus, in your case, you would have two 8-ohms speakers in parallel on each channel, resulting in an impedance of 4 ohms. Do not add more speakers in parallel. To do so might well result in such low *combined* impedance (two ohms or less) that your amplifier would be damaged.

More Power From an Amplifier?

Q. I have a Lafayette 8-track recorder. I have found that I can run the FM portion of my receiver through the deck. With the tape switch on, I notice a tremendous increase in bass and I also notice a considerable increase in volume. What I think is happening is that the tape deck is used as an amplifier. Please give me an estimate of the increase in power that I can expect from this arrangement.—Mark Smith, East Hanover, N.J.

A. Your tape machine, when used to alter the sound from your receiver, is acting as an amplifier, just as you have said. Probably there is a playback correction network in that amplifier, which accounts for the added bass.

Your receiver does not produce more power when the tape deck amplifier drives it. The power amplifier can deliver only so much power. A preamplifier can only boost the input voltage feeding the power amplifier. When the voltage reaches the point at which the amplifier is delivering its rated power, no additional increase can take place. Increasing the signal input voltage further can only produce distortion and possible damage to the amplifier's output stage.

There are also preamplifiers which are incorrectly called "power boosters." These preamplifiers amplify the output of musical instruments such as electrical guitars. They do not add power. They boost the signal to the point where it can drive the power amplifier to obtain its maximum *rated* power.

Wiring a Cartridge for Mono

Q. In some phono cartridge installation instructions, the user is directed to join the left and right channel leads, either at the cartridge or at the preamplifier for monophonic service.

Might this practice not upset the cartridge loading characteristics or spoil the response in some other way?—(Name Withheld), Los Angeles, Cal.

A. Wiring a cartridge for monophonic service in the manner described in the instruction manual will change the recommended optimum load. The actual, audible effect of such a change will ordinarily be of so little consequence that it is ignored.

If you have a problem or question on audio, write to Mr. Joseph Giovanelli, at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

THE INNOVATORS. BY BOSE.

The only Direct/Reflecting® loudspeaker systems.

The Bose 901, 501 and Model 301. The only speaker systems that meet the two basic requirements for preserving the qualities of live music in reproduced sound: the proper balance of reflected and direct sound for spaciousness and clarity; and flat power radiation to assure correct frequency balance and accurate reproduction of instrumental timbre in an actual listening environment.

The internationally acclaimed 901® system utilizing nine full range drivers with an active equalizer to provide the ideal balance of reflected to direct sound at all frequencies, setting the standard for lifelike music reproduction in the home.

The unconventional 501 incorporating an exceptionally linear 10" woofer and two rearward facing tweeters to furnish many of the performance advantages of the 901 system, but at substantially lower cost.

The new Model 301 offering a unique combination of features: Asymmetrical Design, a Direct Energy Control and a Dual Frequency Crossover™ network. This achieves reflected and direct sound with flat power radiation in a bookshelf enclosure, producing a sound quality that is extraordinary from so compact a speaker at so low a price.

The innovative speakers. From Bose. Each unique in concept and design to provide the maximum musical enjoyment for your home. One of them will ideally meet your requirements.

Shown above, left to right, 501, 901, and Model 301. For information, write to us at room AS.

BOSE®

Model 301 Patents Issued and Pending

The Mountain, Framingham, MA 01701

Frequency response and distortion are substantially unchanged. Distortion is probably a bit less because of the cancellation of the vertical component caused by the "pinch effect."

Turntable Cueing Revisited

In the December, 1974 issue of Audio *you described one way to cue up turntables. I can suggest another, simpler method which I've used for several years to produce top-quality tapes, using only a reel-to-reel tape deck, two turntables, two Shure preamps, and a Crown IC-150 preamplifier/control unit. Here's how it works:*

1. Plug outputs from arm into Shure stereo preamps.

2. Plug output from preamplifiers into the two tape inputs on the preamplifier.

3. To play each table: turn the IC-150 function selector to Tape 1 *or* Tape 2.

4. To cue each table: push Tape Monitor 1 *or* Tape Monitor 2.

As you can appreciate, when the monitor is depressed, there is no effect on the Line *outputs feeding any connected tape machines. However, the main outputs feeding the power amps now carry the cue information. Further, any adjustment in cue volume has no effect on the line outputs. When the monitor function is released, the straight program material is still available.*

The separation between the line and monitor functions in the IC-150 is around 75 dB, more than enough for this scheme to work well. This scheme will work with any preamplifier or integrated amplifier having two tape inputs and two tape monitors.

True, with this system, no segue is possible. In such a situation, I use another approach. At my studio, we have a Sony MX-16 mixer. It is set up so that, at the bottom of each slide-pot fader, a micro-switch switches the output of the phono preamplifier from the mixer input to a pair of (added) stereo output jacks, which are then connected to a cue amp. Each slide-pot on this mixer has been equipped with its own micro-switch so that all signal sources can be cued. Multi-source montages are easy to accomplish. This micro-switch idea could be used just as easily with any small, straight-line mixer, such as a Sony MX-12, Telefunken, etc.

By adding a switch to the pots on mixers equipped with rotary pots (Shure, etc.); these mixers can be used for cueing. In other words, when any pot is turned off, it is placed automatically into cue! Works well, too! —Stephen H. Lampen, San Francisco, CA.

Note. *I hope that you find this sort of material interesting and helpful. Those readers who are kind enough to take the time to write up this sort of information are specialists in their fields, and, as such, are privy to knowledge not normally available to most of us.*

So for myself and the rest of my readers, thanks to all of those who have written, and to those who will do so in the future.

I will be especially glad to hear from any one out there who has had success dealing with line transients. I refer to those instances where a refrigerator, fish tank, oil burner, etc., puts a pulse on the power line, which, in turn, finds its way into a music system and produces audible pops or other noise from the loudspeakers. Some equipment is more sensitive to this than others. While this sort of interference can often be eliminated by placing a constant voltage transformer between the power line and the music system, this is an expensive cure.

The tuner that restates the state of the art.

Imagine a stereo FM tuner that performs as cleanly and vividly as your favorite records. That has distortion so low it defies laboratory measurement. That automatically rejects all unwanted noise and interference.

You're looking at it. The YAMAHA CT-7000... the new state of the art tuner. Its cost? $1,200. So listen at your own risk, because you may never be satisfied with any other tuner again.

It's the first tuner with Negative Feedback. Long used in amplifiers to lower distortion, the application of Negative Feedback to the CT-7000 has all but eliminated MPX distortion. (At 400 Hz, for example, it's an unheard of 0.02%—and that includes distortion caused by the measuring instrument itself.) Also, Negative Feedback eliminates the need for distortion-causing Side Carrier Filters.

For superior separation of the left and right channels, Yamaha designed a unique *Phase Lock Loop MPX Decoder.* Instead of being a single IC chip as in other tuners, our Phase Lock Loop consists of discrete components mounted on their own circuit board, thus allowing precise control in production and hand-tuning adjustment to meet exact specifications.

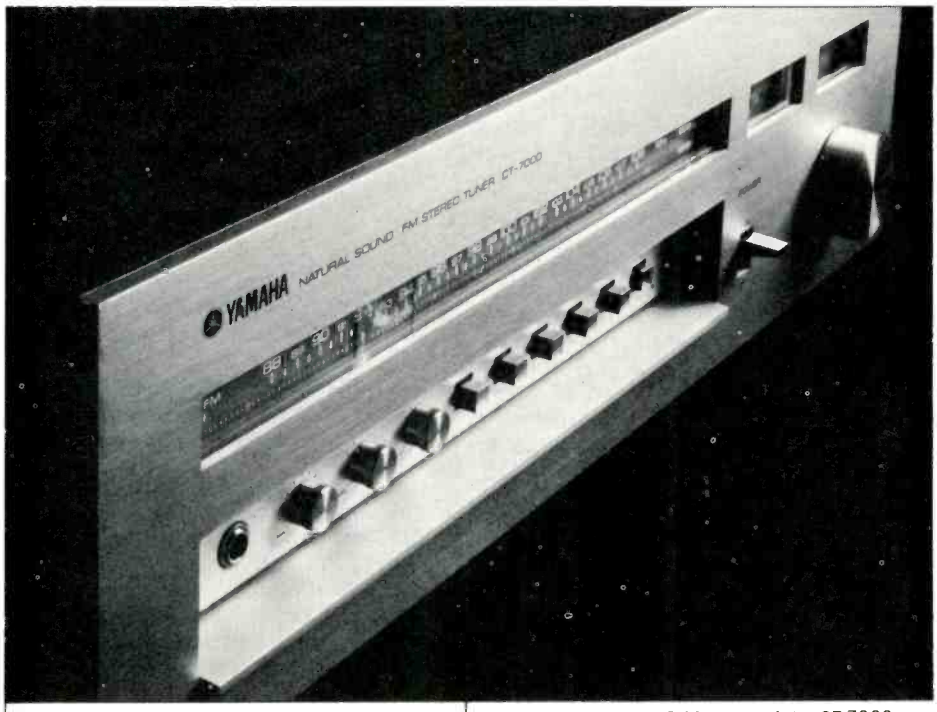
A 7-Gang Tuning Capacitor? Most tuners get by with 4 or 5 stages. We refused to. By designing the Front End with our unique 7-Gang Tuning Capacitor and utilizing Dual Gate MOS FETs, the CT-7000 can receive the weakest stations and, at the same time, accept an extremely high input (up to 1 volt input signal) without overloading.

Advanced IF Amp Stages. Inside the IF amp stage is the world's finest combination of ceramic and L/C filters. This has resulted in an advanced degree of selectivity (the ability to pick out a desired signal while rejecting neighboring frequencies). And maintains proper phase linearity and minimum distortion (less than 0.08%).

A selectable IF Mode lets you choose the width of the tuner's selectivity...narrow setting for crowded band areas; wide setting for uncrowded areas. The tuner's reception can be optimized for virtually every listening situation.

Some other important differences. *An Auto Blend Logic Circuit* automatically operates in three stages to blend high and middle-high frequencies for maximum stereo separation with minimum noise and distortion on even the weakest stations. And you don't need to get up and switch in the MPX filter when a station turns noisy. The CT-7000 does it for you—silently, automatically.

There's Auto-Touch Tuning that automatically disengages AFC while you tune, for maximum station selection. When you release the tuning knob, AFC reengages and locks onto the station, electronically fine-tuning it to the one point of maximum stereo separation and minimum distortion.



A unique Variable Muting Control makes it possible to receive music where there used to be just noise. This control lets you select the muting cut-off level to an unbelievably low 10 dB (3 mμ), yet it can be adjusted to accommodate stations up to 30 dB (30 mμ) in level.

Variable Output Level permits adjustment of the tuner's output to match the other input levels. So, when switching from tape, to records, to the CT-7000, you don't have to readjust your volume control.

The end of Multipath Distortion. Reflection of FM signals off their surroundings causes multipath distortion. And that causes muddled, distorted sound. Until now, you could rely on inaccurate signal strength meters to orient the antenna—or you could invest about 800 dollars in an external oscilloscope.

The CT-7000 neatly solved that problem with a unique signal minus multipath circuit which when activated by the S-M front panel relay, allows the signal strength meter to accurately display the multipath content of the incoming signal. Without guesswork, you now can zero-in the antenna incoming signal to reduce to a minimum multipath interference and distortion. In fact, tests show the S-M meter of the CT-7000 to be three times more accurate for this purpose than an oscilloscope.

Some things we didn't have to do. We could have settled for just having the best performing tuner in the world. But we also wanted it to be the most reliable and durable.

That's why all the push buttons are silky-smooth, precision reed relays instead of switches. Why the flywheel is solid brass. And why, beneath the walnut wood case, each circuit board is protected by a stainless steel cover to guard against stray noises and interference.

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Tape Guide

Herman Burstein

Tape Head Care

Q. I am writing to you in the hope that you will be able to answer questions that my dealer can't. I am the proud owner of a Revox A-77 deck. The manual supplied with the machine is very comprehensive, but it makes no mention of routine head and guide demagnetization. Is such maintenance required for the A-77? Also, my machine is set up for Scotch 203 tape. Will the use of a thicker base tape (1½ mil Scotch 202) cause any significant increase in head wear?—Peter A. Thrift, Bellevue, Nebraska

A. Manufacturers often recommend that heads and guides be demagnetized after about every eight hours of use. On the other hand, at least one manufacturer recommends much less frequent demagnetization. If you want to be on the safe side, I suggest that you write to Revox.

I doubt that there will be significant difference in head wear according to the thickness of the tape. More important is the quality of the tape you use. One that is optimally lubricated and that doesn't shed excessively is best. Tape tension and pressure exerted by pressure pads (is used) also affect in head wear.

Which Tape Deck to Buy?

Q. I am trying to decide which tape deck to buy. I want no compromises. I want it to have 10½-in. reels, three motors, solenoid operation, automatic stop at predetermined places, auto-reverse, smooth handling, 15, 7½, and 3¾ ips speeds. I have read that the only difference between a quarter-track and a half-track recording is about 3-dB better signal-to-noise ratio. Is this true, and how much difference does 3 dB make?

I have read a lot about the Dolby system and wonder if it would provide much improvement on a top-quality recorder? I am listing the machines I am considering. Please tell me which are the best, and also what tapes are the best.—John Nuss, Old Bethpage, N.Y.

A. I cannot make recommendations as to the best machine for your needs. As I have stated here previously, *Audio's* policy prevents me from doing so. Considering the high standards you are setting for yourself and the considerable amount of money you will be spending, I believe you should take the time to get out to the audio stores to check with your eyes and ears the performance of the machines which interest you.

A 3 dB difference in signal-to-noise ratio is significant, but barely so. In other words, it would be slightly audible. With fine tape machines such as those you list I doubt that Dolby would make much difference audibly, unless you go down to the slowest speeds. Dolby makes the most improvement with machines which have poor S/N ratio to begin with.

Correcting Wandering Tape Speed

Q. When I listen to a tape from my mother made in 1964 on a small, cheap reel-type "voice letter" machine, the speed varies throughout the tape, and her voice runs from a squeaky high to a low bass. I have dozens of tapes kept over the years, some with voices that no longer exist, and others which can never be duplicated. All contain some speed variations. Is any equipment available that I can use to correct the speed of these tapes while I make new, even-speed copes of them?—J.R. Kendrick, Honolulu, Hawaii

A. The only solution is to vary the frequency of the a.c. power to which you connect your tape machine. You can build such a power supply from construction articles which have appeared from time to time in electronics magazines. Or you can use an audio oscillator connected to a power amplifier and vary the sine wave output of the power amplifier, using it to supply the a.c. power for your playback tape machine. Of course, the machine you make the new recordings on will use regular a.c. power.

Recording Whistle

Q. For years I have been recording off the air with an Eico RP100 recorder and a Scott 350B tuner with satisfactory results. I recently acquired a new tuner, Kenwood KT6000, and with the same recorder I now get a continuous high frequency whistle along with the program material. I am told this is due to interaction of the bias oscillator of the recorder (50-100 kHz) with the pilot tone (38 kHz) that is part of all stereo broadcast signals. How can this be corrected?—Stephen Gaydica, Hewlett, N.Y.

A. The reason you have been given is probably correct. The solution is to introduce a tunable filter between the tuner and the tape recorder. I suggest that you consult your local audio store, a mail order audio house or the makers of your equipment.

Recording Level Problems

Q. I am recording with a TEAC A-1500U tape deck. I set the monitor switch to Source *and adjust the level so that the VU meter reads 0 on the loudest passages. When the tape is played back, the level is too low (hiss is audible), and peak passages register only -4 or -5 on the VU meter. I*

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

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have played my tapes on another deck (Sony 255) and get the same low playback level. But a tape recorded on the Sony plays back properly on the TEAC. I am using Scotch 290 (½ mil) tape.—John L. Bagwell, Lanham, Maryland.

A. It appears that your problem is miscalibration of the VU meter. Whether this is true for tape in general, or only when you use ½ mil tape, can easily be checked by investing in a small reel of 1½ or 1 mil tape and noting whether you still get underrecording. It is also possible that your machine is underbiased. Up to a point more bias current increases the amount of signal that gets recorded on the tape. If treble response is exaggerated, which can happen when there is too little bias, then underbiasing is indicated. Have an authorized technician check the bias and record/play response.

Concert Hall Recording

Q. I have the fantastic opportunity of recording live in the Teatro Colon, in Buenos Aires, one of the best concert halls in the world. The Teatro Colon, however, does not encourage recording engineers, and its equipment is painfully obsolete. I must get acquainted with modern equipment and techniques for recording live, but none of the magazines to which I am a regular subscriber offers much information on recording techniques and equipment. Would you know of any publication (books, manuals, magazines, catalogues, anything!) that could give me not-too-technical reports on available recording equipment and general information about recording techniques?—Oscar J. Romero, Buenos Aires, Argentina

A. You might write directly to manufacturers of recording equipment. You can get their names and addresses from *Audio* and other periodicals in which they advertise. *Audio* published a series of three articles by David Josephson on Microphones in December, 1973, July and Aug. 1974. You will find a chapter on microphones in *Hi-Fi Made Easy* by Norman Crowhurst (Gernsback Library, 154 W. 14th St., New York, N.Y.). A chapter on microphones is in my book, *Getting the Most Out Of Your Tape Recorder* (John F. Rider, Inc., 114 W. 14th St., New York, N.Y.)A chapter on using a tape recorder and microphones ("Increase Your Enjoyment of Music") is in *How To Select and Use Your Tape Recorder* by David Mark (Rider). And a chapter on stereo microphone technique is in my book *Stereo, How It Works* (Gernsback).

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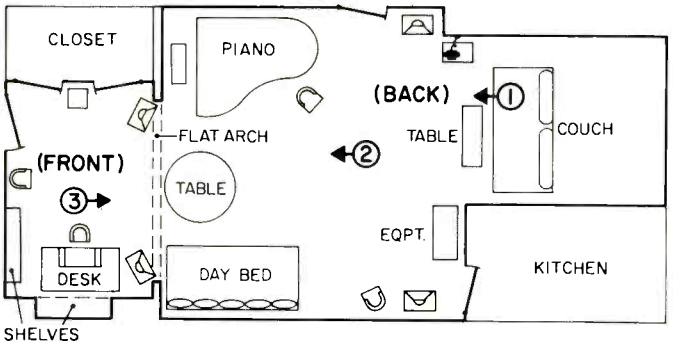
Audio ETC

Edward Tatnall Canby

ON THE THEORY that one diagram is worth a column of words, I spent a lot of time recently on my hands and knees in my New York apartment, taking measurements—see diagram. There you will find my own solution to a major problem these days, how to cram four channels of sound into a crowded, ill-shaped urban apartment. Most people still think it is impracticable.

Far from it. In fact, it took me less time to find the right place for four small speakers in my zany and unsymmetrical apartment than it did to make the diagram, unaccustomed as I am to public drawing. It is a sure thing, I say, that if we don't get four channels into thousands of urban apartments like this, we might as well give up, because urban America *is* America, at least indoors.

For a long time, I've had a hunch that this problem wasn't as bad as most people think. When Electro-Voice recently turned up with a new small-space, big-bass speaker designed expressly for this type of situation, I acted fast. I borrowed four of the Interface: A units, which come in pairs, and hauled a quadraphonic receiver down from the country to plug them into. My four-way solution, as per picture, came after a series of trials in various temporary positions—and I hasten to add that you *must* do this first, before you get into arguments about furniture and decor. Nine times out of ten, there will be no need to do heavyweight moving. Rather, it's likely to be a change of tables, pictures, lamps, and chairs, no more. But the right place, you must understand, is going to be vastly better than the wrong and



thus worth the effort.

I put the front speakers where, years ago, I had found the only workable location for stereo in that same addle-shaped room. I tried them all. You will note that the back speakers, like the front, occupy positions of *approximate* room symmetry, in a highly lopsided area. It is a first principle that one never places pairs of speakers in grossly unsymmetrical locations—say, one with a wall or corner behind it and the other with a big space behind. It will not work. Don't even try. On the other hand, even a barely approximate symmetry, as between that small corner niche, where my right back speaker is (former telephone table location!), and the corner next to the kitchen, opposite, where the left speaker is, can work out astonishingly well. The little niche made all the difference, as I specifically found out.

For three positions, as marked, I achieved a spacious and listenable quadraphonic sound, though you might not believe it. From the recessed couch (1), actually a bit behind the back speakers, the effect is splendid though the left channel is partially in acoustic shadow and the right is rather close. Fortunately, the Interface: A speakers have excellent sound dispersion, so that you must walk right up to one of them before the sound is heard separately. Mark of a good quadraphonic reproducer. From the center of the space (2), I can do my favorite walk-about listening, on foot. There's just room to move in time to the music without bumping into a channel. As for the day bed, it is sonically out of bounds. I don't listen in bed.

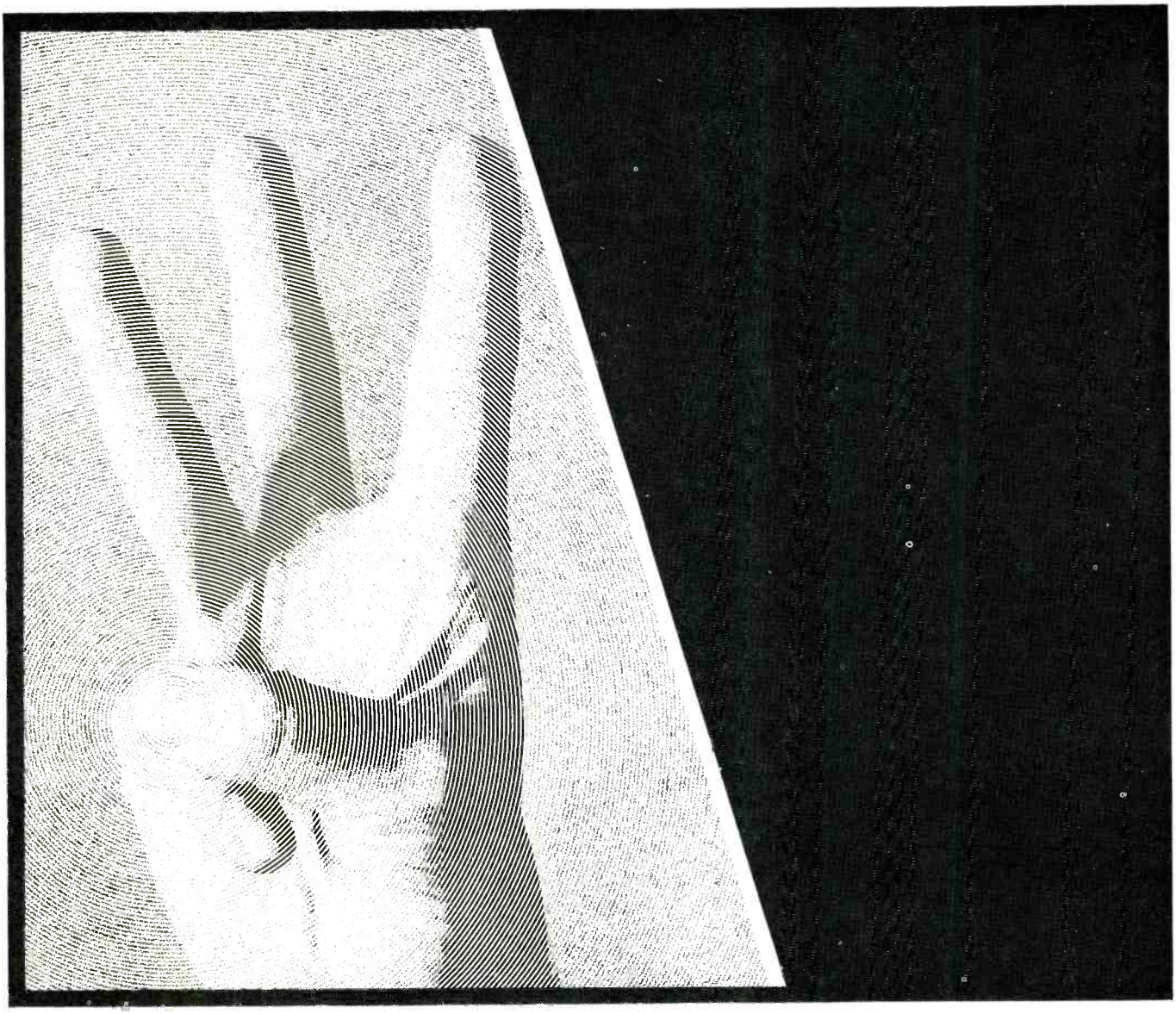
From my work desk in the semi-alcove near the entrance door, I hear a reversed image via reflection. By no stretch could this be called discrete quadraphonic—but I find it pleasant even so, and better than it ever was in stereo from the same place. More info, even if scrambled.

I had long previously found that the placement of the front (stereo) speakers at the edges of the flat overhead arch, *with space behind them,* greatly enhanced the forward sense of distance and fullness of sound as one listens from the main part of the room. Now, that big space is drawn in and around the back speakers to include the whole listening area. I could ask for no more.

As for the E-V Interface: A speakers, they did indeed fit right into this arrangement. They are of a new, little shape, only 14 by 22 inches and so shallow, only eight inches deep, that you can back them inconspicuously near a wall at the back of a table or other support where, with their neat black grille covers, they blend right into th background, out of the way. No need to make separate furniture lumps out of them. The units were designed as an updated, computer-calculated, optimum juggling of a number of ingeniously combined principles for maximum bass in minimum space—an honorable and ancient idea. Inside there is a tuned system for efficiency (I noticed this immediately) and a passive-front radiator which, in effect, replaces a body of air larger than the box could hold, for correspondingly-increased bass range. Also, there is an equalizer unit, one (stereo) for each pair of speakers. It adds 3 dB of bass boost, with a bottom cut-off to avoid rumble and shake.

Now, I, along with plenty of other hi-fi people, have always distrusted electronic boosting of this sort. It is not the ideal way to get bass, which might be said to be the Klipschorn way, for one. But corner Klipschorns do not into an apartment fit, especially one with 10 mini-corners like mine. I found that E-V's very modest 3 dB boost was gentle in action and introduced no audible musical problems for my ears. Moderation is a good principle.

One problem, though not E-V's fault. The equalizer units, two for quadraphonic, must be inserted before the main amps and thus use the familiar record-out and monitor-in system, through pairs of connecting cables. (There are extra ins and outs to take your other equipment.) So for just plain phono, I hooked in 10 signal cables and four power cords in an unsightly mess of wire dangling oehind my equipment table. Suppose I were to add tape, plus Dolby, Burwen or dbx, plus an outboard demod or decode unit? All use in/out monitor jacks, and the wire tangle would be monstrous, even dangerous. Aaargh!!!



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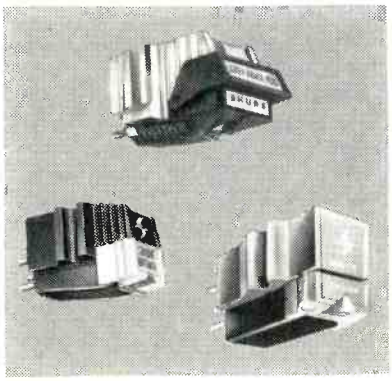

Fact: the lowest cost way to improve your whole high fidelity system is simply to upgrade the source of sound—the cartridge! If you're on a temporary austerity program, the Shure M44E can make a significant difference in sound over the cartridges supplied with many budget component systems. If your budget is a trifle more flexible, an M91ED can bring you into the area of high trackability (with performance second only to the V-15 Type III). And for those who can be satisfied with nothing less than state-of-the-art playback perfection, Shure offers the widely acclaimed V-15 Type III, the recognized number one cartridge in the industry, which, in truth, costs less than a single middle-of-the-road loudspeaker. To read about what a Shure cartridge could do for your system, write:

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Behind The Scenes

Bert Whyte

EVEN AS THE SWALLOWS come back to Capistrano each year, a bit further South in California, the audio fraternity flocks to the annual Los Angeles convention of the Audio Engineering Society. This 51st convention of the AES was held May 13th through 16th in its usual place at the Los Angeles Hilton.

While the country in general and certain sectors of the hi-fi industry are still in the thrall of the recession, this seems not to be the case with the world of professional audio. The 51st convention was decidedly upbeat, with first day attendance breaking all previous AES records, overall attendance setting a new record, and the greatest number of manufacturers exhibiting products to date. While there was some cautionary hedging about business conditions from a few people, in general, the atmosphere was buoyant, confident, and optimistic.

However, it must be noted that while there was plenty of new equipment on display, there was nothing particularly outstanding or revolutionary. A good number of things could be classified as evolutionary updates. In other words, this convention gave us nothing on the order of the BASF *Unisette*, or high polymer piezoelectric films that were the highlights of recent conventions. Speaking of the Unisette, it appears that its production timetable has gone awry once again. The anticipated playback deck from Studer has yet to be seen, and similar decks from purportedly interested Japanese manufacturers have not appeared either. Insiders say cost is the problem, and with the inflation-bloated prices of parts and supplies, this is easy to understand. I hope this can be overcome, and soon, for in this reporter's opinion, the Unisette has great potential and a definite place in the world of audio.

At this convention, as usual, when one walks into the main exhibit area, the eyes are assaulted by a vast panoply of professional products (how's that for alliteration!). Considering that there are 15 other rooms or areas, plus demo rooms on another floor, all stuffed with audio equipment, one hardly knows where to begin. It is impractical to cover everything. . .for one thing you're constantly bumping into people you know, and in no time at all, five or six people are holding a mini-seminar on some aspect of audio, meanwhile doing a damn good job of blocking the aisles. Then you meet those who suggest a brief hiatus from the show to partake of a refreshment. Lastly, it must be admitted that I bypass some products which are of little interest in my audio milieu. Thus, with apologies to those who may feel slighted, some random observations on audio products that caught my eye in my ramblings through the exhibit halls.

You can always count on Steve Temmer, of Gotham Audio, to come up with an exotic product. This time it was the Europa Film high-speed electroplating system for producing record mothers and stampers. The master lacquers are plated in two kettle-shaped containers, and people were kidding Steve that he had a fast food franchise for "broasted" chicken! With racks of ancillary equipment and interconnecting fancy plumbing, the system fairly reeks of precision and high technology. The unit uses 40 volt/400 ampere rectifiers (with a fuse nearly as thick as my wrist!), and deposit time for a 10-mil plating thickness is less than 30 minutes.

There is always a bewildering profusion of mixing consoles at any AES convention, and each year they grow more elaborate. There seems to be a growing trend towards automatic programmed mixdown, wherein once set, a particular mixdown can be repeated whenever desired. Consoles from Automated Processes and Quad Eight featured such facilities. As for so-called portable mixers (transportable would probably be more accurate), there were legions of them, in all sorts of configurations. The baby Neve unit, called Kelso, is particularly attractive and uses those super smooth conductive-plastic faders.

The Dolby stand featured the new CP100 Cinema Processor for the production of Dolby-encoded magnetic and optical sound tracks and—the new sensation—stereo optical tracks. Dolby was hosting a demonstration film, incorporating encoded-stereo optical tracks, at the Doheny Plaza Theater, but unfortunately the theater was located in Beverly Hills, quite a haul from the Hilton in downtown L.A., so I did not get to the demo. Dolby has also gone into the noise *production* business, and Ray and Dagmar Dolby were proudly showing their first model, five-month-old Master Thomas Dolby.

Attracted by a blinding light at one booth, I found it was Crown International lighting up 600-watt bulbs with their M600, a mono power amplifier. If you have a speaker with a 4-ohm impedance, connect it to this unit which will pump out a mere kilowatt! Amplifiers were much in evidence at the convention as witness a new 400-watt/channel unit from Altec, and 300-watt/channel units from JBL and SAE. BGW was on hand with its "Senssurround" Earthquake amplifier, as well as lesser power units. Up on the fourth floor, Yamaha was getting plenty of attention demonstrating its new $1600 vertical FET amplifier, the B-1. Its companion accessory module, for comparing up to five pairs of speakers, should find favor with the high-end hi-fi shops.

At the Philips' booth and on demo on the fourth floor, the new AKG BX10 reverb unit was creating quite a stir. About one quarter the size of the BX20 unit I am currently using, it features the same boooiinggg-free reverb of the big unit and at less than half the price (approx. $1300.00).

Magnificent professional tape machines were being displayed by such as Ampex, Scully, 3M, MCI, and Studer, in various formats up to 24 channels on 2-inch tape. There were no

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new models as far as I could see, but there were updatings and some new accessories. At Ampex, they were showing a new model of Frank Rush, the dean of field reps. Devoid of some 20 odd pounds and shorn of his Confederate cavalry officer's moustache, I hardly recognized the man. Frank showed me what is called a "Search to Cue" device for the Ampex MM-1100. For use as an aid in mixdown and overdubbing, the unit can place a zero reset or cue point anywhere on a tape, in either the *Stop*, *Fast Forward*, or *Rewind* position. An hours, minutes, and seconds counter with an LED digital readout gives the position of the tape. Punch in the *Cue* button and the machine will search forward or backward until it reaches the preset cue position. Press the *Play* button simultaneously with the *Cue* button and it will find the cue spot, stop the transport, and go immediately into *Play* mode. The system is accurate to within plus or minus one half second. I wish they would make such a gizmo for the Ampex 440, if only for the super-accurate counter function. Ah, well!

Eventide Clock Works and Lexicon were showing the latest models of their digital delay systems. There have been various updates, not the least of which is an expansion of dynamic range beyond 90 dB. Cost has come down, but there is a way to go before these units are affordable for far-out experimenters in quadraphonic synthesis.

In the dbx room, they were demonstrating the latest direct-to-disc Sheffield record, #4, which had been encoded with the dbx system. With the master lacquer having a S/N ratio of over 80 dB, this might seem like overkill, but you'll have to judge for yourself. All I can say is that the record was totally noiseless and sounded sensational.

Now to the business of quadraphonic sound. Columbia was on hand in the Patio Room with the most advanced of their SQ decoders. They had gone to the trouble of bringing in sound-absorbing panels from a studio, and with the room acoustics fairly well tamed through this expedient, the sound of the Ben Bauer-designed Leslie DVX speakers was excellent. In a variety of pop and classical items, we heard fine quadraphonic imaging and sound localization, and this was unquestionably the best SQ demonstration heard at any of the hi-fi shows. Sansui held sway on the fourth floor and, with four JBL monitor speakers, gave a good representation of the capabilities of QS. Most impressive was the performance of their latest quadraphonic synthesizer, which can do wondrous things with stereo records. Nippon Columbia was demonstrating their latest UD4 hardware with a variety of recordings using this system. The sound was clean and firmly localized and received some quite favorable comments.

