

Audio

The
Authoritative
Magazine
About
High Fidelity

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OLDEST BOOK
ON AUDIO THEORY?



Crown's Self-Analyzing Power Amplifiers

INTERVIEW: KLH's von Recklinghausen



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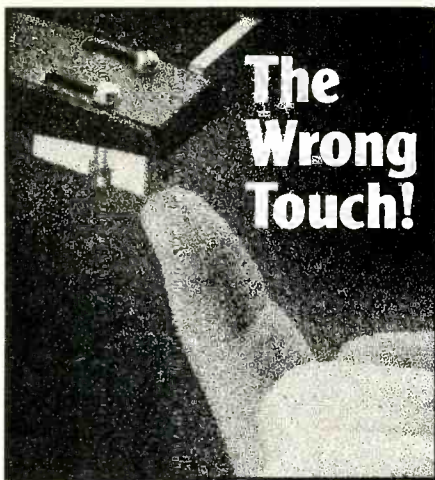
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February 1981

Vol. 65, No. 2

Audio

"Successor to **RADIO** Est. 1917"

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About the Cover: Getting the most out of a power amplifier takes as much time and effort as a body builder puts into winning a championship. Photo by Susanne Buckler; musculature by Derek Prescott; preamp by ADC, the model B-100.



Audio Publishing, Editorial and Advertising Production Offices,
1515 Broadway, New York, N.Y. 10036.
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LUX AMPLIFIERS ARE WHAT MAKES LUX CASSETTE DECKS BETTER.

Lux decks start with half a century of amplifier expertise because while the record and playback heads are the senses of a deck, the recording amplifier is the heart.

Only DC amplification provides low inherent distortion, wide dynamic bandwidth and the headroom to take advantage of metal tape. Then Lux adds the features essential for total performance.

Look at Lux's K-8 and K-15. Wherever possible, mechanical operations are replaced by electronics. Both decks have full IC logic controlled solenoid operation so any function, in any order, is a finger-stroke away.

Meters have been replaced by instant-response fluorescent peak level indicators with a special, 3dB added scale for metal tape. The electronic digital tape counter is precise, easy to read, and shows tape motion as well.

Bias and equalization settings are provided for all tapes, and variable bias control lets you add the final adjustment for your ears only. Other features include automatic play/rewind/repeat functions complete with memory. And Dolby® NR, of course.

Both units are exquisite examples of mechanical, electronic and human engineering in sleek, contemporary rosewood cabinets.

Sophistication ... and then some

Lux's K-15 goes even further, with DC playback amplification as well for even lower distortion. And, Dolby® HX, a new circuit

offering at least 10dB additional headroom in the record mode.

Dolby HX works with the Dolby NR circuitry, monitoring the signal being recorded. The HX system is automatic, continuous variation of bias and equalization in response to signal content, particularly at the high frequencies.

Tape saturation is reduced, and while Dolby NR gives you *less noise*, Dolby HX gives you *more signal*. The improvement is significant and very noticeable when played back on any machine with Dolby NR. Dolby HX works with any tape ... and makes it better.

Lux K-8: 2-heads; DC servo motor drive. Frequency response 20-20,000 Hz, metal tape. S/N ratio 65dB, metal tape, Dolby on. Wow & Flutter 0.055% WRMS.

Lux K-15: 3-heads; 2 DC servo motors; dual-capstan closed loop system. Frequency response 30-20,000 Hz (± 3 dB), metal tape; S/N ratio 69dB, metal tape, Dolby on. Wow & Flutter 0.04% WRMS.

Other exceptional decks in the Lux line range in price from \$299 to \$1935 and include the **5K50** professional deck with 3 heads, 3 motors and dual DC amplification; **K-12**, 2-head, 2-motor deck with dual DC amps; **K-5A** with 2 heads and Lux bridge motor drive; **K-1**, 2-head, servo motor drive. All are metal compatible and have Dolby NR.

The Lux cassette deck ... better because it's built with the Lux Amplifier.

*Dolby is a registered trademark of Dolby Laboratories.



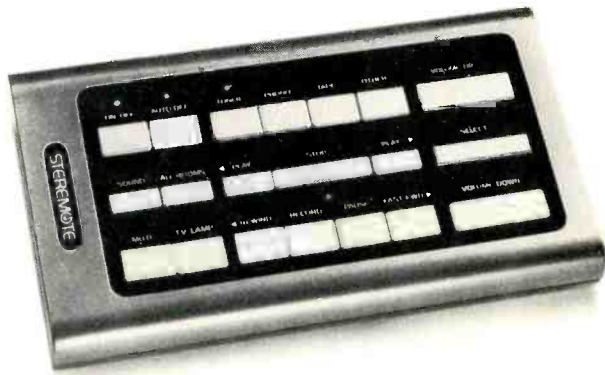
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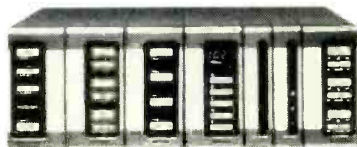
If your system is good enough for you, it's perfect for Steremote.

Your system may consist of just a receiver and turntable. Or it may include a cassette recorder, open reel, TV and video deck. By joining them with Steremote you'll be entertained in more ways than you've ever thought possible. One touch lets you play records, tapes, even change FM stations. You can also take in a video

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AUDIO (155N0004-752X) is published monthly by CBS Publications, The Consumer Publishing Division of CBS Inc., 1515 Broadway, New York, N.Y. 10036.

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54 Burton Court, London SW 3 5Y4, England.
Telephone, 01-730-3592

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Dewey Decimal Number 621.381 or 778.5

Editorial Contributions are welcomed but should be accompanied by return postage. Submissions will be handled with reasonable care, but the publisher assumes no responsibility for safety or return of manuscripts, photographs, or artwork.

Printed in U.S.A. at Columbus, Ohio. Controlled circulation postage paid at Columbus, Ohio and New York, N.Y.

U.S. Subscription Rates: 1 year \$13.94, 2 years \$22.94, 3 years \$29.94.

Other Countries: Add \$6.00 per year.

Back issues, when available, \$5.00 postpaid.

Audio Publishing, Editorial and Advertising Production offices, 1515 Broadway, New York, N.Y. 10036.
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TDK dual spring pressure pad and tape in cassette.

output in the high frequencies. The TDK pad is made from a special mix of organic fiber, cut to exact dimensions. Tape contact is always at an optimum, preventing high frequency dropouts and excess friction.

Having gone to such lengths for perfection, our engineers avoided one last slip up. The anchor. The TDK dual spring pressure pad is precisely positioned in an interlocking pin system. It can spring back and forth but never move laterally. The last threat to sound at that point was stray magnetism. TDK stopped that by placing an extra-thick metal shield behind the pad assembly. Now nothing can stand in the way of perfectly recorded music. You can see *Part Seven* and the other TDK parts perform through the shell of the classic TDK MA-R cassette. It set new standards in reliability and metal sound.

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TDK continues to set the standards with every cassette. In high, normal, and metal bias. In every type of machine. And it's all based on a simple philosophy. Perfection is the outcome of many elements interacting perfectly. TDK achieves a higher standard of musical performance for one unvarying reason. Music is the sum of its parts.



 **TDK**
The Amazing Music Machine.

The Sansui Super Feedforward System: The End of Distortion Disputes.

Super FF

For years, arguments over the causes, and even the significance, of distortion have been raging among engineers and audiophiles the world over: Is the low distortion class-A amp the only practical alternative to the class-B amp even though it is costly and woefully inefficient? Are the new crop of "non-switching" quasi-class-A amps the answer to the class struggle between A and B? Is TIM a legitimate, audible threat to musical accuracy and is this distortion as harmful as har-

monic distortion? Do high-speed devices really take care of switching distortion? And on and on.

At Sansui, with one bold engineering move, we've simply made all of these arguments academic. We've virtually eliminated all distortions. Not just TIM or switching distortion (the goals of many so-called "breakthrough" designs from other companies.) The method we have used is the Sansui Super Feedforward System. And the results are truly uncanny.

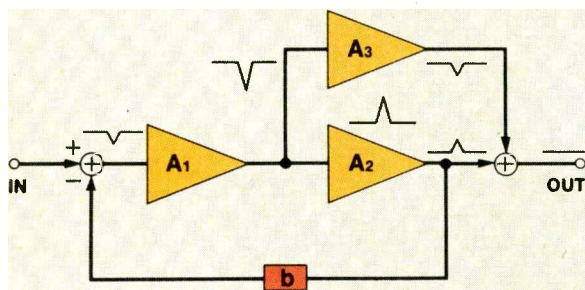
Sansui's revolutionary Super Feedforward System virtually eliminates all types of distortion.

The Sansui Super Feedforward System has eradicated all types of distortion. Gone are harmonic, intermodulation, crossover, switching, TIM (Transient Intermodulation) and envelope distortions. With them are gone other, unknown and not yet quantifiable types of distortion (TIM at one time was considered to be of this type). Switching and crossover distortion generated by the in-out switching operation of the power transistors is suppressed the moment it is generated. TIM distortion is not produced since the Super Feedforward System responds faithfully to the never-repeating, rapidly changing waveforms of real music. And the Super Feedforward System totally eliminates distortion at all frequencies, not just selected frequencies as a negative feedback circuit does. It suffers no instability or oscillation. But most importantly, it eliminates all distortion of both a static and transient nature.

Super Feedforward System: How does it work?

The feedforward circuit theory is not new. In fact it predates the negative feedback circuit that is found in nearly all audio amplifiers on the market today including direct-coupled and "non-switching" types. But feedforward had never been practically applied to an audio amplifier until now.

Fig. 1 Sansui Super Feedforward System



Sansui's Super Feedforward System is actually a hybrid of both negative feedback and feedforward, as conceptualized in Fig. 1. Distortion, generated by power amp stage A_2 , is returned to the input through the NFB loop (b) and added, out of phase, to amp stage A_1 . The out-of-phase distortion is

amplified by A_1 and added to A_2 . This effectively cancels most distortion. This is where the feedforward circuit comes into play. Like the NFB circuit, the feedforward circuit also uses out-of-phase distortion as an error-correction signal, but it bypasses power amp stage A_2 and sends the distortion component to error correction amp A_3 from which it is routed to the output of A_2 to cancel any distortion that may have been generated in A_2 and any distortion overlooked by the NFB loop.

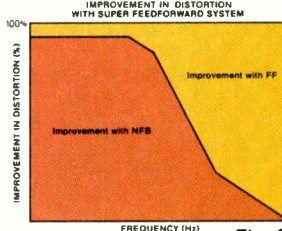
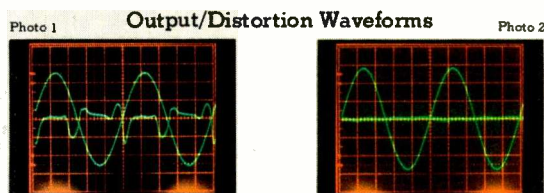


Fig. 2

The concept is simple but effectiveness is 100%, as Fig. 2 shows. In fact, the Super Feedforward System is so effective that it even eliminates artificially-injected distortion completely (Photo 2).



Even artificially-injected distortion (center trace in Photo 1) is eliminated; no distortion appears at output (Photo 2).

The AU-D11 and AU-D9 – the most perfect amps around

When presented at the Audio Engineering Society Conventions in Los Angeles and London, the logic of Sansui's Super Feedforward System was quickly perceived by the engineers in attendance.

And now the theory has become reality. In the AU-D11 and AU-D9, Sansui has added the Super Feedforward System to Sansui's highly acclaimed DD/DC design to create amplifiers that are virtually free of any kinds of distortion. Stated simply, whether you're a firm believer in the advantages of "non-switching" over "high-speed" amp technology, or vice-versa, you get all the advantages of both, with Sansui's new Super Feedforward System. You just can't go wrong.

Sansui continues to be the industry pacesetter in advanced technology. The name to remember is Sansui and the amps to hear are the AU-D11 and the AU-D9.



SANSUI ELECTRIC CO., LTD. 14-1 Izumi 2-chome, Sugunami-ku, Tokyo 168, Japan.

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Audio etc.

Edward Tatnall Canby

Late last fall I was down for two and a half bytes, going on three, with a most unpleasant disease called digitalis. Really stopped me cold. It is an infection of the bronchi, formerly known as bronchitis, but that was long ago. I knew I had it because it came over me within minutes of the close of Session E of the New York AES Convention, the one entitled Microprocessor Applications in Audio. My head at that point was already swimming and my tubes a'grumble, but I stopped outside to talk to Edgar Villchur (he designed the original line of AR speakers), who was comfortably ensconced on a couch. He opined that computers didn't much like him. And I could definitely sympathize.

Does anybody under 25 realize what it is like to be an important, even a distinguished senior audio engineer, trained in the old or pre-computer age and faced with this incredible new world — not merely the new physical technology of audio but, far more important, the new ways of *thinking*? Here is one of the biggest, fastest, most total revolutions in science since the beginning, as startling as the electrical revolution itself in its early phases — a “fluid” that defied all known physical laws — or even the flat earth grown round as a ball, an inconceivable idea, an unbelievable thought a few centuries further back. It's not “space age technology” that matters now. It is *space age thinking*, a wholly new language and never newer than in audio. If you are not easily fluent in these modes, your space age equipment might as well not exist, chips, bytes and all.

Compared to it, the changeover a generation back from vacuum tubes to

transistors was a mere nothing, though plenty of enthusiasts for build-it-yourself tube equipment gave up on the spot, as I well know. My neighbor can make any old tube radio or amp work in minutes, but he will not even look at a transistor. Nevertheless, the important engineers of the vacuum tube era, though they may have had to do a bit of heavy homework, mostly found the basic thinking of the transistor cir-

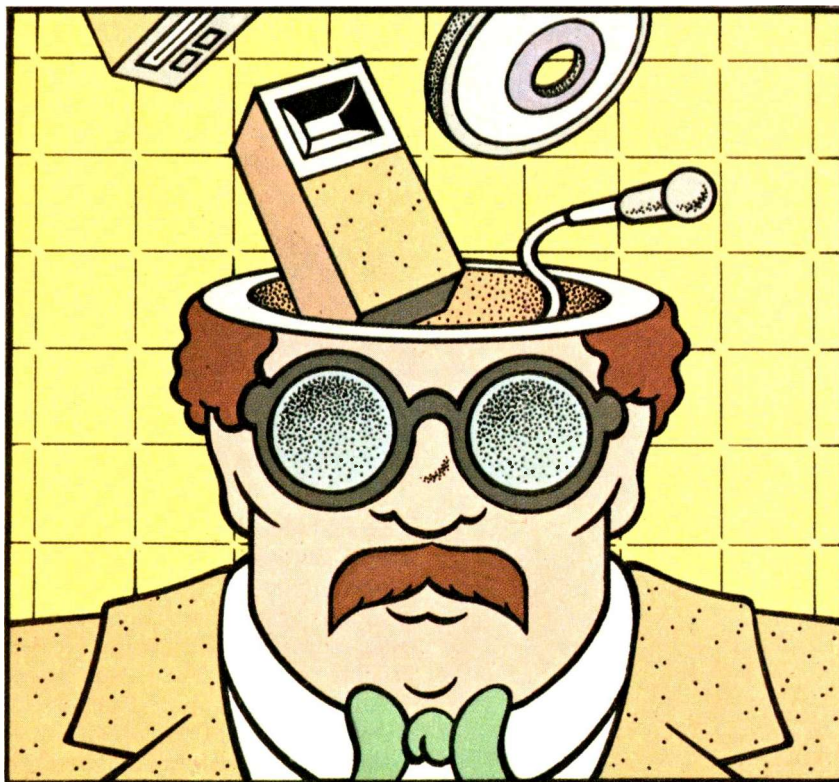
Now, one must learn to think anew, and to speak and to write. There is a new logic. AND/OR. NAND/NOR. There are dozens of new terms which represent new concepts, totally new to audio. Especially, there are the new miracles of “feedback” control (quotes are mine — the term is old-fashioned) and the incredibly ingenious redundancies of that increasingly major procedure, digital error correcting. It

seems to be basic to practically everything in audio that records (stores), plays back (reads) or transmits, whether by electrons — and holes — laser pits, magnetic domains or maybe plain old-fashioned incoherent light.

It is characteristic of such revolutions in thinking that youth instantly springs up and is fluent, whereas middle age struggles manfully and the elderly flounder. Or simply ignore. This last is a well-earned privilege for those who have spent lifetimes of work in our field.

But what of those who are in the midst, who have reached high places and were never more active? A brand-new language of engineering at age 40 or 50? One in a hundred takes to it like the proverbial fish — it can happen. The oldest full-time computer man I know, in charge of all operations for a major soap company, is, I figure, 54. He used to formulate soap. A chemist. The rest of us must struggle. It's like the immigrant older generation, which always speaks a new language with an accent.

There is one way to cope, of course, and that is to surround oneself with young assistants who are naturally fluent in the new language, complementing virtues of long-time practicality found in the senior engineer. The



cuit and the circuit board not enormously different from the old. The transistor was a sensation but it still did more or less the same things, including its basic role as a controllable electrical valve, as per the standard British term. The technology was radically new but not really the basic thinking. The engineer could pick up a lot of new terms, PNP, NPN and the like (and recognize relationships to the old), then relatively soon acquire the practical know-how to design and build important audio equipment, in spite of the startling disappearance of the entire body of vacuum tube technology that had been exclusive in all forms of audio for some half century.

Illustration: Leo Pando

The moving coil replacement from Stanton Magnetics... the revolutionary 980LZS!



Now from the company to whom the professionals look for setting standards in audio equipment comes a spectacular new cartridge concept. A low impedance pickup that offers all the advantages of a moving magnet cartridge without the disadvantages of the moving coil pickup. At the same time it offers exceedingly fast rise time—less than 10 micro seconds—resulting in dramatic new crispness in sound reproduction—a new “openness” surpassing that of even the best of moving coil designs. The 980LZS incorporates very low dynamic tip mass (0.2 mg.) with extremely high compliance for superb tracking. It tracks the most demanding of the new so called “test” digitally mastered and direct cut recordings with ease and smoothness at 1 gram $\pm \frac{1}{2}$ $\pm \frac{1}{4}$.

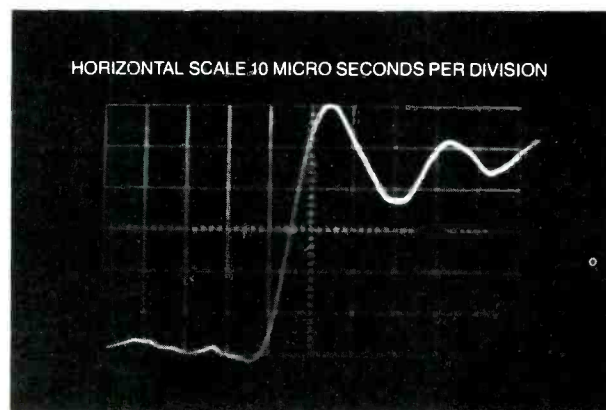
The 980LZS features the famous Stereohedron™ stylus and a lightweight samarium cobalt super magnet. The output can be connected either into the moving coil input of a modern receiver's preamps or can be used with a preamp, whose output is fed into the conventional phono input.

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the great sound characteristics of cleanliness and frequency response long associated with fine moving magnet assemblies.

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For further information write to: Stanton Magnetics, Terminal Drive, Plainview, N.Y. 11803.



Actual unretouched oscilloscope photograph showing rise time of 980LZS using CBS STR112 record.



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older man himself is unlikely to think as fast and as easily as his juniors, but if he is good, he can kibitz with them and get from them what is needed. Splendid things are coming out of this kind of teamwork right now, from those older engineers who are able to take advantage of opportunity in corporate and in human terms. A very workable "field" in the middle of the generation gap.

Anyhow . . . I was drawn to AES Session E by the very first item on the agenda, which struck me as astonishing. It was an account of a "recorder" or, rather, a simulation of a recorder, which was no recorder at all but simply a computer. "A microprocessor-based formatter and controller has been used to make this computer peripheral look like an audio tape recorder."

Now we all remember the Link Trainer for aircraft, around WW II, one of the first complete simulations of a plane in actual flight, and we have perhaps had painful experiences, as kids, with driver education simulators, a later refinement. There are now vast quantities of "models" set up for products that do not yet exist. In our own field, simulation is one of the more prominent techniques taken over by the computer and its methodology. It has enormous importance in loudspeaker design, again before the fact, before there is a speaker in hand, mainly because loudspeaker motion is so incredibly complex as to be unpredictable except by the hunch of genius. Elsewhere the same — everything gets simulated before it is built. That's what we mean now by engineering design.

But here we had something more. First, just a matter of detail. This simulating computer didn't actually look like any tape recorder. But it did what tape recorders do these days. Digital ones, of course. "The microprocessor effectively serves as a special-purpose [computer] operating system to interface user functions." Does it! The thing will go fast forward and rewind, it has play and record, just like the real recorders, though nothing of the sort actually occurs. Just a "model" simulation. Moreover, it accomplishes one of the toughest things in digital recording — it has built-in error correction. But the most unexpected feature, for me, was that this exalted simulation also has built-in digital editing.

Well, natch, if it's that kind of a computer it can insert and retrieve and open up spaces between, and so on. Routine. But if you have been following the progress of "real" digital editing on actual digital audio tapes, to the tune of many thousands of extra-

bucks (some small record companies just don't edit their digital), then you might have been unprepared, as I was, for this casual parameter. *Built-in editing!* Amazing, really.

But there was another shock and a titillation in store for me that really did it. Suddenly, halfway through the presentation, it dawned on me that this "simulation" was no mere model — it was an actual RECORDER. It flies, just like the real ones.

I got so involved at that point, I now can't read my own notes, but as I remember, the thing is a disc-type machine — NOT our audio discs but those utterly different ones with concentric circles of information and no spirals at all, magnetic heads to match, and "cylinders" — another new use of an old word — which, I gather, are the vertically stacked arrays of these circles, one above the other and coordinated. Beyond this, I dare not go but anyone can see that this is no audio disc recording system, digital or other. Not only does the machine simulate all the required functions of a tape recorder but it can "store" two LP sides' worth and more of super-high quality audio signal, correctible, editable, at any time, and playbackable — retrievable or readable, as you wish. So the thing IS a recorder. Ampex, are you listening?