Now to CD-4. JVC was showing their new Mark Three CD-4 system built around a phase-locked-loop modulator, which is said to give significant improvements in sum and difference frequency response, S/N ratio, dynamic range, and distortion. In a joint effort between JVC and RCA, a similar type of PLL CD-4 modulation system was introduced by RCA which they call the "Quadulator." John Eargle, President of the AES, presented a paper on the new JVC system, in their behalf, as did Greg Bogantz of RCA for their new Quadulator. There is no doubt that these new systems for CD-4 have made an audibly superior product. I have several experimental discs at home, and there is no question of the increase in quality over the same recordings made with previous systems. There is a great deal more to this development. I had the privilege of visiting the JVC Cutting Center in Los Angeles as the guest of John Eargle and will be giving you full details of my visit and what I learned about the new modulation system in an upcoming issue.

Finally, before I leave the subject of the 51st AES convention, I would be most remiss if I did not mention the absolutely sensational entertainment presented to us at the conclusion of the awards banquet. Two virtuoso performers on the ARP electronic music synthesizers, Tom Piggott and Mike Brigida, along with a very accomplished rock drummer, gave us a quad concert which was stunning. The sound system was a giant Altec theater system in each corner driven by their new 400-watt amplifiers, augmented by no less than Gene Czerwinski's Cerwin Vega corner plugs as used in the movie *Earthquake*, driven by a mere 6000 watts. Crossover was at 30 Hertz through the new Crown VFX crossovers! The boys gave us a number of great tunes but the absolute end was *MacArthur Park*, which was the most sonically dynamic and exciting sound I have ever heard...at least as a sheer sound experience. The sight of the AES engineers and their wives roaring their approval and stomping and whistling for encores was something I won't soon forget.

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A.

Dear Editor:

Transient IM

Dear Editor:

Thank you for publishing the Leach article on "Transient IM Distortion in Power Amplifiers" (*Audio*, Feb., 1975). This is the type of analysis that is very much needed in the design of audio equipment, to take it out of the "arts and crafts" category and give it a firm scientific basis.

From 1948 until about 1968 (when I bought my first transistor emplifier, a Dynaco Stereo 120), my standard of comparison was a vacuum tube amplifier that I designed and built and wrote up for *Audio (Engineering)* in 1948. All stages were push-pull. The output, from a pair of Wetern Electric 300-Bs, was 30 watts, at about 2% IM distortion, and the power curve was within 1 dB from 20 Hz to 22 kHz. *There was no feedback of any kind.* My friends used to bring in other amplifiers for A-B tests, especially some of the early transistor jobs, and this old 300-B amplifier always won without any argument, until about 1968.

The best praise I have for Leach's article is to say that I wish I had written it!

Curtiss R. Schafer
Sandy Hook, Ct.

More on TIM

Dear Sir:

In his otherwise excellent article on transient IM distortion (TIM) in the February *Audio,* Prof. Leach states that operational amplifiers like the 741 are prone to TIM because of their low 2 to 5 Hertz open loop bandwidth. In audio design, as in servo and other control systems, the term "open-loop" gain means gain around the entire forward and feedback paths. But in op amp terminology, "open-loop" response means the response of the device *without* external feedback. The compensation controlling the bandwidth is usually lead type, rather than lag which (as he notes) reduces TIM instead of increasing it.

The slew rate of the 741 is about 0.5 volt per microsecond—roughly 5000 times faster than it would be if lag compensation were used. This fast slew rate insures that any "holes" resulting from transients will be so brief as to be inaudible. I have critically compared 741s with high grade tube circuits and could hear no difference (closed-loop gain was limited to 20 dB max.). There may be ways of using op amps that could lead to problems, but local feedback around each op amp will prevent this.

Donald E. Phillips
Cedar Rapids, Iowa

The Author Replies

The 741 op amp is internally lag compensated by a 30 pF capacitor. This is necessary to prevent oscillation when external feedback is added. Normally, when the op amp is used with external negative feedback, the bandwidth of the closed-loop amplifier is reduced by placing a capacitor in parallel with the feedback resistor from the output terminal to the inverting input terminal. This capacitor increases the feedback at higher frequencies, thus reducing the bandwidth of the closed-loop amplifier. If the feedback loop is broken, the capacitor has in effect increased the bandwidth around the complete forward and feedback paths, and this is, technically, lead compensation. However, in the case of the 741, lead compensation in the feedback loop is not necessary for stability since the op amp is already internally lag compensated for this purpose.

Although lead compensation in the feedback loop of an op amp will reduce its tendency to produce TIM when used as a voltage amplifier on its own, we must examine what would occur when this op amp is included in the forward path of a power amplifier with negative feedback of its own. Since the bandwidth of the op amp has been reduced by "local" lead compensation in its feedback loop, the open-loop bandwidth of the power amplifier as a whole has been reduced. This can lead to TIM in other stages of the amplifier, although this depends heavily on the particular design.

Nearly all state-of-the-art power amplifiers today employ an op amp input stage, whether discrete components or an IC. I prefer the discrete designs until some IC maker markets a unit in which the amplifier designer can adjust the internal frequency compensation (these exist, but are not in production), and more importantly, the local negative feedback in each internal stage. This way the op amp will be capable of being tailored to meet the specific objectives of the amplifier designer. Otherwise, I think most IC op amps are better suited for d.c. and low-frequency instrumentation amplifiers. However, some of the IC amplifiers designed for r.f. applications may be ideally suited for audio purposes. I have not investigated this in any detail.

Whether IC op amps are suited for mixer and low-level applications where they will not be inside the feedback loop of another amplifier is something I have not investigated. I would refer those interested in this application to Hoge, W.J.J., "Tubes Versus Transistors: A Further Comment," J.A.E.S., June 1974, p. 338. Mr. Hoge gives the results of an actual listening test performed on commercially available mixer amplifiers. His conclusion was that mixer amplifiers which have open-loop bandwidths smaller than the audible frequency spectrum sound inferior.

In my article on TIM, I concentrated on describing its worse possible manifestation in power amplifiers. There are more subtle effects which I did not describe relating to how the THD of an amplifier varies with frequency at a constant power level. If the amplifier's THD increases rapidly with increasing frequency, a subtle form of TIM can be triggered by wideband audio signals with excessive high frequency levels, even though the input stages do not clip. I believe this form of TIM is the one most likely to be produced by a commercially available amplifier.

W. Marshall Leach
School of Elec. Eng.
Geo. Ins. of Tech.

FTC Violators

Dear Sir:

Although the FTC has passed the "honest power in advertising" rule, it has had no effect whatever in our area. Ads still flood the newspapers here claiming 200-watts for 8-track

You never had it so good.

(Akai's new GXC-39D stereo cassette deck.)

You may be asking yourself how we could possibly know what you've ever had —and how good it was. Well, we couldn't. Except when it comes to Akai's new GXC-39D.

Then we say — with what it has and for what it costs — you never had it so good.

This cassette deck is so good you can push a button at a certain spot in the tape and it'll remember. And go back to it anytime you want.

Flick on the Dolby* switch and it'll filter out any bad sounds going to your speakers.

Flick another switch and it's set for low noise tape.

Push another button and it'll pause in the middle of a recording. Push it again and it'll start again, smoothly.

Just turn on the GXC-39D and your tape will be running across Akai's own glass and crystal heads. We developed them.

Lights pop on to remind you the tape is running.

More lights pop on if the recording level is too high.

It has direct function controls so you can go from play to forward to rewind and back to play — non-stop.

And it comes in Akai's professionally styled brushed aluminum finish.

The Akai GXC-39D stereo cassette deck.

We never had it so good, either.

Akai America Ltd., 2139 E. Del Amo Blvd., Compton, Calif. 90220
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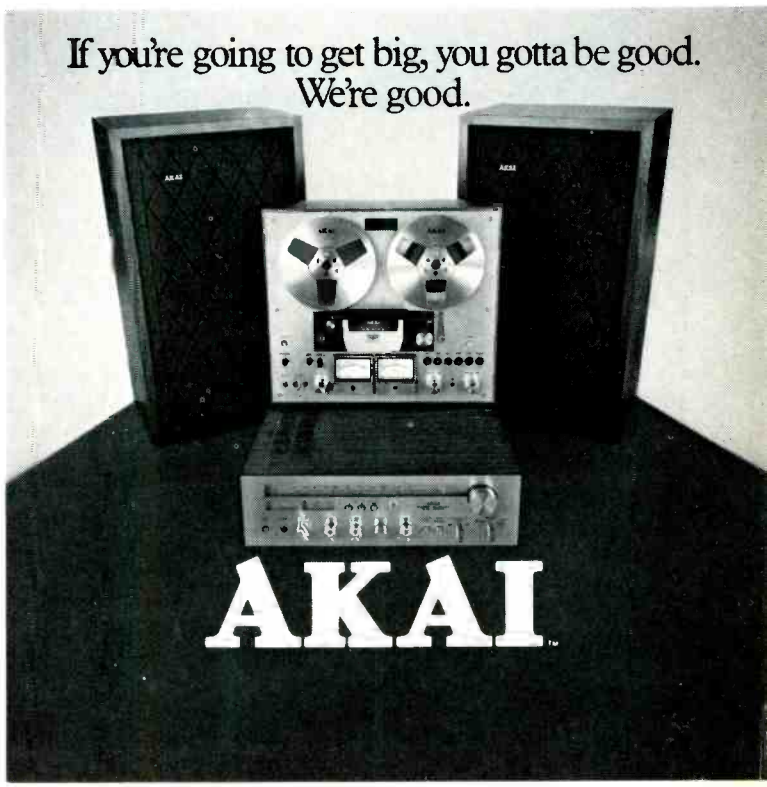

tape players. I phoned several of these advertisers and none of them was aware of the rule; most of them refused to believe me. And one man said, "Even if there is such a ruling, they'll never bother with us—we're too small."

I'm sure this problem exists all over the country in smaller cities. To what department of the FTC should one send clippings of offending ads, along with a letter asking the FTC to inform the violators that they are wrong?

Bruce Cullom
Sound Town, Inc.
Texarkana, Tx.

The rule most certainly applies to 8-track players as well as receivers and amplifiers. Inquiries about the rule should be sent to:

Carthon E. Aldhizer
Div. of Special Statutes
Federal Trade Commission
Washington, D.C. 20580
Tel: (202) 963-7124

In addition, the EIA has published a batch of data on the ruling, and should be glad to send materials to stores in your area. Address Jack Wayman, Electronic Industries Assn., 2001 Eye St. N.W., Washington, D.C. 20006. Telephone (202) 296-5550.

Electo-O-Phonie Enthusiast

Dear Sir:

Since I am an owner of the Elekt-O-Phonie FU-100's immediate predecessor, the F/Mc2, I read Professor Lirpa's review in *Audio* (April, page 54) with great interest. Almost before I finished reading I ran to the nearest Five and Ten Cent store where I bought an FU-100 for my car. It works fine on 12 volts d.c. My only problem came when I fitted the Klipschorns (I refuse to listen to any other speakers) into my Volkswagen. It was worth the trouble, though. Can you imagine my satisfaction as I cruise down the Boston Post Road on my way to work every morning at 140 mph, listening to all eight channels simultaneously?

Alan M. August
N. Providence, R.I.

Dear Sir:

My hat is off to Professor I. Lirpa for his enlightening equipment profile of the Elekt-O-Phonie Model FU-100 Octaphonic Receiver. One question plagues me about this obviously sophisticated piece of gear. What does the "FU" stand for? *Frequencies Unthinkable,* maybe?

Jack Stevens
WXCL Radio
Peoria, Ill.

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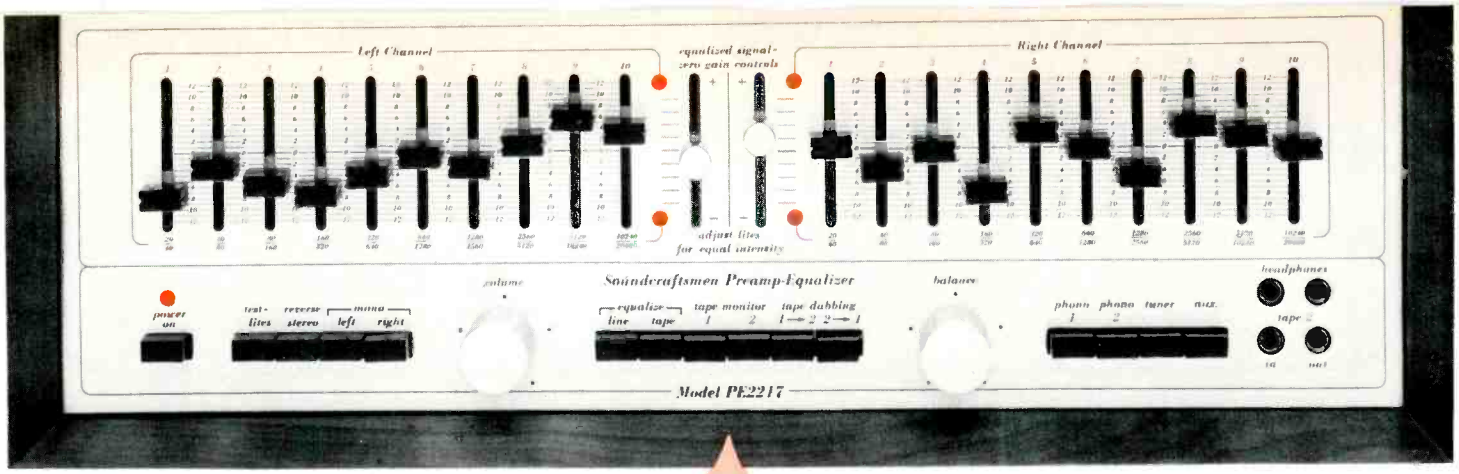

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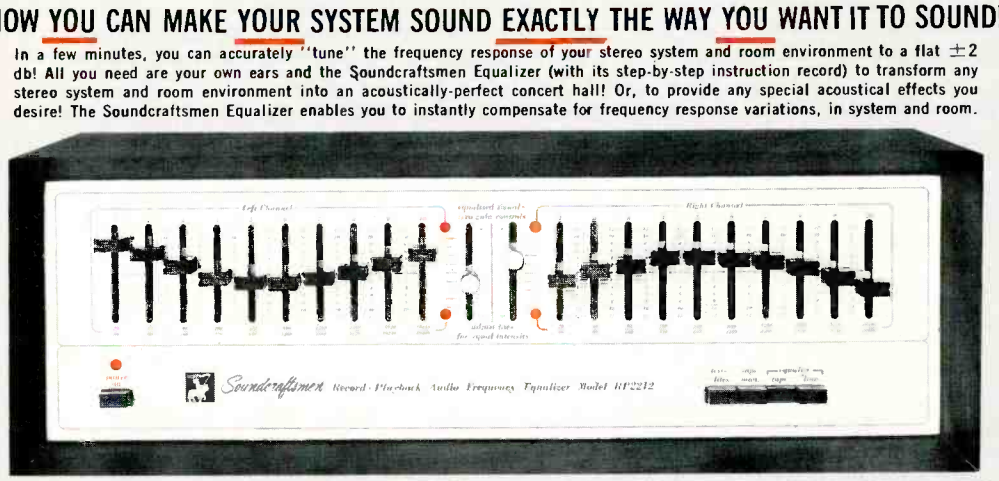

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Editor's Review

HALF A DOZEN of the world's foremost loudspeaker authorities, including A.N. Thiele, Richard Small, J. Robert Ashley, J.E. Benson, Murray, and very probably Paul Klipsch, will be leading a series of tutortial seminars to be held in conjunction with the Australian Institution of Radio and Electronics (IRE) Electro-Acoustic Conference in Sydney, Australia late in August. A special tour has been arranged, the cost of which covers all transportation (including that in Australia), hotel bills, landing fees, tips, but no meals. Estimated price of the two-week tour is $1400.00 per person from Los Angeles, and this represents a considerable savings for a remarkable opportunity.

The group leaves Aug. 16 from Los Angeles, and there will be a two-day stopover in Fiji for jet-lag recovery. The tutorial lectures will be held on the 20th, 21st, and 22nd at the Univ. of Sydney, with the 25th through the 29th spent at the IRE Conference. There will also be some outside touring arranged, and preliminary plans include a concert at the Sydney Opera House.

If you would like to go on this tour, you must act quickly, since a deposit of $250.00 must be in by July 20th and the balance by August 1st. Deposits should go to Bud Edmonds, Research Associates, 66 Minnehaha St., Manitou Springs, Colorado 80829 (303) 685-5776. Further information can be obtained from Edmonds. A remarkable opportunity!!!

Covers

The Edison Triumph shown on this month's cover represents an unusual transitional unit between the Model A and the Model B. Its serial number is 25609, and it was built about 1898. It plays either brown or black cylinders, but only the two-minute variety, and is capable of playing up to 14 cylinders with a single winding of its triple-spring motor. The unit apparently was a top-of-the-line model and sold for about $50.00 with the black and brass horn shown. There was a black, floor-standing horn sold as an accessory.

The Model C reproducer, which goes with this unit, has a spherical sapphire stylus for vertical-cut cylinders and a stretched-copper diaphragm. The unit also has a record shaver and a recorder.

The mechanical refinement of the unit is fairly advanced for the time. The drive belt can be accurately tensioned by means of a screw which lowers the entire motor against the belt, and the nickel-plated chassis features replaceable bearings. A screw-set governor regulates speed.

The unit is owned by an ardent, young collector, Evan Blum, whose specialty is doing restorations of reasonably complete machines. Blum also has about a dozen machines for sale, including a Fireside B which was made for only about two months. The Fireside B played the four-minute wax cylinders but was dropped soon after its introduction because the much superior Amerol cylinders came on the market.

Blum is currently working on an article about sources of supply and services for this field, which we hope to publish in the not-too-distant future. We will be happy to forward any correspondence to Blum, either about his collection or about the article.

Back in June, the credit for the cover was inadvertently dropped, and we apologise to Philadelphia Wireless Institute from whose collection the Radiola Model 27 in the photo came.

Philadelphia Wireless, not incidentally, is one of the nation's oldest and best schools for technical training in the disciplines related to electricity, radio, and broadcasting. The faculty believes in classroom education as it appears to offer better opportunity for back-and-forth interchange between teacher and student. The school also features a variety of radios, TVs, test instruments, and breadboard circuit set-ups for hands-on training. They are located at 1533 Pine St., Philadelphia, Penna. 19102.

Stereo AM

RCA Broadcast Systems demonstrated a proposed stereo AM system at the recent National Association of Broadcasters meeting in Las Vegas. The proposed system multiplexes the two discrete left and right signals on the broadcast carrier for later decoding by the stereo AM receiver. Mono receivers would be able to receive a single composite signal with no degradation in performance.

Hermon H. Scott

Hermon Hosmer Scott, one of the handful of inventive pioneers who helped launch the high fidelity industry when he founded H.H. Scott, Inc. in the mid-Forties, died in April after a protracted illness. He was 66 years old.

Scott graduated from the Massachusetts Institute of Technology, receiving his Master's degree in Electrical Engineering from MIT in 1931. He was subsequently employed by the General Radio Co. as a development engineer, and while there developed the first sound level meter. In 1939 he designed and patented the R/C oscillator, on which most signal generators have been based for many years.

Another significant development was his dynamic noise suppressor, a device which materially lowered the level of scratch on records while preserving most of the musical content. Originally for radio stations, simplified versions were later sold for high fidelity. He held more than 100 patents.

During 1947 in Maynard, Mass. Scott founded the company which bears his name. The firm became one of the two best-known makers of high fidelity components (along with Fisher Radio), and was sold in 1972 to Eastern Air Devices, at which time he retired.

Scott's lifelong interest in music led to his becoming a Trustee of the Boston Opera. He was a Fellow of the Institute of Electrical and Electronic Engineers. He received the John Potts Award of the Audio Engineering Society in 1951, becoming a Fellow of the AES in 1952. In 1961 he was elected Executive Vice-President of the AES, becoming President in 1962, and joining its Board of Governors in 1963. In 1974 he was elected Executive Vice-President of the AES, becoming President in 1962, and joining its Board of Governors in 1963. In 1974 he was made an AES Life Member. *E.P.*

The source of perfection in sound... tracks at one gram (or less) in stereo and discrete.

Frankly, perfection doesn't come easily.

Pickering's engineers pursued the idea of a totally new departure in cartridge design with all the zeal of true crusaders.

They had a reason . . . there was a demand for a pickup to play both stereo and discrete (as well as SQ and QS) with total and absolute precision at one gram.

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The Pickering XUV/4500Q possesses excellent performance characteristics that provide outstanding frequency response and separation beyond 50 kHz. These improvements make possible the most faithful reproduction of the 30 kHz FM-modulated material on discrete records. It is noteworthy that Pickering's exclusive, new design development, which provides superior 4-channel discrete performance, also greatly enhances the reproduction of stereo records.

The XUV/4500Q features Pickering's patented Quadrahedral® stylus assembly. The Quadrahedral stylus assembly incorporates those features that produce extended *traceAbility*™ for 4-channel as well as stereo. This means that it possesses not only superior performance in low frequency tracking, but also in high frequency tracing ability. When combined with the exclusive Quadrahedron™ stylus tip, a brand new shape, it can truly be called: "the Source of perfection in Sound", whether the playback requirement is stereo, SQ, QS or discrete 4-channel.

The specifications are so exciting that we hope you will write to Pickering and Company, Inc., Dept. A 101 Sunnyside Blvd., Plainview, New York 11803 for further information.

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A.N. Thiele~ Sage of Vented Speakers

Ray J. Newman*

RECENTLY A SIGNIFICANT and elegantly-written article describing the nature of vented speaker boxes was republished in this country (1,2) 10 years after its original publication in Australia (3), A.N. Thiele's "Loudspeakers In Vented Boxes." I strongly believe this article is an important milestone in the literature on high-quality sound reproduction, and that it deserves to be shared with a wide spectrum of readers. It has already stirred active interest as shown by several notes and letters in the AES Journal (4,5,6,7) and in recent AES convention papers (8,9).

In his article Thiele investigates the behavior of vented-box speaker systems by analyzing their equivalent circuits as high-pass filters. Using techniques of electrical network analysis, he arrives at a remarkable tabulation involving not one, but 28 ordered ways of creating a vented-box speaker system! The discussion ranges to such matters as the specifics of designing the speaker box, measurement of required loudspeaker characteristics for proper design, and some especially significant discussion regarding loudspeaker efficiency and cone excursion as they relate to different system types. The details of some of these matters together with their implications will be pursued in this article. It should be understood from the outset that only the mid- to low-frequency part of the system, roughly below the frequency at which the cone's circumference equals one wavelength is being dealt with. This in no way detracts from the importance of Thiele's article, as this region is a most demanding one indeed and generally dictates the size and performance format of the complete system.

The following important implications of the generalized vented-box information presented by Thiele are listed here as an early broad summary:

1. Considering the four interrelated matters of *low-frequency limit* (the 3 dB-down point), *usable cone diameter*, *maximum cone excursion* above the low frequency limit, and *acoustic power output*, the nature of many types of vented systems as compared to sealed systems can be summarized as shown in Table I.

2. A simple but elegant relationship between *system efficiency*, *low frequency limit*, *box volume*, and one parameter pertaining to the *speaker mechanism alone* is also described by Thiele. This relationship is valid for both vented and closed systems, and although Thiele's table of 28 alignments indicates that many comparisons are possible (depending on the type of vented system), one of the more useful alignment types (Thiele's fourth-order Butterworth alignment) yields the comparisons shown in Table II between a vented- and a closed-box system possessing flat response. Again this implication, stated in three different ways, is a powerful and useful concept.

3. Thiele's tabulation (Table IV) of 28 ways of creating a vented system is the most interesting and useful information of all. Presented in concise format are a large palate of possibilities for creating correctly-tailored speaker-box systems. Each of these possibilities or, as Thiele refers to them, *alignments* has its own set of interesting characteristics. As examples:

(a) Some alignments describe how to make systems with the low-frequency limit *higher* than box tuning and the speaker's free-air resonance frequency.

(b) Other alignments describe systems with the low-frequency limit *lower* than box tuning and the speaker's free-air resonance frequency.

(c) Still other alignments are realized by using auxiliary electrical filters or equalizers. These illustrate ways of trading off box volume for system efficiency in the lower part of the system's operating range.

The possibilities of the alignment table are fascinating from the standpoint of system design, because they permit a logical and systematized approach in creating a vented speaker system. Further, they permit the system to take many different forms in terms of performance characteristics, box size, and speaker parameters to suit particular design goals. The Alignment Table (Table IV) changes vented-box design from something akin to splashing around in the Dismal Swamp, to having at least a canoe and a compass.

The Alignment Table

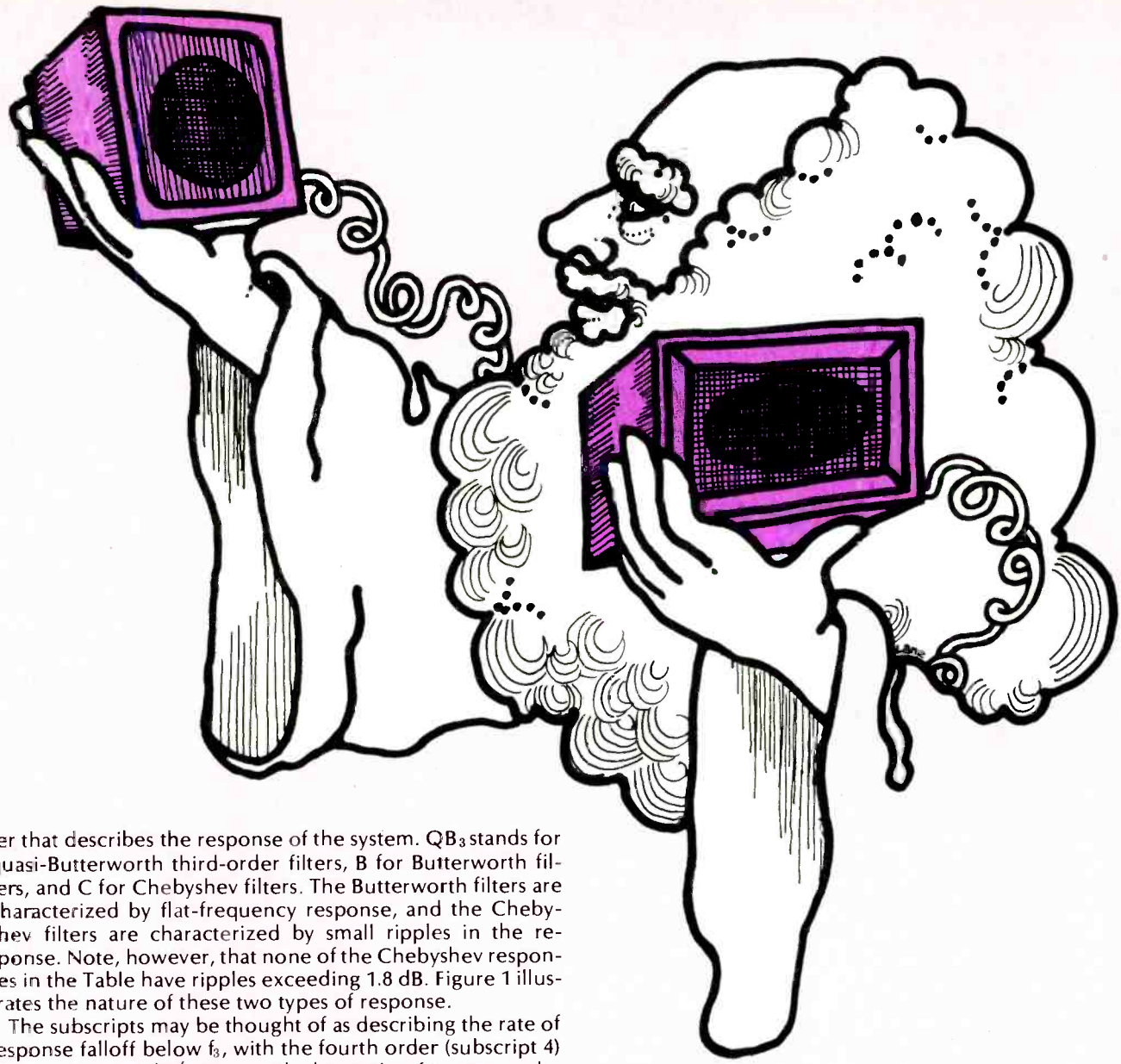
The high point of Thiele's presentation is the table of alignments—methods of properly coordinating the box and speaker for a specific type of system response (12). Table IV, presented here, is somewhat simplified from Thiele's table. The *Alignment Details* column includes the name of the fil-

Table I—Relationships of Parameters of Sealed and Vented Systems.

LF Limit	Cone Dia.	Max. Cone Excursion *	Power Output
Same	Same	Same	8 times sealed
Same	Same	About 1/3 of sealed	Same
Same	$\sqrt{1/3}$ or about .6 of sealed	Same	Same
$\sqrt{1/3}$ or about .6 of sealed	Same	Same	Same

* Considering only the range above low frequency limit, maximum excursion occurs at this limit for a sealed system and at 1.45 times this limit for Butterworth-type (see text explanation) vented systems.

*Senior Systems Engineer, Electro-Voice, Inc. Buchanan, Michigan



ter that describes the response of the system. QB_3 stands for quasi-Butterworth third-order filters, B for Butterworth filters, and C for Chebyshev filters. The Butterworth filters are characterized by flat-frequency response, and the Chebyshev filters are characterized by small ripples in the response. Note, however, that none of the Chebyshev responses in the Table have ripples exceeding 1.8 dB. Figure 1 illustrates the nature of these two types of response.

The subscripts may be thought of as describing the rate of response falloff below f_3, with the fourth order (subscript 4) falling off at 24 dB/octave with decreasing frequency, the fifth order at 30 dB/octave, and the sixth order at 36 dB/octave. Note that all the alignments have basic 24 dB/octave falloff rates due to the mechano-acoustic nature of the beast, and that the more rapid falloffs are a by-product of the electrical filters or auxiliary circuits required (i.e., additional electrical rolloffs of 6 dB/octave and 12 dB/octave for fifth- and sixth-order responses, respectively). Additional table notations are as follows:

f_3 = the 3-dB-down point on the response curve;
f_s = the speaker's free-air resonance frequency;
f_b = the frequency at which the box is tuned (a function of box volume, vent area, and length, not of the speaker mechanism);
C_{as} = the acoustic compliance of the cone suspension system (crudely, how "loose" the suspension is);
C_{ab} = the acoustic compliance of the volume of air in the box ($C_{cb} = NV_b$, where N is a constant dependent on the measurement system used, and V_b is box volume), and
Q_t = the speaker's "Q" when connected to the driving amplifier. (This may be thought of as how far down the speaker's response is at free-air resonance relative to its mid-band response in a very large baffle — i.e. $Q_t = 0.5$ means that the response is down 6 dB at resonance.)

With the above definitions in mind, several observations may be made. Note that only three pieces of information (f_s, C_{as}, and Q_t) are needed to completely describe the nature of the speaker mechanism alone (assuming amplifiers with high damping factors) to create a system, and that the complete system calls for three ratios, involving box charac-

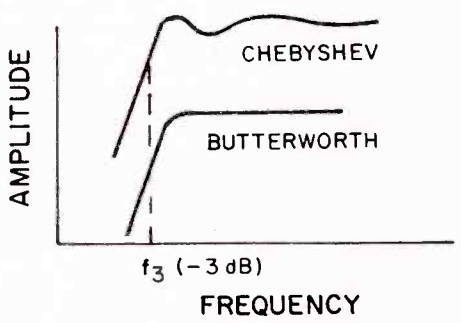


Fig. 1—Nature of Butterworth and Chebyshev filter responses compared.

teristics, low frequency response limit, and speaker characteristics plus the speaker's Q_t to be at *specified values* for a specific alignment. For a speaker designer, this requires the selection of a specific alignment (because of some desired characteristics it possesses), usually coupled with a selection of low frequency limit (f_3), box size, and speaker diameter, and then careful manipulation of the three speaker characteristics (f_s, C_{as} and Q_t) to satisfy the requirements of the table. In practice, this is a rather complicated matter as the initial selection of alignment type, f_3, box size, and speaker diameter involve dragging in many external considerations regarding the amount of power the system must radiate, distortion levels, where the system will be used, etc., which are beyond the scope of this article.

As the table of alignments appeared not to be generally known in the U.S. until recently, many, if not most, available unmounted speakers intended for vented boxes have somewhat random characteristics not necessarily tied to specific table alignments. For such random characteristic speakers the moderately large number of table alignments provides the designer a better chance of finding a reasonable (and hopefully usable) alignment for his speaker. Let us instead, however, consider the table from the viewpoint of a thoughtful designer of speakers who has knowledge of the table's existence prior to creating his speakers.

The first item to note in classifying the alignments in the table is that the first nine alignments do not require auxiliary electrical circuitry or equalization, unlike the remaining 19. Of these first 9, numbers 1 thru 4 are characterized by having the system's low frequency limit (f_3) higher than both the speaker's free air resonance frequency (f_s) and the box tuning frequency (f_b). (This appears in the table as entries showing f_3/f_s greater than 1, and f_3/f_b greater than 1, respectively.) In the case of the first four alignments, the table also implies a speaker considerably more compliant than the air volume in the box (C_{as}/C_{ab} considerably greater than 1) and small Q_t's if you please (Q_t's less than .303), which usually implies large magnets. The remaining unequalized alignments (5 thru 9) indicate low-frequency limits at or *below* the unmounted speaker's free space resonance (f_3/f_s is 1 or less). Also implied here are box tunings at or above the low-frequency limit (f_3/f_b is 1 or less), stiffer speakers relative to the box air volume stiffness (C_{as}/C_{ab} of 1.4 to .485), and more generous Q_t's (.383 to .557). In alignments 5 through 9, the greatest novelty is their ability to maintain output below the speaker's resonance frequency, although often fairly large boxes are required to do this and rapidly rising cone excursion in the region of f_3 to f_b is a by-product. Some interesting possibilities are presented by these 9 unequalized alignments although I suspect that, like as not, most designers of systems would settle on alignment 5 or one near it.