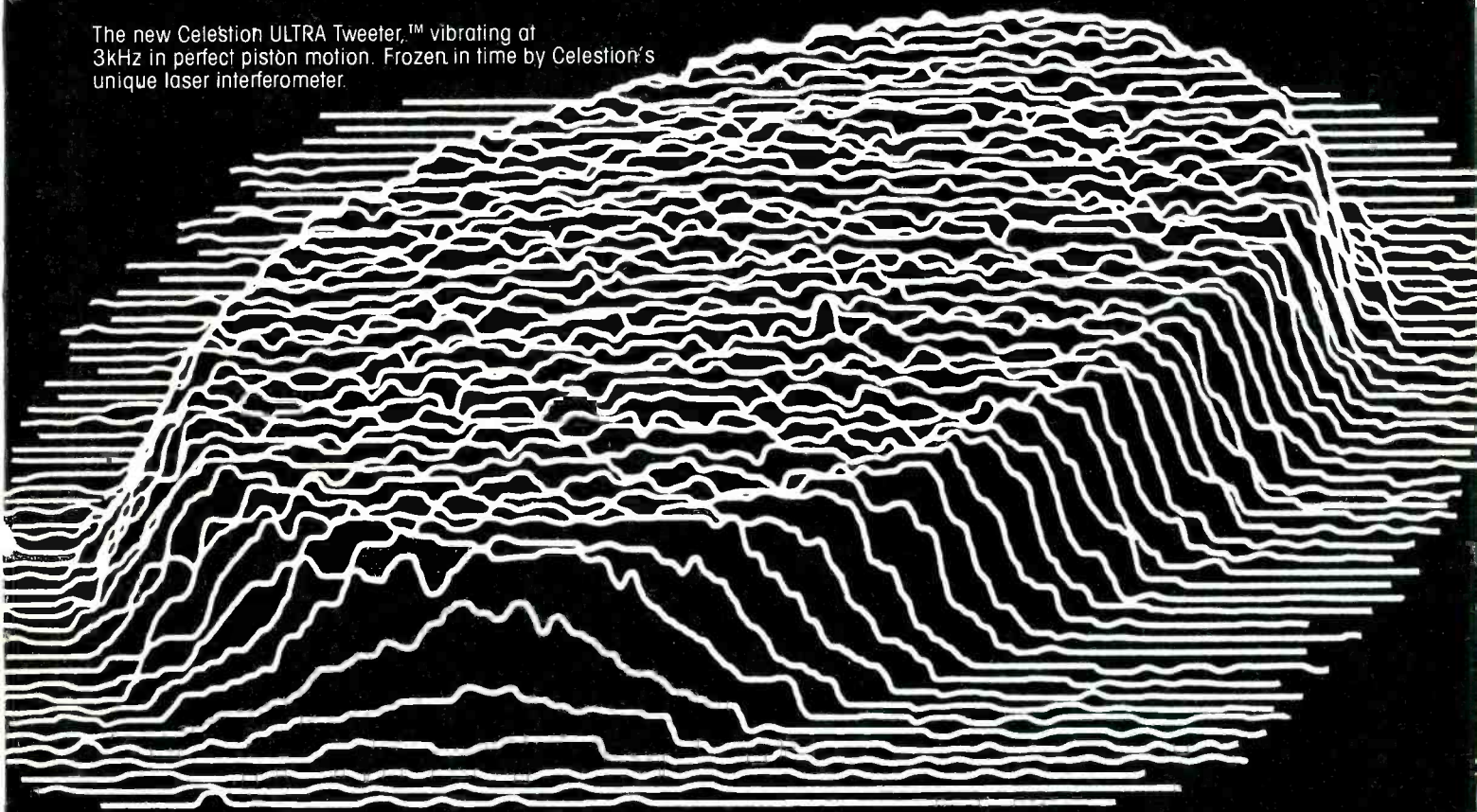
Then there was another one, E-7 (after which I left), a recording system called Alpha Syntauri: Keyboard-based digital Playing and Recording with a Microcomputer Interface. It works with Apple II (but, alas, not with the new Apple III). This was not exactly a recorder in the normal audio sense; it was much nearer to what we used to call a synthesizer. It produced a lot of computer-like noises as the operator played on the little keyboard, and when she stopped, which was often — did IT stop? Not a bit. It just went right on producing its little music.

This really had me confused; this wasn't record and playback, it was both at once and sort of indistinguishable. Definitely a new experience, though I did not think that Beethoven would roll over in his grave very soon. Tinkle, tinkle. But the extremely youthful audience was fascinated, even so.

I would guess that the average age of that audience was around 24, and that includes my own age, which tipped the scales noticeably upward, but let that pass. The lecturers were, by and large, maybe five years older, if that. I did detect a few senior and middle aged citizens, two of whom were sound asleep, also exactly two important audio faces of the older generation whose names I knew. I do not really believe that the rest of the hun-

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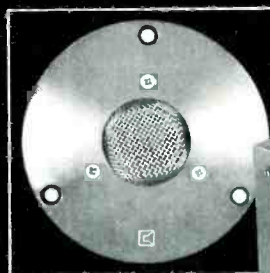
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dreds of AES engineers from age 40 up know all this stuff by heart. I was surprised that more weren't on hand. As they say, this is where the action is.

I skipped some of the other lectures — absolutely beyond my capabilities. But it was all of a sort. Microcomputer control of a wide array of audio functions, in the same style of approach. A Microcomputer Program for Transfer-Function Analysis: Magnitude, Phase, Angle and Group Delay. Simple: this BASIC program models audio filters or system functions — designs them, as I would put it. It also uses Apple II. Then there was Computer Remote Control of Audio-Processing Equipment. This uses the IEEE-488 Standard Interface, so we can make any old thing run remotely. Really basic, all right. There was another computer interface, EUBUS, for a cassette system — will they leave nothing alone?

I have to conclude with a side excursion on a favorite topic, showmanship. As an old-time show person myself, thousands of broadcasts, edited tapes, hundreds of live choral concerts (with spoken comment by ETC) and a few multimedia orgies, I always note the presentation technique — for every lecture is a show, if you mean maximum communication *at the moment*.

Richard Factor, the young fellow who chaired Session E, was excellent, easygoing, informal and informative, and his mike technique was impeccable — how I wish all audio people knew that little skill! They walk away and they mumble. Or they drop their lavaliers on the table, as one did this time. WHAM! Ouch! That remarkable Alpha-S mock-recorder that really records was presented by a very serious German (a substitute?) who proceeded to block his projected data for the entire time, so we had a splendid view of the left half of dozens of graphs and pictures. (When he turned to the screen, the shadow went away.) Silly mistake. There was a ten-minute break before the Alpha-Syntauri team went into action (see above) and emcee Factor explained that there was a li'l trouble with the machinery. After that, we reassembled to find the jolliest total chaos you've ever seen and heard. TV monitors all over the room, showing fancy colored bars — but no sound. Then a variety of squawks and grunts and blasts, and the TV suddenly went dead as the sound came on. TV back again but instead of bars it began to grow monstrous mushrooms, bushels of them. More mushrooms — then suddenly, bars again but with ghosts

to the right. Much banter back and forth among the operators, front and rear — the action seemed to be at both ends of the room. TV off, sound on. TV on, sound out. Suddenly, CLEAR TV and the audience almost shouted. It was fun! After 25 minutes we got underway, and nobody minded a bit.

You lecturers, (a) get things RIGHT beforehand and (b) when the gremlins strike, don't panic! Just be affable. It's not easy, but it helps. I tip my ancient hat to Richard Factor and his team.

Main lecturer for this Alpha Syntauri was Ellen V.B. Lapham, age not stated. Ellen was excellent. She got over a maximum of info in spite of all the electronic casualties en route and I felt rewarded. But when she brought on her friend Laurie Spiegel to help with some of the musico-computer aspects, I groaned. Laurie is a respected figure in this new music and she was to be the final lecturer. She was nice, friendly, but all butts, ifs, ers, and no mike technique. I couldn't get a word she said or make any sense, as I had with Ellen. So, regretfully, I skipped Laurie's lecture on Macro Music from Micros, which looked to be quite important, and went home to nurse my blossoming digitalis. A

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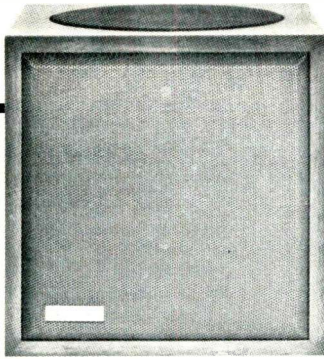
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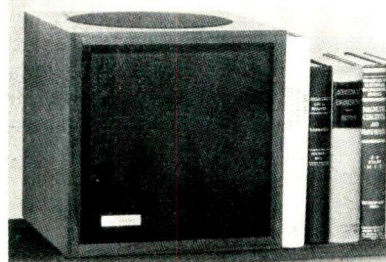
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**Revue du Son*, No. 32 (November, 1979)



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Joseph Giovanelli

Channel Separation Of Phono Cartridges

Q. Because I have been a professional musician for 25 years, I am sensitive to acoustic properties. Hence, I find it necessary to periodically upgrade my music system.

Upgrading a system can be a series of pleasurable experiences. The limiting factor in this upgrading process, however, seems to be the relatively low channel separation in phonograph cartridges. — George Edmond, Jr., Montclair, N.J.

A. I do not think that you should be overly concerned with stereo channel separation in phonograph cartridges, or in other components for that matter. It has been proven that most listeners cannot detect any improvement in stereo imaging with channel separations greater than 12 dB. Certainly 20 to 30 dB of channel separation should not cause any degradation of stereo imaging to even the most discerning listener.

Inasmuch as you are a musician, I am sure you have noticed that sounds which are heard by one ear are, to some extent, heard by the other one. The musicians in a combo or band are just too close to one another to have it any other way.

You can see from this simple example that channel separation in a live situation is not great; even so, the stereo effect is present, enhancing your enjoyment while you are playing.

The rather close spacing between our ears is yet another example of the fact that channel separation is not as important as one might think.

Further Notes on Multiple Speaker Systems

Q. I have had trouble obtaining multi-strand wire larger than 16-gauge, needed because I have 60 to 70 foot cable runs. Is single-strand wire just as good?

Is this a case where very high amplifier damping could be a help?

Aside from damping, is there any loss of speaker quality by connecting speakers in series? — James Smith, West Palm Beach, Fla.

A. Single-strand wire will work just as well as the multi-strand wire will. It is, however, more difficult to handle — especially when attempting to con-

nect it directly to the amplifier or to the loudspeaker terminals. It may be necessary, therefore, to splice a short length of multi-strand wire to this single, main cable. Because this stranded wire is only a short length, 16-gauge wire may be used with no degradation in performance.

Many electrical stores will sell No. 14 gauge stranded wire in the form of zip cord. It is often possible to connect such wire directly to the terminals of loudspeakers and amplifiers. If even heavier gauge wire is required, No. 12 or even No. 16 gauge solid wire can be used. As has been said, however, a short length of cable must be added to this so that the cable can be successfully connected to the terminals of the equipment.

High amounts of amplifier damping will be of little help in situations of the kind we are discussing. The d.c. resistance of the interconnecting cable, the voice-coils of the individual speakers, and of the crossover inductors will be so high as to prevent the damping in the power amplifier from having very much effect.

The decreased damping created by the hookup of loudspeakers in series can, with some loudspeaker systems, produce bass which is not "tight." In addition, the speaker cones can make very wide excursions in the presence of turntable rumble or acoustic feedback. It may be best, therefore, to use a subsonic filter when using series-connected loudspeakers.

Other than those sonic changes from reduced damping, there should be no other audible effects because of the series-parallel speaker connections we have discussed.

Equalizers and Tone Controls

Q. When an equalizer is connected to a receiver, do the tone controls on the receiver still operate? — John Kogler, New York, N.Y.

A. We generally interpose an equalizer between the tape out jacks and the tape monitor jacks. Therefore, just as the tone control still operates when

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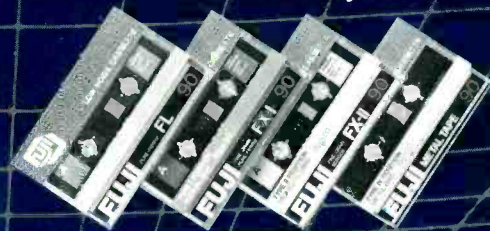
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a tape machine is wired into these jacks, it also works when an equalizer is used. An amplifier does not have any way of knowing whether its program source is being supplied by an equalizer, dynamic range expander, or tape machine. Therefore, all controls will operate normally regardless of what is connected to their tape monitor circuits.

Explain Your Principles, Mr. Speaker

Q. I'm interested in an explanation of how the different types of

loudspeakers function: Cone speakers, panels, electrostatics and dome and horn-types —Carl Joachim, Brooklyn, N.Y.

A. Most speakers, whether dome, panel or cone, work in the same way, employing a voice-coil which is fed by a program source and positioned in a magnetic field. The coil is alternately attracted or repelled by this magnetic field depending on the instantaneous polarity of the voltage of the program source. The amplitude of that voltage will determine the amount of attraction or repulsion. Because this voice-

coil is attached to some kind of diaphragm, dome-shaped, cone-shaped or just a flat panel, the diaphragm must move because it is driven by the moving voice-coil. The moving diaphragm is in contact with the surrounding air, causing it, in turn, to move — thereby generating sound waves.

When ceramic material is flexed, a voltage appears across its two faces. This principle serves as the basis for the well-known ceramic phonograph pickup and for ceramic microphones. When a voltage is impressed across the two faces of a ceramic element, the element flexes. If this flexing element is attached to a diaphragm, the result is a speaker or perhaps a headphone. Speakers operating with this principle have been used mainly as tweeter elements, especially in equipment used by musicians for live performances. The flexing of ceramic material in the presence of voltage is known as the piezoelectric effect.

The principles upon which electrostatic speakers operate are based on phenomena which we notice almost daily but think little about. To illustrate: Run a comb through your hair on a cold, dry day. The comb can take on an electrical charge which will enable it to attract small pieces of paper and the like. This same idea is the basis of operation of electrostatic speakers. The "comb" on an electrostatic speaker is actually a plate with holes in it. High voltage is impressed on this plate, which serves to attract a very thin, light diaphragm. This high voltage, however, is designed so that it will vary in accordance with the signal feeding the device. This means that the attraction of the diaphragm will vary, enabling the diaphragm to be pulled toward or away from the plate.

This is an oversimplification of the principle. Actually, there are two charged plates, with the diaphragm suspended between them. The design of the system is such that the plates are alternately charged, but in such a manner that one plate tends to repel the diaphragm while the other one attracts it. When the polarity of the voltage reverses, the plate which once attracted the diaphragm now repels it, and the plate which once repelled the diaphragm now attracts it. This balanced approach makes for symmetrical behavior of the system.

The horn system consists of a driver coupled into the narrow opening of a horn. (This driver is generally a conventional, cone-type loudspeaker.) The horn serves as a means of coupling the cone motion to the surrounding air in a more efficient manner. The horn does not contain any electrical components.

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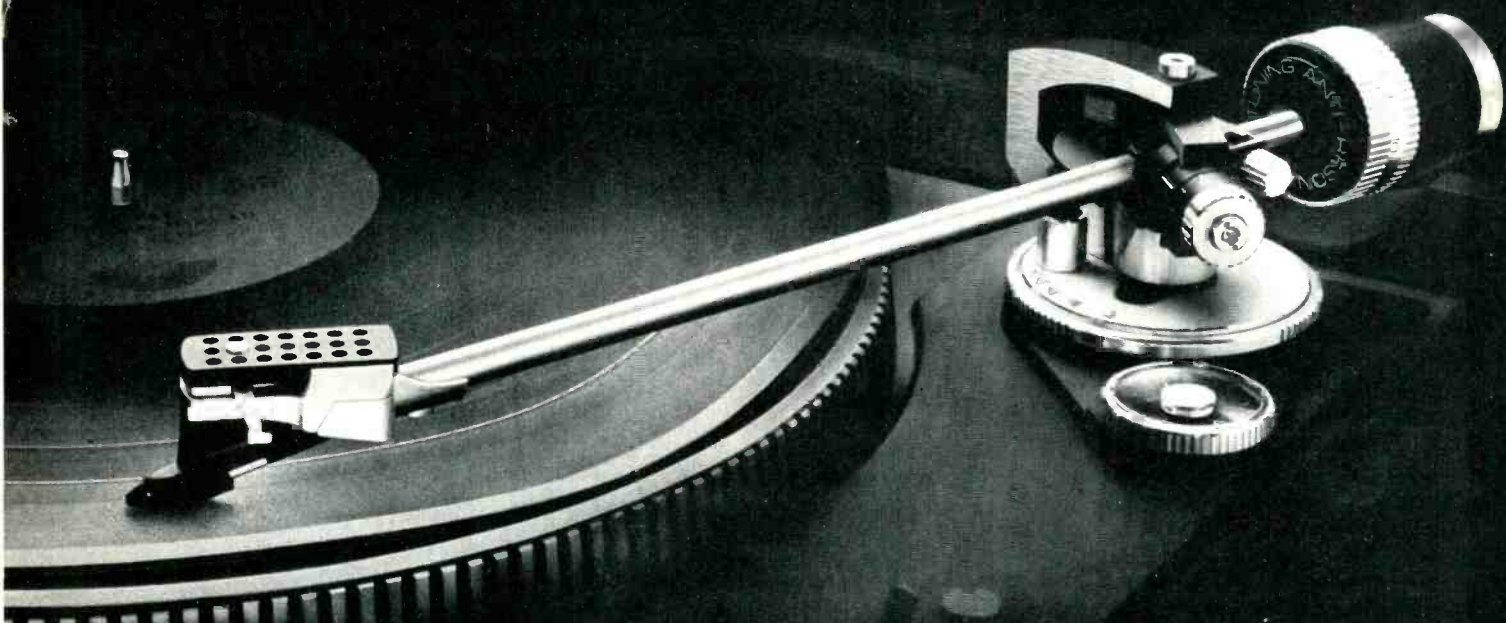
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Janszen. He then begat—not necessarily in correct sequence—the KLH Model 9, the Acoustech units, and he has recently gotten involved with Dennesen. All this history aside, one major problem with electrostatic loudspeakers is that in order to get reasonable efficiency, you have to operate the speaker very close to the breakdown field intensity that exists in air. In the process, too, you become a dust collector. When the air is not terribly clean, as in New York City, you have to periodically send your speakers out for professional cleaning.

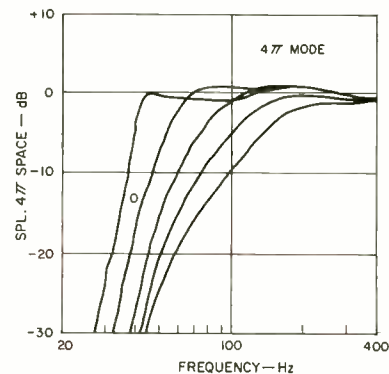
Audio: What about if you place them in an envelope of high-dielectric strength gas, like Dayton-Wright in Canada has done?

DvR's Latest: The Analog Bass Computer

Daniel von Recklinghausen's most recent major technical project was the KLH series of Computer Controlled Loudspeakers, introduced at the June, 1979 Consumer Electronics Show. They are interesting not only on purely technical grounds, but also for the intriguingly different assumptions used as the basis of their design, and for their significance to KLH in the marketing context. Plagued by heightened competitiveness from European and Japanese loudspeaker makers, KLH has suffered from anemic sales throughout the '70s; the Computer Controlled Speaker concept is their long-researched effort to re-establish a strong position in the loudspeaker field.

Detailed in a paper presented by von Recklinghausen at the 65th Audio Engineering Society Convention (available as Preprint 1617 from the Society), the Analog Bass Computer concept is comprised of three basic elements: A variable gain equalizer with equalization slopes that are also dynamically variable, a threshold circuit to determine the levels at which gain and slopes are altered, and a transducer analog circuit that examines the power amplifier signal returning from the loudspeaker for evidence of thermal overload or mechanical fatigue. The analog bass computer is in essence, therefore, an equalizer that changes its equalization curve continuously over a wide range of levels to protect the loudspeaker from damage that might result if a simple bass-boost circuit were used. The loudspeakers themselves — there are three units in the series — are vented designs developed in accordance with the now-classic Thiele/Small speaker alignments (see "A.N. Thiele: Sage of Vented Speakers" by Ray J. Newman, *Audio*, Aug., 1975, p. 30). But while Richard Small's elaboration of Thiele's

"speakers as filters" thesis discusses system types where bass boost and system roll-off are achieved with a relatively simple electrical equalizer, von Recklinghausen's version uses a dynamic equalizer that changes parameters as it goes along — altering the amount of bass boost by more than 30 dB, depending on signal level, and removing the bass boost entirely during very high-level passages. As shown in the family of curves, which apply to the smallest system in the series, the speaker's -3 dB limit may be as low as 40 Hz at moderate signal levels or may be as high as 160 Hz at peak levels.



The big question, of course, is whether a loudspeaker that uses dynamic compression of the bass signal to protect itself and to reduce low-frequency distortion is going to sound realistic playing back wide-range musical material. KLH President Denis Wratten notes that "I would rather listen to some subtle alteration of the deep-bass dynamics than hear the speaker choke up completely on high-level bass passages." Many speaker designers agree that this is the way to build a truly wideband small speaker, though the proof is naturally in the listening; meanwhile, DvR is at work on new projects. G.S.

The speakers make the difference.

"Do Amplifiers Really Sound Different?" With this article, Peter Moncrief, physicist, audiophile and editor of **International Audio Review**, entered what he called "the great amplifier debate." Mr. Moncrief's answer was an unqualified "yes." Ian G. Masters, of **Audio Scene Canada** magazine, explored the same subject and came to substantially different conclusions. The intensity of the debate suggests that the differences — if any — are small.

No such debate rages with respect to loudspeakers. Critics agree: **"Speakers do make a**

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DvR: It's a reasonable approach. In fact, it's an approach that dates back to Van der Graaf and his electrostatic accelerators. But it's also expensive and prone to leakage. Not exactly a broad-appeal consumer item.