The remaining alignments (10 thru 28) all require an auxiliary filter. Alignments 10 through 14 can be realized with passive electrical networks, as the networks here have the function of removing a natural low-frequency rise from the response; in other words they "de-hump" the extreme low end of the system's response. Figure 2 illustrates the nature of these responses.

Alignments 15 through 19 can best be realized with active electrical networks. The networks here are required to lift up the extreme low end, as shown in Fig. 3. These alignments have the interesting tradeoff of box volume for some efficiency loss (with flat response restored by the equalizer) at the extreme low end of the system's range. These alignments can permit smallish boxes to have rather low cutoffs (note the moderately large values of C_{as}/C_{ab}). This may be seen by noting the similarities between alignments 4 (an unequalized alignment) and 15 (requiring a lift equalizer).

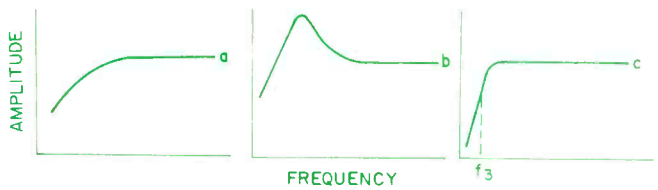


Fig. 2—Nature of response of alignments 10 through 14 before and after addition of the required auxiliary filters.

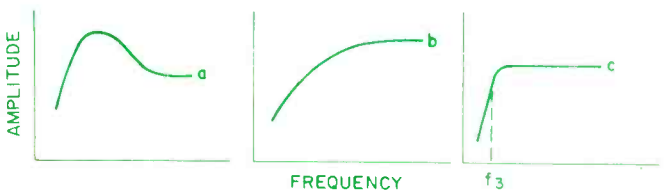


Fig. 3—Nature of response of alignments 15 through 19 before and after addition of the required auxiliary filters.

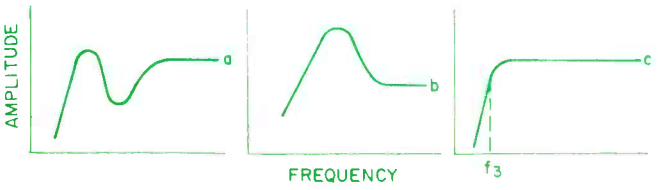


Fig. 4—Nature of the response of alignments 20 through 25 before and after addition of the required auxiliary filters.

Table II— Relationships of low-frequency limit, box size, and efficiency between sealed and vented systems.

LF Limit	Box Volume	Efficiency
Same	Same	4.5 dB greater (or 2.8 times sealed)
Same	About 1/3 of sealed	Same
About 0.7 (½ octave) of sealed	Same	Same

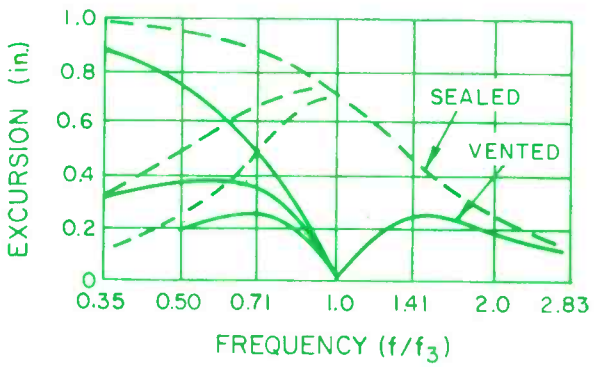


Fig. 5—Cone excursion as a function of frequency for Butterworth-aligned vented systems and for sealed systems, with and without filters (after Thiele).

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Note here that the speaker Q_t values are about the same (around 0.3) and the C_{as}/C_{ab} values are about the same (around 3.0). This would permit taking the same speaker in the same box and altering the vent or box tuning to obtain f_3/f_s = 1.45 for alignment 4, or to 1.0 for alignment 15 (with the 6-dB equalization lift for alignment 15). Thus, by using the equalized system, it is possible to decrease the low-frequency limit by a factor of 1.0/1.45, at the expense of a moderate amount of efficiency loss in the extreme bass—fascinating! The odds against coming up with a correct number 15 alignment by splashing around in the swamp of empirical cut and try without Thiele as a guide are vast.

Yet another group of alignments, which can probably be best realized thru the aid of active filters, are numbers 20 thru 25. In these cases, the filters are required to restore an unequalized system-response characteristic that progressively begins to resemble a dip between the low-frequency limit of the system and its mid-frequency response as alignment number 25 is approached. A rough idea as to what is being done is illustrated in Fig. 4.

In general, alignments 20 through 25 progressively tend toward boxes with large air compliance compared to speaker suspension compliance (C_{as}/C_{ab} is 1 or less), which often implies large boxes with the reward being a low frequency limit usually substantially below the speaker's free air resonance, (Alignment 25 has its −3 dB point at about 0.4 f_s—with a moderate filter boost of only 6 dB. Note that the electrical filters employed with these alignments (as well as those employed with the other equalized alignments discussed) progressively cut off electrical input to the speaker system below its low-frequency limit (f_3), which is an aid in reducing low-frequency cone excursion in the region where such excursion gives little fundamental acoustic output (but often appreciable distortion). The conservation of amplifier power below f_3 also tends to make up for the increased amp output required for the boost filters used by most of the alignments 15 to 25 in the range above f_3.

It is difficult to completely sum up this table of alignments as it contains so many unusual possibilities for vented systems with the most interesting physical realizations of these possibilities often lurking within the f_s's, f_b's, and C's of the tabulation in tantalizing, mind-twisting ways. Some of the gross characteristics of groups of these alignments have been discussed here to illustrate a few of the meanings of the table and pass on the realization of the many possible, often highly sophisticated, ways of dealing with the seemingly simple task of putting a hole in a speaker box.

System Efficiency Relations

A highly significant matter which deals with relationships between several system parameters and efficiency is developed by Thiele. As Small points out in his project note on efficiency (13), several writers have realized the significance of this (14) (15) (16), but Thiele appears to have been the first to record it in the literature. Knowledge of the way system parameters affect efficiency is quite important since amplifier power, even now, is not unlimited, and a designer has to contend also with the problem of speaker destruction, especially in trying to reach live performance sound pressure levels. Efficiency describes how much electrical power input is needed for a particular acoustic power output. This power output, coupled with the size and characteristics of the listening environment, are what determines pressure levels in the environment. Currently, when home speaker designers are reaching for ever-smaller boxes and also trying to maintain an adequate low frequency limit, a knowledge of when the absurd is being approached or of ways of obtaining the best return from moderate-size boxes would seem important. Thiele shows how to grasp this situation in a usable manner for both vented and sealed enclosures. The relatively simple expression that helps to do this is (17) which can be restated as:

$$E = 16 \times 10^{-12} f_3^3 V_b K,$$

Where E is the conversion efficiency presuming radiation is confined by a large flat surface (or radiation into a half space);

f_3 is the frequency at which the system's output is 3 dB down;

V_b is the internal volume of the box (cubic in.). In the case of sealed systems, this presumes that the stiffness of the air in the box is much greater than the stiffness of the loudspeaker mechanism, and

K is a factor dependent on specific system type—usually 1 to 2 for sealed-box systems, and 3 to 4 for vented, unequalized systems.

This expression is indicative of the efficiency of a system at low frequencies (wavelength greater than speaker circumference), but if good total system design is followed, the efficiency over most of the audible range probably should be less than 3 to 6 dB below this level.

Of interest on first inspection is the powerful effect of f_3, which is raised to the third power. Thus, cutting f_3 in half means reducing efficiency by 8 times, or 9 dB. Of lesser influence is the effect of V_b, with the implication that every time box size is halved, so is efficiency (i.e., 3 dB). As noted in the definition, the K factor is between 1 and 2 for most sealed-box systems, and between 3 and 4 for most simple vented systems, although values of 9 to 18 are possible for some vented systems requiring auxiliary filters.

Small (18) points out that comparison of a common non-equalized number 5 alignment with a sealed box can yield the conclusions presented in tabular form at the beginning of this article. Having 4.5 dB of additional efficiency available for the same low-frequency limit and box size can be useful when a designer is working near the limits imposed by very low efficiencies—chiefly very large amplifier requirements and danger of electrical burnout. As home systems often tend to maintain excellent low-frequency performance with the smallest reasonable box size (of even greater interest now, with 4-channel systems), the information in the efficiency equation can be put to good use by employing vented systems to decrease f_3 or decrease box size, while maintaining the same efficiency as a closed-box system.

Table III—Comparison of output, Cone Diameters, and Cone Excursions of Vented Box and Sealed Box Systems under certain conditions.

$\frac{f}{f_3}$	$\frac{\text{Excursion (closed)}}{\text{Excursion (vented)}}$	Increase in output of vented system for same excursion	Increase in dia. of sealed box piston to match output of vented box at same excursion
1.00	Large	Large	Large
1.25	2.80	7.80	1.67
1.41	2.00	4.00	1.41
2.00	1.33	1.77	1.15
3.00	1.12	1.25	1.06

Cone Excursion Considerations

Figure 5 is reproduced from Fig. 10 of Thiele's article (19). Relative cone excursions are illustrated for three cases of sealed-box and three cases of a vented-box of the Butterworth-type alignments. Note the minimum excursion at f/f_3 = 1 inherent in the vented system. Cone excursion in real-

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izable systems can be a very small value compared to the higher-frequency excursions at the same output power. It is fascinating to watch the cone become essentially motionless at f_3 while high sound levels are produced by the system. Peak excursion for the vented system is reached at 1.45 times the low-frequency limit, and decreases as f/f_3 continues to increase. In contrast to this, closed-box systems reach their near-maximum excursion values at in-box resonance and show a constant drop with increasing frequency at a given output level.

The differences in the plots below $f/f_3 = 1$ are due to the effects of auxiliary filters being applied in four of the six examples. The particular examples portrayed involve specific, carefully-coordinated, filter-loudspeaker-system combinations chosen for complementary characteristics. The highest excursion curve of a given box type is associated with an unfiltered system, the middle curve requiring use of a first-order filter (6 dB/octave decrease of the electrical input to the system with decreasing frequency below $f/f_3 = 1$) and the lowest curve requiring a second-order filter (12 dB/octave decrease in system input below $f/f_3 = 1$).

Note that low-frequency-cut filters can be applied to any kind of system, but in alignments 10 through 27, the low-cut feature is automatically a part of the required auxiliary filter. (Alignments 10 to 14 specify first-order filters, while 15 through 27 specify second-order filters.) Thiele believes the input-extinguishing action of the filters below the low-frequency limit of the system is desirable, and reasonably so, since the filter action:

A. Conserves available amplifier power by more nearly restricting its use to the part of the low-frequency spectrum that the speaker system is capable of reproducing well, and

B. Reduces distortion caused by the speaker being driven to what would be (without a filter) its largest excursion in a frequency region where acoustic output is becoming rapidly diminished.

Considering the frequencies above $f/f_3 = 1$, a tabulation is shown in Table III for the ratio of cone excursion of a closed-box system to that of a vented-box system, assuming the same output power is available from each. In one column difference in excursion is tabulated, presuming the *same available piston size for both systems*. A second column translates this excursion to the increase in power output required to bring the excursion of the vented system up to that of the sealed unit. The third column shows the increase in piston diameter of the sealed-box system necessary to match the output of the vented system if the excursion must stay the same. The last column is especially interesting because it illustrates that as the frequency of a Butterworth-aligned vented box approaches three times the low-frequency limit, the vent ceases to function. At low frequencies, the vented system operates as if it were a sealed system with an ever-growing piston size, until at $f/f_3 = 1$ the equivalent piston has grown to immense size. This explanation is appreciably better than the naive concept that, if both sides of the cone were used through venting, the effective substitute speaker would have twice the area (or 1.41 times the diameter). Actually this equivalent substitute speaker would be this size one-half octave above the low-frequency limit, and it would grow rapidly as the limit is approached.

There is a most interesting connection between the substitute speaker matter and the matter of the efficiency increases available through venting. Together these matters imply that f_3 can be pushed lower through venting, or box size further reduced without running out of excursion and/or pushing efficiency into a problem area, if one is satisfied to deal with the excursions presented by current sealed-box systems. Venting also has something to offer if one is concerned about reducing excursion at a given level of size and frequency bandwidth in order to further reduce forms of excursion-related distortion.

Table IV—Summary of Vented-Box Alignments, after Theile.

Alignment Details		Box Design				Aux. Ckts. Required
No.	Type	f_3/f_s	f_3/f_b	C_{as}/C_{ab}	Q_t	
1	QB_3	2.68	1.34	10.48	.180	no
2	QB_3	2.28	1.32	7.48	.209	no
3	QB_3	1.77	1.25	4.46	.259	no
4	QB_3	1.45	1.18	2.95	.303	no
5	B_4	1.000	1.000	1.414	.383	no
6	C_4	.867	.935	1.055	.415	no
7	C_4	.729	.879	.729	.466	no
8	C_4	.641	.847	.559	.518	no
9	C_4	.600	.838	.485	.557	no
10	B_5	1.000	1.000	1.000	.447	yes
11	C_5	.852	.934	.583	.545	yes
12	C_5	.724	.889	.273	.810	yes
13	C_5	.704	.882	.227	.924	yes
14	C_5	.685	.877	.191	1.102	yes
15	B_6	1.000	1.000	2.73	.299	yes
16	C_6	.850	.868	2.33	.317	yes
17	C_6	.698	.750	1.81	.348	yes
18	C_6	.620	.698	1.51	.371	yes
19	C_6	.554	.659	1.25	.399	yes
20	B_6	1.000	1.000	1.000	.408	yes
21	C_6	.844	.954	.722	.431	yes
22	C_6	.677	.917	.500	.461	yes
23	C_6	.592	.902	.414	.484	yes
24	C_6	.520	.890	.353	.513	yes
25	C_6	.404	.876	.276	.616	yes
26	B_6	1.000	1.000	.732	.518	yes
27	C_6	.778	.911	.110	1.503	yes
28	QB_3	.952	.980	1.89	.328	yes

Closing Remarks

I have tried to deal with some selected topics from a most elegant and pertinent article in the literature on sound reproduction apparatus. The highlight of Thiele's presentation is the tabulation of 28 ways of designing a vented-box system and doing it properly every time. Topics dealing with efficiency and excursion were singled out as having special importance in discussing what in vented systems is different and significant from the more normal sealed-box type of direct radiator system. Cone excursion is important, as only so much is available and many forms of distortion are associated with it, but it is the connection between required acoustic output levels and the movement of the speaker cone. Efficiency is also significant as it is the connection between required acoustic output levels and the movement of the speaker cone. Efficiency is also significant as it is the connection between acoustic output and electrical input requirements and intimately involves the effects of box size, low frequency system limits, and system type.

The vented system is certainly not new, but it is a format often handled at less than full potential when chosen. To some extent, this may be a reflection of its relative com-

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plexity of design and operation and also a need for more information on what it can do and how to make it "do" properly. Thiele's article is certainly a most definitive statement in these respects.

Thiele's work has provided the theoretical groundwork for at least two commercially-available loudspeaker systems in recent years: *Interface: A* and *Sentry III,* both manufactured by Electro-Voice, Inc. Thiele's paper also was the basis, by way of Small, for a construction project by Messrs. Lampton, Chase, and De Vries in the December, 1973, and August, 1974, issues of this magazine.

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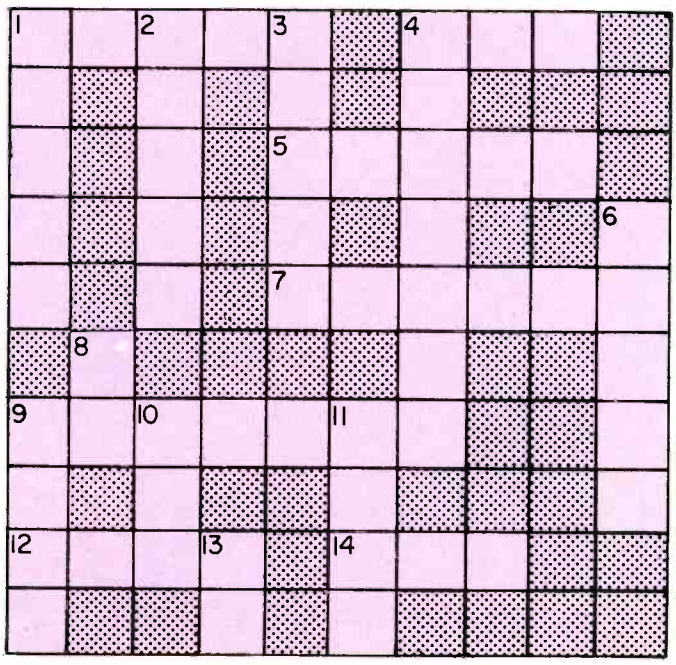
Across

1. Connecting wires; _____ cords.
4. Column in this magazine; Audio _____.
5. The Authoritative Magazine About High Fidelity.
7. Two separate signals from two speakers.
9. Jacks from which signals leave (plural).
12. A function switch _____ selector.
14. Name for 10½-in. tape reels.

Down

1. Common name for RCA (audio) plugs and jacks.
2. Individual part of tape, which carries one sound signal.
3. Erase, Record, and Playback parts of tape machine.
4. Tape in an 8-track cartridge is _____.
6. Man who invented a noise reduction system.
8. Volume Units.
9. Units of resistance.
10. Total Harmonic Distortion.
11. Whole _____, or semi _____; pitch.
13. Initials of editor of 5 across.



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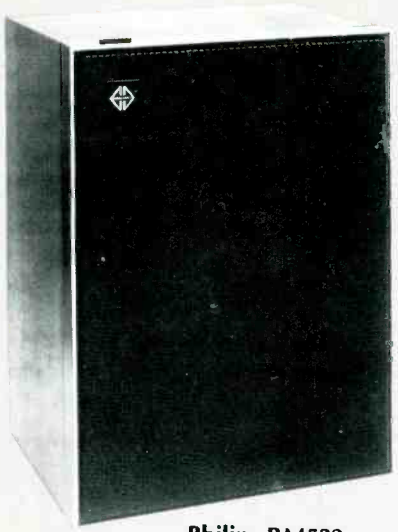

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Motional Feedback in Loudspeakers

George W. Tillett

A BIG PROBLEM loudspeaker designers face today is the difficulty of producing good bass response from a small system. As the enclosure size decreases, the air inside becomes stiffer, which tends to restrict cone motion and force the system resonance higher. For example, an 8-in. speaker with a free-air resonance of 25 Hz might have a resonance as high as 130 Hz in a one cubic foot closed box. This generally means that the low frequencies will be distorted, and what bass is produced will be colored. System resonance is determined by the cone diameter, magnetic field, moving mass, suspension, and the stiffness of the air spring. Thus, the designer can either trade efficiency for bass by using some kind of mass loading, he can use a smaller cone, which might increase the intermodulation distortion (and probably cost more due to the increased magnet size), or he can opt for a vent. This vent can take the form of a tube or duct, but it too must be very carefully designed or it can make matters worse! Alternatively the designer could put the loudspeaker inside the amplifier feedback loop where the distortion could be reduced and the resonances controlled. This concept is called Motional Feed Back, or MFB.

Most engineers believe that when negative feedback was found to improve the performance of amplifiers, loudspeaker designers then began to wonder how the same principle could be applied to reduce the distortion produced by loudspeakers. One might think so, since amplifier feedback was invented a long time ago, but as Josh Billings would say, it just ain't so. Although Black and Blumlein were working on amplifier feedback in 1934 (1), Hanna had filed a patent for a system of servo (motional feedback) to control the response of a balanced armature speaker some 10 years earlier (2), During the next 20 years, many articles on motional feedback were published, and the problems were well summarized by Olson (3) in 1940.

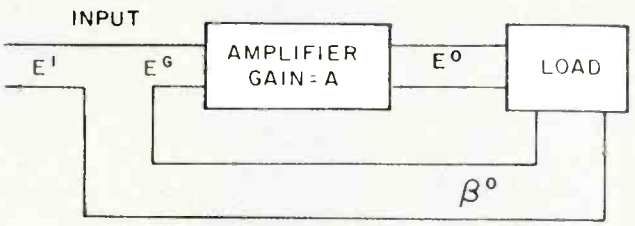

Fig. 1—Block diagram of a system with negative feedback.

In simple terms, negative feedback means that a portion of the output of an amplifier is fed back in opposite phase, thus reducing the overall gain as well as canceling some of the non-linearity (distortion). Figure 1 shows a block diagram of an amplifier with a feedback loop. The gain of the amplifier is A, thus:

$$A = \frac{E^o}{E^G}$$

If the feedback is applied and the input voltage increased to E^1—making up for the loss in gain, then it follows that:

$$A_{fb} = \frac{E^0}{E^1} = \frac{E^0}{E^G - \beta E^0}$$

The gain reduction due to feedback is therefore:

$$\frac{A}{A_{fb}} = \frac{E^0/E^G}{E^0/(E^G - \beta E^0} = 1 \frac{BE^0}{E^G} = 1 - \beta A$$

The quantity $1-\beta A$ is called the feedback factor and is usually expressed in dB. Thus, to say an amplifier has 20 dB of feedback means that the feedback loop has reduced the gain by 20 dB or a factor of 10. If the amplifier has been well designed, then the distortion will have been reduced by a similar amount.

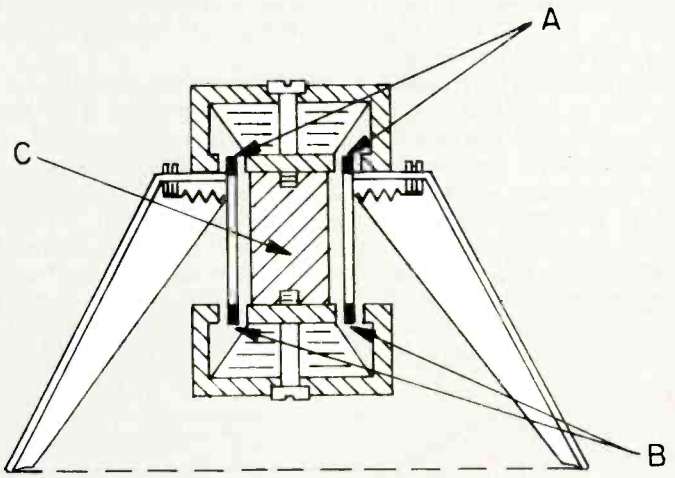

Fig. 2—The Gogny twin voice coil loudspeaker. A is the driven coil and B is the pickup coil. C is made of non-magnetic material and serves only as a mounting piece.

The question is, how to put the loudspeaker inside the feedback loop? Well, there are three methods commonly used. The first uses a separate voice coil to produce the feedback voltage (or current); the second uses a transducer to pick up the output signal, and the last takes a feedback "error" signal from a bridge or other network connected to the loudspeaker.

Applications of MFB

Figure 2 shows a loudspeaker with twin voice coils developed by Gogny in France, patented in 1954. As might be expected, there are a number of problems associated with this kind of construction. The pickup assembly must be kept small to avoid irregularities in the cone radiation, and the electrical coupling between the coils must be kept at minimum. The Gogny speaker had a very short voice coil, measuring only 8 mm (⅓in.) with a diameter of 1½ in. The cone size was 12 in. and the servo control could only function up to the frequencies at which cone breakup occurred. In this case, the crossover point was 800 Hz, and the cone acted more or less like a piston below that frequency. I heard this hybrid servo system several times at the Gogny plant in Paris and was most impressed with the clean bass and overall clarity.

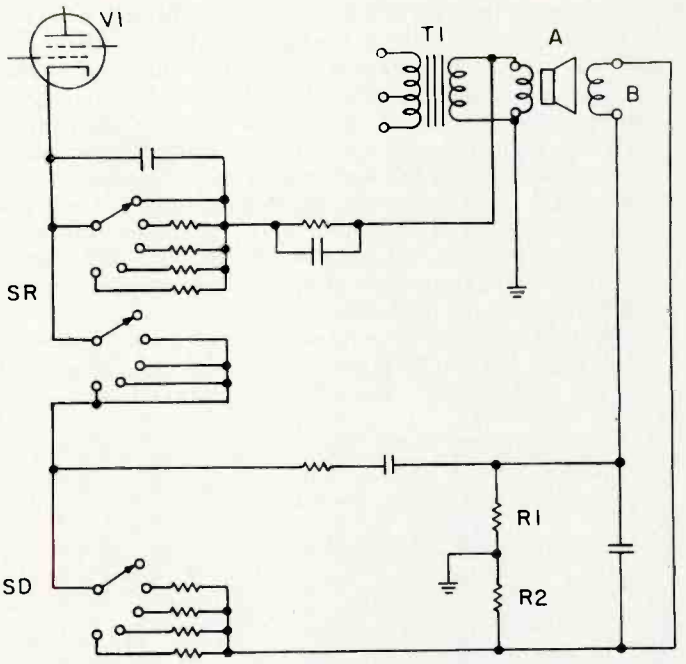

Fig. 3—MFB circuit used in the Matsushita amplifier. A is the driven coil, B is the pickup coil which provides the feedback signal. T1 is the amplifier output transformer.

About the time Gogny was carrying out his experiments, or possibly even earlier, Naraji Sakamoto, of the giant Matshushita company in Japan, also evolved a practical double voice coil loudspeaker. The driven coil was about 1½ inches in diameter and the pickup coil was one inch in diameter. Cone size was 8-in. and, as in the Gogny system, feedback was used only up to 800 Hz. Conventional crossovers were employed with a 3-in. midrange unit plus a 2-in horn tweeter. The enclosure size was 0.83 cubic ft., and Fig. 3 shows the basic circuit used in the companion amplifier. T1 is the amplifier output transformer, and signals from pickup coil B are taken via two paths to switch SD, with another loop taken from driven coil A. Note the two resistors, R1 and R2, giving a combination of negative and positive feedback, an arrangement often used in amplifiers to obtain zero output

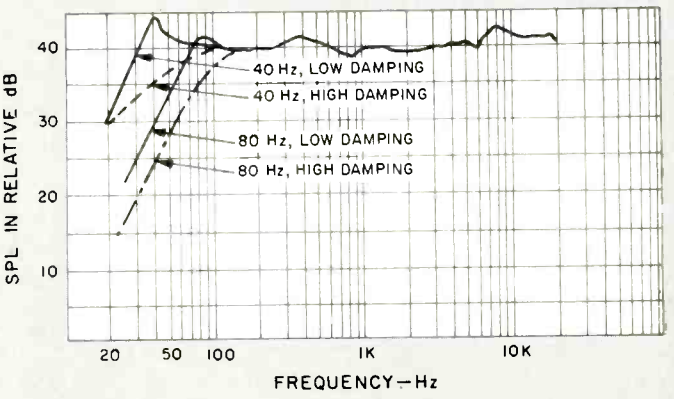

Fig. 4—System resonance and damping in the Matsushita amplifier. Two resonant frequencies, 80 Hz and 40 Hz are shown, each with high and low damping.

impedance in the days when this was thought desirable. The feedback loops are taken to the cathode of a pre-driver tube and control SD will affect the damping, while twin control SB changes the speaker system resonance as shown in Fig. 4. Two extremes are shown, 40 and 80 Hz system resonances, each with high, and with low damping. Although Sakamoto seems to emphasize the importance of resonance control and critical damping to get good bass from a small enclosure, the MFB arrangement also reduces distortion, as can be seen in Fig. 5. Here an 8-in. speaker with MFB is compared to a similar unit without feedback, in terms of second and third harmonic distortion.

The same loudspeaker was used with several other amplifier systems, but the MFB circuitry was simpler, although at least two had bass-lift controls in the feedback loop.

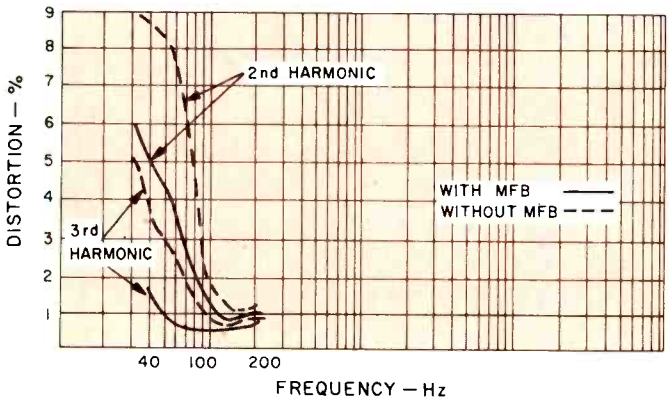

Fig. 5—Second and third harmonic distortion of Matsushita speaker, with and without MFB.

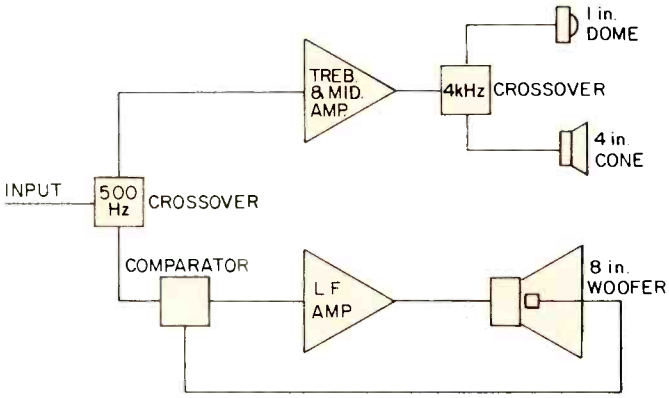

Fig. 6—Block diagram of the Philips RH-532.

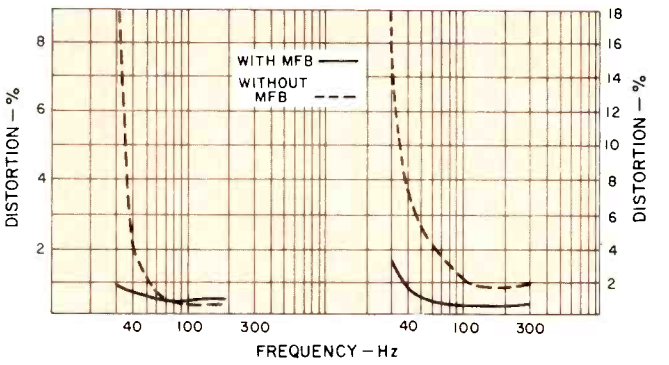

Fig. 7—Distortion of the Philips 8-in. cone (left) and distortion of the 3A speaker (right), each shown with and without MFB.

Feedback Via Piezo Material

Now for a look at the transducer method (4) of MFB—the most successful being the Philips system developed by Klaasen and de Koning (5) about 7 years ago in Holland. The present system (reviewed in our April, 1975 issue) consists of three loudspeakers all housed in a small enclosure measuring only 15 in. H. × 11 in. W. × 8 in. D. The bass speaker has an 8-in. cone, and it crosses over to a 5-in. midrange unit at 500 Hz, with a 1-in. dome taking over at 4 kHz. These speakers occupy only 550 cubic inches, while the rest of the space is taken up by a 40-watt low-frequency amplifier plus a 20-watt unit for the treble and midrange. Truly a case of *multum in parvo!* The transducer used for feedback is really an accelerometer—a disc of piezo-electric material mounted on the loudspeaker voice coil together with a tiny preamplifier. The voltage generated is proportional to the mechanical movements of the cone, which are compared to the input signal by the comparator as shown in Fig. 6. The two signals are 180 degrees out of phase and distortion is reduced considerably, as shown in Fig. 7. This acceleration feedback effectively increases the apparent mass of the moving system so the resonance is brought down. The system resonance is lowered by the use of MFB in this case to 35 Hz. This is a dramatic improvement, for without MFB it would increase to 75 Hz!

The third system of MFB is sometimes called velocity feedback, as it makes use of the back emf generated by the speaker voice coil due to its motion in the magnetic field. In other words, the speaker acts as a microphone, and at resonant frequencies, where the cone movement is larger than the applied signal, an error signal is generated. This has to be separated from the applied signal and there are several ways to do this. A bridge circuit is often used (6) and Fig. 8 shows an example. Connected in series with the loudspeaker is network Ze whose phase angle is equal to the impedance of the loudspeaker in the blocked state. The difference

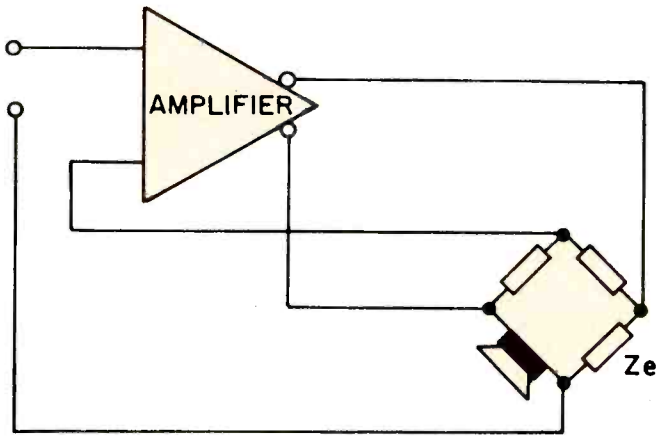

Fig. 8—Typical bridge MFB circuit. Ze is equivalent to the impedance of the speaker in blocked state.

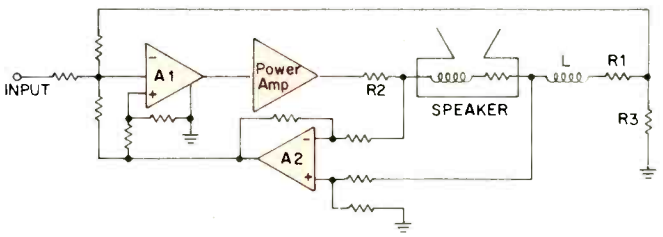

Fig. 9—MFB circuit developed by NASA. L1, R1, and R3 form the sensing network.

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We developed the Servo Statik for one reason—to create the world's finest medium of audio reproduction, regardless of cost. For ourselves, really.