Audio: What about piezoelectric plastics in large-sheet form?

DvR: Piezoelectric plastics in large-sheet form work on basically the same principle as ceramics. Due to the internal electric field of the material, and the externally applied electrical field of the signal from the amplifier, one

side of the piezoelectric material expands while the other one contracts, causing the whole surface to bend. That bending is used in a sort of secondary way as a sound transducer. The approach has virtues. Where it lacks virtue is in its necessity to convert this bending motion—really a form of flapping—into a uniform acoustic output. You end up with a transducer that in its most practical form is perhaps a cylinder. And, as a cylinder, you end up with a transducer that does not radiate uniformly over its circumference.


You must support the piezoelectric sheet in some way, and the supports do not move.

Audio: What about other variations on the flat-sheet principle?

DvR: There are moving conductors, ribbons; there are flat sheets with conductors zigzagging across their backs. For both, you need substantial and expensive supporting magnet structures. Another practical point here relates to the scientific law prescribing that current, direction of motion, and direction of magnetic force in a magnetic transducer of any kind are all mutually perpendicular. Now your motion should be in and out, which means that both the motion and the electrical current flow must be within the plane of the radiating surface. Then you must create a magnetic field perpendicular to those two, and here is where the difficulties come. It's very hard to get a high-intensity magnetic field in this plane, because you are really trying to create sound with the stray energy in an air gap. The larger your air gap, the more losses and the lower the intensity you have. Result: An extremely expensive and inefficient magnetic system, no matter what you do.

You can put the radiating surface between two magnetic structures and operate it as a push-pull device. But you also have a cage of some kind in front of the radiating surface—a cavity resonator—and this will affect frequency response. You may be able to use these resonances positively, for instance, to augment the very high frequency output by placing the cavity resonances in the high frequencies, but they remain resonances and therefore a source of coloration.

Audio: If you had to predict future trends in speaker design over the next ten years, what would you project as the most promising approaches? Do you, for instance, see integration of the loudspeaker and the amplifier being a natural approach in the '80s, as a great many engineers do?

DvR: Integration is one thing that will look good. The use of more reproducible materials as radiating surfaces is another clear trend—away from paper and other fibers and into plastics—whose time is coming. We've seen the light here at KLH, and others will as well, eventually. Paper cones, as used in speakers, have the undeniable advantage of having a very low velocity of sound in the material, coupled with a reasonable amount of mechanical damping. But cones are just paper fibers, and anything that involves fibers always involves some black magic, as well as some degree of inconsistency from one cone to the next. 

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\$260.00 per pair



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High freq. dispersion control	Rotatable rectangular plate with control, mounted in front of fixed tweeter.	Rotatable Vari-Axis™ tweeter with five-position detented control.
Bass enclos. volume	929 cubic inches.	1210 cubic inches.
Bass loading	Single ducted port directly under tweeter.	Twin-ducted port positioned on opposite sides of woofer.
Cabinet panel thickness	1/2" throughout.	1" front panel; 3/4" sides and rear; 1/2" tweeter compartment.
Dimensions	17"W x 10 9/16"H x 9 5/16"D.	21 15/16"W x 12 5/8"H x 9 9/16"D.
Weight	15 1/2 lbs.	24 1/4 lbs.
Warranty	5 years (full).	10 years (full).
Mfr's sugg. list	\$260.00 per pair.	\$299.00 per pair.*

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Complete FRM-3ax specifications are available in Micro-Acoustics literature No. L-1114.

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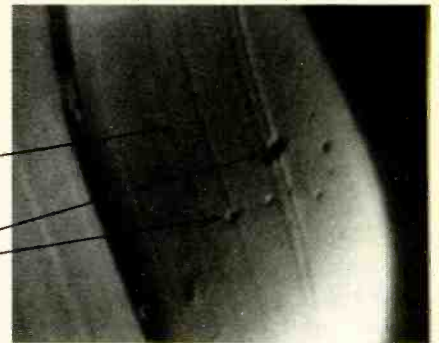


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Research and Resources Manager
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One of the major problems of solid-state amplifier design has been the protection of the power-handling output semiconductors. Amplifier output stages generally experience the greatest stress of any part of the design and at the same time represent the section of the amplifier most likely to employ new semiconductor technology or new design ideas. This combination of stress and relatively new hardware has produced more than one product that performed faultlessly on the test bench but defaulted in regular use. This has been especially true in the professional sound market where the performance demands are sustained at a higher level and operat-

ing conditions are less forgiving of any design shortcoming.

The last ten years have seen various designs intended to solve the fundamental problem, excessive localized heat in the output transistors. This leads to a regenerative destruction mechanism known as second-breakdown. Power transistors have been placed in parallel or in series to spread the dissipation over more devices, and various forms of voltage and current limiting have been added to the mix to limit the possibility of damage. In some cases, all protection attempts have been abandoned except for relatively slow and indiscriminate circuit breakers or fuses. The idea was to save cost and reduce distortion resulting from operation of limiting circuits. An analogy might be drawn between this approach and that of selling a car with no brakes because of the expense and waste of energy that results from an adequate braking system.

The function of the protection system is to prevent total distortion, that is, amplifier failure. The most popular design is the V-I (voltage-current) limiter and its many variants. Such a design is shown in Fig. 1. In order to understand the kinds of problems faced by designers, it is worth a look at the V-I limiter to understand its strengths and weaknesses.

Such limiters were first developed to protect series-regulator power supplies and soon thereafter were used in amplifiers. They all use the resulting summation of a signal proportional to V_{ce} (the output transistors' collector-to-emitter voltage) and a signal proportional to I_c (the output transistors' collector current) to limit the drive signal to the output devices. Either signal may be constructed with a nonlinear network, such as a resistor-diode network, to improve the fit of the allowed locus of stress to the transistor ratings as revealed by a safe-operating-area or SOA plot. Such an SOA plot is shown in Fig. 2 for a single transistor of the type being considered.

As shown, the SOA is valid only for a rectangular pulse of the noted duration and if the case temperature is held at a constant 25 degrees centigrade. A typical protection area for the circuit of Fig. 1 is drawn in dotted lines in Fig. 2. Since it is unlikely that a heat sink can be devised that will maintain the case temperature at 25 degrees under all conditions, it is generally decided to derate the limiter design. The derating process takes into consideration the maximum possible case temperature as bounded by a thermally activated cutout switch. Since the indicated circuit does not respond directly to V_{ce} but rather indirectly by assuming a nominal supply voltage (not necessarily disregarding regulation), it will also be necessary to consider maximum line voltage effects when choosing the derating for the limiter design. (The latter effect may be eliminated by using a different V_{ce} sensing network and/or altering the control topology of the circuit, but the possibility is not shown in Fig. 1, which is the most typical circuit.)

The circuit also does not fully appreciate the history of the signal and, as such, cannot take advantage of the shorter time interval pulse boundaries of the SOA surface shown as a family of curves in Fig. 2. This constitutes the greatest deficiency of the V-I limiter because it does not allow the maximum possible output from the output devices at all times. If the V-I limiter is designed around one of the shorter-time interval boundaries, the amplifier will surely fail in use since long time interval stresses routinely occur when overload or low-frequency inputs are present. The use of transformer or auto-transformer coupling to loads can exacerbate such trouble, as can ultrasonic system oscillations.

The typical extension made to the V-I limiter involves the use of a capacitor as a simple lowpass filter of the signal which controls the limiter. C_1 of Fig. 1 is such a capacitor. This presumes that the thermal circuit of the output devices can be modeled as a single RC circuit, as is shown in many elementary texts on semiconductor device heat sinking. A little examination of real-world data quickly reveals this assumption to be false. Figure 3 is a curve showing the relation of thermal resistance to pulse length for the case of a rectangular pulse of power. The plot of a simple RC network is shown (dotted line) for comparison. The more proper electrical circuit for simulation of thermal impedance would be

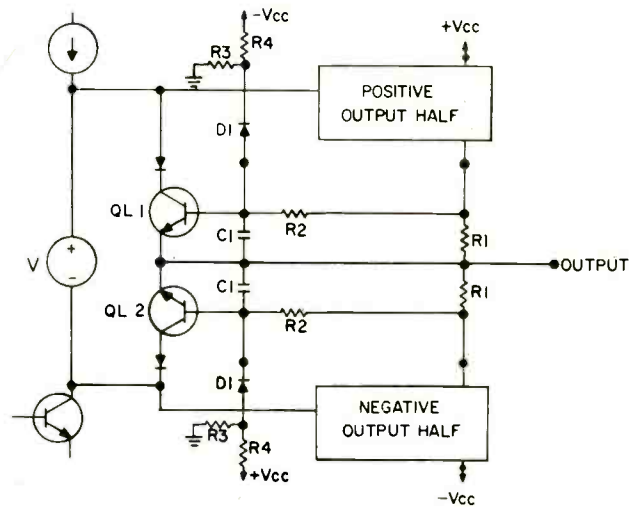


Fig. 1 — Typical V-I limiter circuit.

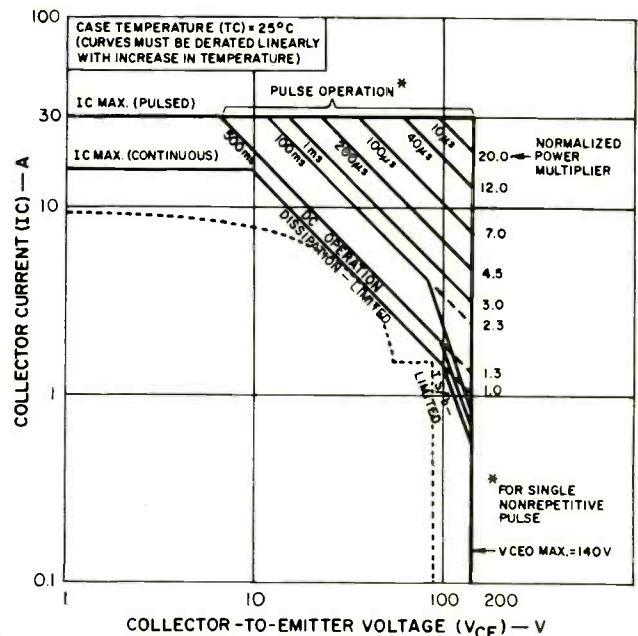


Fig. 2 — A typical SOA plot.

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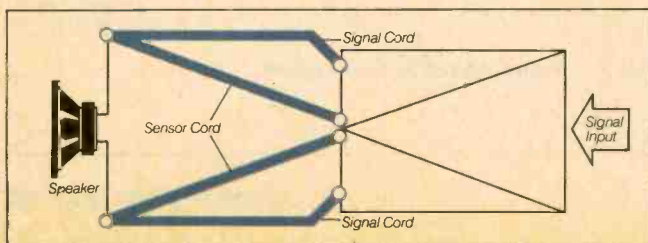
volume control that increases to any preset volume level or fades to silence.

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either an RC low-pass ladder network or its series RC equivalent as shown in Figs. 4A and 4B respectively.

The use of C1 also assumes that the control signal charging C1 is a signal representative of the power stress on the semiconductor device which is, of course, a function not of the sums of voltage and current but the product of voltage and current. The control signal, if properly constructed, must incorporate a multiplier!

In essence, if a protection circuit is to allow a maximum of instantaneous unlimited output (certainly of critical importance when music signals make up the primary signal source), it must take into consideration the complexities of the actual time-temperature behavior of the semiconductor junction. While the V-I limiter may be further elaborated to increase its conformity to these goals, it is cumbersome at best to proceed along these lines. As an additional consideration, temperature dependence of the heat sink must also be fully integrated with the circuit function, if the last safely available output watt is to be obtained. A worthy objective from many a user's point of view would be to eliminate total shut-down in the case of high sink temperatures, in favor of automatically derated output.

Assuming that semiconductor devices are available for use that are not prematurely derated by high voltage to values of power dissipation less than those obtainable at low values of V_{ce} , an ideal protection system might appear as diagrammed in Fig. 5.

The topologies of some output stages are shown in Figs. 6A-6C. Figure 6A is the most common, the "totem-pole" output stage. Figure 6B is the full bridge which is used in high-reliability very-high-power designs, such as our Crown Model M-600. Resembling 6A, Fig. 6C is a variant of the totem-pole which is proposed for reasons which will become obvious. The relationship of 6C to 6B is that it constitutes the "lower-half" (left-hand side in 6B) of the full bridge as opposed to the "upper-half" (right-hand side in 6B) that constitutes Fig. 6A.

Two protection systems (per channel) must be fabricated in an actual power amplifier since there is a minimum of two such power stages that require protection. This poses some practical problems regarding complexity which can not only make the cost prohibitive but may also damage the unit's reliability due to the greatly increased parts count. If this system were deployed in the typical design, it would most readily be done by sensing the output current common to the output terminal of the topology shown in Fig. 6A. This would require the addition of supplies common to the output terminal if we wish to allow the use of IC op-amps in the construction of the protection systems.

Since the control of the output stage may be accomplished by low-voltage drive circuitry which is common to ground, the topology of Fig. 6C is much to be desired for the implementation of the desired protection system. As such, not only may the same supplies that drive the voltage amplifiers be used to power the protection circuitry, but also the circuitry may be easily observed for trouble-shooting and the high-voltage output circuitry may be driven by low-voltage drive amplifiers. In what may come as a surprising result, the nature of the output open-loop impedance and gain is not materially altered by this change since both topologies are

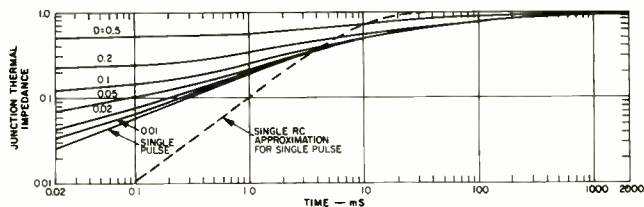


Fig. 3 — Junction thermal impedance vs. time.

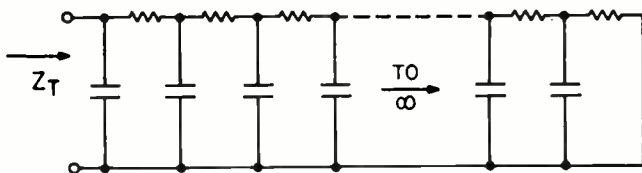


Fig. 4A — Electrical analog of thermal impedance.

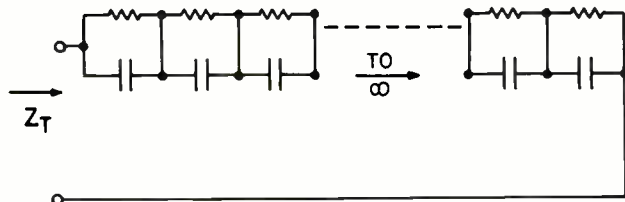


Fig. 4B — Series RC equivalent of 4A.

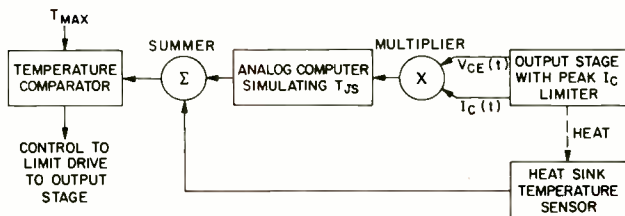


Fig. 5 — Proposed protection system.



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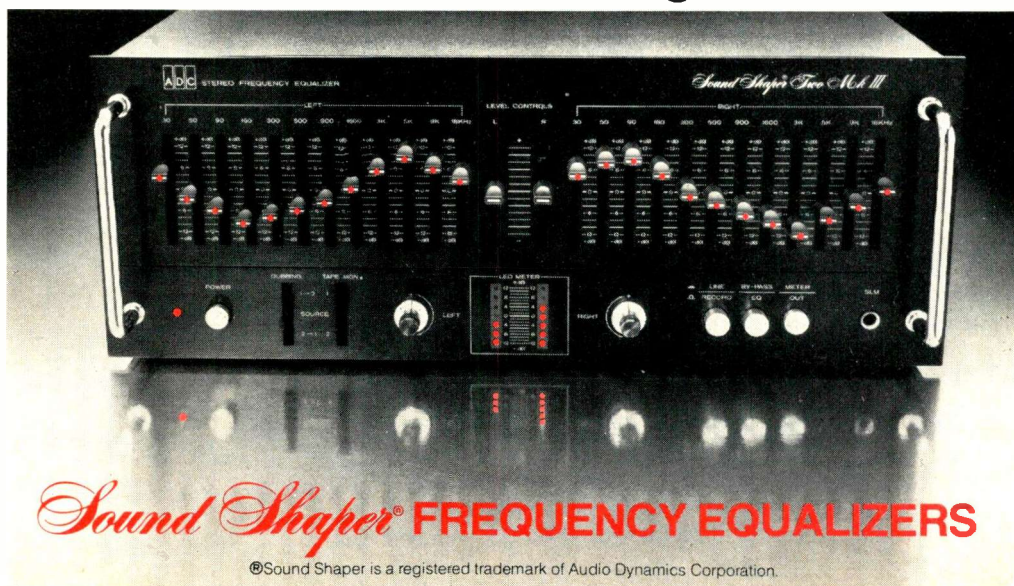
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typically driven by a current source and degenerated by an input capacitance which connects the output stage input to the d.c. supplies of the output stages. The construction of a special set of low-voltage common-to-ground supplies for the controlling circuitry is also useful when the addition of signal-processing add-on accessories are required.

The fact that the main power supplies cannot be common in a two-channel amplifier using the output circuit of Fig. 6C does not pose a serious problem. In an amplifier large enough for such a protective system to offer cost benefits, the weight of the power supply should be well distributed, and in fact the use of two main power transformers is cost effective in terms of chassis structure costs.

The design of the junction-temperature-simulation protection circuitry poses major problems, primarily in acquiring device thermal parameters which are not found on data sheets. To make matters worse, it is not enough to have typical data since the worst case must be covered. Ideally one could calculate the thermal impedance vs. time from a few physical device parameters. This proves to be easier said than done, for variables such as imperfect conformity between device package and mounting surface are not readily analyzed.

The method used to observe the needed thermal characteristics called for observation of the temperature dependent voltage (V_{cb}) of the forward-biased collector-base junction during the cool-down phase following the application of a controlled pulse of power. The heat sink used was fully and accurately represented with all associated heat sources and temperature sensors exactly as they were to be deployed in the final amplifier. The use of the cool-down phase, rather than the heat-up phase, for analysis is dictated by the practical constraints of data availability. Cool-down is equivalent to the input of a step of negative power.

The capabilities for thermal analysis were incorporated into a third-generation nondestructive power transistor SOA analyzer, which upon command will produce the needed power stimulus and cool-down temperature data. Such a custom analyzer was developed after considerable experience in using units of earlier design for 100 percent quality control testing of all output devices used in our amplifiers.

The temperature data must be gathered over a large range of time intervals with rapid sampling being required immediately at the close of the power cycle, and infrequent sampling being required after a number of seconds have elapsed. The use of sampling intervals that are nearly uniformly spaced on a logarithmic time scale represents a reasonable tactic for optimizing the amount of data needed to characterize a given transistor. Such a data gathering strategy requires the use of a computer-driven data acquisition system if the data is to be gathered in one pass. Since a large number of transistors is to be tested, this is mandatory.

The heat-sink temperature vs. time is also digitized and used to deduce the thermal circuit that lies between the heat-sink temperature sensor and the transistor junctions by differencing the junction and sink temperatures. The analyzer auto-zeroed itself at the start of each test to remove device-to-device differences in the 25-degree value of V_{cb} .

The data gathered from each device was captured in records in the computer's disc data files for reduction at a later

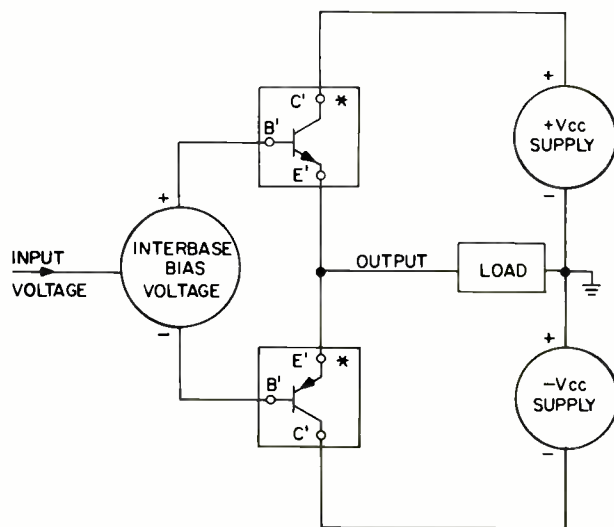


Fig. 6A — Totem pole output stage.

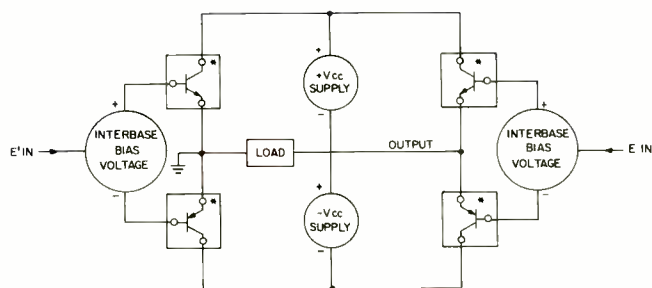


Fig. 6B — Full bridge output stage, as in Crown M-600.