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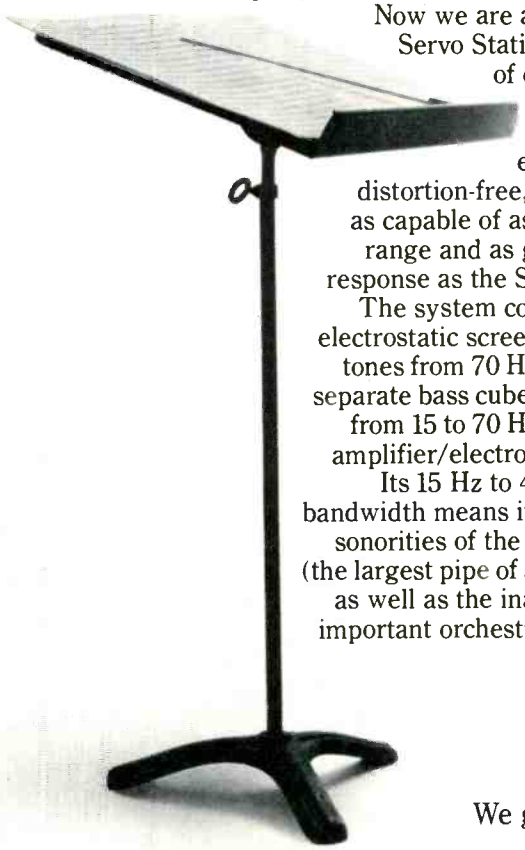

Now we are announcing the Servo Statik 1A. Without fear of contradiction we can state that no speaker ever made is as distortion-free, as accurate, as capable of as wide a dynamic range and as great a frequency response as the Servo Statik 1A.

The system consists of two electrostatic screens which produce tones from 70 Hz to 40 kHz, a separate bass cube producing tones from 15 to 70 Hz and a servo bass amplifier/electronic crossover.

Its 15 Hz to 40,000 Hz power bandwidth means it produces the full sonorities of the 64 foot diapason (the largest pipe of a cathedral organ) as well as the inaudible but vitally important orchestral overtones.

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Its separate Brazilian rosewood veneer bass cube houses an 18″ woofer with a 35 lb. magnetic circuit and a motion sensor as the heart of its servo mechanism system. The servo woofer, driven by its own 150 watt RMS DC servo amplifier, generates unparalleled distortion-free bass reproduction; articulate, tight and accurate.

Its electronic crossovers with high voltage FETS, and crossing over at 70 Hz and 2,000 Hz, provide perfect phase linearity over the entire musical spectrum.

In its unprecedented homogeneity and musicality, the Servo Statik 1A is a staggering achievement.

It costs $3,200.

Yet you don't have to spend $3,200 to get typical Infinity clarity, transparency and depth of sound.

As we said, one of our objectives in conceiving the Servo Statik 1A was to develop a benchmark technology for a more "realistically" priced line of speakers.

The result? Every Infinity speaker, from the POS II at around $100 to the Monitor II at about $450, has achieved superlative reviews from leading testing labs and audio reviewers.

Very soon Infinity will top these technological achievements by introducing the DSP Switching Amplifier™—not just a new amplifier, but a new *concept* of amplification; an esoteric technology that will have far-reaching effect in the audio and music industries.

We've restricted sales of the Servo Statik 1A to a select family of dealers. Drop us a note and we'll be happy to tell you the Infinity dealer nearest you.

We hope you'll treat yourself to the experience of listening to the Servo Statik 1A. Or any Infinity speaker.

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voltage is then applied as feedback (7,8). In a more elaborate version developed by the Ames Research Center of NASA (Fig. 9), a sensing network is formed by L, R1, and R3; the speaker voice coil is shown as a lumped inductance with internal resistance.

Velocity MFB systems are also used by LWE, the French company 3A, and the Belgian firm Servo-Sound. The last-named company also uses a non-linear-feedback arrangement to boost the bass at low listening levels. The French firm calls their system Acoustic Pressure Feedback. It has a 10-in. bass unit with a 4-in. midrange and a 2-in. horn tweeter. The built-in amplifier has an output of 125 watts and is housed in the speaker enclosure. The system measures a mere 18-in. H. × 12-in. W. × 7½-in. D. A bridge circuit is used to derive the feedback voltage. At 30 Hz, the bass cone moves nearly one-half inch with input of only five watts sine-wave power. The distortion characteristics are given in Fig. 7. The bass unit crosses over to the 4-in. unit at 400 Hz, and the crossovers are built-in. Provision is made for a separate 20-watt amplifier for the treble and midrange. These 3A systems are now available in Canada and will be sold here in the near future.

The LWE loudspeaker systems were designed by L.W. Erath and are now marketed by CM Laboratories, Inc. Unlike the 3A system, the LWE servo-control extends over the entire audio spectrum, with one element in the sensing network variable to permit some modification of the bass response. This variable element is called "Room Gain Control," and it has five switched positions. The largest system in the LWE line uses a 15-in. bass speaker, a 6-in. midrange, and two tweeters, while the smallest, Model 10, is a bookshelf system with a 10-in. woofer and a 2-in. tweeter. All these systems are available separately but if they are not used with a CM amplifier the connections inside the amplifier would have to be made by a technician.

Summary

With the growing popularity of quadraphonic sound and the consequent emphasis on small loudspeaker systems, MFB would seem to provide some of the answers to the inherent space problems. I am sure we will see more high quality compact systems with built-in amplifiers with MFB in the not too distant future. If only an MFB system could be devised that would provide complete room correction too. . .!

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Equipment Profiles

JVC 4VR-5426X 4/2-channel FM/AM Receiver

MANUFACTURER'S SPECIFICATIONS

FM Tuner Section

IHF Sensitivity: 2.2 μV. **50 dB Quieting:** 3.0 μV. **S/N Ratio:** 68 dB. **Selectivity:** 60 dB. **Capture Ratio:** 2.0 dB. **AM Suppression:** 50 dB. **Image Rejection:** 55 dB. **I.f. and Spurious Rejection:** 80 dB. **THD:** Mono, 0.5%; stereo, 0.8%. **Muting & Stereo Threshold Level:** 2.2 μV. **Frequency Response:** 20 Hz to 15 kHz ±1 dB.

AM Tuner Section

IHF Sensitivity: 30 μV, internal antenna; 200 μV/m, external. **S/N Ratio:** 55 dB. **Selectivity:** 30 dB. **Image Rejection:** 45 dB **I.f. Rejection:** 50 dB.

Amplifier Section

Power Output: 13 watts/channel continuous power from 20 Hz to 20 kHz at 4 or 8 ohms, 4-channel operation (15 watts from 40 Hz to 20 kHz); 30 watts per channel, 8 ohms, 2-channel operation, from 20 Hz to 20 kHz (32 watts from 40 Hz to 20 kHz). **THD:** 1.0% at rated output; 0.1% at half rated output. **IM:** 1.0% at rated output; 0.2% at half power. **Damping Factor:** 30 at 8 ohms. **Input Sensitivity:** *Phono, 1.5 mV; AUX and Tape,* 200 mV. **S/N Ratio:** *Phono,* 65 dB; *AUX* and *Tape,* 75 dB. **Tone Control Range:** Bass, ±10 dB at 100 Hz; treble, ±10 dB at 10 kHz. **Loudness Control:** +12 dB @ 50 Hz; +6 dB @ 10 kHz.

General Specifications

Dimensions: 18-3/4 in. W. x 6-3/8 in. H. x 15-3/8 in. D. **Price:** $399.95.

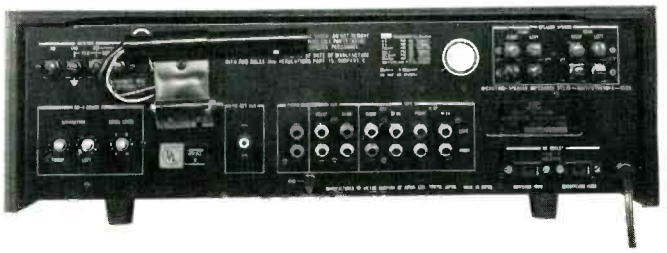


Fig. 1—Back panel of the 4VR-5426X.

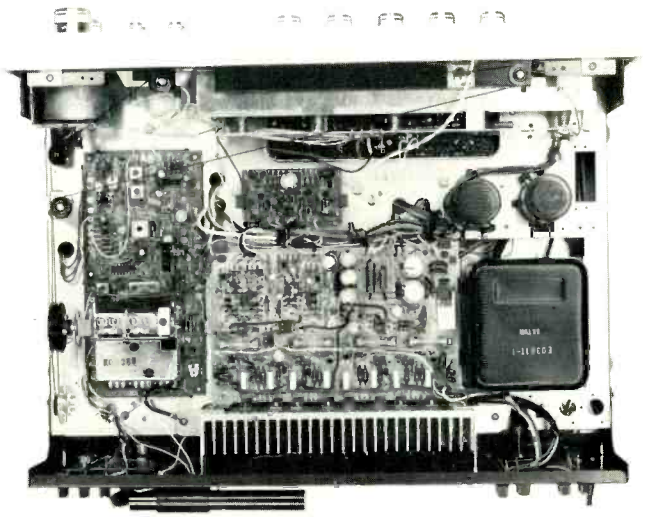


Fig. 2—Internal view.

Japan Victor Company is, as most everyone knows, responsible for the introduction of the CD-4 discrete record in Japan and, in partnership with RCA in this country, has been actively promoting that 4-channel disc format. It is no surprise, therefore, that the company's line of high fidelity receivers (from highest-priced models to this relatively low-cost unit) should include full demodulating facilities for CD-4 record playback. Bowing to demands for universality, the 4VR-5426X also includes matrix decoding for SQ-encoded records and other matrix-encoded discs such as RM and QS, though these facilities are by no means as sophisticated as those found on more expensive units which employ various forms of logic separation-enhancement circuitry.

The front panel of the receiver is designed along fairly conventional lines. The upper section includes a blacked-out dial panel, which becomes illuminated when power is applied. Restricted to one tuning meter for reasons of economy, JVC wisely chose to have that meter (at the left of the dial scale) act as a signal-strength meter in AM, but as a center-of-channel tuning meter in FM. The FM dial scale is linear, and there is a logging scale between the AM and FM numerals to permit easy referencing of favorite stations. To the right of the dial scale are the usual stereo indicator light and the increasingly popular (on 4-channel equipment) "radar" light, which glows when CD-4 records are played. A good-sized tuning knob is located at the right of the dial area.

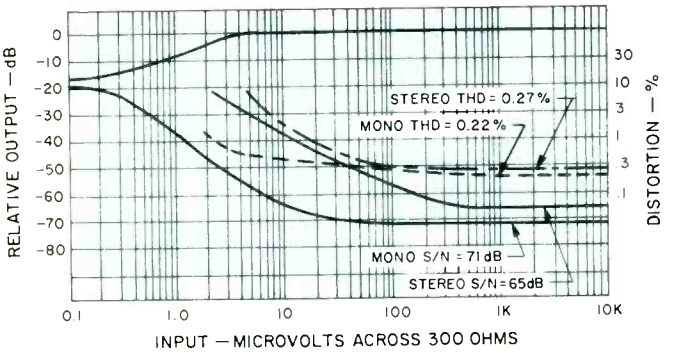


Fig. 3—FM quieting and distortion characteristics.

Controls located along the lower, gold-colored section of the front panel include a lever-style power on/off switch, a speaker switch (which determines whether the receiver is to be operated in its "bridged" 2-channel mode or in 4-channel, since only one quartet of speakers can be connected to the unit), bass and treble controls, a mode switch (with positions for 2-channel, 4-channel discrete or matrix playback), a program source selector switch, four small, individual-channel level controls, and a master volume control. A pair of phone jacks, for front and rear plugs of quadraphonic phones, are located adjacent to the power on/off switch. There are also a pair of push buttons for tape monitoring and loudness control activation.

The rear panel of the receiver, pictured in Fig. 1, includes thumb-screw speaker-connection terminals for the four speakers, *Tape Rec* and *Play* jacks with full 4-channel capability, *Phono* and AUX input jacks and *Antenna* terminals for either 75-ohm or 300-ohm external FM antennas and an external AM antenna. A short, pivotable, AM ferrite-bar antenna is also located on the rear panel. There are three adjustment controls needed for setting up your CD-4 cartridge for optimum separation and lowest distortion, as well as a pair of a.c. convenience receptacles and an FM detector output jack for connection of future 4-channel FM decoders. While a short wire is connected to one of the FM antenna terminals at the factory (it is capacitively coupled to the line cord to serve as a minimal indoor FM antenna), we do not recommend its use as a substitute for a true antenna (indoor or outdoor) if serious FM listening is planned.

Receiver Circuitry

Despite its relatively low cost, the JVC 4VR-5426X has some interesting and sophisticated circuitry built into its compact chassis, a view of which is shown in Fig. 2. The front-end uses an FET r.f. amplifier and a three-gang tuning capacitor for FM. The i.f. section includes a bi-polar transistor as well as a multi-purpose IC for amplification, limiting and detecting. A multi-element, ceramic, tuned filter precedes this IC. A single IC, which incorporates a phase-lock-loop circuit, is used for multiplex decoding, and all AM circuitry is contained in another multi-function integrated circuit. The entire tuner section is built onto a single p.c. module, and there are separate modules for the preamp section, the CD-4 demodulator circuits, voltage amplifier stages, tone control amplifiers, loudness compensation circuits, and the main power amplifier sections. The power amps use a differential amplifier stage and feature direct speaker coupling via protective fuses in each channel. These fuses are replaceable only after removing the unit from its wood cabinet. While a full schematic diagram is supplied with the owner's manual, the CD-4 decoder section is shown as a blank block with no circuit details spelled out.

FM Performance Measurements

IHF sensitivity for our sample measured exactly 2.2 μV, exactly as claimed and, more important, 50 dB of quieting was obtained with *only* 2.8 μV of signal applied in mono mode. Best overall S/N ratio obtained for high-level input signals was 71 dB, equal to performance obtained with receivers costing considerably more than this one. Capture ratio measured 2.2 dB, while AM suppression exceeded published specifications, measuring 53 dB. Stereo sensitivity was 7.0 microvolts, although automatic switching to the stereo mode took place at signal strengths of just over 2.0 μV—the same signal level required to overcome muting when that circuit was actuated. Harmonic distortion at mid-frequencies was considerably better than claimed, with readings of 0.22% in mono and 0.27% in stereo. Quieting and distortion characteristics in mono and stereo are plotted in the graphs of Fig. 3. Aside from the stereo quieting characteristics (it took 45 μV of signal input to reach the 50 dB quieting point in this mode), the measured performance characteristics of the FM section of this receiver are quite surprising when one examines the relatively simple circuitry used in this section. JVC has managed to extract really excellent performance with a minimum of circuit complexity here. Considering the fact that the MPX section is a modern, phase-lock-loop IC with no tuned circuits to align, we would have expected a bit better overall separation figures than we measured in stereo FM, particularly at the high frequency end where separation decreased to 28 dB at 10 kHz, but this is more of an engineering point than one which would truly adversely affect audible results, since mid-band separation is over 40 dB and, more important, distortion over the entire audio spectrum is quite low (under 0.3% at 10 kHz in mono, 1.0% at the same frequency in stereo) as shown in Fig. 4.

Amplifier Measurements

JVC elected to give two complete power ratings for the amplifier section of this receiver, both in strict conformance with the new FTC audio power rule. The 13-watt-per-channel figure applies to the full audio spectrum, whereas the 15-watt-per-channel rating applies if you are willing to settle for a power band of from 40 Hz to 20 kHz. Equivalent ratings

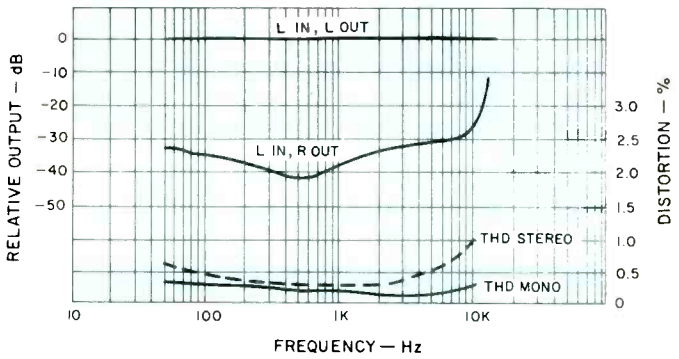


Fig. 4—Separation and distortion versus frequency.

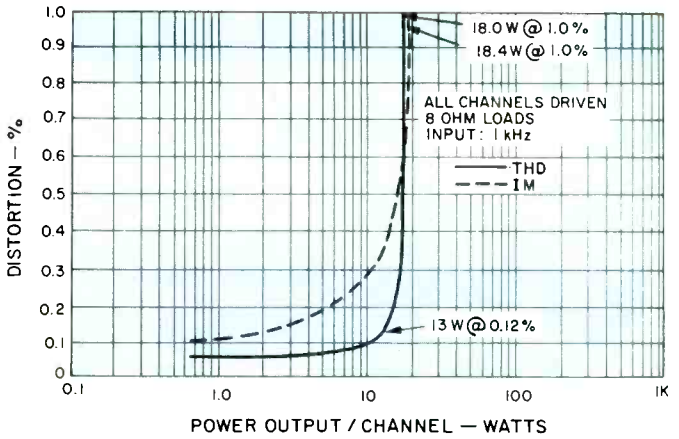


Fig. 5—Harmonic and IM distortion characteristics.

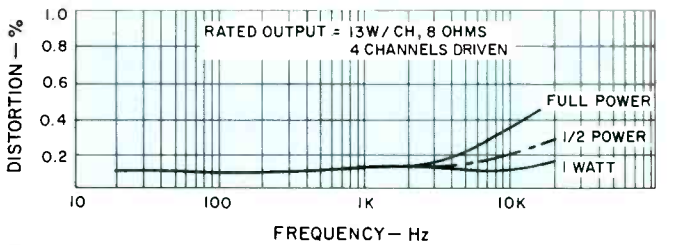
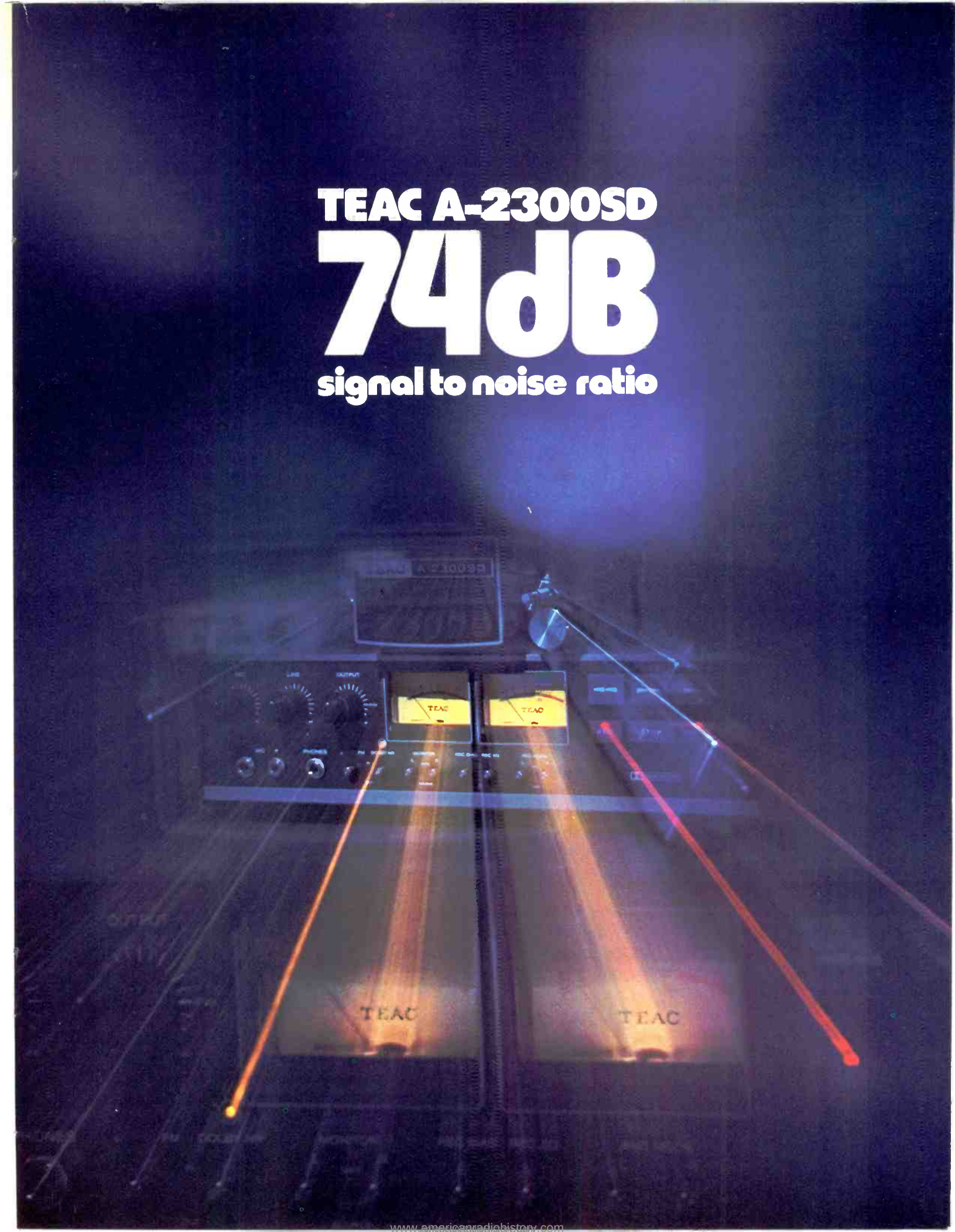


Fig. 6—Distortion versus frequency.

TEAC A-2300SD

74dB

signal to noise ratio



Noise vs signal

Noise is usually defined as an unwanted disturbance of some sort. In a tape recorder, noise does not occur at the same volume level across the entire frequency spectrum. Low frequency hum is generally louder than high frequency hiss, but the human ear does not perceive noise in that relationship.

The sensitivity of the ear is not uniform with frequency, a situation expressed graphically in the well known Fletcher-Munson curves. Since the ear is most sensitive to sounds in the range from 1 kHz to 4 kHz, low frequencies (hum) must be substantially louder than high frequencies (hiss) for the same *apparent* loudness.

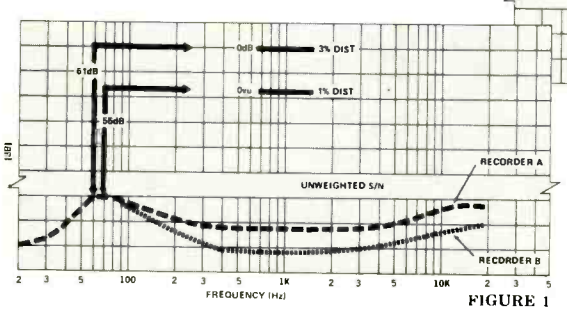


FIGURE 1

You can see from Fig. 1 that recorder A has more hiss than B, yet the unweighted signal-to-noise ratio would be the same for both machines (61 dB). Obviously this method of specifying noise characteristics is inadequate and misleading. It gives no indication at all as to the *kind* of noise measured. Hiss is more annoying than hum because it is more apparent at the same relative level.

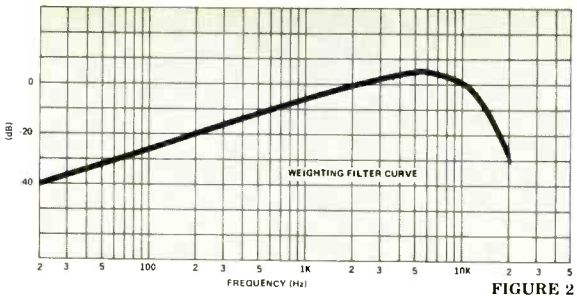


FIGURE 2

What is weighted noise?

Weighting curves simulate the non-linearity of human hearing (Fig. 2). When they are used as filters in signal-to-noise measurements, they make the resultant specifications more credible and meaningful. Comparisons based on weighted noise figures are therefore more valid.

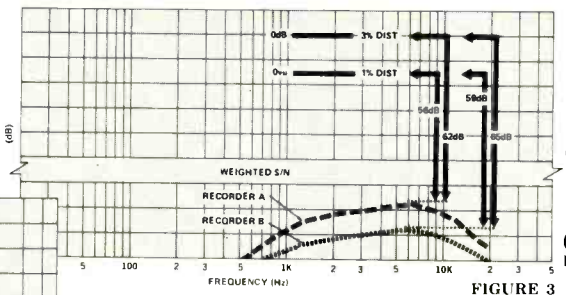


FIGURE 3

Using the previous example of recorders A and B, we now send the overall noise through the weighting filter and then measure the remaining noise. You can see from Fig. 3 that recorder A measures 62 dB, while recorder B measures 65 dB referenced to 3% distortion. Now this comparison more accurately corresponds to what the listener actually hears and the subjective annoyance of the noise.

Why add Dolby?

Because you can gain an additional 9-10 dB reduction in noise with the B-type Dolby system. And that works out to be 74 dB on the A-2300 SD. We took something already quite good, and made it better.

The advantages of integral Dolby.

With an external Dolby unit, irregularities in a tape recorder's frequency response characteristics will be magnified during the signal processing, generally by a factor of two. When the Dolby circuits are an integral part of the recorder, however, the record and playback electronics can be optimized for the encode/decode processing. In addition, with integral Dolby you don't have to pay for an extra power supply, cabinetry and the like.

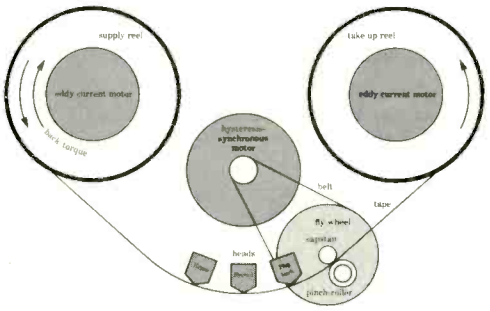
Some popular misconceptions.

There's no doubt that Dolby is an effective means of reducing noise, however the system will not eliminate any noise present on the original signal source. That noise would go through the encode/decode processing along with the signal.

Then there's the feeling that Dolby reduces high end response in the process of reducing hiss. Highs are reduced during decoding, but in exact proportion to the extent they were boosted during encoding – back to the level they were on the original music. Finally, since the Dolby system is level sensitive – low level signals are affected more severely than high level signals – it should be emphasized that very high level signals are virtually unaffected by Dolby.

Complete Dolby flexibility.

The Dolby/FM switch activates the new 25 micro-second de-emphasis curve for decoding Dolbyized broadcast material. In addition, there's an FM copy switch on the back of the unit so you can record the broadcast encoded while monitoring the program decoded for a more accurate listening reference. With the A-2300 SD you can decode any external Dolby source. And the external calibration controls, including a built-in tone generator, help you derive optimum benefits of the Dolby system through accurate level settings.



Tape it.

There's a unique satisfaction to be had in personally selecting and sequencing your own source material. Enjoy tapes that exactly satisfy your particular musical tastes, your changing moods. The tapes you make will bear the imprint of your individuality. They will become the expression of your personal artistic perceptions. And if you truly enjoy listening to music, the qualitative difference that the A-2300 SD makes can offer you years of rewarding and enjoyable musical experiences.

We've been making 3-motor, 3-head tape recorders for over 20 years. Continually refining and perfecting the fundamentals. Consistently providing the features and functions that best fit your recording needs. There's a certain pride here. A reputation for quality and reliability can not be proclaimed. It must be earned.

THE WHITE PAPER

A lot of the information in this ad was excerpted from The White Paper. If you're interested in tape recording in general, and TEAC products in particular, be sure to get your free copy. You can do that by writing us. To audition the A-2300 SD and hear the audible improvement it makes, just call (800) 477-4700* to find the name of your nearest TEAC retailer. We'll pay for the call.

*In Illinois, call (800) 322-4400

A-2300SD

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for bridged two-channel operation, as stated by the maker, are 30 and 32 watts per channel, respectively, all at 8 ohms. Note, that in the bridged mode, the use of 4-ohm speakers is *not* recommended, nor specified by the manufacturer. Based on our measurements, all the stated ratings are a bit on the conservative side. We measured 18.0 watts for 1.0% THD at mid frequencies in 4-channel operation, as shown in Fig. 5. IM distortion, also plotted in this graph, reached its rated value of 1.0% at an output of 18.4 watts per channel. Surprisingly, power ratings were limited at the high-frequency end rather than at 20 Hz, where one normally runs into the higher distortion as one approaches maximum power output. In the case of the 4VR-5426, distortion remained low (0.1%) for 13 watts per channel output at 20 Hz, but tended to rise at the high end for the same output, as shown in the graphs of Fig. 6. Nevertheless, for a 1.0% THD rating, we would have rated the receiver at a full 15-watts per channel, rather than 13 watts. In the case of bridged 2-channel operation, we measured 35-watts per channel at mid-frequencies, but did not plot distortion at other frequencies, since it has been our experience that curves would have been similar to those obtained in 4-channel operation (but at proportionately higher output power). Damping factor, measured in the 4-channel mode, was 32 for 8 ohm loads, while residual amplifier noise (basic amplifier only) measured 87 dB below full output.

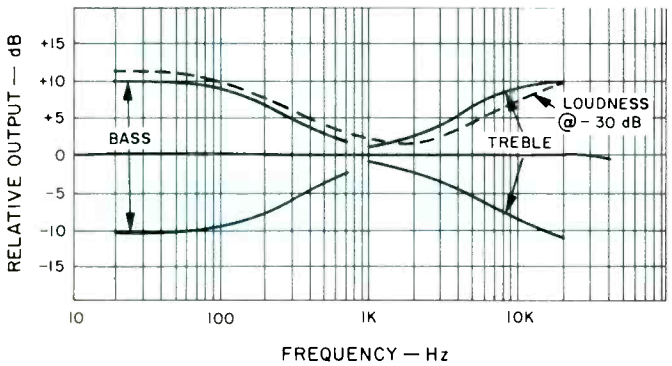


Fig. 7—Tone control range and loudness characteristics.

Preamplifier Measurements

Phono input sensitivity exceeded claims, with a bit over 1.0 mV of signal required at 1 kHz to drive the system to rated output. However, overload capability was rather low, with only 31 mV of input signal (again, 1 kHz) required to create distortion in the preamp stage. Users of this receiver are cautioned not to use high-output phono cartridges with it, since such use may limit dynamic range. Since most people who purchase this receiver will undoubtedly be buying a CD-4 cartridge, this problem is not particularly serious, as these cartridges tend to produce somewhat lower output than equivalent stereo cartridges.

Hum and noise in phono (unweighted) was −60 dB as opposed to the −65 dB claimed by the manufacturer, but this proved to be quite low enough in our subsequent listening tests. While there are no high-cut or low-cut filters in this receiver, the tone controls operated much as expected, and the tone control ranges are graphed in Fig. 7. Also shown in this graph is the action of the loudness control when set at −30 dB below full volume. JVC chose to emphasize highs as well as lows in their loudness circuit, and in our opinion, too much emphasis was added at the high end. Many experts contend that *no* treble boost should be introduced by a loudness circuit or that, at most, it should be just a few dB at 10 kHz. Hum and noise in the high-level positions of the selector switch measured 78 dB below full output.

Listening and Use Tests

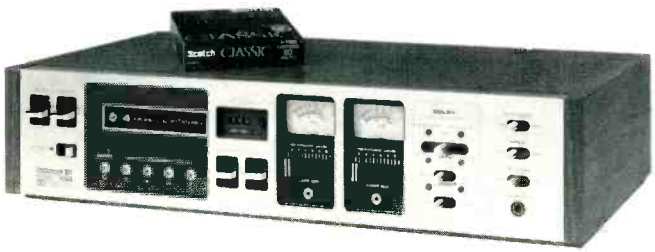
Comparing CD-4 reproduction with either SQ or QS disc playback on this receiver is really a bit unfair, since the CD-4 discs offer noticeably greater 4-channel effects than can be had with these basic matrix circuits. With the limited separation afforded by the two matrix decode positions, listener positioning becomes fairly important and you should try to set up your speakers so that you are located fairly centrally between them. This receiver definitely favors the CD-4 records, however.

As expected, FM reception was amazingly good, considering price and circuitry. There is, unfortunately, no way to switch to mono FM when noisy stereo signals are received and, in view of the fact that automatic switching occurs at very low signal strength, we had to pass up certain stereo stations that were just too noisy in stereo though they might have been acceptable in mono.

In the 4-channel listening mode (the only one we used in our listening tests), it's important to use speakers of relatively high efficiency with this receiver, since 13 watts per channel (or 15 watts, if you accept our modified rating) is not really enough power to drive acoustic-suspension or other fairly low-efficiency speaker types. With the ported, high-efficiency systems we used in our listening tests, the 4VR-5426X delivered enough clean power to satisfy most listening needs in average-to-small sized listening rooms. When you consider its overall performance, its 2-channel "starter" capability, at more than double the per-channel power and its measured and audible performance, this receiver is certainly the answer for those who want four-channel sound but can't yet afford the price of those ultra-sophisticated, super-matrix with logic plus CD-4, higher-powered units which can cost more than an entire system (including speakers, turntable and cartridge) incorporating the 4VR-5426X. If, later on, you want the ultimate of matrix-decoding circuits, you can always add a more elegant, separate, matrix decoder and still come up with a good working 4-channel system at unusually low cost. *Leonard Feldman*

Check No. 70 on Reader Service Card

Wollensak 8080 8-Track Cartridge Recorder



MANUFACTURER'S SPECIFICATIONS

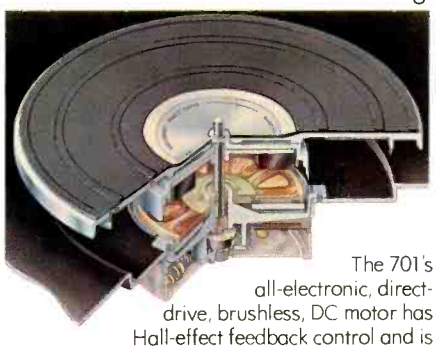
Speed: 3¾ ips. **Wow and Flutter:** 0.1% wtd. rms. **Tape Shut-off:** Manual or automatic. **Input Sensitivity:** AUX, 80 mV; Mike, 0.25 mV. **Output:** 1 V at 0 VU. **Distortion:** Less than 1% at 0 VU. **Frequency Response:** 30 Hz to 15 kHz with Scotch Classic; 30 Hz to 12 kHz with standard tape. **Signal-to-Noise Ratio:** Better than 50 dB without Dolby; better than 60 dB with Dolby. **Dimensions:** 19 in. W. x 10¼ in. D. x 5 in. H. **Weight:** 17 lbs. **Price:** $344.95.

Tape recording enthusiasts who associate 8-track machines with automobiles and $99 compacts should take a close look at the new generation of 8-track units designed for top-quality performance. As they did with cassette machines,

The Dual 701.

Some extraordinary test reports about an extraordinary turntable.

Test reports of the Dual 701, in magazines like this one, have been totally unlike those of any other component. Not just because the reports are favorable; none of these magazines wastes anyone's time reviewing run-of-the-mill products; there are too many good ones available. The reports are different because of two themes that run through them.



The 701's all-electronic, direct-drive, brushless, DC motor has Hall-effect feedback control and is energized by a regulated power supply.

One theme acknowledges that the 701's performance is actually superior to the measuring capability of available test instruments. For example, Hirsch-Houck Labs in Stereo Review found the wow level of the 701 "essentially at the residual level of our test record—about 0.03 per cent." So did Popular Electronics.

The Feldman Lab Report in FM Guide stated: "We could detect no flutter whatsoever, and the low readings that we did get for wow were no doubt the result of using a record which was not absolutely concentric."

Stereo & HiFi Times found "arm friction was lower than my capability to measure reliably."

The second theme throughout the reports is the unequivocal ranking of the 701 at the pinnacle of perfection in record playback. In the following quotes, note the absence of such familiar qualifiers as "one of the" or "among the."

Stereo Review: "...technical performance characteristics surpass to a greater or lesser degree those of any other integrated record player we have tested."

FM Guide: "The Dual 701 is probably the smoothest acting, most rumble-free system we have ever tested."

Popular Electronics: "In almost every respect, the Dual 701 surpassed just about every other record player—manual or automatic—that we have tested."

High Fidelity: "...the Dual 701 has placed itself in the select group of products against which we must measure the performance of others."

And, the highly conservative English publication, HiFi News & Record Review, with typical British understatement commented: "The experience of listening to records of the highest quality on this turntable is not likely to be forgotten...you will never again be satisfied with anything less perfect."

If you wish to experience the same caliber of performance as these highly experienced and most critical of all audio experts, you need only visit your nearest United Audio dealer and ask for the quietest turntable ever made. You are in for an extraordinary experience—with this fully automatic, single-play, electronic, direct-drive turntable. $400, including base and dust cover.

The 701's unique counterbalance houses two separate anti-resonance filters which absorb resonant energy in the frequency ranges of the tonearm/cartridge system and the chassis.

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Wollensak is showing the way with innovations and improvements in these machines. Introduced last year, the Model 8080 has a frequency response which extends to over 16 kHz and exhibits an excellent signal-to-noise ratio and low distortion. This new standard of performance can partially be explained by the fact that the machine was designed for use with the new Scotch Classic cartridge tape, which has better high frequency response than earlier formulations. However, there are real improvements in the machine itself, as we shall see from the results obtained with Scotch HO/LN tape.

Styling is neat and workmanlike, with a black and satin finish on the front panel. The cartridge compartment is on the left, and under this door are five indicator lights, one for *Record* and one for each of the four tracks. The track *Select* switch is on the extreme left, along with two other lever switches for *Fast Wind* and *Eject*. Next in line come the two VU meters, located in recessed panels, slide controls for recording levels, and two miniature microphone sockets. Then come two groups of three lever switches for the following functions, *2-chan./4-chan.* select, *Regular/Special Tape* select, *Dolby* select, *Auto Eject On/Off, Repeat Program All/One* select, and *FM Listen On/Off*. Just beneath the last three is a headphone socket which takes a standard stereo plug. Input and output sockets, shown in Fig. 1, are at the rear, together with the Dolby calibration controls, and a spare a.c. outlet. The *FM Listen* switch enables the Dolby decoder section to be used independently of the rest of the unit so that you can decode a Dolby FM broadcast and feed the signal to the rest of your sound system. Flipping the FM listen switch turns the unit on without having to insert a cartridge. The Dolby switch has three positions, *FM Decode, Record/Play,* and *Off*. In the first position, the decoder is in circuit for listening to or recording Dolby broadcasts. In the *Record/Play* position, Dolby encoding is in circuit for recording and decoding for playback. The *Off* position switches the Dolby section out completely.

The tape select switch has two positions, one for regular tapes such as Scotch HO/LN, and a *Special* position for Scotch Classic tape. This second position changes the equalization of the 8080 so that the characteristics of the Classic tape are more closely matched. It operates only in *Record* mode and doesn't affect playback.

The *Auto Eject* switch works in conjunction with the *Repeat* switch. In the record mode with the *Auto Eject* switch on and the *Repeat* at *One*, the cartridge will record the selected track and then eject. With the *Repeat* switch in the *All* position, tracks 1 through 4 will be recorded on the cartridge, which will then be ejected. With the exception of the *Pause* control which also functions as a *Stop* switch, the other controls call for no particular comment.

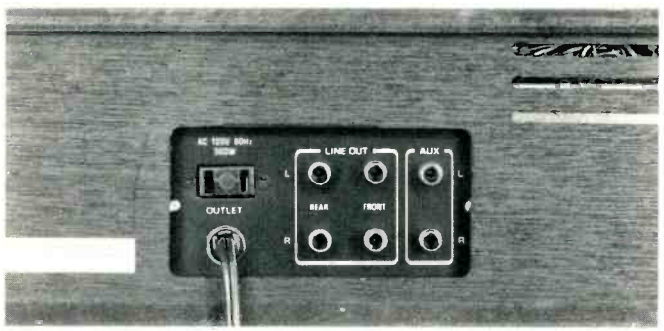

Fig. 1—View of back panel.

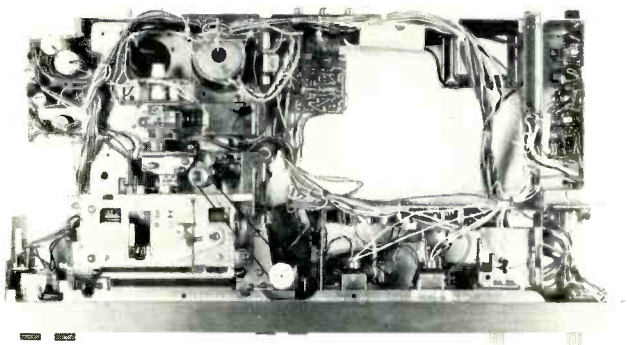

Fig. 2—Interior view.

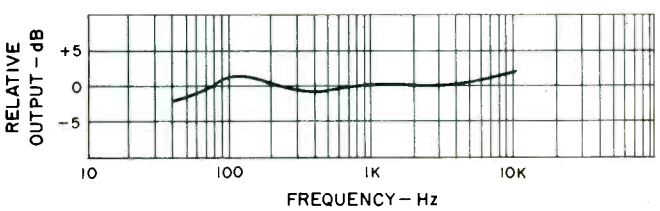

Fig. 3—Playback response from a standard test tape.

Measurements

Figure 3 shows the playback response from a standard test tape, which is now obviously outdated because of the new standards of performance achieved by Wollensak. This high level of performance is underlined by the results obtained

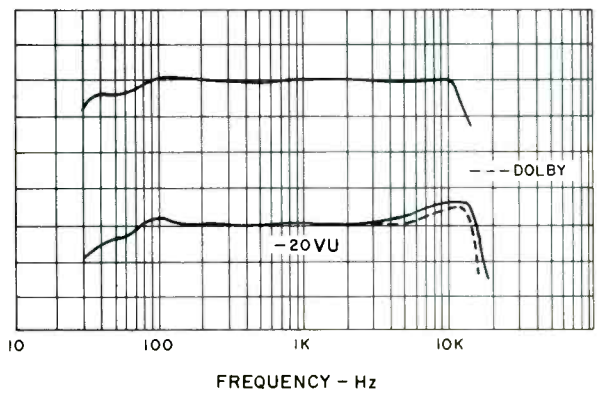

Fig. 4—Record-play response with Scotch Classic.

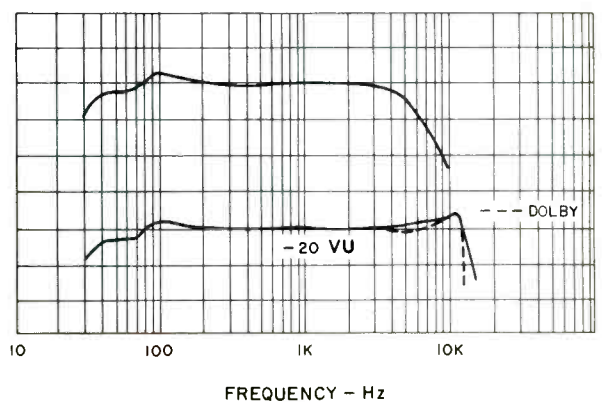

Fig. 5—Record-play response with Scotch High Output, Low Noise tape.

The new Sansui LM Loudspeakers that set the AES Convention on its ears.

LM 330
CUT-A-WAY

At the Convention of the Audio Engineering Society in Los Angeles last May, Sansui demonstrated a new concept in loudspeaker design.

The reception from these experts—chief engineers of radio and TV stations, record producers, recording engineers and sales executives of audio companies—was even more sensational than we ourselves expected.

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Unlike conventional speakers, the LM design incorporates a multi-radiational tweeter device. High frequencies instead of being lost through encapsulation, are diverted through three special exponential horns and recovered into sound energy that adds a breathtaking sense of ambience, and realism. The LM speakers also display extremely stable and well-defined stereo images. At the same time, both the transient response and efficiency of the system are greatly increased. An extra large woofer assembly gives exceptionally strong bass response ordinarily available only in much larger and more expensive speakers.

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with Scotch Classic tape, which is shown in Fig. 4. The 3 dB point for Classic was 16.5 kHz, with response rising from the 3 kHz point. With the machine switched to *Regular* tape and using a Scotch High Output/Low Noise cartridge, the results shown in Fig. 5 were obtained. The −3 dB point here was 14.3 kHz—not all that far under the Classic, though headroom was somewhat less. Response of the Dolby system was well within the 2 dB tolerance for both cartridges.

Distortion at 1 kHz is shown in Fig. 6 and distortion versus frequency is plotted in Fig. 7. Signal-to-noise ratio, using a standard A weighting, was 50 dB for the Scotch HO/LN tape and 52 dB for the Classic, increasing to 60 and 62 dB, respectively, with the Dolby system switched in. Input sensitivity to read 0 VU was 84 mV for line inputs and 0.24 mV for microphone inputs. Output at 0 VU was 850 mV. Erasure was better than 66 dB, and crosstalk (measured at 400 Hz) was 67 dB between adjacent tracks and 45 dB between stereo channels. Wow and flutter, that old bugbear of cartridge machines, was measured at 0.18 percent, DIN record-play. The maker's specifications give a wow and flutter figure of 0.1 percent weighted, but no details are given as to the standard so that it is possible that refers to playback only. Fast forward speed is about 3.5 times the normal record-play speed of 3¾ ips, and a 90-minute cartridge was timed at 6.75 minutes. Tape speed was found to be less than 0.25 percent slow.

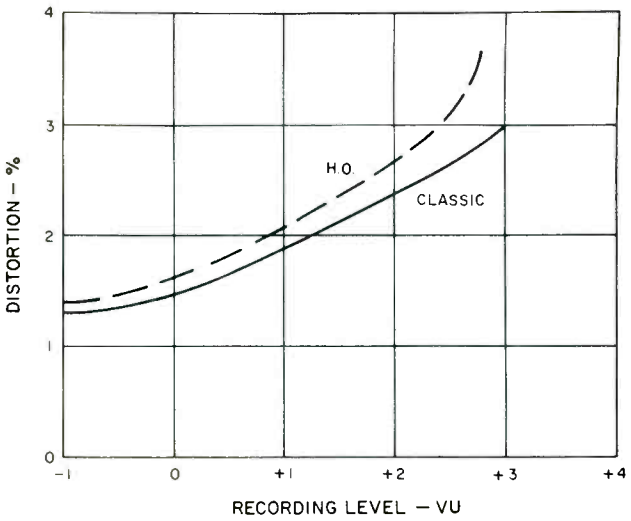


Fig. 6—Distortion at 1 kHz.

Listening Test

The first question most readers will ask is how does the 8080 compare with a similarly priced cassette machine? In terms of the basic performance parameters, such as frequency response, distortion, and so on, there isn't much to choose between the two formats at this price level. There's no getting around the inherent design limitation of the 8-track's inability to rewind for "instant" replay, but how much of a disadvantage this will actually be will have to be decided by the individual user. However, the argument for compatibility in both auto and home tape formats should not be overlooked, and, of course, one wants the best possible unit for home use.

The 8080 will play quadraphonic cartridges and can make two-channel recordings as well. There are only two recording amplifiers, so you cannot record in four channels.

For the first use test, I hooked up the Model 8080 up to my sound system and played some Columbia quadraphonic tapes, including *Man of La Mancha* and Bartok's *The Miraculous Mandarin*. Overall sound was clean and spacious with a clarity and crisp definition of transients which I have never heard before from an 8-track machine. I missed

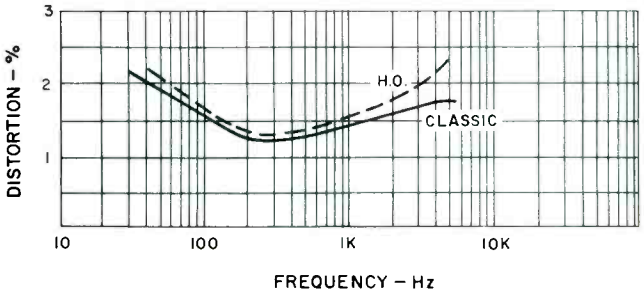


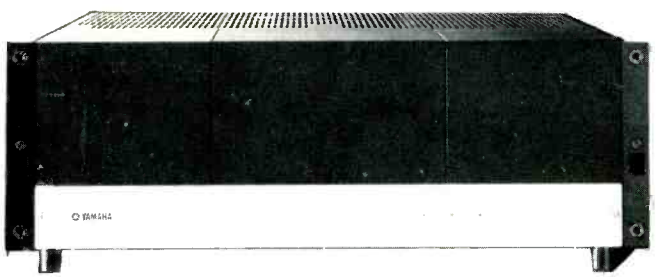
Fig. 7—Distortion versus frequency.

the convenience of four VU meters but balancing the channels was not *that* difficult. No trouble was experienced in making excellent stereo recordings from discs or off the air, although I did find it rather tedious to wait while the tape wound itself before I could listen. But then, I usually make a number of short recordings for test purposes, rather than immediately beginning with the transfer of a complete symphony, for example. As more and more FM stations adopt the Dolby system (there are over 90 presently), the chances are that Wollensak's method of Dolby inclusion will save you money at some time in the future.

Particular attention was paid to the construction of the 8080, particularly to the mechanics involved in head motion to select the various tracks. Tolerances are very small here, and any wear or mechanical distortion could cause problems. No evidence of skimping or bad design was found, and the machine should stand up for years of hard use. Of course, the heads must be kept clean, as with every tape machine, and only good quality cartridges should be used. Wow and flutter figures are greatly influenced by the cartridge itself, and I was not really surprised to find one cartridge, the brand of which shall not be named, virtually unplayable! The moral is obvious. *George W. Tillett*

Check No. 71 on Reader Service Card

Yamaha Model B1 Power Amplifier

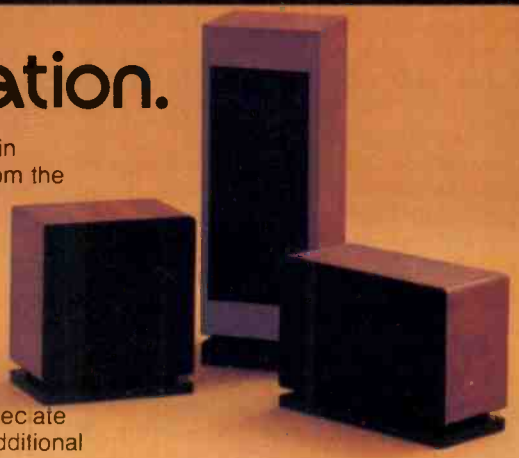


MANUFACTURER'S SPECIFICATIONS

Continuous RMS Power Output: 150 watts per channel, with 8 or 4 ohm loads, both channels driven from 20Hz to 20 kHz, with 0.1% or less total harmonic distortion. **IM Distortion:** 0.1% at rated power, SMPTE. **One-Watt Frequency Response:** 5 to 100 kHz, +0, -1 dB. **Power Bandwidth:** 5 Hz to 50 kHz, 0.5% distortion. **Hum and Noise:** 110 dB. **Damping Factor:** 100 at 1 kHz, 8 ohms. **Input Sensitivity and Impedance:** 0.775 V, 50k ohms. **Weight:** 95 lbs. **Price:** $1600.00; UC-1 control unit, $250.00 (optional).

The Yamaha B-1 is one of a new breed of amplifiers from Japan using vertical field-effect transistor (V-FET) output devices. The unit is beautifully made, solidly constructed, and

A tribute to appreciation.



Music appreciation. Art appreciation. Appreciation for excellence in performance. A fulfillment that comes from the experience, not from the parameters by which it was created.

The Contrara Group of loudspeakers is a tribute to that appreciation. We should not deliberate how Amilio Contrara has sculpted the walnut, blended it with cloth and merged it with technology to bring visual satisfaction. Nor, how he has balanced the electronics with physics to provide audible gratification.

Ours is only to enjoy. To appreciate. To savor. Something only our ears and eyes can savor for themselves.

If you enjoy your music and quality craftsmanship, you'll appreciate the Contrara Group; it's a tribute to your sensitivity. Write us for additional information. We'll send you a booklet on appreciation and a list of locations where you can enjoy Contrara.

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very heavy, weighing about 95 lbs. The UC-1, a companion control unit with peak-reading power meters and speaker switches, adds another 14 lbs. After moving this amp about several times, this writer would recommend a small crane or fork lift for prospective owners.

The chassis has two heavy side pieces with a sub-floor between for most of the front-back distance. Power transformers and filter capacitors are bolted to this sub-floor, along with PC and other connectors for all the sub-assemblies including two output-device heat sinks and one power amp drive board per channel, two regulator boards, a protection board, another large heat sink with 6 regulator transistors and several power resistors, the front panel chosen, and finally the input amplifier and filter board. The output device heat sinks are rather large and the output devices themselves are in a large case—about 50% larger than the usual diamond-shaped TO-3 output device. The wiring is neat, and workmanship excellent. The standard front panel insert takes about 30% of the height, starting at the bottom of the front edge, and is horizontally grained, clear anodized aluminum, contrasting with the black remainder of the amp.

Controls with the standard insert are a pushbutton main power switch and two output level controls. Three light-emitting diodes (LEDs) indicate *Power On*, and either *Thermal* or *Overload Protection* circuitry activation.

The UC-1 can either be snapped onto the B-1's front, adding about 2-1/2 in. to the depth, or used in a remote location with its long, heavy interconnecting cable. Controls are a lever *Power* switch, lever *Rumble-Filter* switch, master speaker *On/Off* switch, five pushbutton switches for selection of five speaker pairs, and 10 speaker level controls. These last are driven from the input buffer and amplifier, and the wipers drive the power amp inputs. This control unit thus allows five pairs of speakers to be compared at equal volume levels without the insertion of high-level speaker line pads which could degrade power and damping characteristics. Yamaha must have believed that the B-1 was so good (with good reason) that it would be used as a reference amp in a demo room set-up for comparisons of high-end speakers.

Fig. 1—Rear of the Yamaha B-1 amplifier.

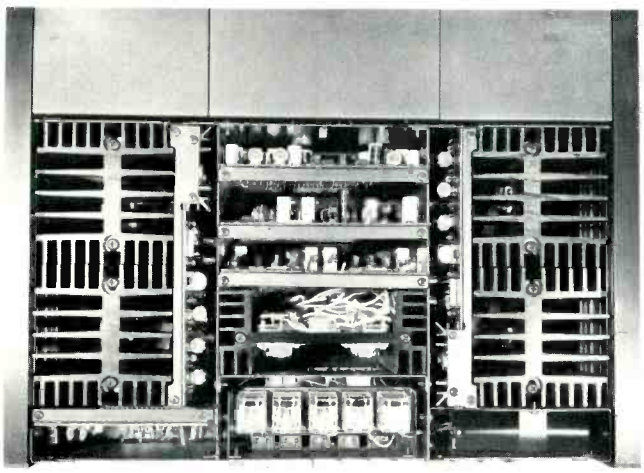

Fig. 2—Interior of the B-1 amp.

UC-1 Control Unit

The remaining feature of the UC-1 is a pair of wide dynamic range, peak-reading power meters. These meters cover a dB range from -50 to +5 and a resulting power range, as calibrated, of 1 mW to 300+ watts into 8-ohm loads. These meters are absolutely first-rate. Peak power is really what counts in regard to amplifier clipping and available headroom. Reading power over such a wide range without changing meter ranges is very useful and informative, and this system is by far the most accurate and meaningful of any meter set-up seen thus far. The equivalent ballistics are such that the meters accurately capture short duration peaks of long duty cycle, then quickly move up to indicate the captured peak, and finally decay relatively slowly. The only system which might be superior would be a peak-reading power meter which measured actual power delivered into the load by sensing the voltage and current delivered, though no such meter is commercially available presently.

On the back of the B-1 are 10 speaker output connectors, two primary power fuses, one unswitched a.c. outlet, a connector for remote turn-on of power, and two pairs of signal input RCA jacks. One pair of these input jacks is a direct input to the power amp, and the other, labelled *Normal*, goes to the input buffer amp. A small slide switch selects either *Normal* or *Direct* input, and a second such switch can activate a 10-Hz rumble filter, with a ground binding post completing the rear panel. Considering its construction and features, this amp is outstanding, as it well should be for its price.

Circuit Description

A good deal of basic information about V-FET technology was published in the February, 1975 issue of *Audio*. We will refer back to some of this description later on.

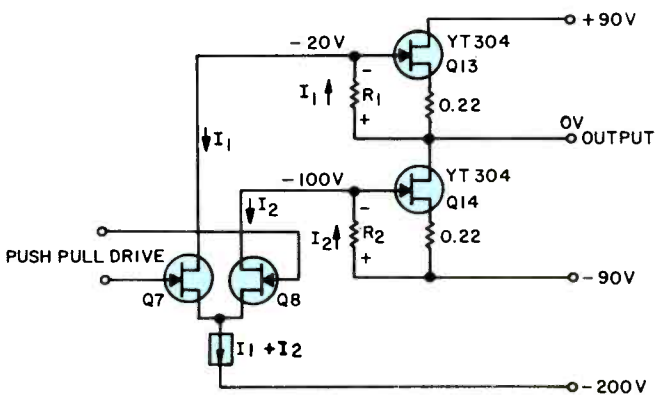

Fig. 3—Simplified drive circuit.

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The AR-11
A new standard of accuracy from Acoustic Research

Musical accuracy
The AR-11 is the most accurate speaker system ever made by Acoustic Research. Its performance, drivers, and crossover are identical to those of the recently introduced AR-10π, except that the AR-11 does not incorporate a Woofer Environmental Control and the associated crossover components.

The AR-11 is designed for optimum performance when placed against a wall, as on a bookshelf, or slightly away from two room surfaces, as illustrated.

New drivers
The AR-11 uses a substantially improved version of the 12 inch woofer with which Acoustic Research introduced the acoustic suspension principle to home listeners, as well as the dome midrange driver of the AR-3a. It also uses a newly designed ¾ inch highrange based on the original high-frequency dome radiator introduced by Acoustic Research in 1959. This highrange incorporates new diaphragm materials, voice coil, and construction techniques that have produced significant improvements over earlier versions.

These drivers, in combination with a new crossover network, have resulted in a speaker system with uniformly dispersed flat energy output to the highest audible frequencies. The AR-11 is able to transmit the information from a program source to listeners in most positions in a listening room with an unprecedented degree of accuracy.

Complete specifications of the AR-11 are available on request from Acoustic Research.

As with all AR speakers, the workmanship and performance of the AR-11 are guaranteed for five years.

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Telephone 617 769 4200

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☐ Please send specifications of the AR-11

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The schematic diagram of the B-1 is rather large and complicated, with the circuitry for the power amp proper taking up about 20% of the total space but not including the power supply for both channels. Starting with the power supply section, a small power transformer is connected to the incoming a.c. line without going through the power switch. This powers a simple one-transistor, relay-driver circuit. Turning on the power switch grounds one end of the transistor base turn-on resistor and pulls in the relay, which then feeds a.c. to the two main power transformers. It is then easy to turn the amp on from a remote location, a simple contact closure being all that's required.

The main winding on each transformer feeds plus and minus, full-wave rectifiers and two 15,000 μF capacitors for the output stages of each channel. The developed voltage is about ±90 V d.c. The remainder of the windings are used, one phase per transformer, to develop full-wave rectified d.c. for five voltage regulators which produce +12, ±25, +40, and -200 V d.c. These are all full electronic regulators with error-sensing amplifiers which control series-pass transistors.

The +12 is used for the output stage protection circuitry, the speaker switching relays, and the relay mounted on the input buffer amplifier that switches in the capacitors for the low-cut rumble filter. The ±25 is used to power the input buffer amp and the meter electronics of the UC-1. The +40 and -200 are used by the main power amps only.

Each ±90 V supply for an output stage is routed through a series-pass power transistor, an NPN for the plus and a PNP for the minus, before arriving at the output stages. The series-pass transistors are normally fully saturated or fully on. The drive circuitry for these will be cut off, thus shutting off the supply to the output stages if the load current is excessive or if the V-FETS get too hot due to restricted ventilation (thermal overload). Further, if the bias supply for the power amps (-200 V) or the +40 V fails, the supply to the V-FETs is cut off. Recovery from any of the above conditions is rapid and automatic as soon as the fault condition is corrected.

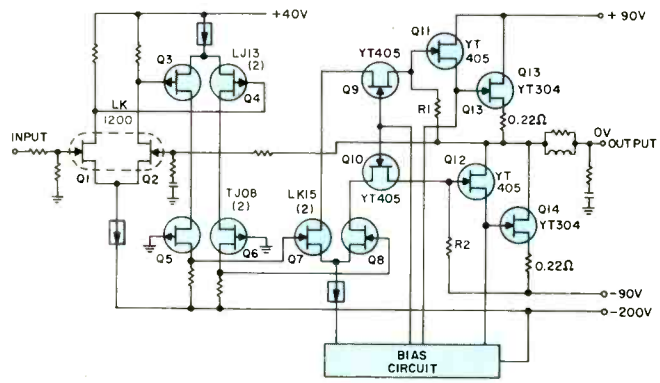

Fig. 4—More complete schematic.

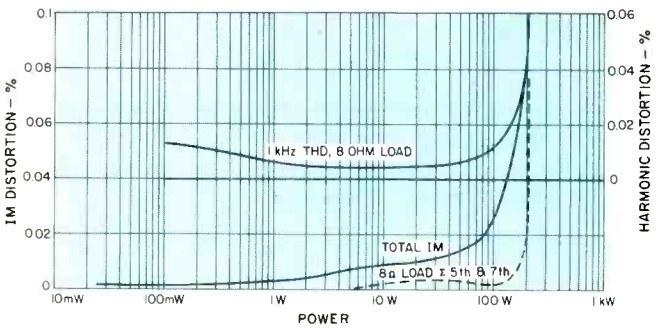

Fig. 5—THD and IM versus power.

There is one more protection circuit, mainly concerned with protecting the load, which senses the d.c. potential of both output lines and opens the speaker relay if either output line exceeds ±2 V d.c. This circuit also functions as a time-delay mute during power turn-on, keeping the speaker relay open for several seconds.

A complete schematic for the UC-1 wasn't available, though there is a block diagram, but its operation is fairly straightforward. The output of the power amp, suitably attenuated, goes first through an a.c. logarithmic amplifier and then into a linear detector. The d.c. voltage thus produced then goes through a d.c. log amp and into a peak-hold circuit. The final result is a d.c. voltage proportional to the peak value of the log of the power amplifier output voltage. This d.c. is used to drive the meter and gives equal deflection for each decade of power shown on the meter.

The input buffer amplifier serves to present a high input impedance (100K) to the signal source on normal input, provides a low impedance drive for the level controls which are 1 K, and is an active circuit for the 12-dB-per-octave rumble filter. The overall gain is 1X for input to the level control. The circuit itself has an N-channel horizontal (or normal) FET input differential pair in which both output phases are differentially combined to drive a following inverting P-channel H-FET. This stage is operated common source, like a common resistor with a bipolar, with a source degeneration resistor of 150 ohms. The second stage drives a small power N-channel V-FET source-follower operating with a drain current of about 25 mA. Overall negative feedback is taken back to the inverting input to set the closed-loop gain at about 1.3X for proper operation of the active low-cut filter when in operation. This slight gain is taken out by a series resistor that feeds the level controls.

The power amplifier circuitry can best be approached by looking at the output stage, and a simplified schematic of it is shown in Fig. 3. A more complete, though still-simplified diagram is shown in Fig. 4. The output stage should be called single-ended push-pull, rather than quasi-complementary. This distinction was discussed on pages 48 and 50 of the February, 1975 *Audio*. Of interest is the fact that only FETs are used from input through output, no bipolar devices are incorporated, and there are only two output devices.

One thing common not only to this circuit but all V-FET amps seen thus far is that the saturation voltage drop of V-FETs is considerably higher than bipolar devices, and therefore the ultimate power for a given supply voltage is lower than with bipolar designs. A typical bipolar amp deliv-

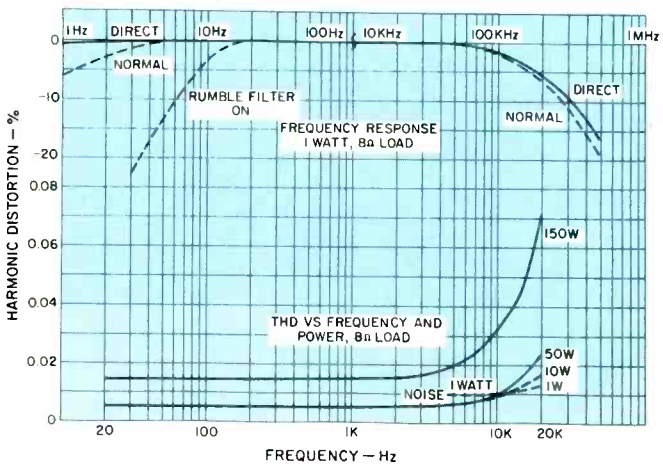

Fig. 6—One-watt frequency response into 8 ohms with THD versus frequency and power. Note break at 100 Hz/10 kHz in response curve.

ers about 230 to 250 watts into 8-ohm loads with a ±75 V supply, whereas the B-1 puts out about 220 watts with a ±90 V supply. This simply means that the ultimate power conversion efficiency of V-FETs isn't as high as that of bipolar devices.

Listening and Use Tests

Considerable time was spent a few months ago listening to the B-1, mostly with a rather efficient, equalized speaker array which concentrated attention on the lower portion of the amp's power range. In this use, the Yamaha B-1 was judged to be outstanding, definitely one of the best amps heard up to that time. Some additional listening was done then with Magnepan NG-2167F speakers, which are quite inefficient and thus used a different portion of the Yamaha's power range. It was this writer's opinion that the B-1 was as good as, if not slightly better than any bipolar amp heard until that time. It sounded a bit smoother and more like a very good tube amp than the hottest bipolar contender. When it was driven into clipping, however, it didn't sound as clean as the best bipolar amps.

A second B-1, this time with the optimal UC-1 control unit, was obtained recently for this review and the amp sounds as good as remembered. This reviewer has been doing a great deal of listening evaluation recently with the Stax SRX Mk-II electrostatic headphones, and the first thing that was done with the second B-1 was to listen to it with the Stax phones. The sound is extremely good, and the only amps which have been judged superior with 'phones listening (and then not by a great margin) are a pair of modified Marantz Model 9 tube units and a specially developed Class-A transistor amp, neither of which are commercially available.

The peak-responding meters are an absolute pleasure to watch and use. It was noted that for equal outputs from a common signal source, the B-1 would frequently read peak powers from 5 to 10 times what was indicated by conventional meters on another solid-state amp, meters which were otherwise correctly calibrated for RMS watts on a steady-state sine-wave basis.

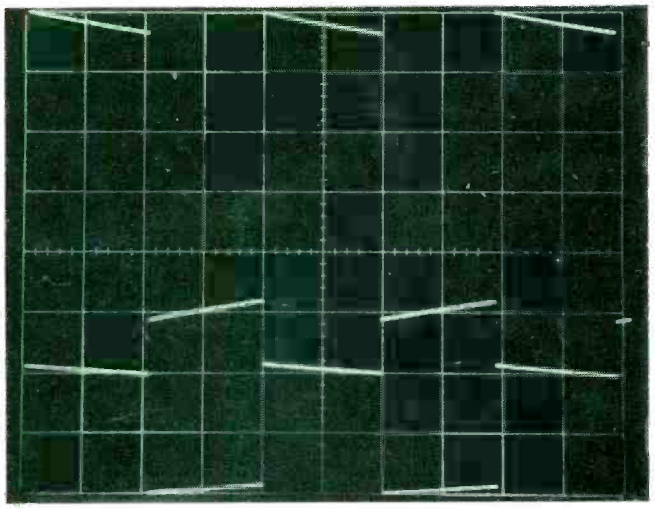

Fig. 7—50 Hz square waves, 8-ohm loads, 5 mS/cm. Top, 290 watts, 20 V/cm; bottom, 3.13 watts, 5 V/cm.

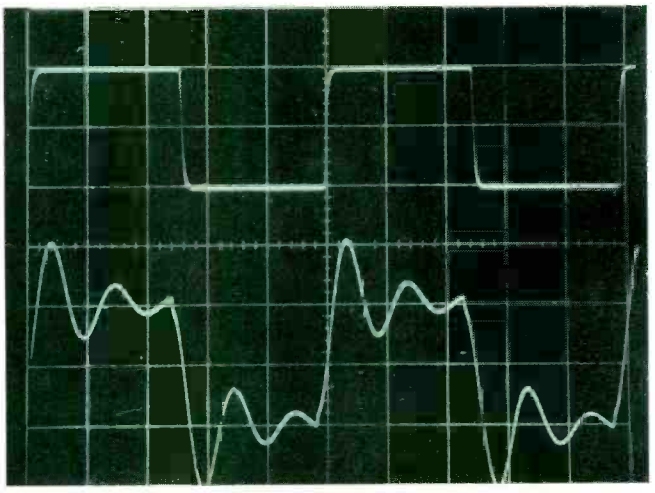

Fig. 8—10 kHz square waves, 5 V/cm, 20 μS/cm. Top, 3.16 watts with 8-ohm load; bottom, about 3 VA, 2 μF load.