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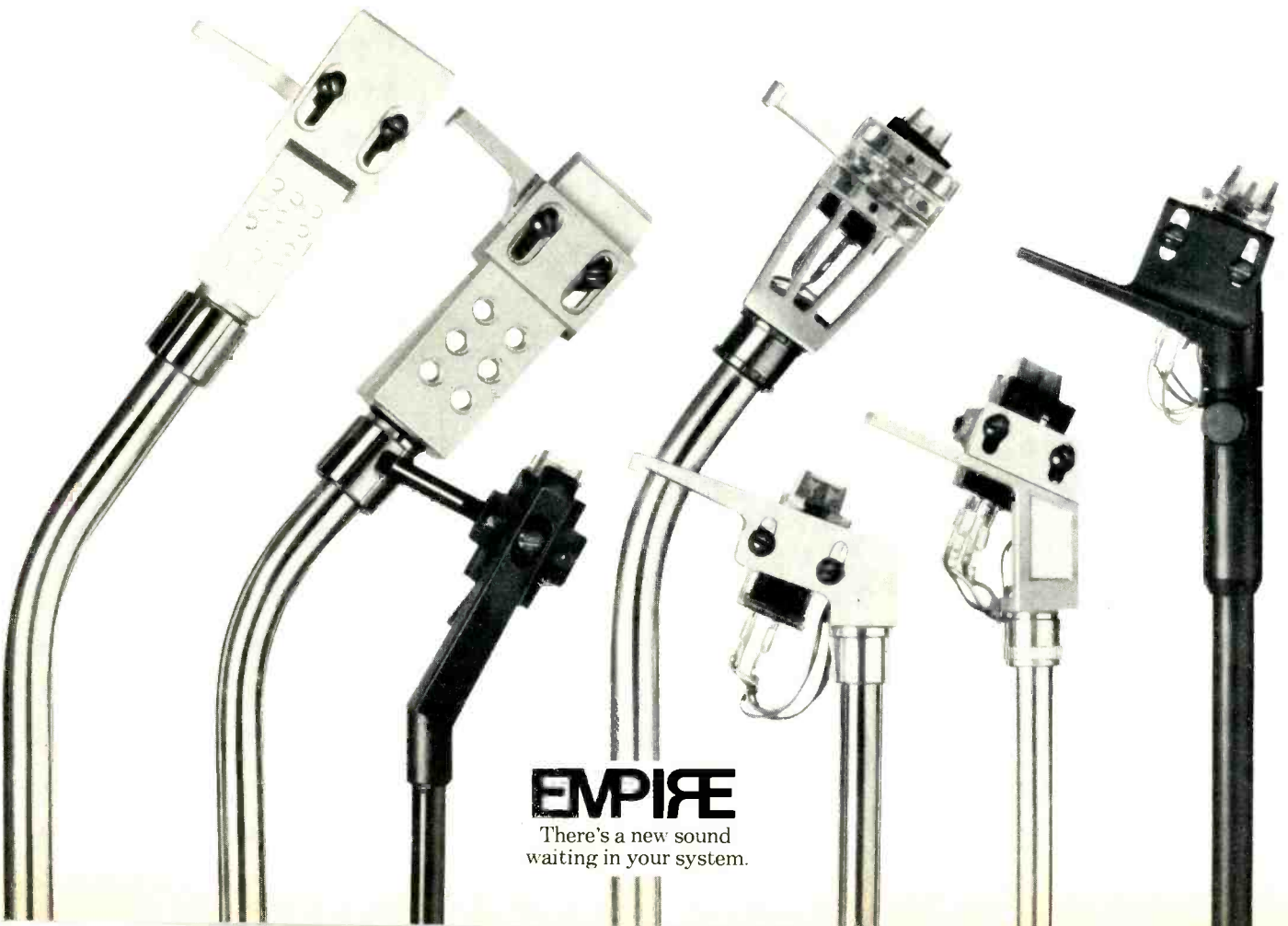
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date. This allows any desired algorithm for determining worst-case behavior or studies of the statistics of thermal impedance to be made as desired.

The method chosen for worst-case study of the data required the construction of a pseudo-device that represented the hottest temperatures seen at any given instant in time. This did not necessarily result in just one device governing the worst-case model. The computer proceeded to find the characteristic values of the RCs used in the model of Fig. 4B. This task is only suitable for a computer algorithm as no direct solution method is known for determining the coefficients, much less for hand calculation (which would take many man-years).

It was found that a three RC network gave an excellent fit to the data with an accuracy greater than the components to be used would actually produce. There was therefore no advantage in using four or more RC sections to simulate the junction behavior.

The resulting circuitry of the protection system is a two-quadrant multiplier which computes the product of I_c and V_{ce} and is implemented with a monolithic transistor pair and op-amp current mirror. The single-ended output of the mirror is mixed with the output of a temperature-sensitive IC whose current output is proportional to absolute temperature.

The protection circuit's temperature computer is composed of an inverting IC op-amp with the determined RC impedance analog networks in the feedback loop. The virtual ground input receives the instantaneous power signal from the multiplier as well as the signal from the thermal sensor. As configured, a single quad-pack op-amp suffices to construct the protection circuit along with two monolithic dual transistors and two IC heat-sink temperature sensors. Since the output stage is built with one heat-sink module per output stage half, no interstage interaction interferes with the analysis. The circuit design is such that the protection circuit saturates at low junction temperatures, i.e. below 25 degrees centigrade. This is in conformity with the device power derating being confined to the region of 25 to 200 degrees.

Another parameter which must be honored on the transistor's data sheet is the maximum d.c. collector current. To this end, a conventional diode drive-limiting network is employed. Failure to honor this specification will result in emitter lead-bond failure. Limiting collector current implicitly prevents exceeding the maximum d.c. base current. The instantaneous limiting of collector current also prevents any possibility of large amounts of dissipation occurring in very short time intervals (microseconds) which would not be accurately analyzed by the simulator, thus assuring the validity of the simulation.

Views of the two amplifiers incorporating this design are shown. Both amplifiers share the following features. The rear panel has slide switches for engaging low-frequency protection to protect drivers from inadvertent d.c. or subsonic exposure. The detection of d.c. will then result in disabling of the main power supplies via relay control. This is a much more reliable system than a relay disconnect of the load which may not successfully break an inductive circuit having d.c. excitation. (The relay may weld with the arc!)

The front panel display of the PSA-2 contains seven LEDs.

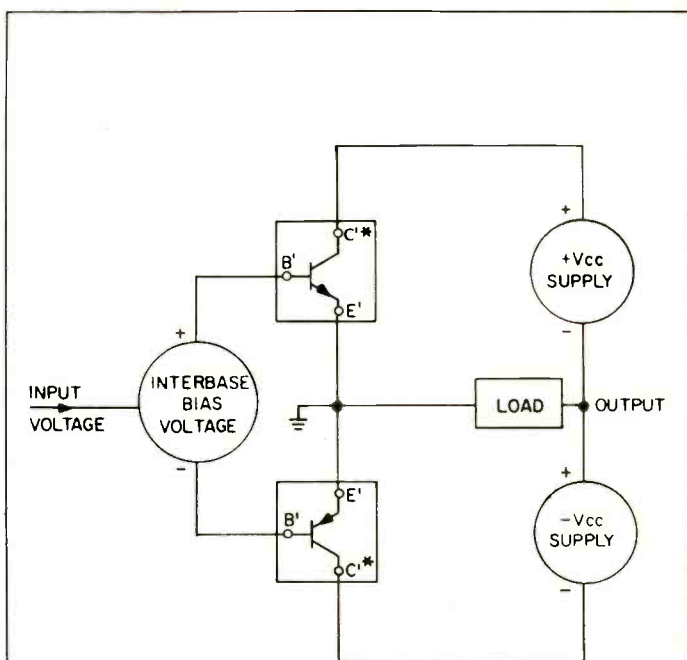


Fig. 6C — Modified totem pole.

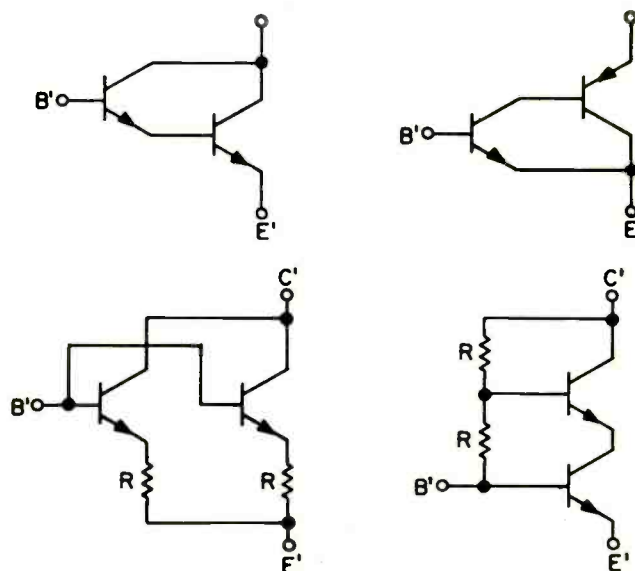


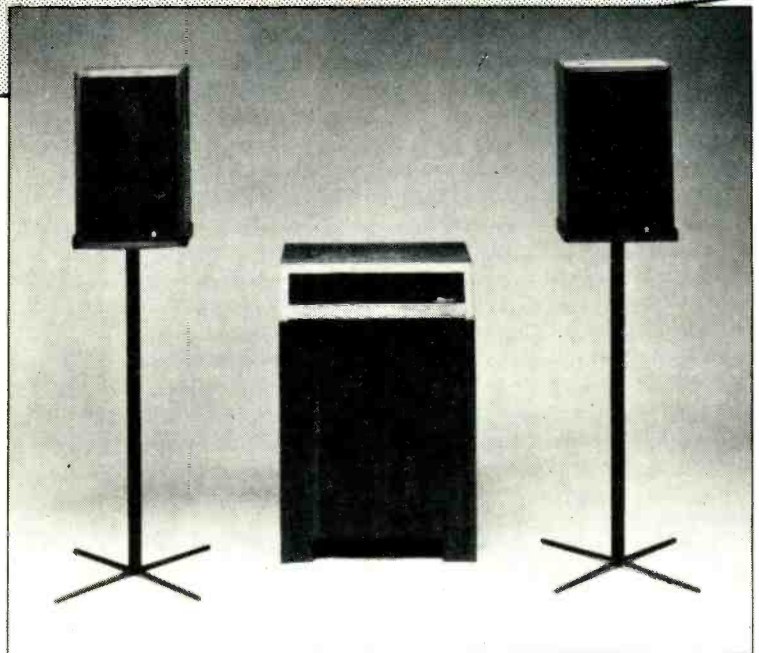
Fig. 6D — The composite transistors, marked with an asterisk in Figs. 6A-6C, use any combination of the above.

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Enter No. 5 on Reader Service Card

An orange power indicator with channel independent yellow main power supply standby indicators shows if the supplies have been disabled. The supplies may be disabled for several causes such as turn-on delay, low-frequency output load protection, or transformer overheating. Two green LEDs indicate the presence of reasonable signal levels short of overload. Upon overload of any form — clipping, slew-induced, or protection circuit induced — the Crown-developed IOC indicators (red LEDs) will light rather than the green signal LED in the overdriven channel.

The front panel display of the SA-2 has two 15 LED (green) Jacob's ladder type displays in place of the two green signal-present LEDs of the PSA-2 display. One LED on each display indicates the current value of the peak signal, which another indicates the recent largest peak value of the signal for that channel. This display may be optionally ordered on the PSA-2 amplifier.

The incorporation of modern data gathering and numerical methods have made possible the design of power amplifier

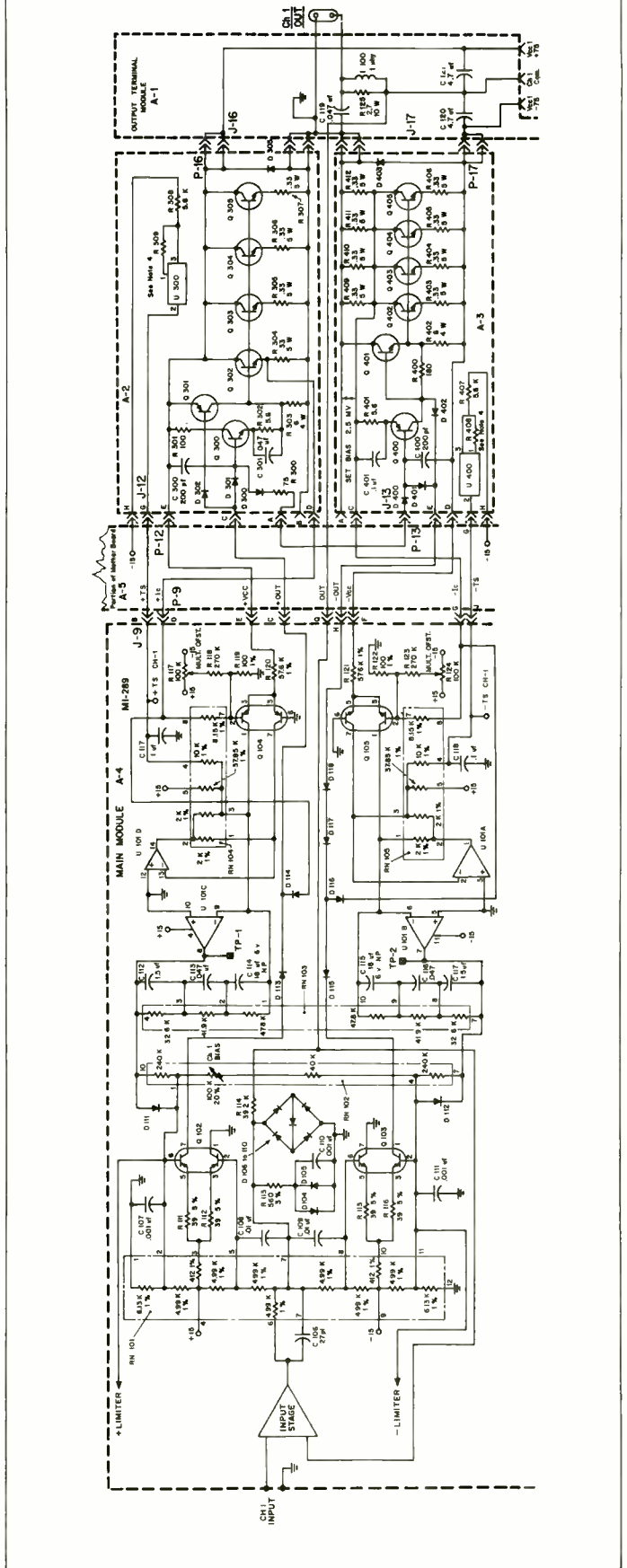
Fig. 8 — Two Crown amplifiers, PSA-2 and SA-2, which incorporate the protection system.



protection circuitry that was previously impractical. Such designs are capable of withstanding torture tests (which represent real-world stress conditions), with a high degree of confidence of survival. This has been achieved with a subsequent enlargement in the undistorted audio output as compared with previous means of reliable protection.

To make maximum use of the concept, a new variant of the "totem-pole" output stage was deployed with considerable improvement in the observability of the amplifier output stage parameters. In short, a new generation of "solid" solid-state amplifiers has arrived that contains four analog computers which are the stepchildren of a digital computer's analysis of the output transistors.

Fig. 7 — Schematic of the actual protection system.



High-Fidelity Performance At Half-Speed! Skeptical?

So were the experts until they tested the Nakamichi 680ZX!

"...almost perfectly flat response out to 15 kHz....few cassette decks could match this at regular speed, much less at half-speed!"

(Stereo Review, August 1980)

"...comparable to the very best (full-speed) decks....After putting an entire 'Carmen' onto a single C-90, we glanced at our collection of fractured acts....with rueful eyes" (High Fidelity, May 1980)

"...excellent performance..." (Audio, September 1980)

And At Standard Speed....

"...simply superb....cannot be surpassed..." (High Fidelity, May 1980)

"...all responses....extend to 24 kHz or more..." (Audio, September 1980)

"...one might almost as well buy a ruler to draw 'curves.'..." (Stereo Review, August 1980)

With Exclusive Nakamichi Features Such As

Auto Azimuth Alignment that has "...a capability to handle any skew ever observed." (Audio, September 1980)

Fluorescent Metering that is "...unequivocally the most useful display available..." (High Fidelity, May 1980)

And a *Random Access Music Memory (RAMM)* that is "...uncommonly adept..." (High Fidelity, May 1980)

Experience the "...truly revolutionary development in cassette recording." (Stereo Review, August 1980)



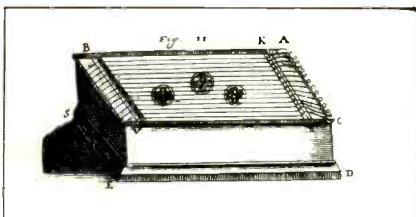
The Nakamichi 680ZX. Now at your Nakamichi dealer.



Complete reprints of these reviews are available at your Nakamichi dealer, or write to: Nakamichi U.S.A. Corporation, 1101 Colorado Avenue, Santa Monica, CA 90401.

ACOUSTICS CIRCA 1657

Explorations Into Our Acoustic Heritage



Don & Carolyn Davis

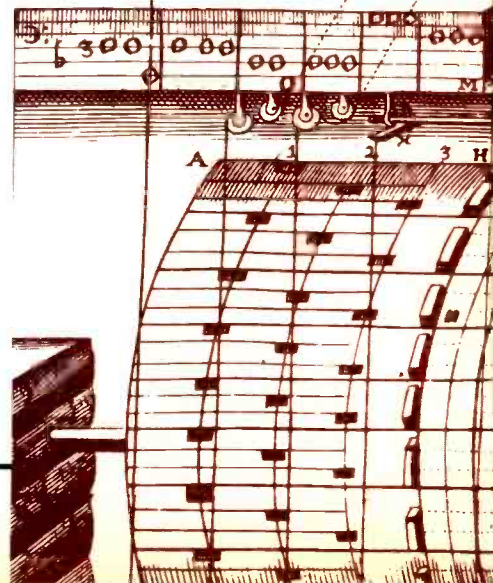
As we travel about the United States conducting our Syn-Aud-Con seminars, it is our pleasure to seek out sellers of used and old books. During our fall, 1978 tour of the eastern United States, we spent several days in the Williamsburg, Va., area between classes. Poking about, we made our usual inquiry regarding, among other subjects, books on acoustics. The bookseller replied, "Well, just one, and it is an old one."

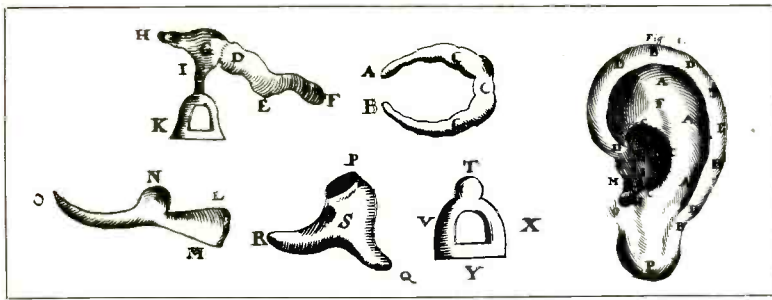
What was brought out for our inspection was a vellum bound, first edition dated 1657 and entitled *Magiae Universalis*. The author, Kasper Schott (Latinized into Gaspard P. Schotto in the frontispiece — before the advent of the metric system, academia used Latin to protect scientific data from the great unwashed). The publisher was Herbipoli.

The Renaissance period saw a flowering of publications, as the growing body of knowledge of mechanics was applied to acoustics. The works of Bacon, Galileo, Leonardo Da Vinci, Tycho Brahe, Kepler, Stevinus, et al. soon led to the infancy of experimental acoustics.

Schott, a contemporary of Mersenne, Kircher, Von Guericke, Hooke, Boyle, Moreland, and Porta among others, was a Jesuit professor of physics at Wurzburg (1608-1666). Uniquely illustrated, his book is a combination of scientific insight, superstition, and sheer nonsense, as are many present-day textbooks on the same subjects. It helps to understand the contributions of such a book when our perspective is placed nearer the time period it represents.

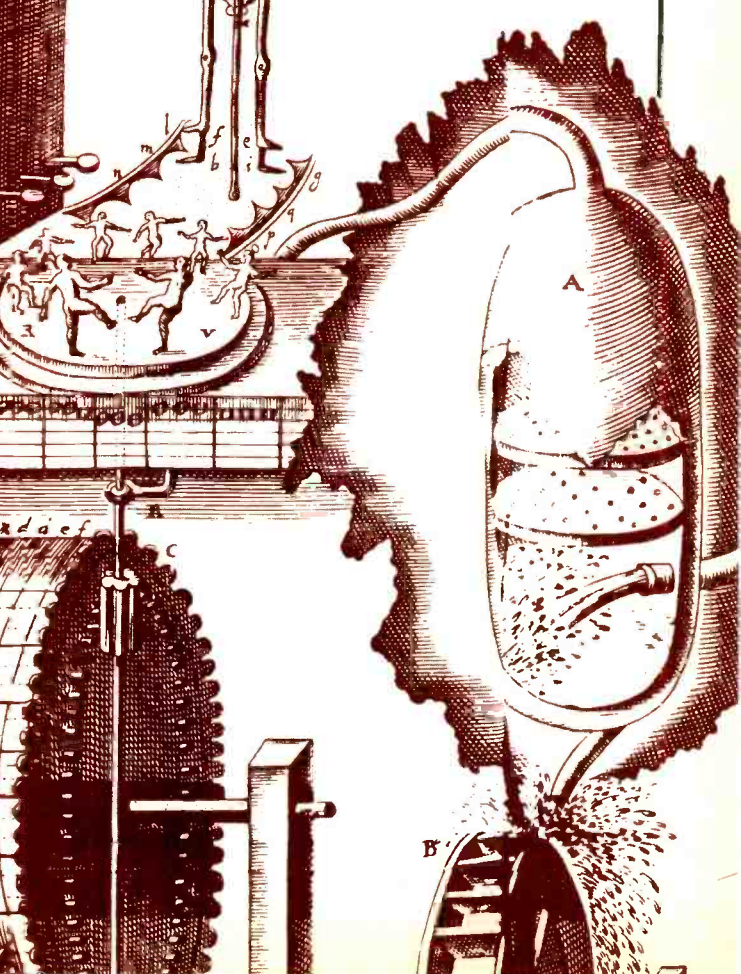
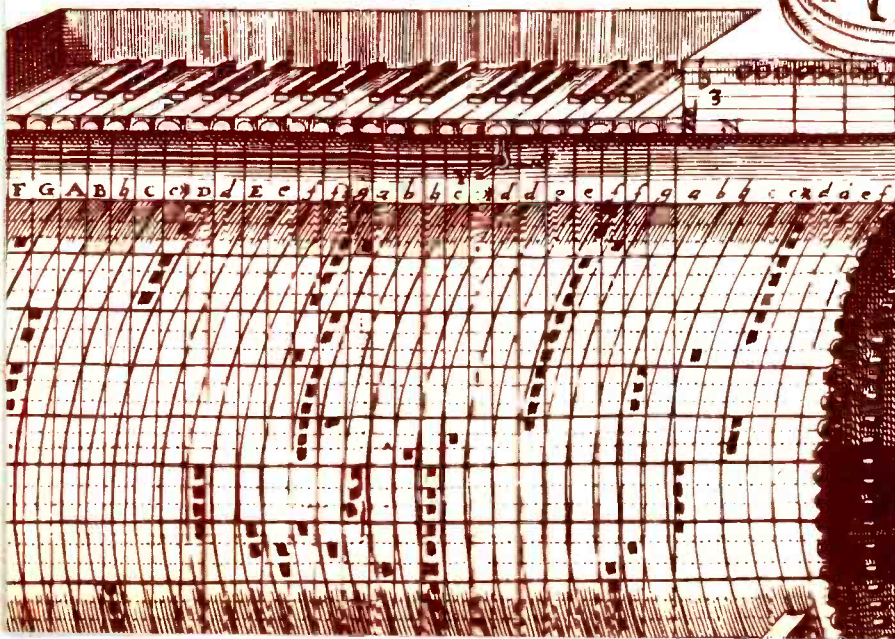
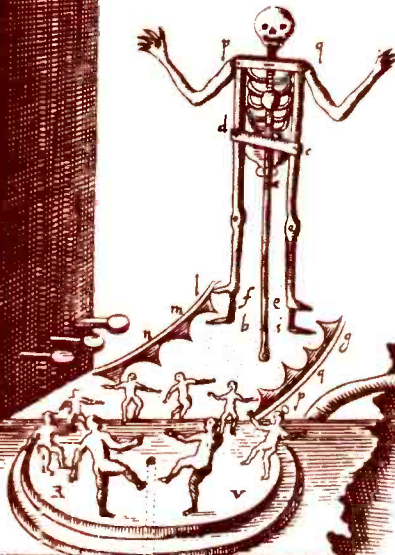
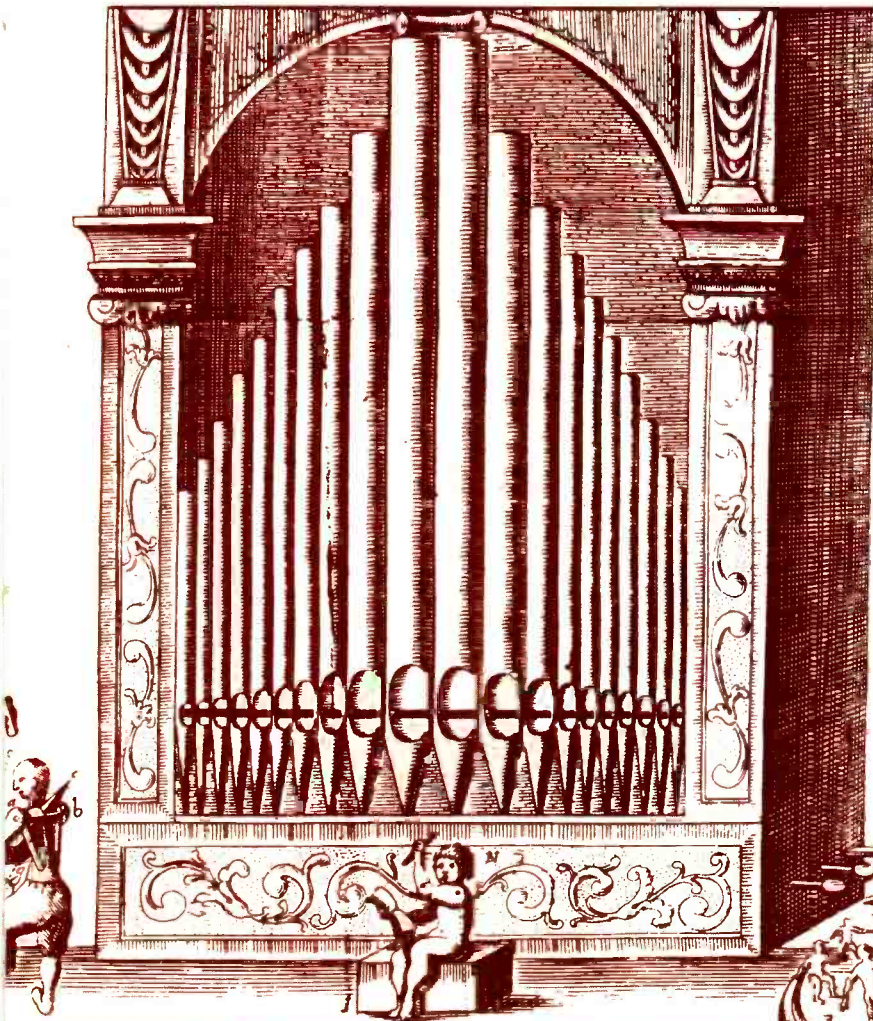
The Arabs for centuries after the beginning of the Christian era preserved the fragments of the earlier Alexandrian science. During the post-Crusade period, the center of instrument making, primarily astronomical instruments, shifted from the Arabian areas to Nuremberg, beginning about 1400 A.D. By the middle of the 16th century, precise engraving on brass was well advanced, due in part to the interest in book printing.

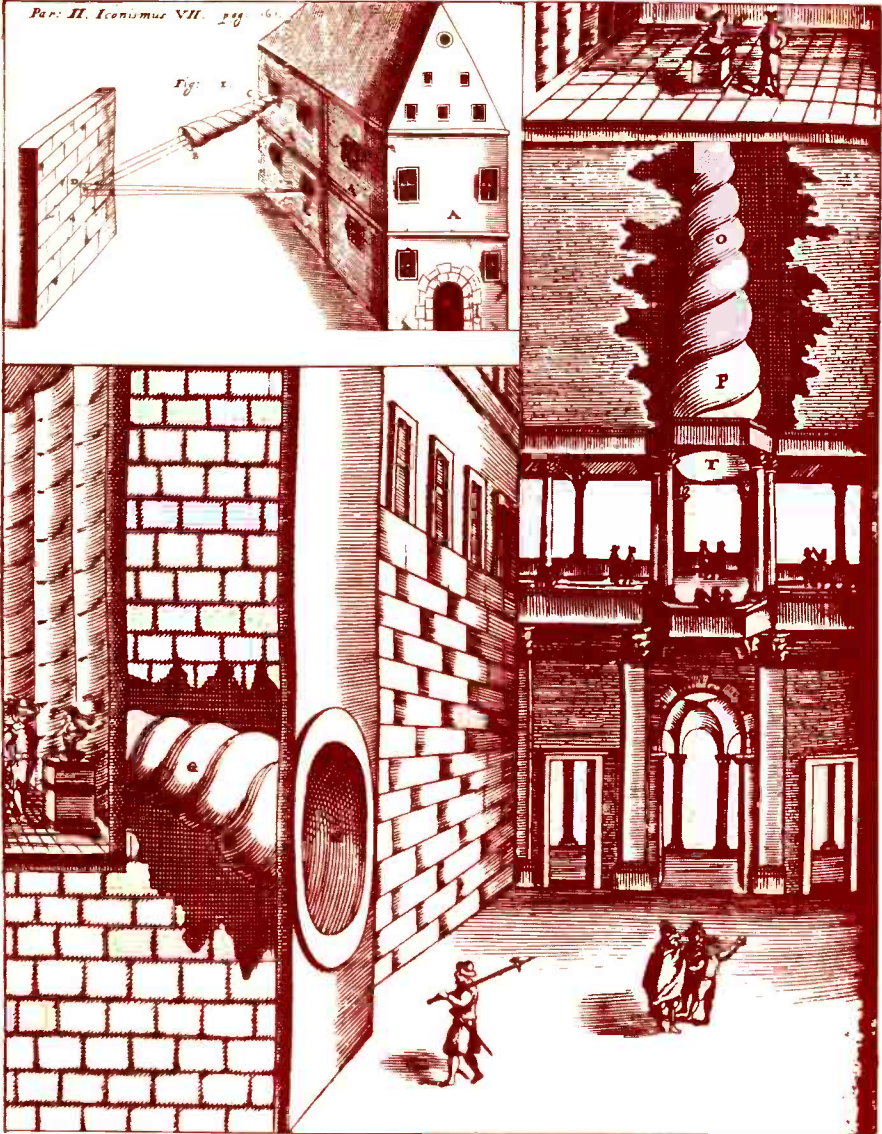




This precision led to improved gears. Gears opened the door to wonderful automata and gadgets such as the Strasbourg clock of 1354. This device included a mechanical rooster which flapped its wings, stretched its metal feathers, opened its beak, and crowed every day at noon. The year 1642 saw Pascal invent and build what is often called the first real calculating machine.

Marin Mersenne published his *Traite de L'Harmonie Universelle* in 1627 in which he described the measurement of the velocity of sound — in "pied de roy" — the royal foot (1 toise = 6 paris or pied de roy). Before employing a pendulum, Mersenne found that the human pulse was more reliable as a timer than was respiration.



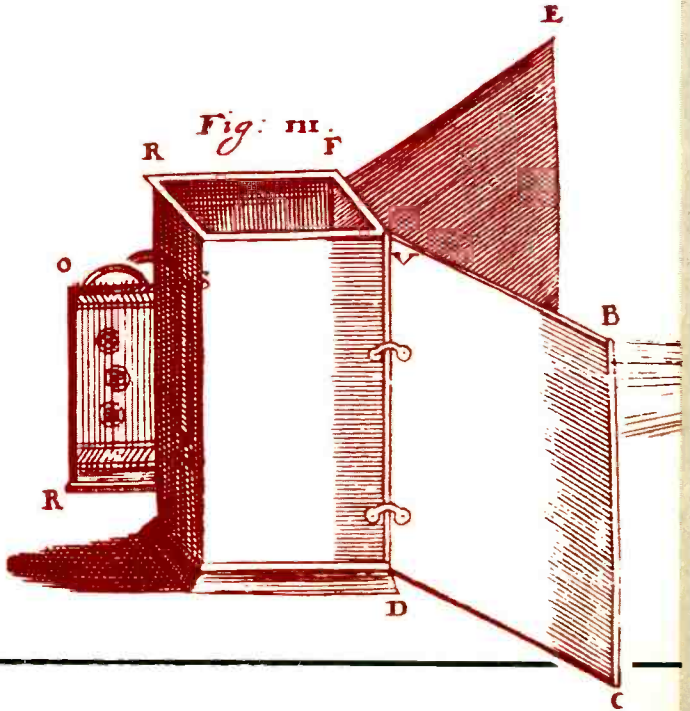
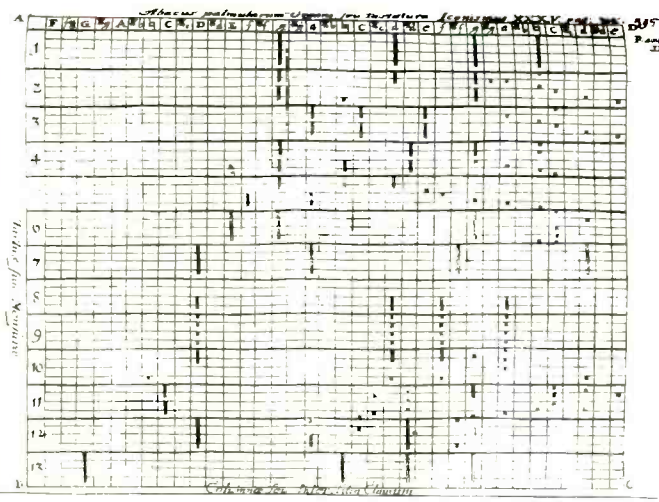


Using "second minutes" (the minute again divided into 60 parts was called a second minute), he came up with 230 toises per second. The pendulum used was called an *horloge a secondes minutes*, which could be roughly translated "stopwatch."

Mersenne's careful calculations as to how long the time delay was in hearing the "last trump" on Judgment Day anywhere in the world revealed a mathematically based experiment system (approximately 10 hours for the most distant listener was his surprisingly accurate conclusion).

Anathanasius Kircher (1602-1680), a professor of mathematics in the Jesuit College of Rome, now the *Pontificia Universitas Gregoriana*, wrote in 1650 the *Musurgia Universalis* in which he dealt in some detail with acoustical horns and certain limited aspects of geometry in architectural acoustics. Kircher, so far as can be determined, was the first in a long line of horn advocates who had difficulty in explaining how the devices actually operated.

In the midst of all this acoustical and intellectual ferment, Schott published his book. His most original contribution was a description of Otto Von Guericke's work with air pumps. From this description, Robert Boyle (1627-1691) and his assistant Robert Hooke (1635-1703) made their vast improvement in air pumps and the subsequent experiments with ticking watches in vacuums.



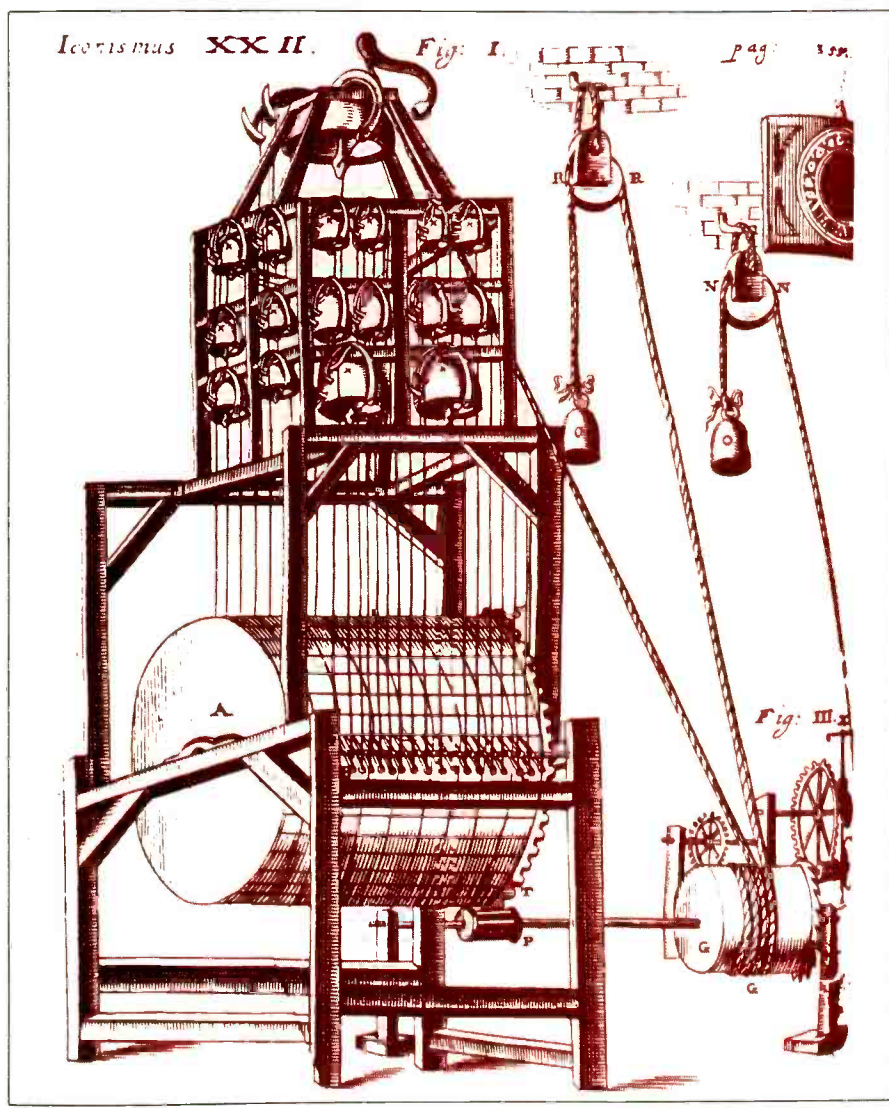
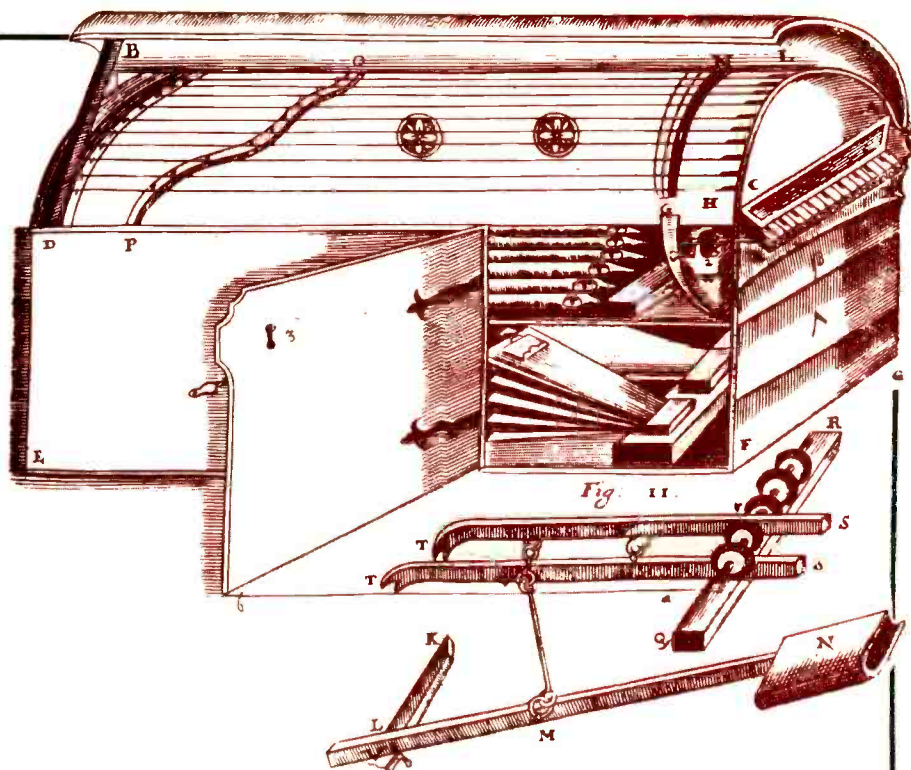
Kircher is quoted at length in Schott's book, and it appears that many of the automatic players for bells, organs, and strings, illustrated in detail in Schott's book, were developed from Kircher's *cylindrum phonotactica* (levers actuated by teeth projecting from a revolving drum). Many of the horns illustrated were actually constructed.

Kircher built a loudspeaker trumpet 22 *palma* long (about 16 feet if you assume a *palma* equals 8.7 inches—the length of a palm). With it, he spoke to the gatekeeper without having to leave his quarters. He also used it as an ear trumpet by means of which he could eavesdrop on conversations taking place in the courtyard—all to the amazement of various visitors who were invited to share the experience. It is reported that similar techniques were used by the tyrant Dionysius, the Elder (430-367 B.C.). Wiretapping, it would seem, has an ancient if not necessarily honorable precedent.

Reproduced here are some of the illustrations from Schott's book. Paper was of better quality in 1657 (one wonders what else); we are told that present-day book paper has only a 25-year life.

The Jacquard Loom (1810) utilized punched cards (actually designed by Falcon in 1728) and is widely considered to be the first use of such programming. Thus it is of major interest to observe the varied programming techniques Schott includes in his book. It seems the ancients are still stealing our inventions.

As Dick Heyser remarked to us upon hearing about our acquisition, "You don't own that book — you are the temporary custodians of it." It is in that spirit that we share these illustrations from *Magiae Universalis*. A



Equipment profiles

Realistic Model STA-2200 Stereo FM/AM Receiver



Manufacturer's Specifications

FM Tuner Section

Mono Usable Sensitivity: 10.3 dBf (1.8 μ V/300 ohms).

Mono S/N: 68 dB.

Image Rejection: 75 dB.

Capture Ratio: 1.5 dB.

I.f. Rejection: 95 dB.

AM Suppression: 55 dB.

Harmonic Distortion: Mono, 0.2 percent; stereo, 0.3 percent.

Stereo FM Separation: 48 dB at 1 kHz.

AM Tuner Section

Sensitivity: 10 μ V.

Image Rejection: 45 dB.

I.f. Rejection: 47 dB.

Distortion: 1.0 percent.

AM Frequency Response: 40 Hz to 3 kHz, ± 6 dB.

Amplifier Section

Rated Power Output: 60 watts/channel, 8-ohm loads, 20 Hz to 20 kHz.

Rated THD: 0.02 percent.

Input Sensitivity: Phono, 2.2 mV; high level, 160 mV.

Phono Overload: 200 mV.

S/N: Phono, 65 dB; high level, 75 dB.

Bass Control Range: ± 10 dB at 50 or 100 Hz.

Treble Control Range: ± 10 dB at 10 or 20 kHz.

Price: \$599.95.

Audio components bearing the name "Realistic" are manufactured exclusively for and sold by the thousands of Radio Shack stores located throughout the United States and through their widely circulated mail-order catalogs. The company headquarters in Texas is manned by its own engineering staff who supervise the products which are then generally manufactured overseas. It is indicative of the general trend in stereo receivers to note that last year, Radio Shack's top model, selling then for just under \$600.00, offered 120 watts of power per channel, exactly twice as much as this year's entry at that price point, the STA-2200. Clearly, the emphasis here is on sophisticated features, such as true frequency synthesis, which is incorporated in the STA-2200, rather than on the so-called "power race." The digital display system used in conjunction with the frequency synthesis tuning system, the 12-station memory system (6 for AM and 6 for FM stations), the use of the digital display as a time clock plus its alpha design-

nations of program source, stereo FM reception, etc. all add to the cost of this receiver so that, in effect, Radio Shack has traded power for convenience features and tuning accuracy — worthwhile trade-offs in my view.