Measurements

The B-1 was first operated for one hour at one-third rated power, 50 watts, into 8-ohm loads, as per the FTC power output regulation. The amp operated without thermal shutdown for the full hour required by the rule but did become extremely hot, as was expected. Temperatures didn't exceed 100° C, however, since the thermal cutouts on the heat sinks are set at that temperature.

Voltage gain into 8-ohm loads was found to be 43.5X or 32.8 dB on direct input and varied from 5.5X to 43.0X, 14.8 to 32.7 dB, through the normal input with minimum to maximum settings of the front gain control. (Note that all measurements were made through the direct input unless otherwise noted.)

IM and 1 kHz THD versus power are shown in Fig. 5. THD versus frequency and power are shown in Fig. 6, along with one-watt frequency responses for direct, normal, and rumble filter-in settings. One interesting observation was that the high frequency response on normal inputs didn't change much with the gain control settings due to their low 1K ohm value, in contrast to other units with higher impedance input volume controls.

Distortion for this unit is satisfactorily low and is not very different from many current bipolar designs. In Fig. 6, the 10-watt distortion is so close to the 50-watt values that one curve is shown for both. The 1-watt distortion is buried in noise at about 0.01% and climbs just above this value between 10 and 20 kHz. It was noticed that the amount of higher order odd-harmonic distortion was rather depen-

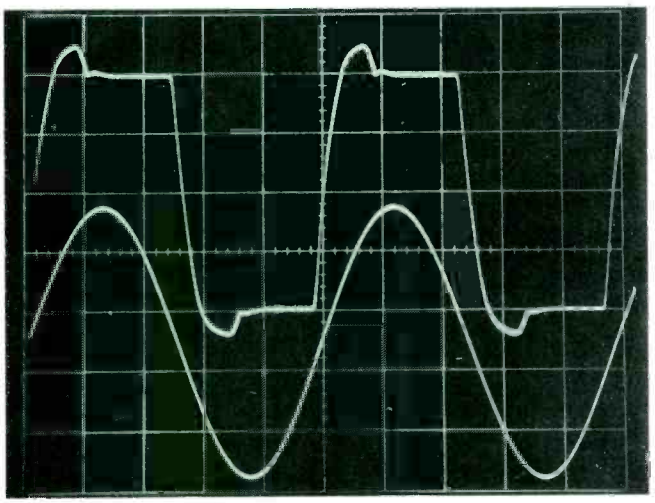

Fig. 9— Top 20 kHz square wave 20 V/cm, 10 μS/cm about 200 watts with 8-ohm load; bottom, 200 VA, 40 V rms, 0.15% THD.

dent on output-stage idling current, and at least 400 mA, Yamaha's design value, is required to keep these distortion components negligibly low. Distortion measurements through the input buffer amp on normal input were virtually the same as when bypassing this amp through the direct inputs. 'Scope photos of amplifier responses are shown in Figs. 7, 8 and 9 for various levels, waveforms, frequencies, and loadings. Fig. 7 shows the response to low and high-level 50-Hz square waves into an 8-ohm resistive load, while Fig. 9 indicates the response to a 10-kHz, relatively low-level square wave with resistive and reactive loads. The ringing with the 2 μF load is typical of solid-state power amps and is aused by an output RL buffing network that is used in the B-1 as well as most other solid-state amps. Attempts at 'scope photos with much higher levels than 10 to 15 V p-p, 1 to 2 μF loads, and fast square waves caused the protection circuitry to activate. Some 20 kHz high-power square waves are shown in Fig. 9. The overshoot for the square wave with a resistive load starts at 15 to 20 V p-p and gets larger as the level increases to the 80 V p-p shown. This amplifier, like many others, is in a slewing condition when it changes state from one level to another where the level changes represent a large fraction of the available output swing for a fast step input. Large error signals are operating inside the amp to cause it to go to the required new level as fast as it can. The speed and manner that the output reaches the new level is determined by how the amp is compensated for stability and how fast these RC networks can be charged by the available current in the stages where they are located. The overshoot in the B-1 is its particular way of recovery from a heavy slewing condition. Note, however, that the amp behaves essentially the same for a plus-to-minus as for a minus-to-plus transition, which is a tribute to the symmetry of the circuit. Several of the recently reviewed power amps recover or reach their new levels with less or no overshoot. However, it is not clear at this time whether this phonomenon has any particular sonic significance.

Table I—Output Noise.

Bandwidth, Hz	Right, μV	Left, μV
Direct		
20 to 20k	85	54
400 to 20k	67	48
Normal, Rumble Filter Out		
20 to 20k	105	90
400 to 20k	93	82
Normal, Rumble Filter in		
20 to 20k	110	95
400 to 20k	97	86

Output noise with shorted inputs is shown in Table I as a function of measurement bandwidth, direct or normal input, and rumble filter in or out. It can be seen that the input amplifier used for normal inputs does add some noise, but even the highest noise level of 110 μV is still some 110 dB below rated output of 150 watts into 8 ohms. These are truly excellent output noise figures, indeed.

Power output at visual onset of clipping for 4-, 8-, and 16-ohm loads was 213, 220, and 144 watts, respectively.

Conclusions

The Yamaha B-1 amplifier is a fine piece of equipment and has some very useful and interesting features. It is an excellent first implementation of a new technology, though it is hoped that with time the price and complexity of V-FET amps will decrease. This amplifier can be recommended as a state-of-the-art device for those with the wherewithall to afford it. *Bascom H. King*

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ELAC/Miracord 760 Automatic Turntable

MANUFACTURER'S SPECIFICATIONS

Speeds: 33 1/3 45, and 78 rpm. **Wow and Flutter:** 0.06%, and 0.07%, respectively. **Rumble:** -44 dB. **Variable Speed:** ± 3% of nominal. **Dimensions:** 14 ½ in. W. x 12 ½ in. D.; base, 18 ½ in. W. x 14 ½ in. D. **Price:** $199.95.

The Miracord 760 is an updated but less expensive version of the Model 50HII which we reviewed in May, 1972. It costs $199.95, as compared to $249.95 for the 50HII. Surprisingly, there are few differences, and those are minor. There are strobe rings on the turntable instead of a neon-lit window, no stylus brush is included, and the turntable platter does not have the beveled edge of the 50HII — and that's about all. Everything else, motor, changing mechanism, and arm, are the same or nearly so, and the two models even look alike.

On the right are three black pushbuttons for 7-, 10-, and 12 in. records, and a fourth button, a red one, activates the *Stop* switch. At the left front is a three-position speed-change switch, and the variable speed control is behind that at the rear corner. An anti-skating control, calibrated for 1 to 6 grams, is at the right rear near the tone arm pivot.

The arm is counterbalanced, and its weight has a milled plastic strip that meshes with the extension of a small control knob (see Fig. 2). Adjustment is simplicity itself. All you do is turn the knob until the arm (with cartridge attached) is balanced, then turn the control on the pressure dial (to the left of the pivot) to read 2 grams or whatever figure is recommended by the cartridge maker. The anti-skating knob is then set to the same figure. The plug-in head will take most cartridges, and the metal mounting insert is adjustable for

Fig. 1—View of Arm mount.

quick, easy alignment. In front of the arm pivot is a long cuing lever whose lifting height and lowering time are adjustable. A silicone-filled dashpot provides nice, slow lowering of the arm. The platter is quite heavy, weighing a bit more than 6 ¼ lbs. There are two strobe scales, one for 60 Hz and the other for 50 Hz.

As with the 50HII and other Miracords, the 760 has two spindles: a short one for single play and a "Magic Wand" for automatic play of up to 10 records. If the short spindle is inserted upside down the record will play continuously, a di-

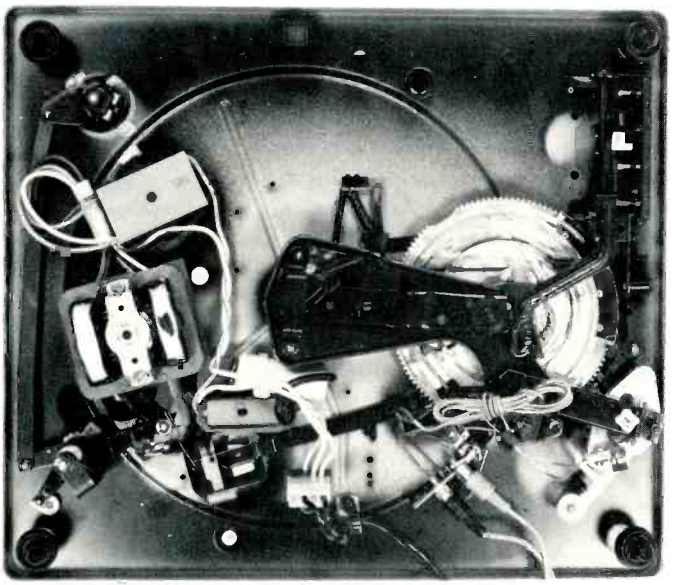

Fig. 2—View underneath the turntable.

version that will probably have limited appeal, though it's certainly useful for test engineers! The long spindle holds the record on three small supports which drop each record very gently. The silicone-damped mechanism of the arm insures that the fragile (and expensive) phono stylus is not damaged as it lands on the record. The motor is a 4-pole asynchronous type which keeps the speed constant. Drive is applied to the inside of the turntable rim by a rubber idler wheel.

Two phono cartridges were used for the tests: a Shure V15-III, and an Audio-technica AT20, a top-of-the-line CD-4 pickup. The first measurements were for wow and flutter, and the figures came out 0.05% and 0.06% respectively, slightly better than the specified 0.06% and 0.07%. The rumble measurement was -54 dB (ARRL), also excellent for a machine in this price range and notably better than the maker's claim. Tone arm resonance measured with the Shure cartridge was approximately 7 Hz, well below the critical region. As expected, the speed remained stable over the range from 90 to 130 volts. The variable speed control gave its specified variation of plus and minus 3%.

The stylus pressure scale is calibrated in grams from 0 to 6, and it was found accurate within 5% above one gram. Arm tracking error was about 0.5 degrees at the worst position. The force needed to trigger the changing mechanism was less than 0.5 grams, a far cry from the cumbersome old built-like-a-battleship models of 20 years ago that used to need *ounces* to start the cycling sequence. The arm's friction was quite difficult to measure, being below 25 milligrams.

Cycling time was 16 seconds, a little slower than some other changers but not judged a disadvantage because the records and pickup are handled so gently. The cuing control worked smoothly and with precision, a pleasure to use. Special low-capacity cables are recommended for use with CD-4 cartridges; those supplied plug into sockets underneath so changing them is an easy matter. In order to see the strobe markings clearly the unit has to be placed near a fluorescent light; no doubt some ingenious souls will mount a small neon lamp nearby.

Summing up, the Model 50HII is still an excellent record changer at $249.95, but at a saving of $50, the 760 is a real bargain. *George W. Tillet*

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GTE-Sylvania Model AS210A Speaker System

MANUFACTURER'S SPECIFICATIONS

System Type: Two-way acoustic suspension. **Drivers:** One 10-in. (25.4 cm) woofer, one 1 ½-in. (3.8 cm) dome tweeter. **System Resonance:** 42 Hz. **Crossover Frequency:** 1.5 kHz. **Impedance:** 8 ohms nominal. **Power Requirements:** 10 watts average. **Size:** 15⅝in. W. x 11 ¾ in. D. x 24 in. H. (39.7 x 29.8 x 61 cm). **Weight:** 51 lbs. (23.1 kg). **Price:** $99.95.

The Model AS201A speaker system, from GTE-Sylvania, is a two-loudspeaker design. The bass frequencies are handled by an acoustic suspension enclosure housing a 10-in., high-compliance woofer, while the upper frequencies are carried by a 1 ½-in. dome tweeter. The cabinet is of moderate size and is finished in walnut vinyl. The grille is sculptured brown foam, held in place by grip fasteners on the front panel board. The units are designed for either floor or shelf mounting.

A recessed cavity on the rear of the enclosure contains the speaker terminals and two toggle switches. The terminals are of the 5-way three-quarter inch spacing variety which allows ready hookup by spade lugs, twisted wire, or banana plugs. The plastic insulated caps on these terminals are colored for polarity identification—red for positive and black for negative. Printed next to the respective terminals are the legends *Pos* and *Neg*, so the user should have no trouble making proper connection.

Two toggle switches are mounted above the speaker terminals. One, a three-position switch, is labelled *Mid Freq.* and has the marking *Normal, Lo,* and *Hi* in vertical-ascending order. This may be a good technical solution for a single switch which changes the mid-frequency response in a two-way system, but it is less than perfect human engineering since the lowest acoustic position is the center switch position. The other toggle switch is better. It is a two-position *High Freq.* control marked *Hi* and *Lo.* Fortunately, the acoustic effect of both controls is modest, so the user cannot go far wrong.

The foam grille is massive-looking, but almost perfectly transparent acoustically. It is held to the front panel with Velcro fasteners, which allow it to be removed readily for cleaning. A Sylvania logo is fastened to the foam front in one special place with a Velcro fastener. As received, the logo was mounted for vertical speaker placement with the woofer at the bottom of the panel and the rear panel control labels upright. If horizontal shelf mounting is desired, the logo can be rotated ninety degrees, and refastened to stay upright. If you do this, be certain to make the logo appear in the upper right corner so that the tweeter will be farthest away from the shelf. This is to prevent shelf reflection from the tweeter. The panel side of the grille is hollowed to fit the slightly protruding speakers so there is only one way the grille will attach properly. Because of the weight of the AS210A only a very sturdy shelf should be used.

The AS-210-A is covered by a five-year warranty for any part which fails in normal use during this period. The warranty also covers replacement labor or service charge for the first two years.

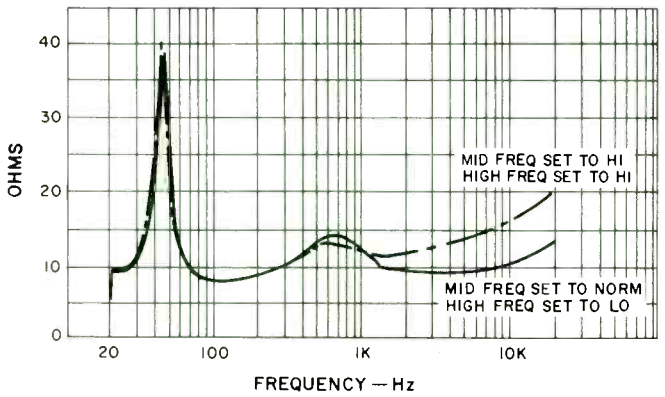

Fig. 1—Impedance.

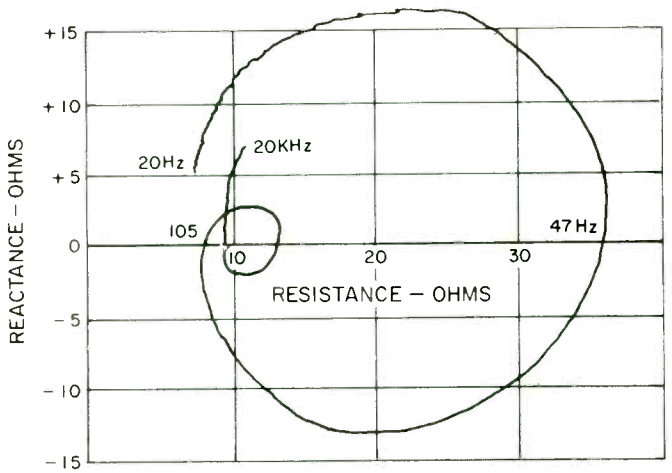

Fig. 2—Complex impedance plot.

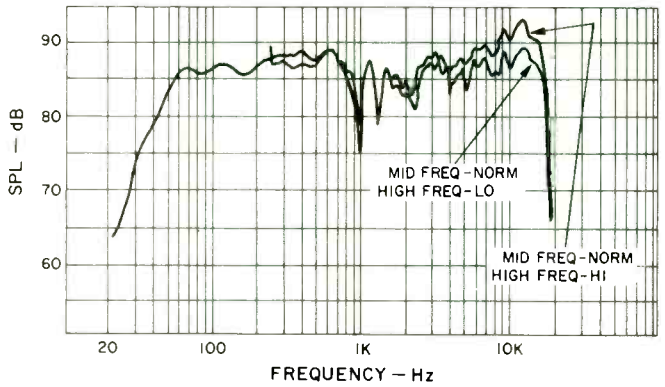

Fig. 3—One-meter, on-axis anechoic amplitude response, one-watt input.

Technical Measurements

The magnitude of load impedance which the AS210A presents to an amplifier is shown in Fig. 1 for two positions of the equalization controls. While there are six possible equalization combinations, the two shown in Fig. 1 represent the extremes, so far as the load impedance is concerned.

When it comes to impedance there is one thing you can depend upon—loudspeakers are never pure resistors. That is no fault, they do not have to look like resistors. Yet, the recent fuming and fussing about the method of testing power amplifiers for power has all but ignored the true load which the amplifier must drive—the speaker. As this reviewer has pointed out before, one can calculate a loudspeaker's complete impedance, magnitude, and phase angle, from measurement of impedance alone. That is why we show that measurement. But perhaps a better service can be provided if we also evaluate the loudspeaker as it might cause problems when used as a load for a power amplifier. Amplifiers designed to drive pure resistances may experience stomach aches when asked to drive actual loudspeakers at high level. This is *not* the fault of the loudspeaker, but is certainly caused by its presence.

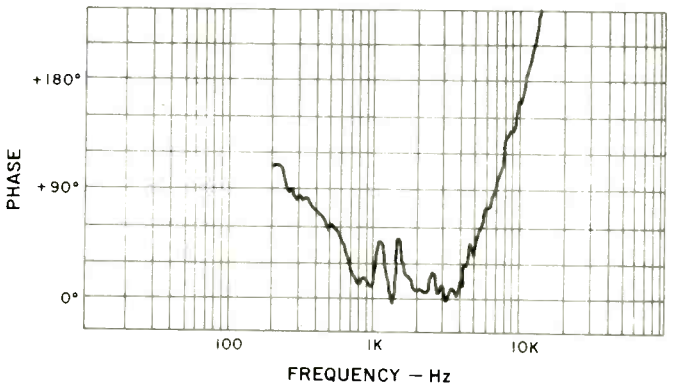

Fig. 4—One-meter, on axis phase response, corrected for acoustic position of midrange driver.

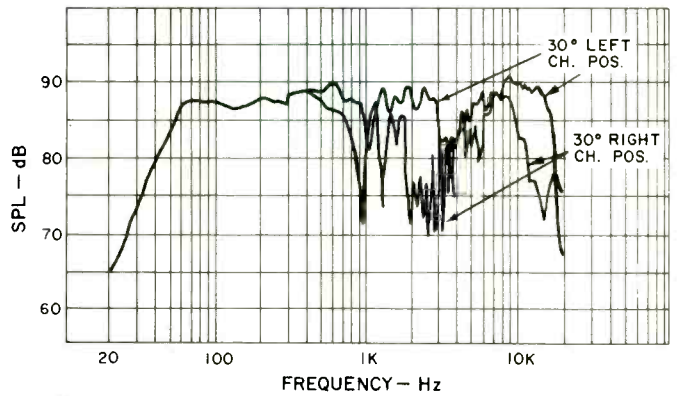

Fig. 5—One-meter anechoic amplitude response for 30° off-center listening positions.

Figure 2 is the measurement of the complex impedance of the AS210A for the *Mid Freq = Norm, High Freq = High* positions of equalization. The frequency range covered is from 20 Hz to 20 kHz. Only a few frequency values are marked on this plot since Fig. 1 shows the frequency characteristic for the same data measured as magnitude.

The lowest value of impedance presented by the AS210A is slightly below 8 ohms, and is resistive. Two main resonances are shown, one of them is the characteristic resonance of a sealed enclosure (the large circular arc in Fig. 2) which peaks here around 43 Hz. The other is a midrange peak at 600 Hz. This speaker is resistive at four frequencies between 20 Hz and 20 kHz. The worst reactance load at high frequencies, where many inexpensive amplifiers experience difficulty, is a capacitive reactance of only 11 degrees phase angle near 1100 Hz. The worst reactive volt-ampere drive near bass resonance should offer no problems to any reasonably well-designed amplifier. These plots show that the AS210A offers no load problem.

One-meter on-axis anechoic frequency response is shown in Fig. 3 for amplitude (SPL) and in Fig. 4 for phase. The axial SPL is quite smooth. The low frequency response is a textbook 12 dB-per-octave rolloff below 55 Hz. Some crossover notching occurs at around 1100 Hz but the trend is smooth up to an upper limit around 18 kHz.

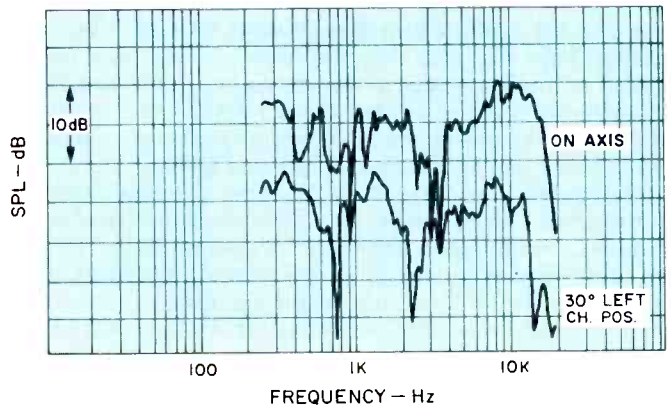

Fig. 6—Three-meter room response—speaker on floor.

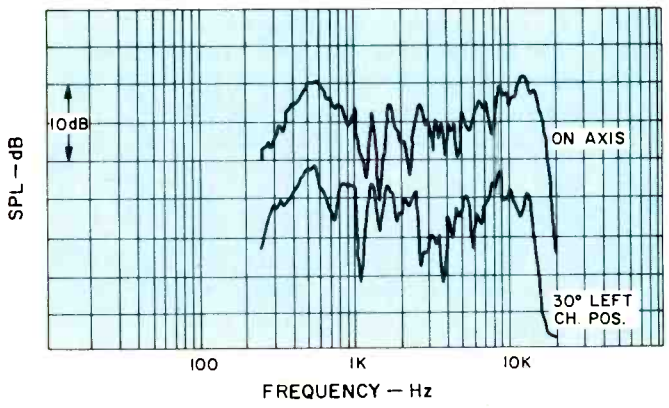

Fig. 7—Three-meter room response—speaker 24 in. above floor.

The axial phase response reveals that the woofer and tweeter are in phase at crossover with no sudden phase shift to mar performance. The axial response is principally minimum-phase throughout the frequency range. Above 3 kHz the tweeter has a 90 degree phase lag for this measurement. Only one phase measurement is shown, and this is corrected for the average acoustic position in the range from 600 Hz to 3 kHz. The acoustic position from 3 kHz to 12 kHz is such that the sound reaches the ear 0.1 millisecond earlier than sound in the 600 to 3 kHz range. The sonic effect of this arrival difference usually is to emphasize speech sibilants

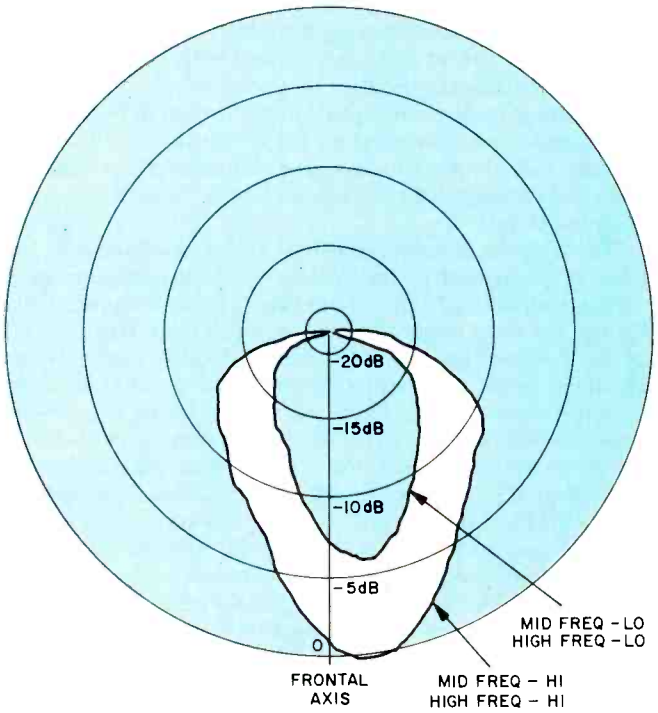

Fig. 8—Horizontal polar energy response.

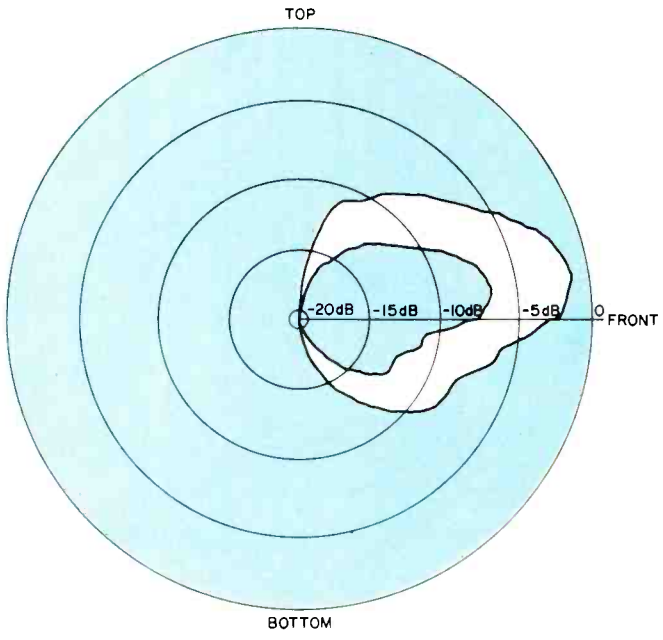

Fig. 9—Vertical polar energy response.

and crispen short-duration sounds. However the magnitude of delay in this speaker on axis is so small as to be negligible.

There is a distinct off-axis effect that deserves some notice. The best frequency response occurs directly in front of the AS210A. When the speakers are placed in a right channel and left channel stereo position, however, the anechoic response is not as smooth, as can be seen in Fig. 5. With the speaker rotated so that its axis falls to the right of the listener (right channel stereo position), the unit is distinctly nonminimum phase. In the frequency range from 1100 Hz to 2100 Hz the 30-degree right channel position has a nonminimum phase transition of 1440 acoustical degrees lag. Even a 10-degree angle offset from the on-axis position provides a 720-degree acoustic phase transition. This indicates that the best sound will be obtained with the speakers angled directly toward the listening position.

The three-meter room response is shown in Figs. 6 and 7. These measurements are the Fourier transform of the first 13 milliseconds of the loudspeaker's impulse response. They show the characteristic timbre for "early" sound in a normal listening situation.

The listening test revealed that an off-floor speaker position, as suggested in the instructions, provided more accurate sound than floor mounting. Figure 6 shows the response for floor mounting flat against a back wall. The data of Fig. 7 shows the response with the AS210A raised 24 inches off the floor, placing the center of the speaker at ear level, approximately one meter above the floor. The off-floor response may be seen to be distinctly superior. And as in the anechoic measurements, the on-axis response is better than that off-axis. I definitely recommend rotating these speakers in toward the listening area. The equalization used for all of these measurements was *Normal* for mid-frequency and *High* for high-frequency switch positions.

The polar energy response is given in Fig. 8 for the horizontal direction and in Fig. 9 for the vertical direction. Two extreme equalizations were used for the polar tests. In one case both mid-frequency and high-frequency switches were set to *Low*, and in the other both were set to *High*. It is obvious from Fig. 8 that there is a distinct left-channel sound superiority that verifies the anechoic and room test measurements. This measurement shows that a substantial amount of sound will be reflected off the back wall if the speakers are rotated toward the listening area while placed against that back wall. In some listening rooms this might give a stage-filling spread of sound pleasing to some ears, but not so realistic to others. To minimize this effect it may be necessary to experiment with the speakers pulled away from the wall. The broad horizontal dispersion of frequencies indicates that large reflecting objects, such as book cases, should not be placed next to the AS210A if they extend past the front of the enclosure.

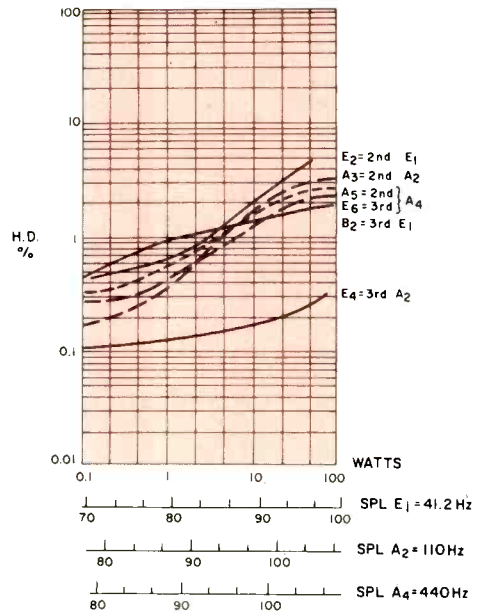

Fig. 10—Harmonic distortion for musical tones E1 (41 Hz), A2 (110 Hz), and A4 (440 Hz).

Harmonic distortion for the musical tones of E_1(41.2 Hz), A2 (110 Hz), and A4 (440 Hz) is shown in Fig. 10. This distortion, though not spectacularly low, stays at quite acceptably low levels, generally below 1% through the usual listening range.

Intermodulation of 440 Hz by 41 Hz is shown in Fig. 11 as a function of drive level. There are about equal amounts of phase and amplitude modulation on A4 caused by E1. At 10 watts the amplitude modulation is 4% peak-to-peak and the phase modulation is 6 degrees peak-to-peak. At 40 watts there is 8% amplitude modulation and 10 degrees phase modulation. These are both principally 41 Hz modulations.

In the crescendo-handling test, incoherent noise of 80 volts peak-to-peak magnitude caused a one-half dB drop on a very low level A4 inner musical voice while barely suppressing a middle C voice. It can be concluded that applause and hand claps will not cause significant modulation of low level musical passages when the AS210A is driven within its power rating. Both A2 (110 Hz) and middle C (262 Hz) are one-half dB softer at 20 watt drive level than they should be based on the acoustic gain of each at the 0.1 watt drive level. Sudden loud passages may therefore cause a tiny lateral spread of musical voices in the stereo image for those left-of-center or right-of-center sounds which have more of their energy in one channel. This effect is virtually nonexistent below 1 watt and at normal listening levels.

The energy-time curve of Fig. 12 is very good for a speaker in this price range. This is the envelope of the impulse response computed for a one-meter on-axis position. The major sound energy arrives at 3.0 milliseconds, with very small reverberant and diffractive scattering arriving after that time. Integration of this data reveals that 95 percent of the sound energy arrives within 3.1 milliseconds and 99 percent arrives within 3.4 milliseconds. The only late straggler (arriving at 4.6 milliseconds) is due to enclosure-boundary diffraction, and that is almost 30 dB down. The dominant frequency for the first sound arrival is in the 10 kHz range. Therefore record ticks and scratch might be accentuated to a small extent.

Listening Test

Two listening positions were chosen for auditioning the AS210A. In one position the speakers were placed flat against a wall and raised off the floor so as to be nearly ear

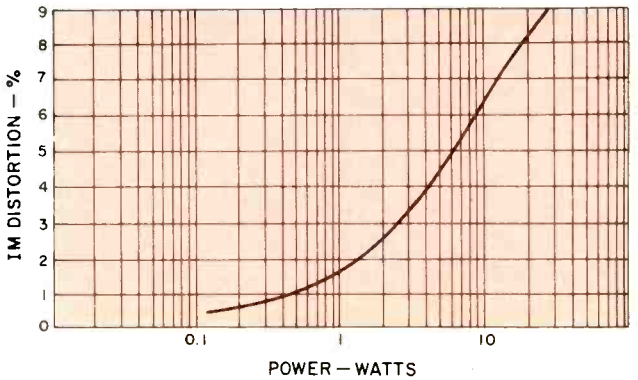

Fig. 11—Distortion of A4 (440 Hz) by E1 (41 Hz), mixed 1:1.

height for a listener who is seated. In the other listening position the units were placed on the floor, slightly away from the back wall. The stereo listening angle was about 60 degrees for both positions.

From the standpoint of overall sonic balance of the midrange and upper frequencies the better of the two positions is the raised, wall-mounted location. However the bass frequencies appeared to my ears to be too strong when the

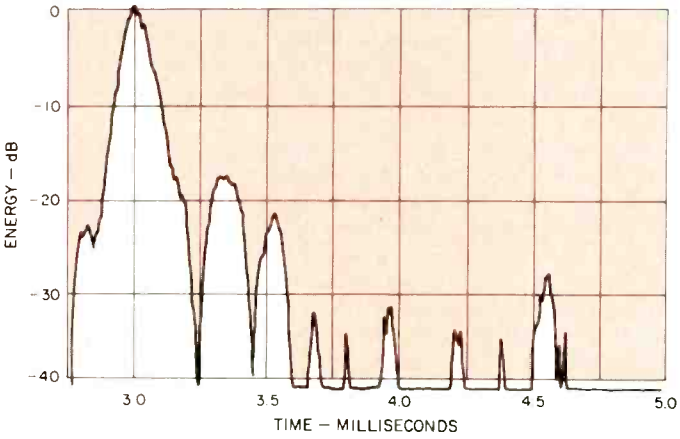

Fig. 12—Energy-time response.

speakers were against the wall. The floor position reduced this bass dominance but did so at the expense of midrange clarity. The AS210A, in my opinion, needs all the midrange level you can get from conventional tone control equalization. This is because of the strong bass (200 Hz and below) which tends to overwhelm the midrange frequencies even with the *mid frequency* equalization in the *Hi* position. The very highest frequencies, carried by the tweeter, can be brought up to the level of the bass frequencies with the tweeter control in *Hi*. Even with a *Lo* tweeter control setting on the AS210A and conventional tone control boost, the midrange appears to lack punch.