The gold-colored front panel of the STA-2200 features a large, highly visible digital panel used to indicate both AM and FM frequencies selected. FM frequencies are displayed in 200-kHz increments, while AM stations are tuned in 10-kHz increments. When programs other than AM or FM are selected, the display becomes a digital time clock, indicating "AM" or "PM." Even in the radio listening mode, the user can cause the display to revert to time indications by depressing a push button located behind a small "sliding door" panel to the left of the display area. Additional buttons set the hour and minute of the digital clock, dim the intensity of the display, turn off output-power LED displays and signal-strength LEDs, and activate the "station memory" feature.

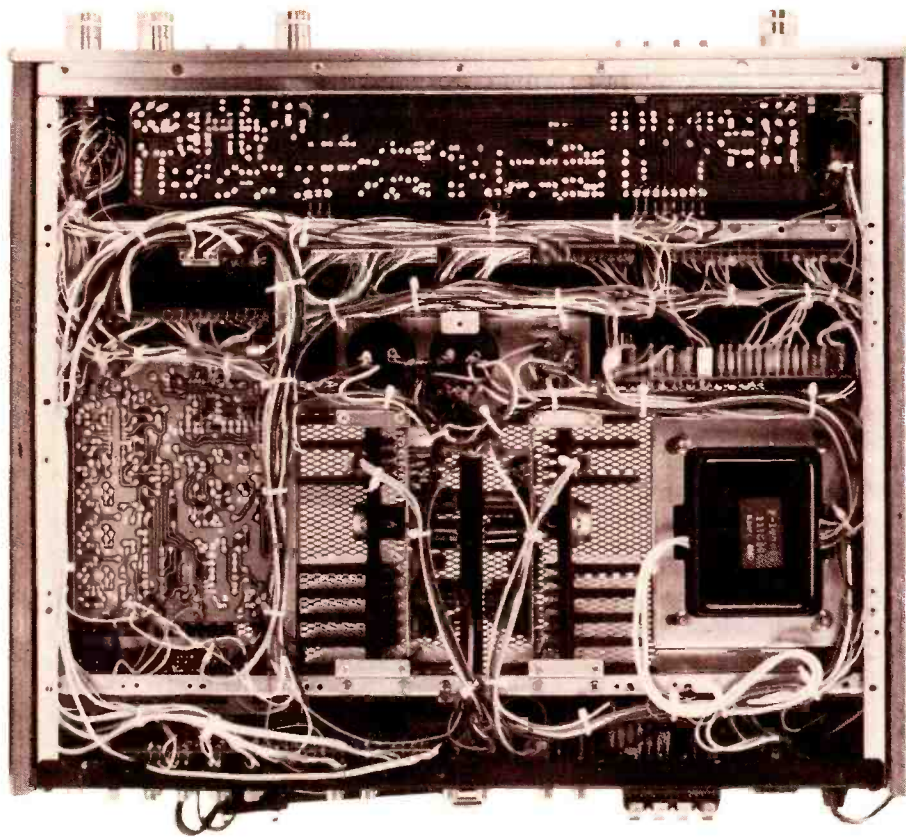
When the "memory set" button is depressed, the listener has five seconds in which to enter the frequency of a station (either AM or FM) by depressing one of the six numbered buttons located beneath the digital readout area. To the left of the sliding panel door are tape monitor and dubbing switches used in conjunction with up to two tape decks connected to the receiver.

Several tuning options are available. Pressing the tuning "Up" or "Down" buttons starts the electronic tuning system scanning in the chosen direction until the next usable signal is received. Other buttons, equipped with arrows like the first pair, are used for manual tuning while just below these is a "scan" button which, if depressed, starts the tuner scanning to each of the memorized station frequencies in turn, pausing for five seconds at each frequency for quick auditioning. A hold button stops the scanning sequence if the listener chooses to remain tuned to one of the pre-selected stations. The usual power on/off switch is located at the lower right corner of the panel.

Two rows of 10 LEDs each, located at the lower center of the panel, serve as power-output indicators and are calibrated in watts, referred to 8-ohm loads. A push button nearby selects 10 watts or 100 watts as full-scale for these indicators. Other push buttons in this area of the panel include an FM mute switch, mono/stereo switch, an MPX high-blend filter switch, and a loudness-contour switch. Concentrically mounted volume and balance controls are located at the lower right of the panel, along with the usual stereo phone

jack. Bass and treble controls at the left section of the panel have a pair of tiny push buttons located between them. These select either of two bass or treble turnover frequencies at which boost or cut is to begin (150 Hz or 300 Hz for the bass control, 6 kHz or 3 kHz for the treble control). The program selector rotary switch is also located in this section of the panel, and in addition to the usual phono, AM, FM and AUX settings, there is a setting for Dolby FM. The complete required Dolby FM circuitry is included in the receiver together with the necessary 25-microsecond de-emphasis characteristic required when listening to such transmissions.

The rear panel of the STA-2200 contains a line fuseholder and switched and unswitched a.c. receptacles at the left, while nearby there are spring-loaded, color-coded speaker terminals for up to two pairs of speakers systems. Surprisingly, there are also phono-tip jacks for speaker connection, just in case the user owns a pair of speakers having permanent cables terminated in such plugs. Two sets of tape-out/tape-in monitor circuit jacks are provided, as are European type DIN multiple-contact connectors. Preamp-out and main-amp input jacks are interconnected by wire jumpers which may be removed for separate access to these two sections of the receiver. High-level (AUX) and low-level phono inputs are located far from any a.c. hum fields at the opposite end of the rear panel, as is a chassis-ground terminal. The 75-ohm and 300-ohm FM and external AM antenna terminals are located at the upper right of the panel; the usual pivotable AM ferrite bar antenna is also provided.



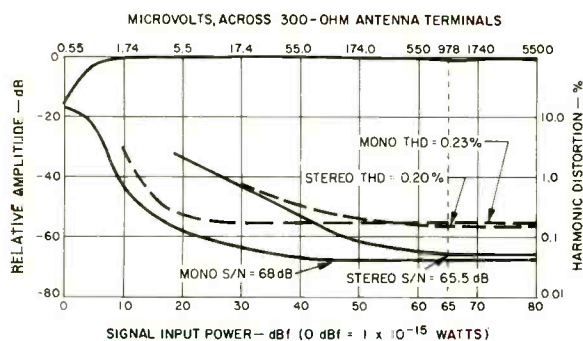


Fig. 1 — Mono and stereo quieting and distortion characteristics.

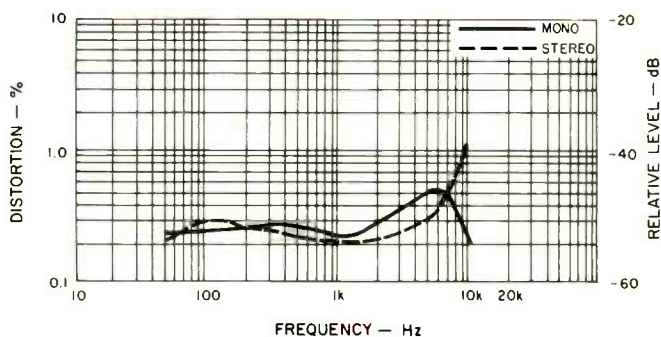


Fig. 2 — THD vs. frequency, FM tuner section.

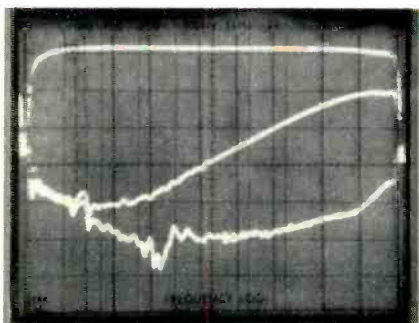


Fig. 3 — Frequency response and stereo separation.

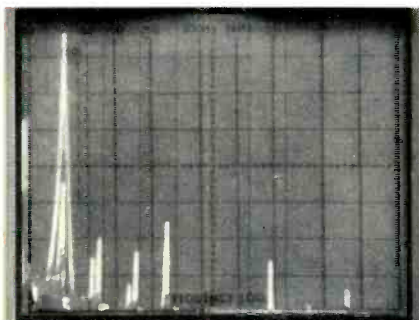


Fig. 4 — Crosstalk components for 5-kHz signal.

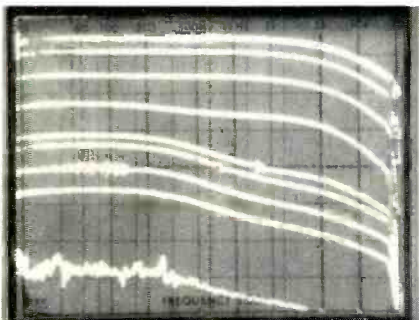


Fig. 5 — Action of Dolby FM decode section at different modulation levels.

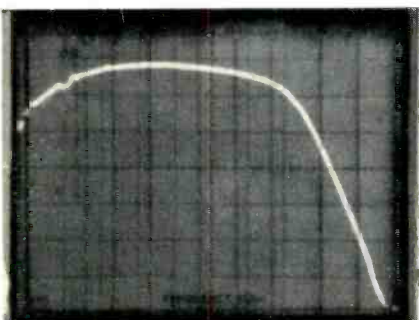


Fig. 6 — AM frequency response.

The internal view of the receiver discloses the excellent layout which has been used in constructing this versatile receiver. The FM front-end is equipped with a dual-gate MOS-FET r.f. amplifier, and tuning is accomplished by means of varactor diodes, controlled by a microprocessor. The FM i.f. section employs three ICs and three linear-phase ceramic filters. A quadrature detector is used to recover the FM composite audio signal which is fed to a phase-locked loop stereo-MPX-decoder circuit C-MOS IC. MOS-FETs are also used in the power amplifier section. Automatic protection circuits protect the output devices against voltage surges, overloads, speaker shorts and thermal overheating, which may also affect the speakers.

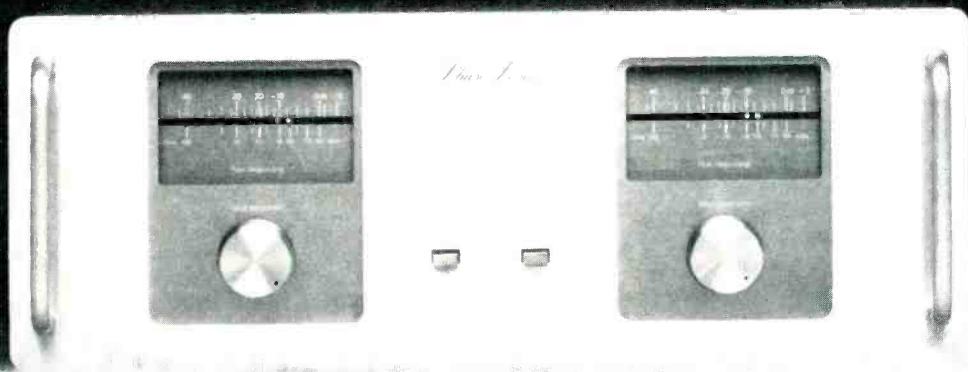
FM Performance Measurements

The curves of Fig. 1 indicate general quieting and distortion characteristics of the tuner section of the STA-2200 for both mono and stereo FM operation. Usable sensitivity in mono measured 9.8 dBf (1.7 μ V), actually a bit better than claimed. Stereo sensitivity was an impressive 17.2 dBf, or 4 μ V referred to 300-ohm inputs.

As in the past, Radio Shack proves reluctant to publish a great many performance measurement specifications for their high-fidelity products. Their reasoning is that such technical specifications tend to confuse prospective purchasers who would rather hear how the product sounds than worry about the "numbers." While that may well be so, we still believe that our readers want to know as much about the product as possible, and that means both objective measurements and subjective listening tests. Accordingly, we measured just about all of the FM performance parameters possible. Specifically, 50-dB quieting in mono was an excellent 2.5 μ V or 13 dBf. In stereo, the 50-dB quieting point was reached with input signals strengths of 36.5 dBf or 36.8 μ V. Radio Shack does report an S/N ratio in mono of 68 dB and that is exactly what we measured. In stereo, the S/N drops slightly, to 65.5 dB. With Dolby FM circuitry turned on (and test signals adjusted appropriately at the signal generator), the signal-to-noise ratio improved to 70.5 dB in mono and 69.5 dB in stereo.

Unlike conventional signal-strength meters, which are generally useless above signal strengths of 50 μ V or so, the LEDs used in the STA-2200 to indicate signal strength were sensibly calibrated, as follows: 70 μ V, 100 μ V, 230 μ V, 500 μ V, 1600 μ V, in ascending order from illumination of the first through the fifth LED. At reference signal levels of 65 dBf, distortion in mono measured 0.23 percent at 1 kHz, while in stereo the harmonic distortion level was actually a bit lower, 0.20 percent. These distortion readings remained fairly constant at mid and low frequencies, as shown in Fig. 2, but increased to

ONE OF THE WORLD'S GREAT POWERS.



THE PHASE LINEAR 700 SERIES TWO.

Over seven years ago, Phase Linear took the audio world by storm when it introduced the first truly high-power, high-fidelity amplifier: the Phase 700. Everyone was stunned at the incredible 350 watts per channel, with ultra low distortion. (In those days, popular mythology held that amps would never need more than 50 watts to a side. In fact, who had even heard of clipping?)

Naturally, the skeptics scoffed. But audio critics and music-lovers worldwide listened. And for the first time, they heard recorded music reproduced in the home accurately. No muddy rumble at the low end. No harsh, distorted clipping of the highs. The era of great power amps had begun!

Today, it's generally accepted that you need an amplifier with a massive reserve power to drive inefficient high-technology speakers and reproduce all the musical transient peaks without clipping. The amplifier with unquestioned ability to meet this criteria is the Phase Linear 700 Series Two.

GREATER POWER RESERVES MEAN GREATER HEADROOM

The Phase 700 Series Two is rated at 360 watts per channel,

with distortion virtually inaudible at 0.09%. With this tremendous power, the Phase 700 can reproduce musical transients with ease, giving you almost unlimited headroom. As a result, your music sounds lively, with incredible realism. Even the deepest notes are clearly distinguishable.

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The original Phase 700 was designed for home use, but it rapidly won the approval of the pros. Its proven dependability on the road made the 700 a favorite touring amp for super groups and sound reinforcement companies.

The Phase 700 Series Two retains this legendary reliability, and improves sonic accuracy by utilizing an advanced BI-FET input stage. This integrated circuit keeps the output virtually identical to the input. Beautiful music in, beautiful music out.

The 700's instantaneous LED output meters move at lightning speed, accurately monitoring the output voltage, with calibrations for 8 and 4-ohm applications. If you're listening at quiet levels, you can activate a Meter Range Switch to upscale the meter by 20dB. You have a visual indication of output activity, in addition to the Electronic Energy Limiters that prevent damage from accidental overloads.

If you demand great performance, don't settle for less than a great amplifier.

SPECIFICATIONS:

Output Power: 360 WATTS, MIN. RMS PER CHANNEL 20Hz-20kHz INTO 8 OHMS, WITH NO MORE THAN 0.09% TOTAL HARMONIC DISTORTION.

Continuous Power Per Channel At 1000Hz With No More Than 0.09% Total Harmonic Distortion: 8 OHMS-450 WATTS, 4 OHMS-550 WATTS.

Intermodulation Distortion: 0.09% Max (60Hz: 7kHz-4:1).

Damping Factor: 1000:1 Min.

Residual Noise: 120uV (IHF "A").

Signal To Noise Ratio: 110dB (IHF "A").

Weight: 45 lbs. (20 kgs).

Dimensions: 19"x7"x10"

(48.3cm x 17.8cm x 25.4cm).

Optional Accessories: Solid Oak or Walnut Side panels. E.I.A. standard rack mount configuration.

Phase Linear®

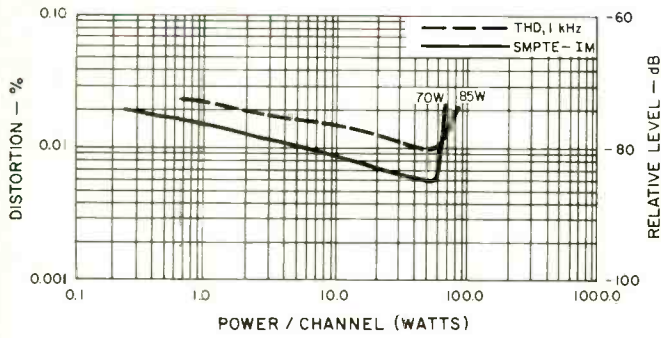


Fig. 7 — Distortion vs. power output.

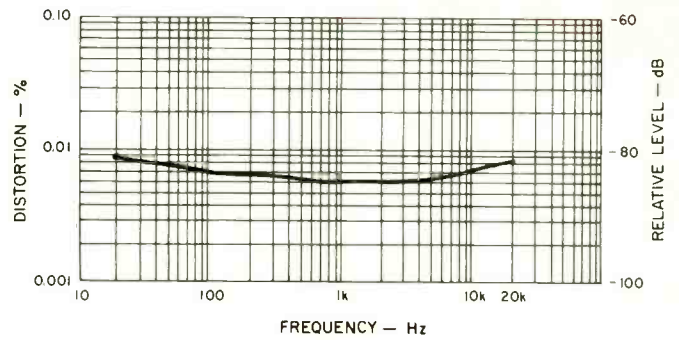


Fig. 8.— Distortion vs. frequency at rated output.

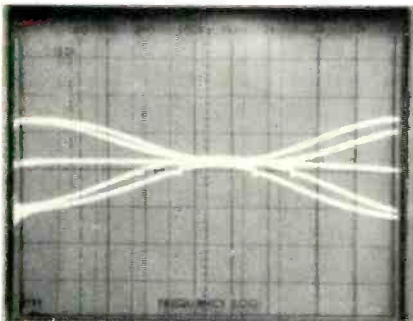


Fig. 9 — Bass and treble control range.

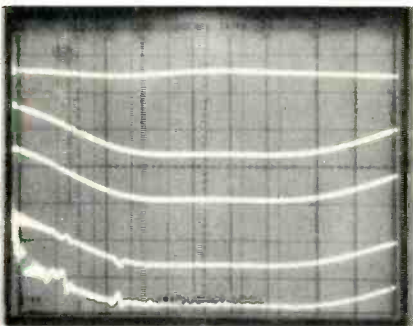


Fig. 10 — Loudness control compensation at various control settings.

kHz and 44 dB at 100 Hz. The center trace in Fig. 3 shows the decrease in separation that occurs when the MPX high-blend switch is activated. Sweeps in this and other 'scope photos run from 20 Hz to 20 kHz, and vertical sensitivity is 10 dB per division unless otherwise noted.

Figure 4 depicts a linear sweep of our spectrum analyzer from 0 Hz to 50 kHz. A 5-kHz reference signal occupies full screen height (desired channel signal), while a second sweep of the output of the opposite channel shows separation at 5 kHz (approximately 42 dB) as well as other crosstalk and sub-carrier (19 kHz and 38 kHz) components to the right of the desired signal frequency.

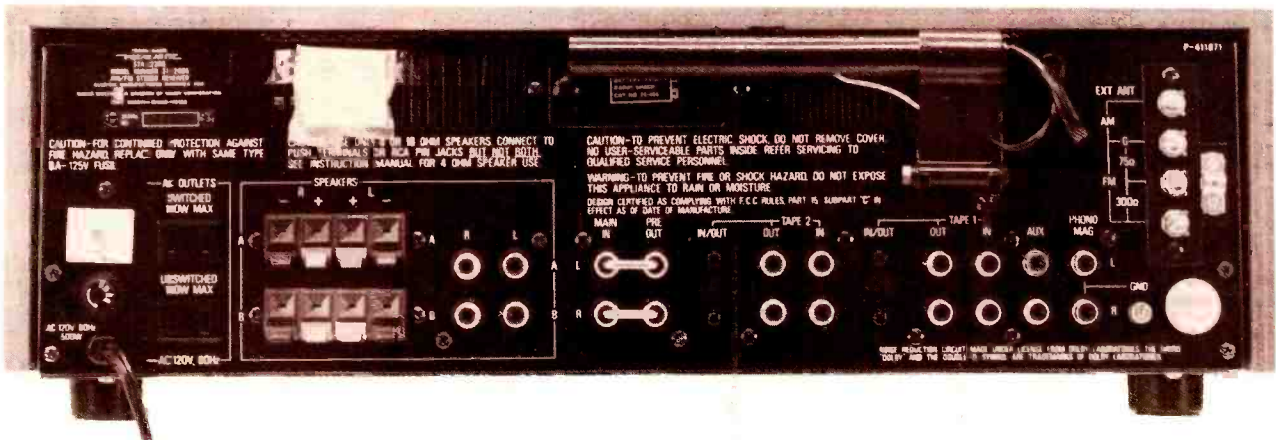
Tracking of the Dolby FM circuitry seemed to be a bit off, as can be seen by examining the upper curves of Fig. 5. Note that now response is no longer flat over the entire audio range but seems to roll off a bit at the high end, even at full modulation levels. At lower modulation levels (lower curves), we see the action of Dolby decoding as the response curves are altered compared with those above.

Capture ratio of the FM tuner section measured 1.5 dB as claimed. Alternate channel selectivity was better than 70 dB, and AM suppression measured marginally better than claimed with readings of 56 dB. Image rejection was 75 dB, while spurious rejection was 83 dB. Stereo threshold occurred with signal inputs of 20 dBf, and muting threshold was set at 4 μ V (17.2 dBf).

Much to Radio Shack's credit, they are one of the few makers of stereo receivers or tuners who specify frequency response for the AM tuner section of their products. As shown in the spectrum sweep of Fig. 6, they actually do a bit better than claimed, with response extending from 40 Hz to 3.5 kHz for a ± 6 dB tolerance. Clearly, nothing to rave about here, but at least the spec is legitimately stated.

0.52 percent at 6 kHz for mono and to 0.36 percent in stereo for the same test frequency.

Frequency response was extremely flat from 30 Hz to 15 kHz, with no more than 0.5 dB deviation at any frequency in between those extremes. Response, as well as separation characteristics in stereo FM, are depicted in Fig. 3. Separation at 1 kHz (lower curve) was 50 dB, decreasing to 40 dB at 10



Amp and Preamp Measurements

At mid-frequencies, the power amplifier section of the STA-2200 receiver delivered a full 70 watts per channel into 8-ohm loads for its rated THD figure of 0.02 percent. For the same level of SMPTE-1M we were able to push outputs to the equivalent of 85 watts, as shown in the curves of Fig. 7. As might be expected, power output at the frequency extremes of 20 Hz and 20 kHz was not as great, but nevertheless exceeded the published rating of 60 watts. We measured outputs of 67 watts per channel at 20 Hz and at 20 kHz for 0.02 percent THD. Power bandwidth (for the rated 60 watts per channel output) extended from 9 Hz to 31 kHz, and the amplifier had a damping factor (referred to 8 ohms and measured with a 50-Hz signal) of 68. Dynamic headroom was a comfortable 1.58 dB, and we measured a slew rate of around 13 volts per microsecond.

Frequency response, measured via the high level (AUX) inputs, extended from 8.5 Hz to 27 kHz for -1 dB roll-off and from 4.0 Hz to 55 kHz for the -3 dB roll-off points. Phono input sensitivity, measured in accordance with IHF/EIA standards, was 0.28 mV (for 1-watt output), while signal-to-noise in phono for a 5-mV input signal and referred to 1-watt output measured 72 dB. For the high-level inputs, input sensitivity was 18 mV, and S/N (this time referred to 1-watt output with a 0.5-volt input) measured 77 dB. At minimum volume settings, the S/N improved (again, with respect to 1-watt output) to 83 dB. Phono overload at 1 kHz measured 200 mV.

Always a welcome feature in an all-in-one receiver, the action of the selectable turnover-type tone controls is depicted in the multiple sweeps of Fig. 9. Note that when the 150-

Hz bass turnover and 6-kHz treble turnovers are selected, midrange frequencies are virtually unaffected when the controls are in their full clockwise (boost) or counterclockwise (cut) positions. Loudness contour curves shown in Fig. 10 are typical of those obtained with this type of volume/loudness circuitry.

Listening Tests and Summary

As some of our test results indicate, frequency synthesis in tuners, while it certainly insures near-perfect tuning accuracy, does not generally result in a tuner that exhibits state-of-the-art signal-to-noise or distortion figures. The choice of this sophisticated tuning system along with its station memory facility in no way affects amplifier or preamplifier performance, both of which were exemplary in the sample I tested. When operated within its rated power levels, the Realistic STA-2200 delivered clean, natural sound in phono and tape reproduction. Tone controls are well designed, and the subsonic filter in the phono section is a welcome addition, even if it has to be built-in and permanently "on."

The pure audiophile may not think highly of the fancy tuning schemes, the LED displays, the digital time clock and the alpha-numeric displays generally, but we would guess that the music enthusiast who simply seeks convenience, ease of use, and reliable FM and AM performance will find the STA-2200 to be appealing both in price and in performance. With speaker efficiency higher than it was a few years ago, the 60-plus watt per channel capability of this receiver should fill the needs of most listeners who want an integrated receiver. The tradeoff chosen by Radio Shack was a wise one!

Leonard Feldman

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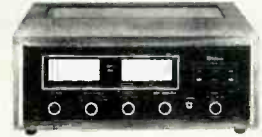
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SAE Two C4 Stereo Cassette Deck



Manufacturer's Specifications

Frequency Response: 30 Hz to 14 kHz,
30 Hz to 18 kHz with high-output
and with metal tape.

Signal/Noise Ratio: 55 dB, CCIR/ARM;
63 dB with Dolby NR.

Separation: 40 dB.

Crosstalk: -65 dB.

Erase: 65 dB.

Input Sensitivity: Mike, 0.18 mV; line,
57 mV.

Output Level: Line, 350 mV.

Flutter: 0.08 percent wtd. rms.

FF & RWD Times: 70 seconds for C-60.

Dimensions: 18¼ in. (464 mm) W x 5¼
in. (147 mm) H x 13¾ in. (340 mm) D.

Weight: 20 lbs. (9 kg).

Price: \$500.00.

The Model C4 stereo cassette deck is one of the SAE Two series of high-fidelity components. The manufacturer's stated philosophy on the introduction of this lower-priced line was to "combine the advantages of SAE's engineering preeminence with the efficiency of Japanese manufacturing." The front panel is a brushed, nonreflective black, with white designations for functions and switch positions. The combination is attractive and easy to read, in general, except with the lowest lighting levels. There are six, three-position toggle switches with spring loading and large handles, which are aids in making changes. The functions and settings are as

follows: *Timer/Rec-Off-Play, Memory/Stop-Off-Repeat, Dolby NR/Mpx-On-Off, Bias/Metal-Hi-Low, EQ/70-70-120, and Input/Mic-Line-Rec Mute.* The timer function will certainly be helpful to some, and the inclusion of *Repeat* for memory adds convenience if there is any need to replay something, perhaps to check a recording just made. There is no bias-switch position for FeCr tapes, but there is a worthwhile bias-adjust pot, with the desirable center detent. The *Rec Mute* function removes the signal from the meters and the headphones, so monitoring must be done with the main system.

The record-level control has a very large, easily set knob

and, with rotation, has the feel of a multi-step attenuator. There is also a level-balance control with a center-position detent. Metering is by bluish fluorescent bargraphs, scaled from -25 to +5 dB, with Dolby level indicated at about +3 dB. Each bar has 12 double-segments to cover the range, with smaller steps around 0 dB. Tape-motion controls are all light-touch bar switches. Each one has a red status light at the top, with the exception of *Stop*. The C30 remote control unit supplied with the deck repeats all of the functions, but it does not have any status lights. The logic allows switching among all of the modes, including going into *Rec* while in play or fast wind. This feature may not be used by some, but if there is a need for flying-start recording, the C4 has it.

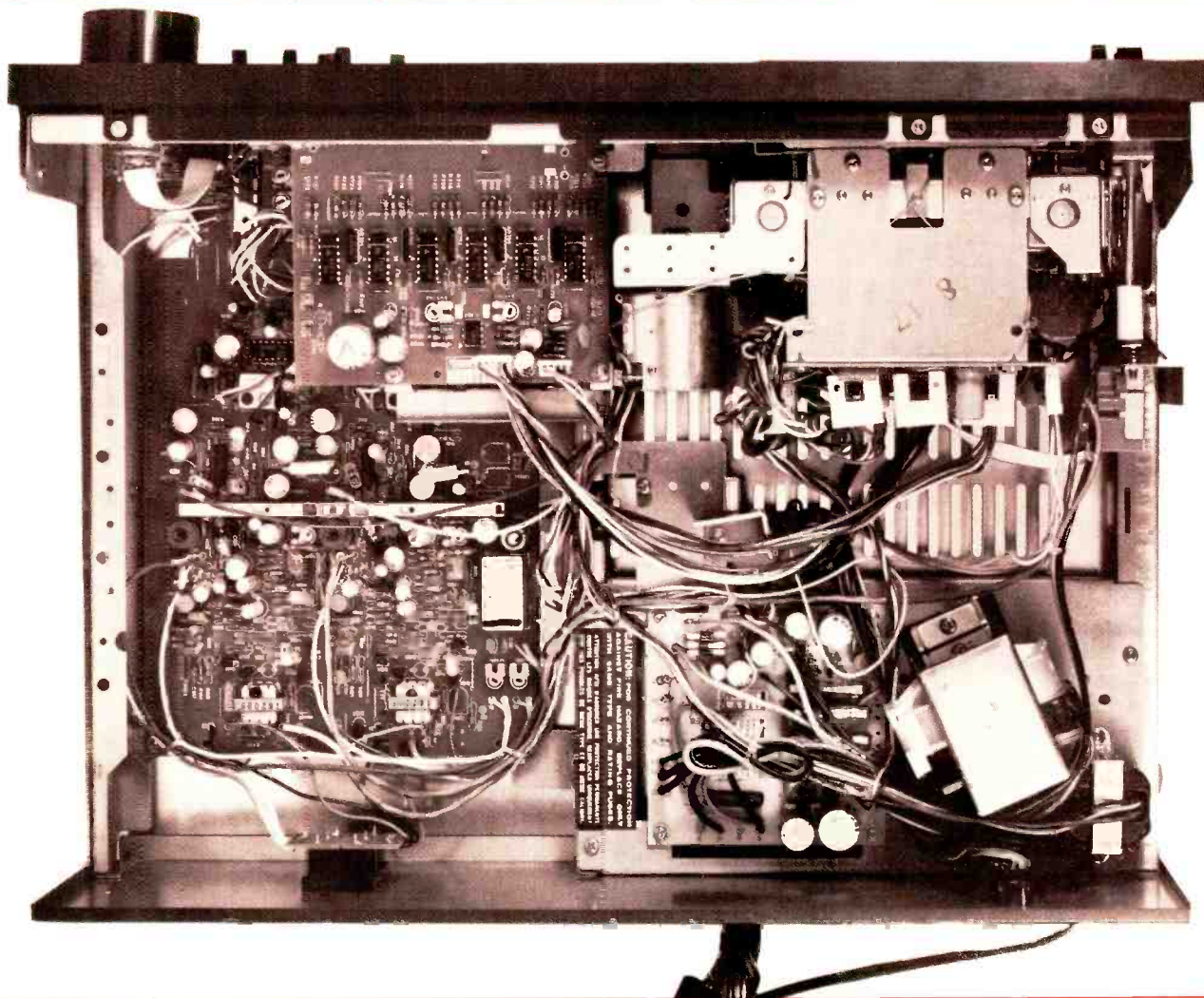
The cassette carrier/door opens smoothly to provide excellent access for cleaning and demagnetization. The push buttons for *Eject* and *Power* caused a little confusion as their shapes are not typical, and the designation "Eject" is closer to the a.c. switch than is "Power." There are phone jacks for mike inputs and for stereo headphones. The line-in/line-out phono jacks are on the rear panel, as is the socket for the remote control. Removal of the steel top and side cover (with

wood end pieces) revealed one large p.c. board with smaller ones for logic, motor control, and power supply. The soldering was very good with very little flux residue. Parts were identified by number, although adjustments were not labeled with the functions. Most interboard connections were direct-wire soldered, with some multi-pin plugs. Four internal fuses were noted, all pigtail type and soldered in. There were two transformers, one quite large and one small. The lack of a schematic prevented determining the splitting of power functions between the two.

Performance

The first test made on the SAE Two deck was on playback response, and the playback responses were both very flat over most of the range, but were down 2 to 3 dB at the lowest and the highest frequencies. The meter indication for Dolby level was a dB low. In a record/play test with a 10-kHz tone, there was about 50 degrees of phase jitter, average for a cassette deck.

With the aid of a pink-noise source and a 1/3-octave RTA, about a dozen tape formulations were checked for perform-



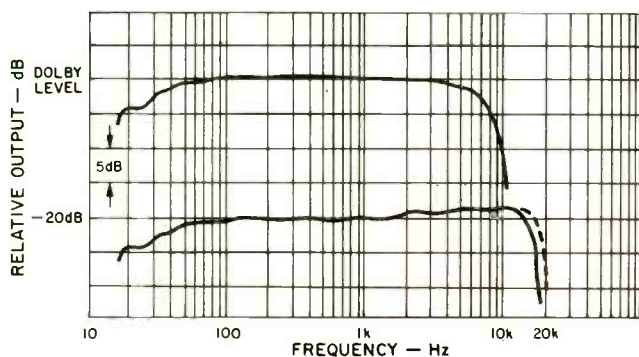


Fig. 1 — Frequency responses in Dolby mode with Maxell UD-XL I tape. High-end response without Dolby NR (dashed line).

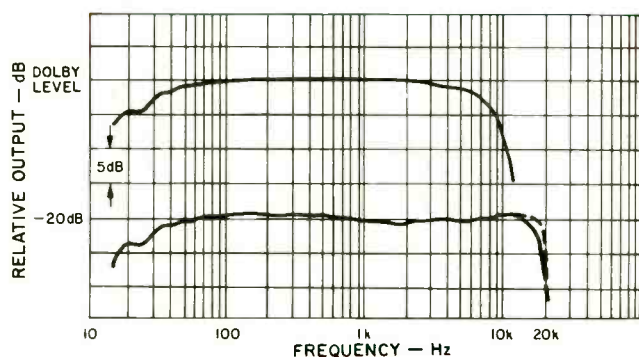


Fig. 2 — Frequency responses in Dolby mode with BASF Studio II tape. High-end response without Dolby NR (dashed line).

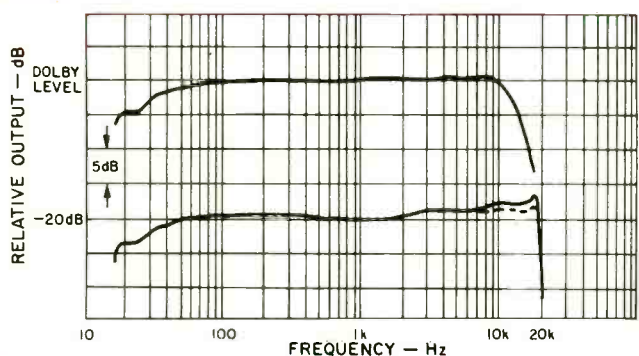


Fig. 3 — Frequency responses in Dolby mode with TDK MA-R tape. High-end response without Dolby NR (dashed line).

ance. Maxell UD-XL I, BASF Studio II and TDK MA-R gave the best results with the C4, but Scotch Master I, TDK D, Memorex High Bias and Scotch Metafine were very close — particularly with the use of a little bias trim. Swept record/playback responses were run at both Dolby level (200 nWb/m at 400 Hz) and 20 dB below that. The results for the three tapes used are shown in Figs. 1 to 3 and in Table I. The figures are at least as good as the manufacturer's specifications, similar to those for other decks in the same price category. The responses in Dolby mode were very close to those without NR, better tracking than with quite a few decks. The bias control had a range of ± 2.5 dB at 10 kHz with BASF Studio II. The multiplex filter was down 3 dB at 15.6 kHz and over 30 dB at 19 kHz. Bias in the output during recording was satisfactorily low.

Fig. 4 shows the results of measuring the level of the third harmonic distortion, HDL₃, with the three tapes with 1 kHz at record levels from -10 dB re: Dolby level to the three-percent distortion limit. The lowest distortion was obtained with Maxell UD-XL I, and the results for the other two tapes match each other. The figures are to spec, and the associated, and quite good, signal/noise ratios are given in Table II. For distortion as a function of frequency, the results were typical at the lower frequencies, but much lower than most decks at the highest frequencies (see Fig. 5). With 1-kHz test tones, separation between channels was 44 dB, crosstalk was down at least 80 dB and erasure was greater than 80 dB, all excel-

Table I—Record/playback responses (-3 dB limits).

Tape Type	With Dolby NR				Without Dolby NR			
	Dolby Lvl		-20 dB		Dolby Lvl		-20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell UD-XL I	30	7.2	31	17.0	30	7.3	31	19.3
BASF Studio II	30	7.0	29	18.0	30	7.1	29	20.0
TDK MA-R	30	12.8	29	20.3	30	12.8	29	20.5

Table II—Signal/noise ratios with IEC A and CCIR/ARM weightings.

Tape Type	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby NR		Without NR		W/Dolby NR		Without NR	
	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Maxell UD-XL I	62.0	65.0	53.4	56.4	61.5	64.5	51.3	54.3
BASF Studio II	63.0	65.0	54.7	56.7	62.5	64.5	52.5	54.5
TDK MA-R	63.9	66.4	55.3	57.8	63.0	65.5	52.5	55.0

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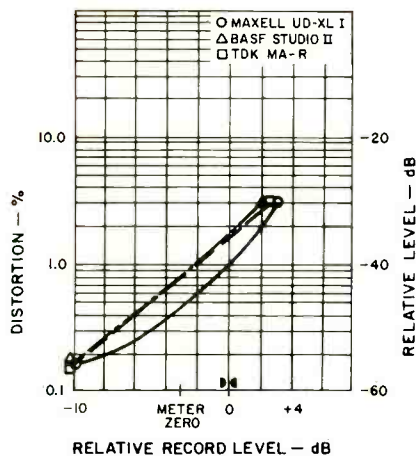


Fig. 4 — Third harmonic distortion vs. level in Dolby mode at 1 kHz with Maxell UD-XL I, BASF Studio II, and TDK MA-R tapes.

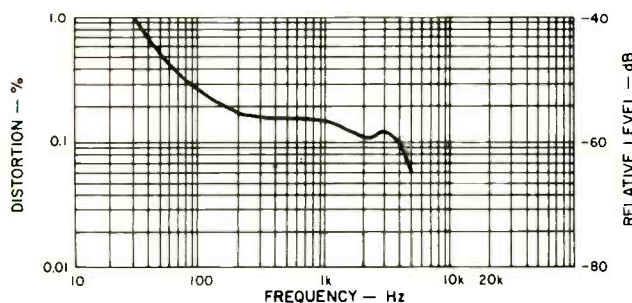


Fig. 5 — Third harmonic distortion vs. frequency in Dolby mode at 10 dB below Dolby level with TDK MA-R tape.

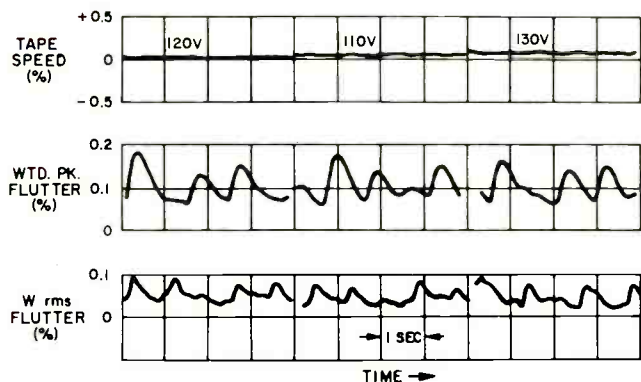


Fig. 6 — Flutter (three trials) and tape play speed vs. line voltage.

lent results. The erasure of metal tape at 100 Hz was about 70 dB, very good.

The input sensitivity on mike was 0.22 mV; that for line was 54 mV — both substantially to spec. Input overload points were quite high, 48 mV for mike and something over 29 V for line. Output level clipping first appeared as some flattening of the negative peaks of the test signal at around +10 dB relative to meter zero. The two sections of the level pot tracked within a dB from maximum down at least 50 dB, excellent performance. The output levels were 50 mV for headphones with an 8-ohm load and 380 mV at the line outputs, which dropped to 335 mV with the standard IHF load. There was satisfactory volume with most headphones tried, although some were slightly low in level. The fluorescent-bar meters are scaled from “-25” to “+5” with single-dB steps from “-1” to “+1.” All of the thresholds were accurate, much better than with most meters.

The response time was checked with a 5-kHz tone burst, and the attack time was actually on the fast side of the limits for peak program meters meeting IEC Standard 268-10. The decay time was much too short, being about the same as the attack time.

Tape speed at 120 V was about 1.3 percent fast, more than found with most decks. With changes in line voltage (Fig. 6), there was a slight increase in speed, but the speed was generally smooth. Typical values for flutter were 0.075 percent wtd. rms and 0.12 percent wtd. pk. There were fairly regular perturbations that caused momentary figures noticeably larger. Wind times for a C-60 cassette averaged 68 seconds. The time from tape run-out to automatic stop was 3 to 4 seconds. Less than 1 second was needed to change wind directions, and just about 1 second to go from wind to play mode.

Use and Listening Tests

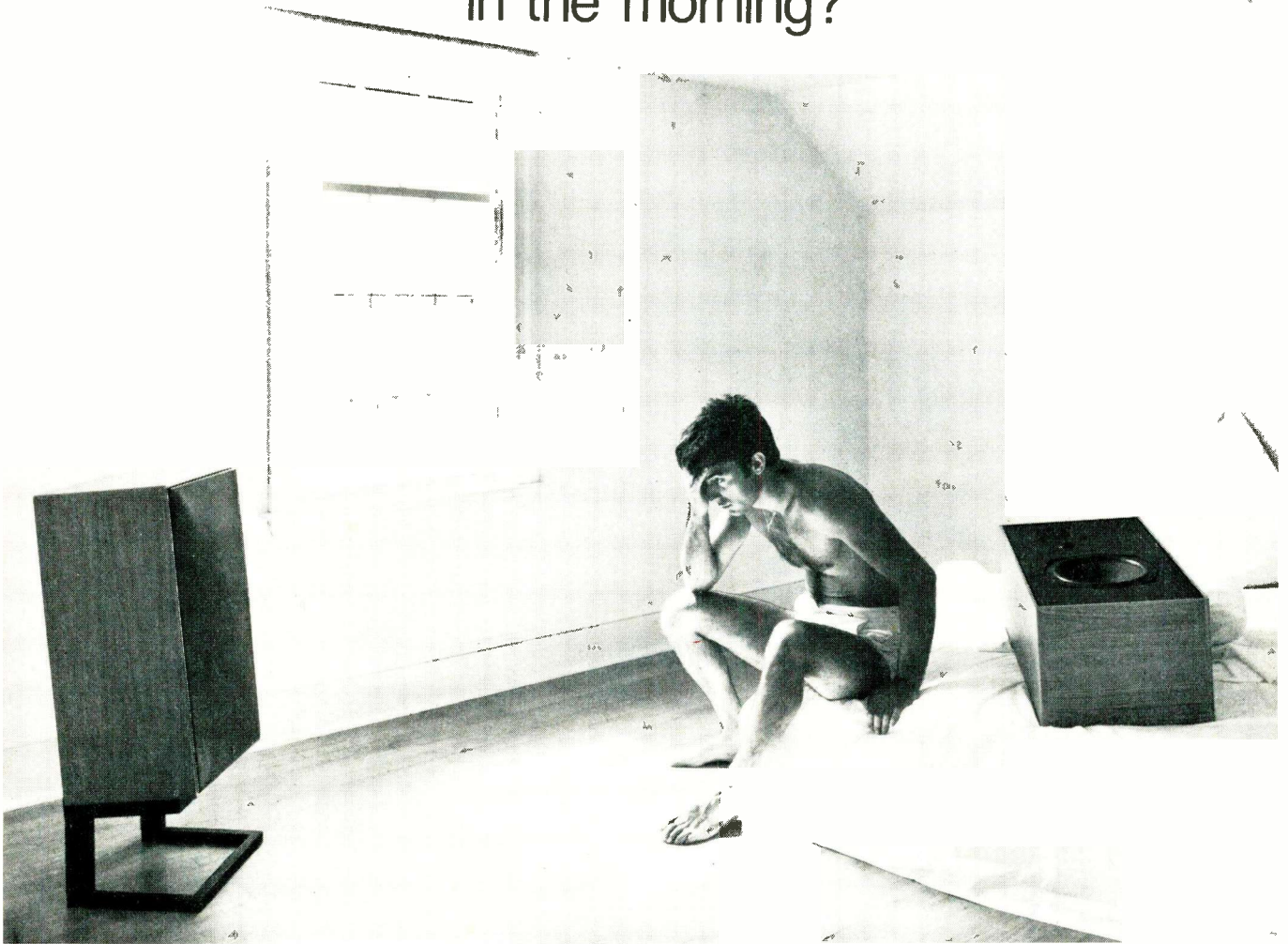
All required maintenance tasks were a snap to perform, even without removing the door/cover. Loading and unloading cassettes was simple, with a little care to ensure missing a little step inside the door. The great flexibility of the tape motion controls and the memory functions were used to advantage a number of times during the testing. It was hard to see the scales of the meters in a less-than-bright room, and the very rapid decay made metering difficult in trying to set maximum levels. All timer and memory functions worked as intended in a number of trials.