The bass heaviness of this system, coupled with the robust high frequency response, may constitute sound that is pleasing to a great many listeners. I am not one of them. I must admit that classic pipe organ sounds very good on this system and creates a good, space-filling illusion. Vocals and percussion bass instruments did not appear as accurate to my ear.

Stereo localization is moderately good with this system, with a slight tendency for lateral spreading of some stereo instruments. For those instruments which contain most or all of their energy in the frequency range of the tweeter, the sound is darn good. The tweeter is, in fact, the star performer in this loudspeaker system. The articulation and transient performance of the tweeter is excellent.

The AS210A is not a speaker system that I can recommend as a primary stereo system for a very large room. There are, however, several applications where the sound qualities of this speaker can be put to good use. One is as the important rear speakers of a quadraphonic instalation. The distribution of sound energy may complement that of some of the higher quality systems one might use for the front. A second application is that of low-cost stereo speakers for a very small room, as in many college dormitories, where the bass response of many systems often sound anemic. The AS210A should shine in that environment. *Richard C. Heyser*

Check No. 74 on Reader Service Card

Bang & Olufsen Model 2200 Cassette Deck

MANUFACTURER'S SPECIFICATIONS
Frequency Response: 30 Hz to 14.5 kHz. **Signal /Noise Ratio:** At least 52 dB with CrO_2 tape; at least 61 dB with Dolby. **Input Sensitivity:** Line, 0.2 V at 2.2M ohms; mike, 0.1 mV at 1000 ohms. **Wow and Flutter:** Less than 0.2%. **Erase:** At least 70 dB. **Output Level:** Line, 660 mV. **Speed Deviation:** Within 1.5%. **Fast Forward or Rewind Time:** 70 sec., C-60. **Dimensions:** 19.7 in. W. x 2.9 in. H. x 9.1 in D. **Weight:** 12.6 lbs. **Price:** $460.00.

The Bang & Olufsen 2200 cassette recorder has a clean and uncluttered appearance, with a flat top panel in black finish with real wood skirting on the sides and front. The flush-mounted *Off, On, Dolby,* and *CrO2* push-button switches and status lights are located at the left end. Immediately to the right are the slide-type record-level controls. Adjusting the control's narrow-bar knob moves a sheet of transparent plastic with a horizontal green line which indicates level on the scale printed white on a black background under the sliding plastic.

The level meters are located in the middle of the deck, with a record indicator just in front. The meter needles and the normal-level scales are white, with high levels in red, all against a black background. Illumination from the back of the meters provides additional contrast, and the tapered shape of the needles aids in reading varying levels. To the right of the meters is the cassette well, which has a note on

Fig. 1 — Rear view of the B&O BE-2200.

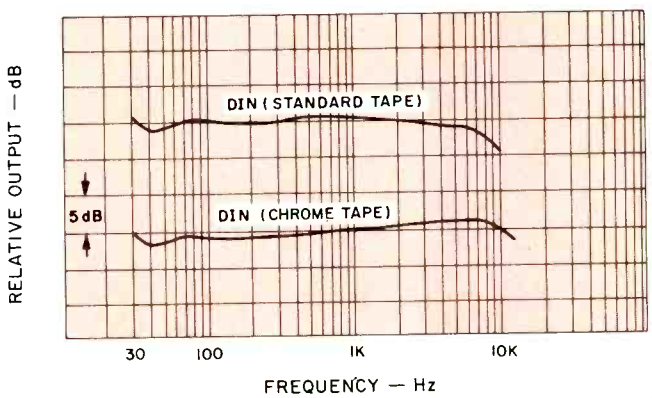

Fig. 2 — Playback from DIN test tapes; top, standard, and bottom, chrome.

its cover that the machine is equipped with high-density ferrite heads. Tape is inserted into the tray attached to the cover and positioned by pushing down on the cover. In front of the well are the *Eject, Stop, Rewind, Play, Fast Forward, Record,* and *Pause* piano-style keys.

Next to the cassette well and at the right end of the deck are the stereo phone jack and a DIN microphone jack. These are recessed below the top of the panel and can be covered by a small sliding panel with a bar knob. An added convenience is the inclusion of a *Stereo/Mono* switch for the microphone, facilitating feeding both channels with just one mike. Behind the well are the counter with its *Reset* button and the memory *On/Off* switch.

Line input and output connections are made at the back with a 5-pin DIN socket. B & O provides an adapter cable with four phono jacks to facilitate connections to the typical American system. There is also a DIN socket with input/output levels to match European radio standards. Plugging into the microphone jack disconnects the line inputs.

Performance

The 2200 deck performed very smoothly in all of its tests, meeting all of its specifications. Playback response with a standard DIN tape was within 2 dB from 31.5 Hz to 6.3 kHz, but with a droop of almost 5 dB at 10 kHz. Playback response with the CrO_2 DIN tape was better at the high end, with a droop of just 2.4 dB at 12.5 kHz. (See Fig. 2.) The record/playback response curves of this unit were particularly noteworthy because of their flatness. Using Capitol Music tape with Dolby out, shown in Fig. 3, the response curve was flat within a fraction of a dB from 50 Hz to almost 10 kHz at -20 VU. At this level, the 3-dB-down points were at 26 Hz and 16.0 kHz, superior to the 30 Hz to 14.5 kHz specification. Similar flat responses were obtained with BASF LH and Memorex MRX_2. The headroom at 0 VU was limited to 6.1 to 7.1 kHz with these tapes, with low frequency droop also in evidence. With the fast-response meters provided, this limitation (shown when using constant-level test signals) is more apparent than would be the case in actual practice. One of the benefits associated with the flat response of these low-noise tapes was that any mistracking in the Dolby circuits was minimized.

Performance with two ferrichrome tapes, Scotch Classic and Meriton, was less satisfactory overall. Although the headroom at 0 VU was better than the low-noise tapes, there was rising high-frequency response at -20 VU in Dolby mode.

The Dolby-out record/play responses with TDK KR chrome tape showed good headroom at 0 VU, within 3 dB out to 15.0 kHz at -20 VU and generally flat at both levels. With Dolby in, the response was quite acceptable at -20 VU with elevations of 2 dB at 100 Hz and 6 kHz.

The harmonic distortion of the 2200 over a range of input levels (1 kHz) was determined using a spectrum analyzer. In this way distortion products were measured at low input levels where noise would normally cause higher, erroneous readings with commonly-used distortion meters. BASF LH, Capitol Music, and Memorex MRX_2 showed the lowest total distortion over the test range, reaching 3 percent distortion at about +3.5 VU. The ferrichrome and CrO_2 tapes reached the same distortion level at +1 VU. The levels of the harmonics generated with a 0 VU input signal over a frequency span of 30 Hz to 10 kHz were also measured. The analyzer showed that the dropping figures for distortion from 2 kHz to 5 kHz were the result of harmonics being eliminated by tape saturation effects. Also revealed was the fact that the distortion products at 10 kHz were actually forms of subharmonics, perhaps beat notes with the bias oscillator. The average A-weighted signal-to-noise ratio for three low-noise tapes was almost 54 dB relative to 0 VU, about 57 dB relative to a 3 percent distortion reference.

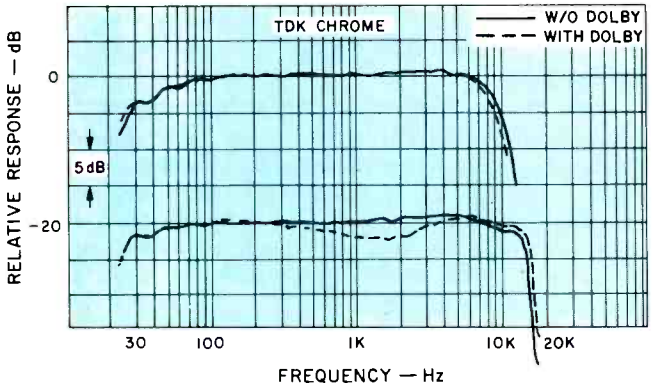

Fig. 3 — Record/Playback response, Capitol Music tape, with and without Dolby, recorded at Zero VU, and at -20 VU.

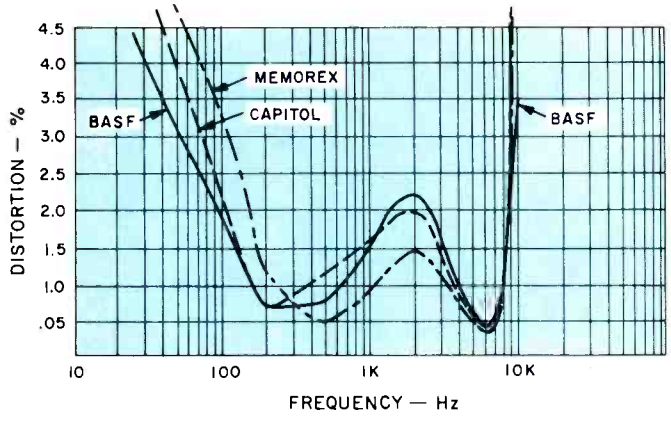

Fig. 4 — Harmonic distortion at 1 kHz, three tapes, with Dolby. Variations were so small (less than 1% generally), that curves could not be shown separately.

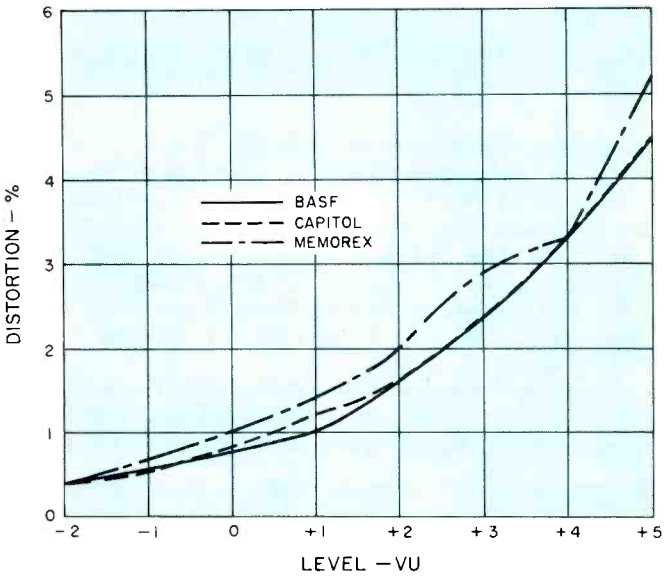

Fig. 5 — Distortion versus frequency for three tapes.

With Dolby in, the average signal/noise ratio reached 61 dB and 64.6 dB. Results with ferrichrome and chromium dioxide tapes were not as good, though the TDK KR did meet the B & O specification of over 52 dB without Dolby and over 61 dB with Dolby. The 3 percent distortion reference is quite appropriate for this deck, with its fast-response metering. These meters are frequency dependent, with greater deflection at the frequency extremes, about +5 dB at 40 Hz and 10 kHz, a good idea in most respects.

The spectrum analyzer was needed to verify that the unit did indeed surpass its 70-dB erase specification, actually doing at least 1 dB better without Dolby, and at least 6 dB better in Dolby mode. Crosstalk between stereo channels was -28 dB, acceptable although a bit high, and more than 60 dB down between adjacent channels of opposite-play direction. The best flutter figure obtained was 0.08%, and 0.19% was the average for DIN weighting, within the specified 0.20%. Average rewind time was 65 seconds, well within the 70-second specification. Tape speed was 0.6% fast with 120 V a.c. power.

The drive signal input to the headphone jack was 775 mV across 8 ohms, giving good listening volume with phones of various sensitivities and impedances, a desirable feature. Microphone input sensitivity of 0.094 mV was slightly better than the specified 0.1 mV. Line sensitivity was 107 mV, noticeably better than the specified 200 mV.

The output for 0 VU indication in playback was 700 mV compared to the specified 660 mV. With no output controls, the level played back was dependent upon the record sensitivity of the tape used. There is no output from the recorder line output when in *Record* mode, although the headphone jack is driven. The dynamic action of the meters was checked by feeding in a single-cycle tone burst of the same amplitude as would provide a 0 VU indication if it were continuous. The meters reached -3 dB with a 705 Hz burst and -1 dB with a 345 Hz burst which have 1.4 and 3 millisecond periods, respectively.

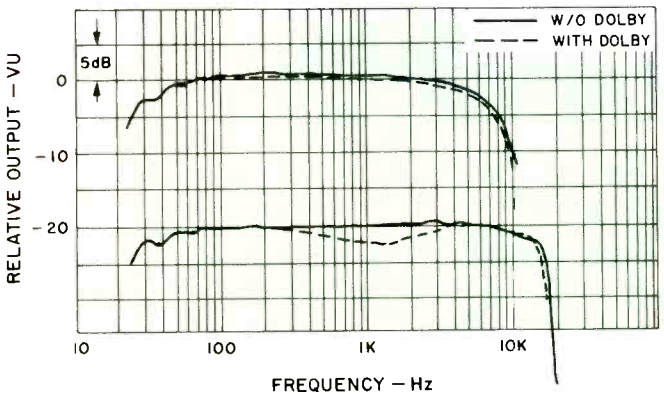

Fig. 6 — Record/Playback response, TDK KR (chrome) tape, with and without Dolby.

In-Use Tests

The meters of the B & O 2200 are superior to many others classified as peak responding. The attack time is visually well correlated to the audible character of the music. The decay time is well chosen so there is no sense of a lagging indication of level. The record-level controls slide smoothly with no binding.

The tape motion controls responded to a light touch, continually conveying the impression of quality construction. A minor criticism is that the solid black of the memory *On-Off* switch against the black background of the top panel made it difficult to be certain of the status of this function. A light-colored band around the button would be an aid.

The instruction book is not lengthy or detailed, but adequate. A schematic is supplied, of excellent quality with component values and functions clearly identified. On the back of the schematic, two board layouts pinpoint the location and function of all the adjustment pots. This information will be of great value to owner or serviceman in peaking the performance to match a particular tape. Access to most of the circuitry is gained by removing four bottom screws. High quality workmanship and components are evident throughout the machine.

Listening tests were performed by making copies, both with and without Dolby, of the *October Excursion* and *Epiphany* movements of Respighi's **Feste Romana.** Perhaps the best indication of the quality of the playback with various tapes is that no change could be heard between the dubs and the original. On the other hand, the ferrichrome tapes gave the plucked mandolin a slightly wiry sound, and their poorer noise performance was apparent. The chromium dioxide tapes failed to give improved performance over the low-noise varieties, which proved to be very well matched to this cassette deck. *Howard A. Roberson*

Addendum

SAE MK-IIICM Amplifier

It was discovered recently that two inaccurate 'scope photos appeared in the January, 1975 review of the SAE Mk-IIICM power amplifier. Specifically the upper trace of Fig. 7 on page 63, showing low frequency tilt at high power, and the upper trace of Fig. 10 on page 64, showing an exponential leading edge on a high power 20-kHz square wave, are in error.

The square-wave and pulse generators used for these photos both have a d.c. component in their output equal to one half of the peak-to-peak signal output. In the Mk-IIICM design, there are two back-to-back diodes from the signal input to the overall shunt loop-feedback resistor. The purpose of these diodes is to reduce the amount of internal overdrive signal when the amplifier is driven heavily into clipping. With a d.c. component on the input square wave, one of these diodes conducts and, by rectification, upsets or influences the fed-back output signal, thus causing low-frequency tilt at higher output powers (greater input voltages) and an exponential shape on the rise time of a large, fast step-input change.

With the d.c. component removed with a suitable external series capacitor and shunt resistor with a very long time constant, which is representative of normal use with preamp outputs, the high-level 50-Hz square wave would have virtually no tilt, and the large fast step-input response would be more linear or straight sided, and have a full-power rise time closer to 3 or 4 μS than the 6 to 7 μS indicated in the review.

The use of these signal generators having the d.c. component generally does not affect other input a.c. coupled amps which don't have input limiting diodes used in this manner, and the 'scope photos shown with those reviews are correct.

The Column

Fred DeVan

Dixie Rock: Wet Willie
Capricorn CP-0149, stereo, $6.98
Keep On Smilin': Wet Willie
Capricorn CP-0128, stereo, $6.98

Wet Willie, Capricorn's brash, spunky, "best of the bar bands," has made the most perfunctory disc possible on **Dixie Rock.** It's dry, plodding, and pedantic, by Wet Willie standards. This band has put out such exciting, driving, gutsy performances in the past that this record is disappointing. It's as if old age or road fever had struck them comatose. All the thrill I got from picking up the album was dashed by the merely better-than-standard boogie music it contained. Better than standard, but not the Wet Willie they showed on their earlier album, **Keep On Smilin'.** That one was so good that nothing could surpass it. **Dixie Rock** sounds like an uninspired quickie that no one cared about. Even though the band has so much talent, they succeed in making the inevitable so-so album that plagues every good group occasionally. Wet Willie is not a mediocre band, so let's keep on smilin' and talk about **Keep On Smilin'.**

That one was dynamite—presented by the best sock-em "bar" band in the South. Uninhibited, vital, colorful, skillful, contemporary rock. Boy, what a band that was—and still is. I'm sure a little rest and reflection will help them vindicate themselves for the lower quality of **Dixie Rock.** The stompin', spunky, ultimate boogie style that's their trademark really came together on **Keep On Smilin'.** The strong vocals that always fit, and funky horns that fly, really set them apart from other groups. These qualities exist on all their albums, but **Keep On Smilin'** is their best recorded performance.

Country Side of Life, Keep On Smilin', and *Soul Sister* are among the finest tracks to come out of the Macon, Ga. home base of Capricorn Records, and location of their fantastic studio. It's such a good studio that it's probably easy to be lazy and laid back when working there. *Alabama* is a lovely, wistful love-anticipation ballad that is far superior to the usual change-of-pace, slow tune most bands throw into their act. The basic pace of their rhythm section is a laid-back, rolling and bopping masterpiece. And very Southern. However, they are never sloppy. Even with boogie lyrics, the "Willietts" tighten everything up by raising the excitement level with amazing vocal interplay and strength. The whole band wails, but unlike the Boston style (J. Giles), the vocals are allowed to come up front.

A lot of this is accredited to Tom Dowd, the band's producer. All the good things about sound and performance excitement that Dowd forgot when he did Eric Clapton's **461,** are deftly applied to **Keep On Smilin!** When Tom Dowd produces a good record, he delivers a great one. The sound is as gutsy as the band and the material. Clean and open.

The delineation between instruments and voices is faultlessly clear, but the pressing I have is one from the height of the vinyl shortage madness and is junk. Somehow through the slush and gravel, the wizard of Warner manages a nearly-acceptable record. I don't think a current pressing of the album would be so bad. If you do get one that's excessively noisy, drop a note to the nice understanding folks in Burbank. That's the only way they will be able to find those evil old oil-crisis-caused discs. Keep on Smilin'.

Dixie Rock

Sound: B+	Performance: C

Keep On Smilin'

Sound: A?	Performahce: A+

Reality: Monk Montgomery
Philadelphia Int'l. KZ33153 Stereo, $4.95.

What a refreshing treat this record is! After all the thundering bass players with their 16-foot high amplifier-speakers going thump, whump, along comes Monk Montgomery with the electric (Fender) bass *as a lead voice!* A bass player up front—playing melodies, chromatic structures, and obligattoes—not just guitar chords. And playing warm and light! A Fender bass behaving like a tenor sax, a trombone, a cello, a scatting male voice. Low and sensual, rich and sensitive. Monk's brother Wes was a gifted guitarist who died at an early age several years ago. Monk is one of the few musicians who didn't scoff at the Fender bass in the early Fifties when it was first produced. At that time he was with the Lionel Hampton big band, and he was one of the very first acoustic bass players to adopt the electric. He not only used it, but almost alone lifted it out of its toy novelty class to make it the most used of all electrical musical instruments. We have all had our musical orientation changed by the existence of this instrument. Without it much of the music we hear today would be impossible.

In addition to my formal training on the acoustic (double) bass, and experience playing trombone, euponium and tuba, I own and play an electric (Fender Precision) bass. Thus, I have some understanding of how unusual are the things Monk Montgomery does with his instrument. He is a master!

Specifically, on *I Love You, Camille* (written by Bill Cosby) he glides through the theme in two-part harmony with Ron Feuer on Hammond organ to create sound so haunting and lovely that it just stopped me in my tracks. He moves over the full range of "his" instrument with astonishing ease and aplomb. One would never guess that these sounds are coming from the same instrument that growls and roars behind the likes of Brownsville Station, or any other of the hundreds of practitioners of bad taste who pollute the air with bad rock and roll.

Monk Montgomery doesn't play rock. He doesn't play jazz. He doesn't play anything that we have a name for, but he does play taste. He is a real musician—a true virtuoso. Perhaps I can't be objective because I understand the technical problems presented by what he's doing. Yet as I write this I realize I'm listening to nothing less than perfect musical expression and performance. If you've ever played any instrument, even a kazoo, you will know the first time you hear him that something extraordinary is going on.

What it is or how it is done is less important than being aware that this performance is a masterpiece. If rearranged and restructured it could be called *Concerto for Electric Bass and the Philly Sound.* If hyped up and roughened, it would have a dozen descriptions from as many press agents. But leave it as it is: just call it wonderful, pleasant, contemporary music at its finest.

Since the label is Philadelphia International we expect quality and class. Perfect recording is therefore taken for granted. The sound of Philly is one of the most sought-after in popular music today. It is universal and in one way or another appeals to almost everybody. But this disc is above even that elevated standard.

I've listened to every record thus far released by PIR, Inc., and I've yet to find a bad one. They issue many different kinds of music, but the Philly quality is always there. If America has an equivalent to ECM (of Germany) it is the Sound of Philadelphia (i.e. PIR). **Reality** is a departure only in the material presented, and it's one of the best efforts of the energetic young musicians who run the company. They've promised 17 discs in the next two or three months, so I plan to take a long look at PIR soon.

Right now, I'm going to put on Monk Montgomery's **Reality** one more time, grab my Fender bass, sit in the center of my listening room and get totally carried away. I love this record!

Philadelphia International Records Discography
Listed here are some of the best records issued by PIR:
War of the Gods, Billy Paul, **KZ32409; Half and Half,** Cleveland Eaton, **KZ32077; Yellow Sunshine,** Yellow Sunshine, **KZ32405; Spiritual Concept,** Spiritual Concept, **KZ32404;** and three by the O'Jays: **Live in London, KZ32953, Back Stabbers, KZ31712, Ship Ahoy, KZ32408.**

Sound: A Performance: A

Light of Worlds: Kool & the Gang
De-Lite 2014, stereo, $6.98.

For quite some years Kool & the Gang tried to get a break playing a jazz-affected kind of barroom blues. Struggling for all they were worth, they spiked their product with a heavy dose of tight 4/4 dance rhythms, and played jazz around the big beat. At first they had to play funky in order to

eat, and they played their jazz around bars in the Jersey City area in the mid-Sixties where no one was listening.

As time went by, the seven-man band got more and more affected by the funky stuff while attempting to deny their jazz roots. Out of the necessity to eat and a healthy dose of frustration, a blending of the two seemingly conflicting forms became the musical direction of the band. They changed their name from The Jazziacs and made their first album in 1969, but after seven albums and five more years, they were still little known.

After their seventh album, **Kool Jazz,** (De-Lite DEP 4001) they decided to do a commercial, repetitious little thing called *Jungle Boogie,* which hit #1 on the R&B charts. It sold scads of 45 doughnuts and my daughter Yvette (then 11) drove me nearly nuts playing it. I hated that record, but I heard something that made me curious. She conned me into watch.ng them on television and what I saw looked to me like a jazz band that had sold out. We discovered the group's previous, more rewarding albums, and suddenly *Jungle Boogie* fit into a much bigger scenario. Now she and I both listen to all the Kool & Gang we can find.

Today the group is an unqualified success with three gold records in six months, all out of album number 8, *Wild And Peaceful* (Delight DEP 2013). Now we have number 9, *Light Of Worlds* exibiting a further catharsis of the band. Here they show the development of their years of hard work.

This album is not a departure from the format that made them happen. A little James Brown thumping, a bit of Herbie Hancock keyboards, a little Stanley Turrentine sax blowing, and a lot of Kool & The Gang. This music is jazz stepping into rhythm & blues, not adapted R&B. The music stretches from easy listening to hard thumping on one disc. This mix probably limits their audience acceptance, since if you go to hear them for one style you get the other styles whether you like them or not. This *Light of Worlds* appears spotty because of the wide range of subject matter it covers.

The whole record is quite enjoyable and easy to listen to often. Frankly, I hope they continue to confuse their fans, cause it's seldom you get musicians who steadfastly follow their own instincts and are not swayed by success into starving the audience. Why should everything that they do after a hit be reminiscent of that hit?

The sound is good, at times exceptional. Mastering and pressing are excellent, with no noise, pops, or crackles, even in the very light keyboard passages which supply a delicate dimension. The engineering is rich and detailed. The synthesized quad sound is superb with excellent instrument location in either SQ or QS mode. With all their texture a true quad album would indeed be a delight, but there is little wrong with this stereo disc.

Kool & The Gang are a pleasure to explore. It is obvious that there is a lot to be heard from them in the future. Fortunately, while we await their next offering, we have nine already to nicely fill the time.

Sound: A Performance: A+

Nightbirds: LaBelle
Epic KE-33075, stereo, $5.98

Patti LaBelle is an almost-middle-aged singer who has been around for

as long as I care to remember. She is a chameleon who changes her style abruptly, yet successfully. This is a whole new thing for her, and it's her best yet. Compared to what she has done before it's almost non-commercial, yet it will probably be her biggest success ever. It has broad appeal that makes it work, but it's not the instant Top-40 thing she used to do. In fact, the most interesting aspect is that it is a very unusual effort, unique in many ways, both musically and conceptually.

Its stellar tune is *Lady Marmalade*, a wild, sexy song, with a feminist slant on it all (but you have to be bi-lingual to get the whole message) sung in English and French, by three strong Black females.

On *Don't Bring Me Down, Nightbirds, What Can I Do For You,* and *All Girl Band,* LaBelle, Sarah Dash, and Nona Hendry romp and roll through their material like the unisex Valkyries from 1975 that their fans think they are. Maybe they *are*. I don't think Allen Toussaint has a Richard Wagner fixation, or any other personality problem, but he has produced one hell of a record with this band and these three supercharged raunch-and-roll superwomen. Seen up close they look completely out of character until they start to sing.

LaBelle is not everybody's trip, but it's definitely an interesting one. **Nightbirds** has amazing lyrics which could only come from someone with a mature point of view. LaBelle are not kids (nor are they like Stella Dallas) but they are having fun, as always.

Their band is splendid. Maybe the horns stumble around a bit, and the sound could be better. I am not sure what it is, but it's not Allen Toussaint's usual crystal-clear sound. There are also a few spots where I thought I could hear some distortion. Nothing vital, however. Curious, successful, refreshing.

Sound: B Performance: A

New Skin For The Old Ceremony: Leonard Cohen
Columbia KC-33167, stereo, $5.98

Canadian poet-singer Leonard Cohen has a new record out. For Leonard Cohen fans, it probably is as good as, or better than, his previous one. But I am not at all a Leonard Cohen fan. I spent a lot of time trying to accept his own particular presentation of words. Possibly my bias comes from the anti-music quality of his performance. Like Rod McKuen, the words are all that's really of any importance to him. His standard lethargy pervades this disc. For all his possible virtues, he bores me so much that I didn't hear the whole album. Maybe someday I will.

To all Leonard Cohen's special friends, I am sure **New Skin For The Old Ceremony** will be welcome. It's probably better than I realize.

Sound: B Performance: B

The Baker-Gurvitz Army
Janus JXS 7015, stereo, $6.98.

A must for Ginger Baker followers, like me. It's spotty, sometimes good, sometimes spectacular, sometimes frustrating. The sound also varies, and is a bit sloppy. The production is casual, at best. As usual, a few spots of fine Ginger Baker flash. **Cream, Blind Faith,** and **The Ginger Baker Air Force** still remain the best of Ginger Baker! Try this one—you may not love it, but it's worth trying.

Sound: A Performance: B

(Continued on page 79)

Advertising Index

(Continued from page 73)

Physical Graffiti—A Pre-view: Led Zepplin
Swan Song 200, stereo, 2 discs, $13.98

No matter that I have heard only two cuts from this record, and those only under surreptitious circumstances. Led Zepplin's new album continues their incredible money making. Why shouldn't they make money? They have never made a record that wasn't worth three of most other groups.

House of the Holy was phenomenal. Anything that sustains Robert Plant's vocal and visceral exercises has to be phenomenal. Jimmy Page's guitar is a phenomenon (one of the tracks I heard had one of his acoustic solos). John Bonham has more strength and stamina than a whole orchestra, the most unpredictable drummer in the world. John Paul is like a musical genius in an instrument store. They are Led Zep, and Led Zep is Rock and Roll perfection. Only they are palatable when you want to hear Led Zepplin music. No one else can do or does what they do. I have never heard of a Led Zepplin copy group, nor anyone else grifting from their most individual, distinctive brand of music. No one else even comes close. You don't have to understand or like them to be blown away by the likes of *Stairway to Heaven,* or *Ramble On.*

I've seen hard-headed mid-fifties Jazz freaks driven into delerium by the fact that something done by Zepplin fascinates them. But that's normal. Led Zepplin does something fascinating to someone all the time.

Sound: ? Performance: A

Crossword

Answers to puzzle on page 38

1P	A	2T	C	3H		4E	T	C	
H		R		E		N			
O		A		5A	U	D	I	O	
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9O	U	10T	P	U	11T	S			B
H		H			O				Y
12M	O	D	13E		14N	A	B		
S			P		E				

Canby's Capsules

Edward Tatnall Canby

Chopin: Vars. on Mozart's "Lá ci darem la mano" (Don Giovanni), Op. 2; Fantasy on Polish Airs, Op. 13; Andante Spianato and Gnde. Polonaise brillante, Op. 22. Claudio Arrau; London Philharmonic, Inbal. **Philips 6500 422,** stereo, $7.95.

A roundup of the few Chopin works for piano with orch. aside from the two familiar early concertos. Arrau does them solidly, effortlessly; but the two side 1 items are pretty heavy stuff, on the edge of being overblown—though Schumann didn't think so at the time and hailed Chopin as a genius. True! And so was S. The "Spianato" on side 2 is more familiar as well as more easily digestible. The usual superb Philips recording.

Bach: Mass in B Minor. Palmer, Watts, Tear, Rippon; Amor Artis Chorale, Engl. Chamber Orch., Somary. **Vanguard VSD 71190/91/92** (3 discs), stereo, $20.94.

The Mass is more profound, more contemplative, more dramatic, than this professional-type big-time performance with its loud pro-style chorus, unblended, a too-prominent vocal quartet, a restless, bouncy quality to the faster movements and not enough thought in the slow ones. The low soloists are best—Helen Watts and Michael Rippon. It's all very brassy and somehow harsh in sound, unperceiving. Somary is a lot better in Handel.

The Four Antiphonal Organs of the Cathedral at Freiburg. Bach: Four Great Toccatas and Fugues. E. Power Biggs. **Columbia MQ 32933,** SQ quadraphonic, $6.98.

Biggs' effervexcent organ escapades are always fun—but why does Columbia pick such unlikely acoustics for proving SQ "discreteness," complete with diagrams? Four organs from one (electric) keyboard, panpotted into a square, but the huge reverb allows only a vague directionality though the sound is magnificently "surround"—*and* how. Sturdy Biggs Bach, quite intelligible in spite of the big mix.

Highlights from Handel's Judas Maccabaeus. Harper, Watts, Young, Shirley-Quirk, Amor Artis Chorale, Wandsworth Sch. Boys Choir, Engl. Chamber Orch., Somary. **Vanguard VSQ 30029,** SQ quadraphonic, $7.98.

Johannes Somary's numerous Handel recordings—both complete and in excerpt format as here—are fast, efficient, modern, and very pro, adequately "authentic" too; but musically I find them on the hard, dogmatic side, minus much feeling for rhythmic and dramatic balance. Top-rank solos—his women are best (Harper, Watts); basso Shirley-Quirk rumbles like an earthquake. A very pro. chorus, loud, accurate, energetic, wobbly, and unblended. Yes—the old sanctimoniously sincere Handel of the mammoth performance is gone. I sometimes miss it.

Stravinsky: Les noces (two early versions); **Le Chant du Rossignol: Symphonies for Wind Instruments.** Orpheus Ch. Ens., Gregg Smith Singers, Col. Symph., Craft. **Columbia M 33201,** stereo, $6.98.

Curious! Definitely for female voices and four pianos, a la "Sacre," **Les noces** went through two discarded versions, 1917 with orch.; 1919, incomplete, with percussion, two cimbaloms, harmonium, and player piano! Here are both. Robert Craft's didactic touch doesn't give much life, though everybody works hard and well. And did they get the player piano working? He doesn't say. I'd like to know. Wouldn't you? Unimaginative.

A Tribute to David Oistrakh, 1908-1974. Columbia MH 33328, 2 discs, mono, $13.96.

If you are an Oistrakh fan, here are his U.S. recordings 1955-56, in excellent mono fi, boiled down to two LPs from the original 3 discs. Mendelssohn, Mozart, Vivaldi, Shostakovitch; at Phila. and New York.

Ravel: Bolero; La Valse; Rapsodie espagnole. Boston Symphony, Ozawa. **Deutsche Grammophon 2530 475,** stereo, $7.98.

The Ravel Centenary—and already he is so far away. Younger performers miss the point, that steely, taut elegance of the earliest neo-classic. Ozawa, in Boston, at least gets all of the drive and tension though tempi are hurried and details not sharp. The big Boston liveness is superb for huge brass and drums in this hair-raising *Bolero; La Valse* is fast and rightly maniac—the waltz gone controlled-insane. *Rapsodie espagnole* (D-G mispells it on the cover!) is split between sides, which spoils its mood.

Piano Music of Ravel, Vol. 1. Pascal de Rogé. **London CS 6873 stereo** $6.98. *(Valses nobles et sentimentales, Tombeau de Couperin, Sonatine.)*

Rogé is very much the younger neo-Romantic, even to long hair. His Ravel is heartfelt, expert, but cast in a dreamy, untaut style that will astonish those who thought they knew Ravel pretty well. Very slow, full of great pauses, meditations, relieved only in the furiously fast movements—which Roge does with easy ability. Fine if you have no preconceptions—but try Gieseking's Ravel (Angel mono) for another generation's thinking.

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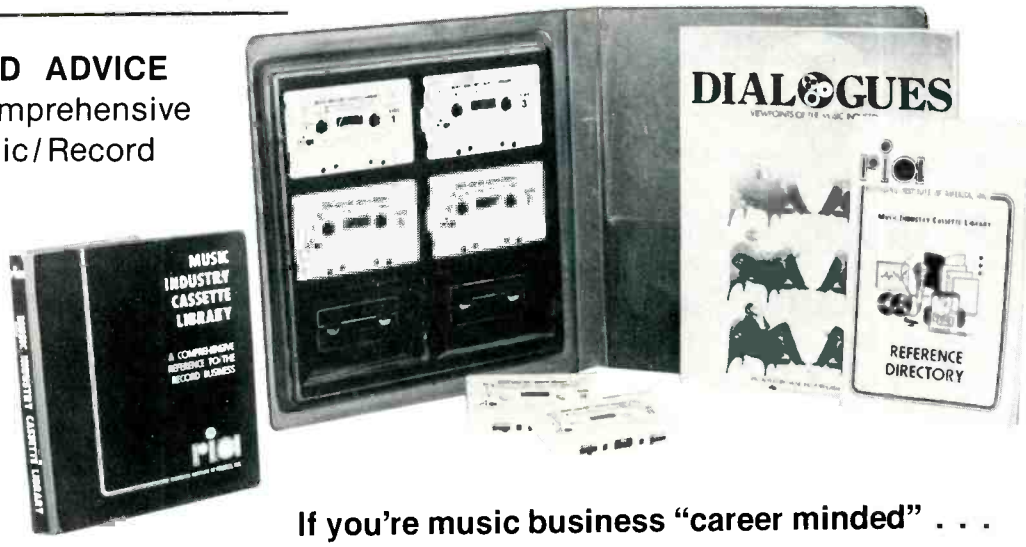

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big fat trout lure for the taking, and every so often somebody in the West makes a grab and licenses the Czech material. I can think of three or four labels, including one of the major "low price" lines, created especially for Supraphon. Somehow, none of them seem to have survived long. Somehow, the sonic quality has always been a wee bit doubtful, and who was to say whether the fault was Supraphon's or the importers?

To change my analogy, I think maybe Vanguard has now cracked this particular nut. Vanguard's quality control (their phrase) has always been excellent and accounts for the superior sound on this company's reissues over recent years. The sound was there from the beginning. Maybe Supraphon has updated? In any case, these are flawless recordings, up to anybody's high standards and up to Vanguard's own. You won't find any better surfaces, not even from Philips, either. A happy beginning, I'd say.

The Czechs understandably go in for Czech/Bohemian music and, for rather clear reasons, a bit of Russian too. It is their strong point, this repertory, and nothing to be ashamed of, politics or no. In listening here, my only reservation, not a strong one, is to note that (predictably) there is a lower tension in this playing that we in the West, especially in America, somehow expect in our own performances. The Violin Concerto benefits—you can push Dvořák just so much and no more, anyhow. Shostakovitch in particular benefits a great deal. The Fifth is traditionally played over here with a certain beetle browed fervor and sardonic intensity, which to my mind merely brings out its fatuous side. Shostakovitch is that way—too fulsomely serious-minded, which too easily turns into, so to speak, serious-windedness. I found the relaxed Czech performance very attractive. It takes the wind out of Mr. S. but leaves the substance. Of which there is, really, quite a lot!

George Flynn: Wound. John Cage: Winter Music (version for 4 pianos). George Flynn, pf. **Finnadar QD 9006 (Atlantic),** CD-4 quadraphonic, $6.98.

Well, here we go, and in quadraphonic too. Whammo! The various schools of contemporary music, you see, are just as rigidly stylized as "classical" music has ever been, and as pop music is too; this is the crash-bang school of piano, if I may wax descriptive. I don't mean it is unimportant. I'm just saying that it is definitely, unswervingly crash-bang.

Also somewhat aleatoric, which means, by chance, on purpose. The Cage piece was a pioneer effort of this sort back in 1960. George Flynn's own work stems from Vietnam horrors as of c.1968 and that is just the way it sounds, all raw and bloody. I can practically hear the bullets tearing flesh and the bombs and the shrieks of the dying. Brrrr—stay away: war.

It seems anticlimactic to speak of CD-4 is such a context, but in an ambient sort of fashion it does add to the impact of *Wound* though the sound is as of a single piano. In *Winter Music* the CD-4 is more pointed. This curious collection of pianistic options on paper—you take your choice, within specified limits, as you play—is done four times (all on the same piano, I suppose) and each of these appears in one channel, all at once. To be consistently aleatoric, Mr. Flynn did *not* listen to the other channels via phones as he laid down each performance The conjunctions of the four, then, are completely chance, or almost anyhow. Needless to say, they are all different. Different choices.

So far so good. But this concept is a lot easier to understand than to listen to. No beat, no perceptible rhythm, just very slow, casual dissonant chords, produced every once in a

while on impulse, with great stretches of time in between. A rigorously restricted format, even if important in its implications. But who listens to implications?

Variationen über einen Walzer von Diabelli (Variations on a Waltz by Diabelli). Jörg Demus, hammerflugel. **Archive 2708 025,** 2 discs, stereo, $15.96.

So it won't sell (and at such a price!). So what! I can only tell you that this is one of the most exciting and dramatic piano recordings in the history of the art and it really flipped me. Not only the music, most of which for a quarter century I have wondered about in vain. But the instruments, the "hammer grands"—no less than three early 19th-century grand pianos, with "wings," that is, the raised-up tops, beautifully restored to like-new usefulness. And on top of this, performance by Jorg Demus that is no less than stunning. Demus (remember him 'way back as half of the two-piano Demus/Badura-Skoda team?) is one of the top keyboard exponents of the Viennese school and, uniquely, a fine artist who has given himself to performing the older Viennese music on the instruments for which it was written. An unbeatable combination.

In 1821 Diabelli, a music publisher and sometime musician himself, launched a sort of piano competition by inviting some 50 prominent Austrian composers, including many from what are now Czechoslovakia and Hungary, to each write a variation on a little waltz of Diabelli's own, the whole to be published in a grand collection. Beethoven, in his late curmudgeon period, at first refused, then testily came up with a gigantic work, no less than 33 variations in late-Beethoven monumental style, his last big piano piece. It had to be published separately, of course. In recent times most important pianists have tackled the Diabelli Variations, and eight recordings are now listed in Schwann.

But what of the dozens by other composers, including a variation from such as Schubert, the boy Franz Liszt, Czerny, Hummel, W.A. Mozart II (Mozart's youngest son), and a host of unknowns as of today? Not an audible peep. The usual 19th-century leader-worship has prevailed; (a) Diabelli's Waltz is a nothing-Waltz (ah, but how cleverly shaped for variations, as Beethoven saw!) and (b) the other composers were nothing-composers.

Well, here is the Beethoven, on one disc, two sides complete. *And* here

are most of the others, more than 30 of them, on the second disc! Beethoven, of course, towers high and waxes difficult as we already know from standard-piano versions. But let me tell you, all things considered, the other composers including unknowns from Assmeyer(!) to Worzischek are extraordinarily good. There is not one of the short pieces which is in any way stupid, banal or trite; many are really beautifully contrived. If any similar group of our own contemporaries could turn out such a high-level and well-styled collection as this, we could be said to have a developed culture. Beethoven, we are now given to understand, stood high on the shoulders of other men. Without them, he would have been, let's say, a minor Ives.

Play straight through these consecutive little pieces—the Diabelli Waltz holds them together admirably for the ear, and Carl Czerny's brilliant coda carries the whole to a cheering, scintillating finish, and you don't need to know which is Schubert or Liszt, which Assmeyer. It all flows.

By far the most notable of the three pianos, as recorded, is the Gröber, 1815-25, out of Innsbruck, built in an earlier type of configuration. It is used for most of the non-Beethoven variations, alternating easily with the similar British Broadwood of 1802. On disc, this Gröber is extraordinary—such brilliance of color and timbre, not cool stainless steel as our modern grand but all brass and bronze, wiry like a thunderous Hungarian zither with keyboard attached. It sounds out as the loudest of the three, but this is undoubtedly a recording phenomenon. The Broadwood is a milder version of the same. Beethoven's music is played on a tougher, later, harder, Conrad Graf piano of 1839, like the last piano Beethoven owned. It seems *less* loud—but again this is surely because of its much heavier percussive sounds—violent transients difficult to record.

Did Beethoven himself pound out these hard-edged metallic *forte* jabs? Without a doubt! He was well known for breaking strings.

Correction

May's *Classical Reviews* of Michael Murray's Bach and Widor recordings listed an inoperative address. Organ recording enthusiasts can now order these discs from:

Century Advent Recording
878 Clarence Road
Cleveland, Ohio 44121

Jazz & Blues

Hampton Hawes at Montreux, 1973
Three LP Records

Playin' in the Yard: Hampton Hawes
Musicians: Hawes, electric and acoustic pianos; Bob Cranshaw, electric bass; Kenny Clarke, drums.
Songs: *Playin' in the Yard, Double Trouble, Pink Peaches, De De, Stella by Starlight.*
Prestige P-10077, stereo, $6.95.

Hampton Hawes, master contemporary keyboard artist, makes up for lost recording time in this series of three Montreux Jazz Festival releases from Prestige Records. Hawes slipped from view in this country in the mid-Sixties, leaving recordings and memories of his vibrant bop style. Recently he returned on **Blues For Walls,** his first Prestige release. At that time he showed broadened capability at the keyboard and as a composer.

On these live recordings Prestige has captured the added dimension of this marvelous musician in company with his peers. Listeners will find time flying as they enjoy Hawes' excursions on acoustic as well as electric piano.

His tasteful and sprightly use of the electric piano is gratification a-plenty for this keyboard-o-phile. He dances fancifully over the keys on the medium-tempo blues *Double Trouble,* then Cranshaw continues, frolicking on his Fender bass before the trio goes into the rock section of the number. This lasts for several choruses before Hawes switches to acoustic piano. Bass and drums drop out, and he revs up his motors for an extended solo flight. He's like a lark as he zips in and out of tempi with never the slightest hint of uncertainty. He highlights part of this cadenza painting a blues rainbow with his right hand while underlining it with a groovy walking-bass line in the left.

Bob Cranshaw deserves credit for his keen ear and excellent time. His notes throb with that extra duration exercised only by top bassists. He does a fine job of holding things together in *Pink Peaches.* The tune begs for a funky-street beat, which Clarke is unable to supply, apparently because he's unfamiliar with jazz-rock and tends to play a rather cluttered style here. And, though he makes a noble effort, his time wavers. But with Cranshaw present, Clarke finds the right way back to the time.

Playin' in the Yard, the title tune and longest cut on the date, is done almost as two-beat swing. I say *almost,* because Clarke vacillates be-

tween the two-beat and the more funky rock beat which Jack De Johnette played behind the tune on Rollins' **Next Album.** Nevertheless, the tune comes off very well. Cranshaw cops some solo time ably backed by Hawes' clever and effective understatements. This is an excellent tribute to tenor giant-composer Sonny Rollins.

My favorite cut is *De De.* It is an easy mellow ballad, a la bossa nova, with tranquilizing effects. *Stella by Starlight* is . . . well . . . *Stella by Starlight.*

Sound: B Performance: B

Blues a la Suisse: Dexter Gordon
Musicians: Gordon, tenor saxophone, Hampton Hawes, electric and acoustic pianos; Bob Cranshaw, electric bass, Kenny Clarke, drums.
Songs: *Gingerbread Boy, Some Other Spring, Secret Love, Blues a la Suisse.*
Prestige P-10079, stereo, $6.95.

Dexter Gordon's last release, **Generation,** is a tough act to follow, especially when you know hands down that it was his best album to date, featuring an explosive rhythm section and more than noteworthy solos by Freddie Hubbard and Dexter. It would be even tougher to follow if anyone else had to do it. But since Dexter plays better all the time, if better than great is possible, and since live recordings are more natural than studio dates, **Blues a la Suisse** is way up there near **Generation.**

This is a quartet date featuring Gordon on tunes he has not previously recorded. *Gingerbread Boy,* by another tenor giant, Jimmy Heath, gets a thorough going-over by Dexter. Played somewhat slower than Miles Davis played it on his record the tune looses none of its punch.

As with the rest of the album Dexter monopolizes the solo space on *Secret Love,* giving what's left to Hampton Hawes. I confess, I've been spoiled by the way James Moody did *Secret Love* on his **Never Again** album. The head on Moody's version *sounds* tighter because the rhythm section *is* tighter, and Mickey Tucker vamps the opening rhythmically in a most compelling fashion. Nevertheless, Dexter compensates with a superb solo flight of his own.

Sound: B Performance: BT

Ammons and Friends at Montreux: Gene Ammons
Musicians: Ammons and Dexter Gordon, tenor saxophone; Cannonball Adderly, alto saxophone; Nat Adderley, cornet; Kenny Clarke, drums; Hampton Hawes, electric piano; Bob Cranshaw, electric bass; Kenneth Nash, congas.
Songs: *Yardbird Suite, Since I Fell For You, New Sonny's Blues, Sophisticated Lady, Treu Bleu*
Prestige. P-10078, stereo, $6.95.

Surprise! Well, to me, anyhow. The late Gene "Jug" Ammons shows that on this recording he had turned away from the commercial "soul" routine he'd been into for several years. Actually I had an inkling he might be coming back to the mainstream when I heard some of his buddy Sonny Stitt's work (**Tune Up,** and **Constellation,** on Cobblestone). Then I ran across an album of Gene's called **Big Band Jug.** Need I say more? And then when I looked down the list of tunes and personnel on this record I guessed he was into some heavy blowing.

Sure enough, I was right. The quartet opens with *Yardbird Suite.* After mystically working through the head, in a *Night in Tunisia* vein, Ammons takes off for a whole bunch of swinging choruses. *New Sonny's Blues* by Sonny Stitt gives us the delightful opportunity to catch the rhythm section doing the blues—featuring a Hawes solo after one by Jug.

Ellington's beautiful *Sophisticated Lady* brings out the soft side of Ammons. His solo is sweet and relaxed, and Hawes' cute and subtle runs make ideal backing.

Dexter Gordon and the Adderly brothers arrive in time for the merriment of the finale on *Treu Bleu,* an Ammons up-tempo swinging original. Nat Adderley's creative use of staccato notes in a syncopated array is the most effective solo of the lot. Toward the end of the tune the four horns play leap frog, swapping four-bar phrases all around. After an effervescent statement by the four in unison, it's back to the head. The ensemble work is slightly sloppy, but who cares after the walloping these titans give the tune?

It's anti-climatic to say there is something that mars this otherwise-excellent performance. It's Kenny Clarke's drum work. He tries too often to do too much. And his kicks, instead of propelling the group, get in the way. If you let that one deficiency keep you from buying this record you will just miss one of Gene Ammons' best performances on record.

Sound: B Performance: B

As to the technical quality of these three recordings, you can get a fair sample by listening to Hawes playing

the head of *Playin' in the Yard.* Behind him you can hear the snares vibrating clearly, and throughout the rest of the tune the cymbals come through cleanly, showing treble sound comparable to most studio recordings. Cranshaw's bass is also vibrant and undistorted, highlighting the good, firm bass reproduction.

These three Montreux albums contain hours of pleasurable listening. If your ears can stand a bit of drum noise, or if you can do a little on-the-spot drum editing, you'll find the music here is top notch. To those responsible for choosing the musicians for the Festival, I say a more appropriate drummer could have been found.

If you must choose between these discs, choose **Blues a la Suisse.**

Eric Henry

Preclusion: Patrice Rushen
Musicians: Rushen, electric and acoustic pianos, clavinet, ARP synthesizer; George Bohannon, trombone; Oscar Brashear, trumpet, flugelhorn; Hadley Caliman, flute, alto flute, soprano sax; Joe Henderson, tenor sax; Ndugu, drums; Tony Dumas, electric bass, "blitz" bass; Kenneth Nash, percussion.
Songs: *Shortie's Portion, 7/73. Haw-Right Now, Traverse, Puttered Bop-corn.*
Prestige 10089, stereo, $6.95.

Patrice Rushen is all of 20 years old. Wow! Can you believe it? An album chock full of her own compositions and arrangements on which she shows off her keyboard talents. You might think that for someone to arrange her own recording session at such a young age she must be the child of movie stars or record producers or some such. Not here! No way! There's no nepotism or anything else involved here, save the merits of a young talent hard at work. Patrice is excited about her first record, and rightfully so. It represents her—the dues she's paid, the culmination of her previous musical experiences with trombonist Melba Liston, singer Abbey Lincoln, various soul groups and studio work and, of course, her producer and teacher Reggie Andrews.

Shortie's Portion makes a swinging helping for any avid pair of ears. Miss Rushen is on acoustic piano here for two solo outings, separated by a couple of horn solos. Her solos show the influence of McCoy Tyner, among others. More than that, they herald the arrival of a developing keyboard giant sprouting much more than musical cliches and memorized riffs and licks.

The two horn solos are by trumpeter Oscar Brashear and tenor saxophonist Joe Henderson, who sounds magnificent here which is not unusual when he and his irreplacable, unrelacquered, mellow old tenor sax get together. It is unfortunate that Henderson's own recent releases, **The Elements (Milestone MSP-9040)** and **Black is the Color (Milestone M-90530** are not commensurate with the talent that the man has to offer. This is simply due to the musical variety being constricted to no more than a hair's breadth, hence posing overbearing limitations on the already overly-exploited ear. Henderson is heard to great advantage on albums by other artists including Flora Purim's **Butterfly Dreams (Milestone M 9052)** and Ron Carter's **All Blues (CTI 6037)**. When Henderson gets together to play good music, what comes out is one of the most identifiable and influential reed voices in music today. This is certainly the case here.

Miss Rushen's compositions are interestingly constructed. There aren't any hodge-podge, hackneyed themes or lines to be trampled over just once more. 7/73 is a beautiful bossa-like ballad which Patrice sprinkles with spice and everything nice on electric piano. If there are any influences on her compositions (what am I saying? of course there are; everyone has some), I detect some Thad Jones in the phrasing and rhythmic structure. The tune hints at Thad's *It Only Happens Every Time* from Thad Jones and Mel Lewis' **Consummation** LP **(Blue Note BST 84346)**.

Traverse really is an appropriate title for this tune. Much musical ground is covered. The beginning brings to mind the sounds of a summer evening with little more than the breeze of a soft wind and a Jiminy Cricket scampering lightly over the keys of the acoustic piano. Then, Patrice swings lightly with bass and drums (no horns). And, suddenly, magically, we are whisked away to a super-samba wonderland.

Today, as music expands in all directions, there is a growing expectation of and necessity for the new keyboard artists to be familiar with the whole array of keyboards. On **Puttered Bopcorn**, a super funky tone and not a redone bopper, as the play on words suggests, Miss Rushen performs on Arp Synthesizer. Bassist Tony Dumas helps groove this tune. By the way, what is a "blitz" bass?

In order for some folks to be swayed to purchase an album, the music has to fit some label or category. Is it all swing? Or Latin? Rock, Bop, or what? **Preclusion** is all of these and more. It's not hung up in any one bag; it's all good music. And, if you have to have a label for it, it's all Patrice Rushen! Here's where the one-time diamond-in-the-rough has made the transformation into a still-being-polished, but glowing gem. Nothing adds more to an album of good sounds than *sound* reproduction. Justice has been done in mixing and pressing this LP, as much as can ordinarily be expected by American standards. I highly recommend **Preclusion**. *Eric Henry*

Sound: B+ *Performance: A-*

The Greatest Jazz Band: Jimmie Lunceford and his Orchestra. **Olympic Gold Medal 7123,** mono, $4.98.

The title of this album stakes out a brash and extravagant claim certain to be challenged by admirers of Basie, Ellington, Goodman, and Fletcher Henderson, at the very least. While certainly not *the* greatest of all jazz groups, Lunceford's crew was in the front rank, dominating, along with the four mentioned above, the big band scene in the Thirties.

In a way, Lunceford's and Basie's bands were complementary, each making its forceful impact by different means. Where Basie's men drove into blues and stomps with roaring enthusiasm, their simple riff style propelling the mounting orchestral tension, Lunceford relied on the opulence and detail of studied orchestrations and more precise execution, approaching, closer than any other band, the standard set by Benny Goodman which brought this kind of ensemble playing closest to perfection.

The Lunceford band was one of the slickest show bands of all time. Its trumpet men dazzled audiences with gimmicks such as throwing their horns in the air and catching them with the accuracy and timing of professional drum majors. The trombone section would swivel right and left while playing swinging tunes—a trick that Glenn Miller copied and which contributed to his band's popularity.

But what the stiffer and more mechanical Miller band could not copy was the innate ensemble quality that made Lunceford's the most relaxed of orchestras. The lazy, caressing beat of *Morning After* is as fine a tribute to the Lunceford discipline as the precision and swing on the uptempo *Battleaxe*. *Moonlight and Music* and the Sy Oliver arrangement of *I'm Walking Through Heaven With You,* though it has a Dan Grissom vocal, really showcase the opulent sound of the Lunceford sax section. Led by altoist Willie Smith, the cohesion and instinctive understanding of the five-man reed team is readily apparent. Their phrasing and blending are so complete that the listener is all but convinced he's hearing a single instrument. The Lunceford sax section achieved the most delicate pianissimo effects, yet it could swing the whole band with tones as forceful as the band's vigorous brass. *Annie Laurie,* a Lunceford standard, is a fine swinger which spotlights the brass section in a vivid, sharply-disciplined performance. Trummy Young's bold, open trombone work is a consistent joy, along with Paul Webster's piercing, high-register trumpet solos.

The gifted arranger-trumpeter Sy Oliver, who was the most important shaper of the band's sound, had gone over to Tommy Dorsey by the time these recordings were made. With TD he was to achieve greater fame and make more money, but the Oliver influence remains in each of these selections. All are played in the relaxed, crisply-phrased Oliver manner. Even the highly commercial ar-

rangements that back singer Grissom reflect the brilliance and subtlety of Oliver's scoring. Needless to say, this Lunceford collection is highly recommended.

All of the tracks on this Olympic LP were taken from the Long-Worth Co. radio station library. They were recorded in 1942-43. The pressings of those transcriptions (16 rpm) had respectable sonic quality for the day.

John Lissner

Sound: B+ Performance: A+

The Colours of Chloe: Eberhard Weber

Musicians: Weber, bass, cello, ocarina; Rainer Bruninghaus, piano, synthesizer; Peter Giger, percussion; Ralf Hubner, drums; Ack van Rooyen, flugelhorn.

Songs: *More Colours, The Colours of Chloe, An Evening With Vincent Van Ritz, No Motion Picture.*

ECM 1042 ST, stereo, $6.98.

Nothing less than great music from beginning to end! This music far surpasses what words can say about it.

Weber has created an album full of titillating sounds, employing both classical and jazz idioms. It's not fusion in the sense of the familiar jazz-rock fusions we know so well. Instead each selection maintains its own musical identity. There's no watered down jazz or classical music herein, or any other bastardizations thereof. Each is its own thing, yet somehow they complement each other perfectly. Weber's orchestrations for the cello section of the Sudfunk Symphony Orchestra lay an elastic foundation which maintains the discipline of classical music even while allowing the jazz section to function freely.

Close your eyes and savor the delectable piano solo on *Colors of Chloe*. Bruninghaus brings us out of a forest of strings into a cool summer waterfall. Sparkling and refreshing notes form a melodic continuum over the ridges of the rhythm section. You like flugelhorns? Well, Ack Van Rooyen plays the plating right off his horn on the free 'n up *Evening with Vincent Van Ritz*.

What else the album has going for it would take up more space to describe than is available. There's good music here and there's lots of it. Everyone's ideas gel together splendidly without being hindered by the muck of technique that often results when young masters get together. Weber plays a five-stringed bass. If we couldn't figure that out from his octave jumps on *Chloe*, the picture on the back cover would tell us.

Colours of Chloe is on ECM—the Rolls Royce of jazz labels. Only superior music is allowed to grace these letters of distinction, so conventional sugary strings and geared-up synthesizers are absent. Rather, Weber draws uncanny voicelike textures from these usually over-exploited instruments. What we've been conditioned to expect from synthesizers and strings, and what he's produced are at opposite ends of the spectrum.

The sound of **Colours of Chloe** is not the sound of Europeans imitating jazz from America, as happened after bop, in the Fifties and Sixties in Europe. Weber is representative of many younger European musicians, developing music that is new, modern, and distinctly their own. Eberhard Weber isn't Chick Corea, but his music is just as valid. His reputation will grow among *afficionados* of good music, and then . . . well . . .

This is one of the year's better jazz releases, whether it sells or not.

Eric Henry

Sound: A Performance: A

Tape & Turntable

Bert Whyte

Appalachian Spring. Aaron Copland, composer, conducting the Columbia Chamber Orchestra. **Columbia MQ 32736,** SQ disc, $6.98.

If you are familiar with the music of the ballet suite, scored for full orchestra, you will be fascinated with this (the original) chamber orchestra version which utilizes only 13 instruments. Aaron Copland tells us that the scoring and the size of the orchestra were dictated by the size of the small concert hall in the Library of Congress, where Martha Graham was to dance the premiere performance.

Needless to say, this is a much more intimate sounding version than the full orchestral suite. When you're listening to it, inevitably your mind supplies the missing brass and percussion and the other parts with which most listeners will be familiar. This is very clean, open sound, with beautiful strings and woodwinds in a quadraphonic recording that furnishes lovely warm ambience, and proves that four-channel sound can be successfully used in small-scaled productions. **Appalachian Spring** is, of course, a masterpiece and always a delight to hear, whatever the format.

Peter and the Wolf: Prokofiev. **Young Person's Guide to the Orchestra:** Britten. Will Geer, narrator. J. Somary w. English Chamber Orch. **Vanguard VSQ 30033,** SQ quadraphonic disc, $7.98.

A glance at the latest Schwann catalog reveals that there are 15 recordings of **Peter and the Wolf,** and 12 versions of the **Young Person's Guide,** with narrators as diverse as Capt. Kangaroo, Peter Ustinov, Boris Karloff, and Mia Farrow, to name just a few.

Obviously, this new Vanguard recording is up against some stiff competition, but it has some very potent factors in its favor. For one thing, it is the only quadraphonic version currently available. This in itself might not influence some people, but believe me, this is quadraphonic sound of rare excellence, and a most persuasive reason for using this medium. Play this recording in stereo, and then play it through a reasonably sophisticated SQ decoder. The enhancement of the acoustic perspective is dramatic, and the sense of involvement in the recording environment is so real, that the stereo sound seems confined and almost one-dimensional by comparison. There is little quadraphonic "trickery" employed here . . . no wildly-swinging pan-pots or channel switching. The object here was to achieve very natural sound, exemplified by a feeling of air around the instruments; a smooth, spacious projection of all the orchestral elements, without "spotlighting" for exaggerated effect, nor the stridency which mars far too many recordings these days.

The sound is ultra-clean, with extended high frequency response in the silky sheen of upper register strings. The very exposed and open scoring of **Peter and the Wolf** calls for precise internal balances, and in this recording they are splendidly realized. I never heard any instrument or group of instruments cover or "swamp" one another.

In this type of recording the narration is usually recorded separately from the music, and then spliced in at the appropriate places in the score. This was done here nigh to perfection, with most discreet and judicious use of plate-type reverb for continuity between voice and orchestra.

Will Geer, who does the narration, is a fine character actor currently appearing as the gruff old grandpa in **The Waltons** television show. Rather amusingly, in the **Young Person's Guide,** he does the narration in a pleasant well-modulated voice, with beautiful diction, but in **Peter and the Wolf** slips into his "mountain twang" and at times the "cornpone" gets a little thick. No doubt devotees of **The Waltons** will feel very comfortable with his performance.

All in all, this is a superb recording with some really rich sonorities. Listen to the *Procession* in the finale of **Peter and the Wolf** for some great blaring brass sounds and the clean, solid impact of low frequency percussion.

Theater Music

Donald M. Spoto

Sunset Boulevard: The Classic Film Scores of Franz Waxman. National Philharmonic Orch. Chas. Gerhardt. **RCA ARD1 0708,** CD-4 Quadradisc, $6.98.

By the 1930s, Hollywood had come a long way since the days of the mighty Wurlitzer, the large pit orchestra and the matinee music which accompanied films. This early music was performed more for pragmatic than esthetic reasons: the whirr of projectors, the banging of movable chairs, and the noise of undisciplined patrons had to be masked.

With the advent of sound film, major studios realized the importance of a good musical score. Dramatic value (or more accurately, melodramatic value) was added, and serious composers were commissioned for major films: Arthur Honegger, Dmitri Shostakovich, Sergei Prokofiev, Virgil Thomson. Some composers, however, became famous for their film scores alone, and among RCA's numerous new releases, none is more significant than this one of Franz Waxman's work.

Two-time Oscar winner (*Sunset Boulevard* and *A Place in the Sun*, both included in this recording), Waxman may well be, with Bernard Herrmann, the greatest of film composers. The moment of creation in *The Bride of Frankenstein* (1935) owes much of its emotional complexity to Waxman's beautifully terrifying score with its glorious bells and eerie understanding of the thin line of demarcation between the grotesque and the gorgeous. Hitchcock's first American film, *Rebecca* (1940), was enhanced by his sensitive neo-Gothic music, and *The Philadelphia Story* had Waxman's genius adding delicious counterpoint and bittersweet harmony.

His scores for *Prince Valiant* (1954), *Sunset Boulevard* (1950), and *Taras Bulba* (1962) are surely interesting, and far better than the kind of monotonous lushness to which Max Steiner and Alfred Newman too frequently descended. But Waxman's greatest scores are not represented in this album. They are *Sayonara* (1957) and *The Nun's Story* (1959), the latter very likely the finest film score ever composed. It is long out of print in its original Warner Brothers soundtrack version, with that lovely photo of Audrey Hepburn in white veil and wimple on the album cover. My own much-played copy may be one of the few copies around.

Franz Waxman has the kind of imagination, sensitivity, understatement, and depth of feeling that make him one of the great composers of our time in a very special kind of genre. He deserves better than this disc, on which Charles Gerhardt and the National Philharmonic (whomever they may be) perform loudly but without great feeling. And the cloying rumbles in the bass may lead you to think you've amp trouble. Not so; it's just a badly cut quadradisc.

Performance: C Sound: C

Judas Maccabeus (Highlights): Handel. English Chamber Orch., cond. by J. Somary.
Singers: Harper, Young, Watts, Shirley-Quirk.
Vanguard VSD 71200, stereo, $6.98.

The musical genre oratorio originated in Rome about 1600, with performances of religious cantatas at the oratory of St. Philip Neri, whence the name. The history of the English biblical oratorio can be dated to 1732, the premier date of Handel's **Esther.** Among that composer's other oratorios, few are as popular as **Judas Maccabeus,** and this Vanguard recording of highlights is a splendid version indeed.

Conductor Johannes Somary, whose precision and style we have enjoyed for many years in New York, where he is music director at the Church of Our Savior, leads an enthusiastic cast and the English Chamber Orchestra. Somary rightly emphasizes Handel's airy touches in this 1747 work. He keeps the Amor Artis Chorale and the Wandsworth School Boys' Choir stoutly in front of baritone John Shirley-Quirk in the finale *Rejoice, Oh Judah!* but modulates them for the soprano-alto duet with chorus, *Hail, Hail Judea, Happy Land!* And who could repress a smile at *Sound an alarm!* The trumpets fairly open up the celestial gates at music like this!

Heather Harper's soprano has a lilting, sustained quality in this recording that has not always been evident. *Wise Men, Flattering* is delivered with elegance and control—not easy, given the phrasing Handel and his librettist Thomas Morell indicated. Vanguard and Somary demonstrate good taste and a high degree of professional musical ethic in this and related discs. And the cutting has been done without warble, whoosh or scratch. The 18th century couldn't have had music reproduction, but if it had, how pleased Handel would have been with this!

Performance: A Sound: A

Classified

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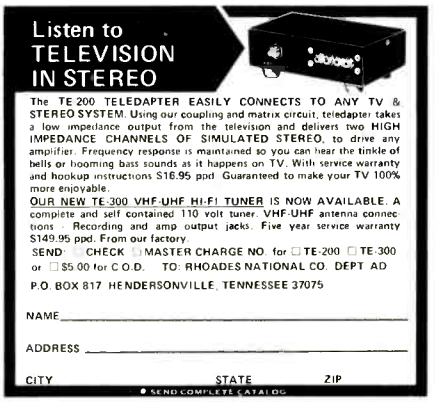

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for performance of home tape decks."

(Stereo Review, February, 1975)

Hirsch-Houck Laboratories further noted, "The dynamic range, distortion, flutter and frequency-response performance are so far beyond the limitations of conventional program material that its virtues can hardly be appreciated."

The frequency response of the TC-756-2 is rated at 30 to 30K ± 3 dB at 15 ips. Hirsch-Houck Laboratories said, "Although no claims are made for the TC-756-2 in this regard, it is the first machine we have seen whose frequency response should allow it to copy CD-4 discs in their encoded form."

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Ask any audio expert what makes a speaker good. If he's *Stereo Review's* Technical Editor, Larry Klein, he'll tell you, "A speaker should have no character or sound quality of its own . . . a speaker should be neutral." Or ask Julian Hirsch: ". . . uncolored sound is the only kind of speaker response that gives the listener a good chance of hearing a balanced sound."

If you listen to the experts, you'll look for neutrality in speakers. That's why you should listen to the T-200, Technics' 2-way speaker system. Hirsch-Houck Labs did: ". . . highs were virtually perfect . . . response of the woofer was notably smooth . . . difficult to believe that the sound is coming from an inexpensive compact system." *Popular Science* rated the T-200 "excellent . . . good tonal balance . . . very clean, accurate sound."

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For the complete reviews and other technical information, write: Mr. Jack Bloom, Panasonic, 1 Panasonic Way, Secaucus, N.J. 07094.

Technics also offers you the T-300 and T-500. The reviews aren't in yet, but since they share the neutrality and other important characteristics of the T-200 and T-400, we expect the experts to be equally enthusiastic.

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