The instruction book is quite brief, but the text gets right to the point so the meat content is fairly high. There are few illustrations, and there is little detail in the ones provided. The suggestion of using FM noise and recording at -20 dB is a good one, but the user should adjust bias for the best listening results, as adjusting for the best level match flirts with sonic difficulties. A number of records were copied for comparison with playback: *The New Brubeck Quartet*, *One Cut Above*; Linda Ronstadt, *Hasten Down the Wind*; Holst, *The Planets* with the Concertgebouw Orchestra with Neville Marriner, and others. The first attempts had some harshness at times, and there was some overload on the kickdrum on the Ronstadt disc. The conclusion was that the recording levels were somewhat high, and lowering them for the second trials gained improvements in all cases and resulted in good recordings. Stop clicks were a few dB out of tape noise, but record and pause effects were generally not discernible.

The C4 offers tape motion control flexibility that many other cassette decks do not, though it does not include mike-line mixing which could be important to some. Overall, the SAE Two C4 cassette deck will stand up on a comparison to other decks in the same price class. *Howard A. Roberson*

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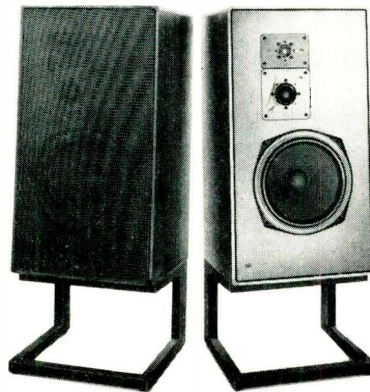
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Mordaunt-Short Signifer Loudspeaker

Manufacturer's Specifications

System Type: Three way, reflex.

Drive Units: MS DCB 300 bass, MS DCM 135 midrange of special design, and Isophon 25-mm soft-dome tweeter.

Frequency Response: 38 Hz to 20 kHz, ± 2 dB.

Crossover Frequencies: 500 and 4000 Hz.

Nominal Impedance: 8 ohms.

Power Handling: 250 watts continuous, contoured noise.

Dimensions: 810 mm (31.9 in.) H x 385 mm (15.2 in.) W x 325 mm (12.8 in.) D; stands, 230 mm (9 in.) H x 385 mm (15.2 in.) W x 350 mm (13.7 in.) D.

Weight: 29 kg (63.8 lbs.).

Price: \$1,740.00 per pair with stands.

The Signifer is a full-range loudspeaker system manufactured by Mordaunt-Short Ltd., UK. Standing slightly over a meter when placed on its stand, the enclosure houses a three-way reflex system. Finish is in wood veneer and accent is provided by a brown-cloth snap-on grille.

A woofer with 25-cm active piston diameter is used in a vented design enclosure to cover the frequency range from 20 to 500 Hz. A 135-mm midrange driver covers the range from 500 Hz to 4,000 Hz, and 25-mm dome tweeter provides the very highest frequencies. The midrange and tweeter are positioned slightly to one side of the vertical axis of the enclosure, and the two systems come as mirror image pairs.

The cabinet is finished in wood veneer on all sides and front. The front panel is recessed one centimeter so that the snap-on grille essentially fits flat with the sides when in place. A metal strip on the lower part of the front panel holds a five-position rotary switch labelled "acoustic environment balance control," marked in unit steps from -2 to +2.

Connection is made to push-on posts mounted in a recessed cavity on the rear of the enclosure. This cavity also houses a 3.15-ampere fuse. Connection polarity is clearly marked by a combination of red cap and raised + symbol. No difficulty should be experienced in proper electrical connection to these loudspeakers, even by those with no previous experience in hookup.

The loudspeakers come with a parts kit containing a spare fuse and a length of trimmed and tinned hookup wire. There is also a reprint of a review which this system received in the UK, but absolutely no user manual or instructions of any kind. A check with the manufacturer revealed that this was not an inadvertent oversight in shipping, and that a brochure is in process of preparation. As a consumer advocate, I per-

sonally object to any situation of this kind. Firstly, the mounting stand must be assembled by the user, without instructions. Granted, it doesn't take an Einstein, but there are some who might like a sketch of what it is supposed to resemble when assembled, and what to do with it.

Second, our correspondent did point out one potentially significant user item, to quote: "Please take note of the patented midrange drive unit. It has no conventional surround and this severely limits the excursions. This physical limitation to frequency response insures a flat, smooth midrange."

Finally, the speakers are supplied with tweeter and midrange as mirror-symmetric pairs, but there is no identification on the speakers as to which should be left or right in a conventional stereo listening configuration. The correspondent pointed out this design feature and stated that the tweeters should be placed towards the middle, determining left and right. In my opinion, a simple L and R on the back of the speakers would serve the purpose nicely.

With that off my chest, I must point out that the Signifers show excellent workmanship and attention to detail.

Laboratory Measurements

The magnitude of impedance which the Mordaunt-Short Signifer presents to a power amplifier is shown in Fig. 1. Two measurements are included, equalizer at nominal and equalizer at maximum clockwise position (+2). Although this is rated as an 8-ohm system, a minimum impedance of 4 ohms is reached at 1.5 kHz in the +2 equalizer position. I recommend that this speaker therefore be considered a 4-ohm system from the standpoint of drive requirements and amplifier connection.

On the matter of amplifier connection, Mordaunt-Short

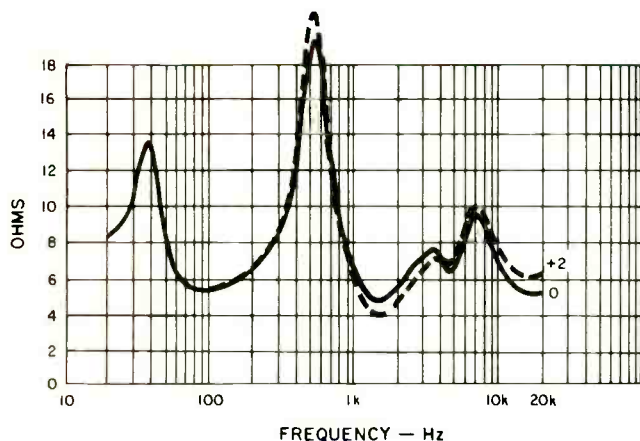


Fig. 1 — Impedance measured at the terminals for two equalizer settings.

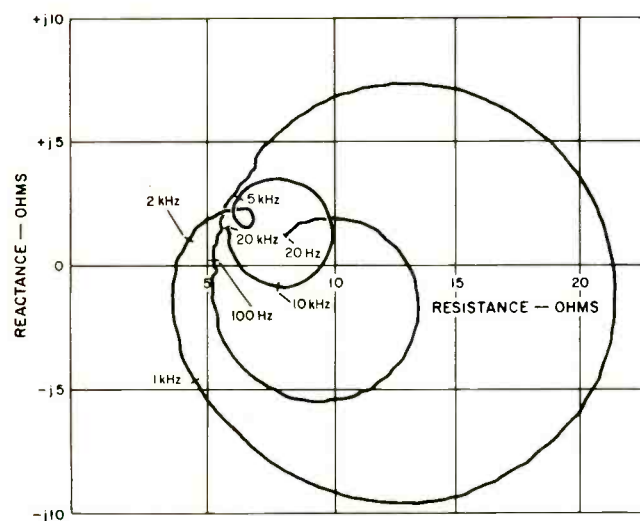


Fig. 2 — Complex impedance at the terminals for the +2 equalizer setting.

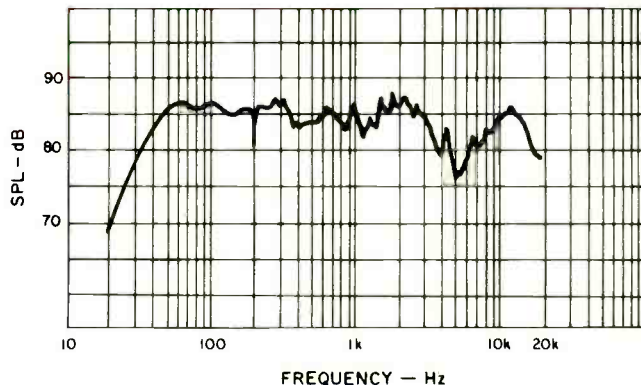


Fig. 3 — Anechoic frequency response at one meter on-axis for a constant-voltage drive level corresponding to one average watt into 8 ohms.

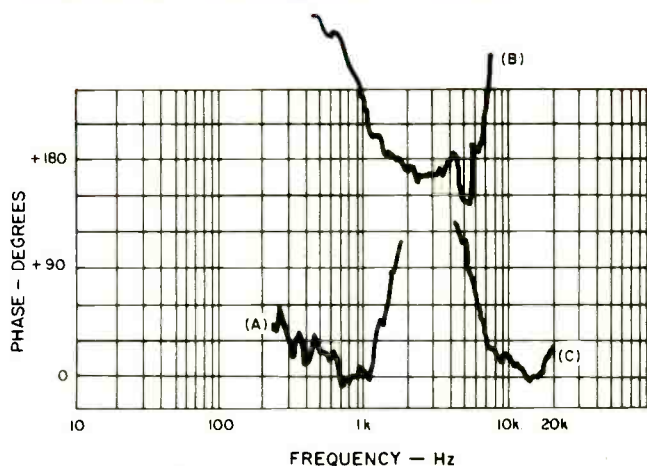


Fig. 4 — Phase response measured in the same position as Fig. 3, corrected for (A) acoustic time delay of woofer, 3.9170 mS; (B) acoustic time delay of midrange, 3.3482 mS, and (C) acoustic time delay of tweeter, 3.0965 mS.

provides a length of hookup wire with each speaker. This wire is quite small in diameter and has a net short-circuit impedance of 0.342 ohms resistance and 5.5 microHenries inductance. In view of the extreme loudspeaker impedance change, over five to one, from 500 Hz to 1.5 kHz, I recommend that this wire not be used since its line drop will change the acoustic response by nearly 1 dB in this important part of the frequency range. Use large diameter hookup wire for this speaker.

The complex impedance for the +2 equalizer position is plotted in Fig. 2. Although the lowest magnitude of impedance is reached at 1.5 kHz, the impedance around 1 kHz will present a more severe load to many power amplifiers. The impedance of around 4 ohms with a capacitive reactance phase shift of nearly 45 degrees may cause difficulty for some power amplifiers, particularly those amplifiers with internal current limiting protection circuits. High-quality power amplifiers, capable of driving low impedances, should be used with this loudspeaker.

The one-meter on-axis frequency response is shown in Figs. 3 and 4. Figure 3 is the sound pressure amplitude for a constant-voltage drive corresponding to one average watt into an 8-ohm resistance. The equalizer is set to its nominal

position for these measurements. Low frequency response is uniform down to a cutoff of around 40 Hz. With the exception of a broad dip at 5 kHz, the anechoic response is quite smooth out to 15 kHz.

The one-meter anechoic phase response is shown in Fig. 4. Since acoustic positions differ for woofer, midrange, and tweeter, three phase measurements are shown, and each phase measurement is corrected for the appropriate air path and time delay. On this axial location, the sound from the tweeter arrives before the sound from the midrange and woofer drivers. The midrange sound is delayed 0.2517 millisecond relative to the tweeter, and the woofer is delayed 0.8205 millisecond. The phase measurement shows that acoustic crossover frequencies are 1 kHz and 7 kHz. The polarity of drivers is such that a positive-going voltage on the correspondingly marked loudspeaker terminals produces an in-phase positive-going sound pressure at the listening location for sound from the woofer and tweeter, and negative-going for the midrange. The sound from each driver (woofer, midrange, and tweeter) is minimum phase, but the combination of polarity reversals and differential time delay cause the net response to be of non-minimum phase type.

The three-meter room response, Fig. 5, is the frequency

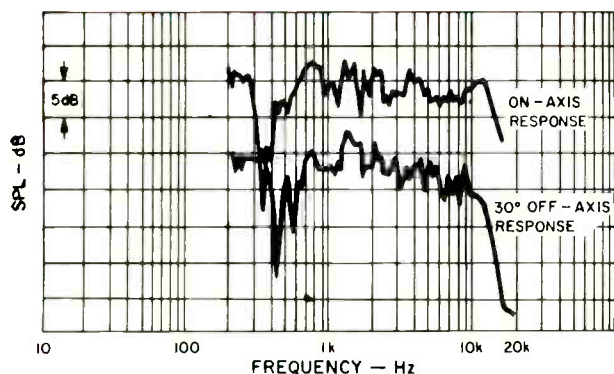


Fig. 5 — Three-meter room test.

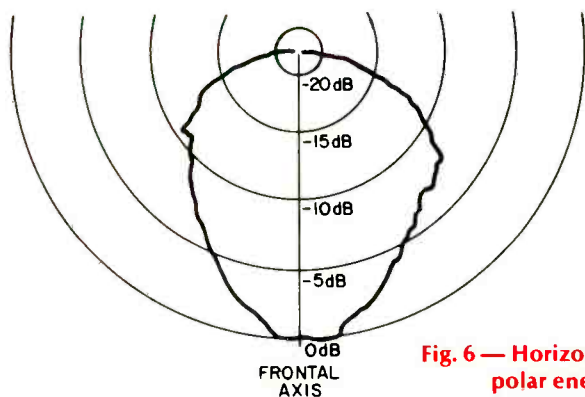


Fig. 6 — Horizontal polar energy response.

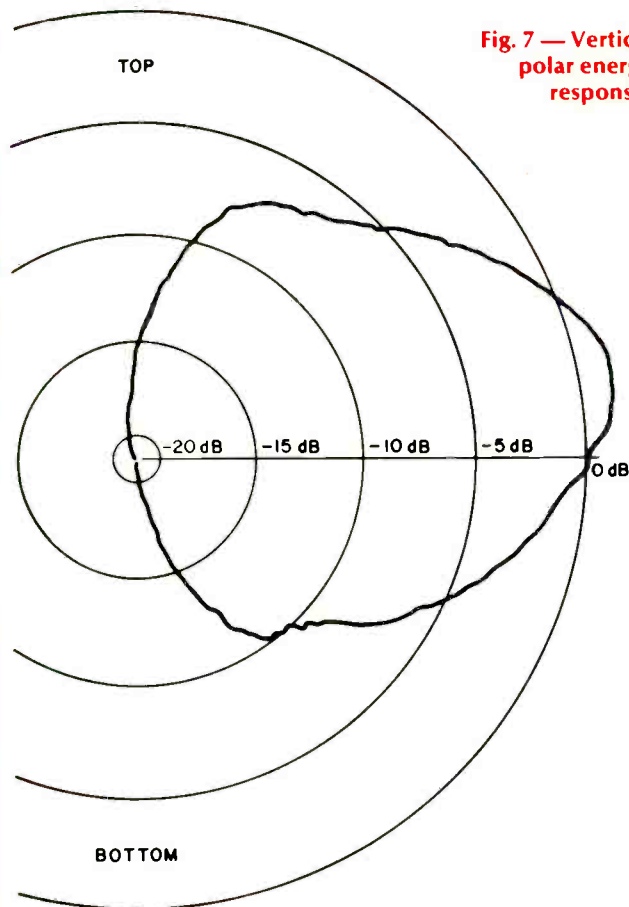


Fig. 7 — Vertical polar energy response.

spectrum of the first 13 milliseconds of sound which arrives at an average listening position three meters from the loudspeaker and one meter above a carpeted floor. The system was placed 25 centimeters in front of a rear wall for this test. The upper curve is the response directly in front of the loudspeaker. The lower curve, displaced 10 dB for clarity of presentation, is the response 30-degrees off-axis with the speaker in a left-channel stereo listening position. This room response is smoother in upper register than the anechoic response, which is quite unusual. The difference is the listening position relative to the front of the enclosure. Direct on-axis room listening provides better high-frequency performance than off-axis listening, as was confirmed by the earlier listening test. The speakers should be rotated toward the listening location for best high frequency performance.

Horizontal and vertical polar energy responses are shown in Figs. 6 and 7 respectively. These measurements verify that significant reduction of direct sound energy occurs for horizontal listening positions more than 20 degrees off the geometric axis. The Signifiers should be rotated toward the preferred listening position for best stereo balance as well as frequency response. Since there is a substantial amount of sound energy launched upward, as well as forward, these speakers should not be placed directly under acoustically reflecting objects, such as overhanging shelves.

Harmonic distortion for the musical tones of E_1 , A_2 , and A_4 is shown in Fig. 8. Distortion components remain moderately low up to an average power of 60 watts. Above this level, the tones of E_1 and A_2 show some acoustic distress.

Intermodulation on A_4 (440 Hz) by low E_1 (41.2 Hz), when both are mixed at equal drive level, is shown in Fig. 9. Up to 10 average watts, intermodulation is principally phase modulation of the higher tone by the lower tone. Above this drive level, a small amount of amplitude modulation begins to creep in to add to the phase modulation. The phase modulation does not significantly rise for levels above 20 watts. A burst of 100 average watts produces 3 degrees peak-to-peak phase modulation and 10 percent amplitude modulation with a net 5 percent reduction and 1.5 degree phase advance of the tone of A_4 .

We measure musical dynamic capability of a speaker by the extent to which a low-level inner musical voice has its level changed by the presence of broad-band high-level sounds not otherwise related to that tone. It is a measure of dynamic compression which we call a crescendo test. The Signifer passed this test exceedingly well. A tone of middle C (262 Hz) had its level changed less than 0.1 dB by the addition of white noise with an rms level 20 dB above that of the tone. This property was maintained up to peak levels of over 250 watts. This means that solo instruments will not jump kangaroo fashion on the stereo stage with loud orchestral outbursts.

Another measurement related to subjective stereo dynamics is that of acoustic transfer gain. An ideal speaker is one for which each dB increase of drive voltage produces a dB increase of sound pressure. If the sound pressure increment is less than a dB per dB, the effect is similar to that of compression. If the compression, or expansion, is frequency dependent as well as power level dependent, both timbre and dynamics will be adversely affected. The Signifer has a mild compression in transfer gain with power level but little change with frequency. Relative to 0.1 average watt, the one-watt sound of 50 Hz is down 0.2 dB, 110 Hz is down 0.2 dB, 262 Hz is down 0.1 dB, and 440 Hz is down 0.25 dB. At 10-watts drive the compression is 0.5 dB, 0.4 dB, 0.6 dB, and 0.4 dB for these same frequencies. Above 60 watts, the compression on 50 and 110 Hz is greater than one dB, while middle C

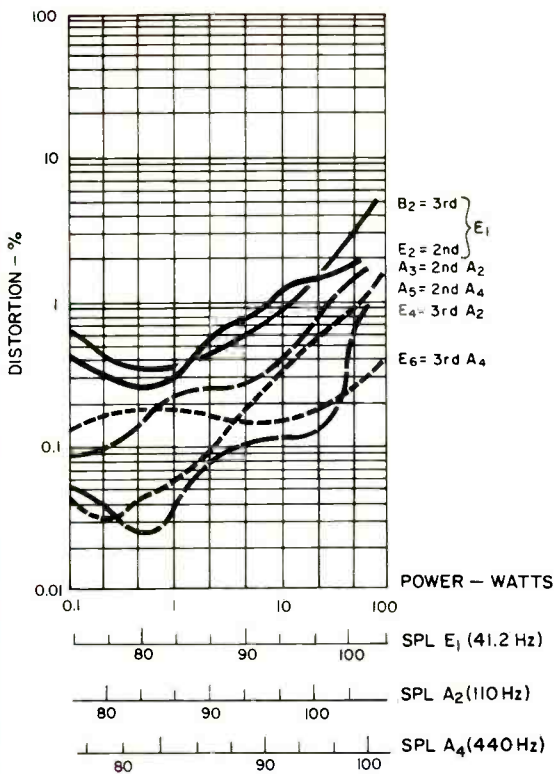


Fig. 8 — Harmonic distortion for the tones of E₁ or 41.2 Hz, A₂ or 110 Hz, and A₄ or 440 Hz.

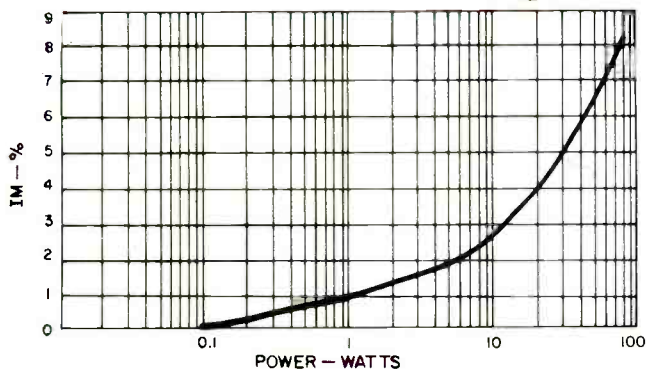


Fig. 9 — IM distortion on A₄ (440 Hz) by E₁ (41.2 Hz) when mixed in one-to-one ratio.

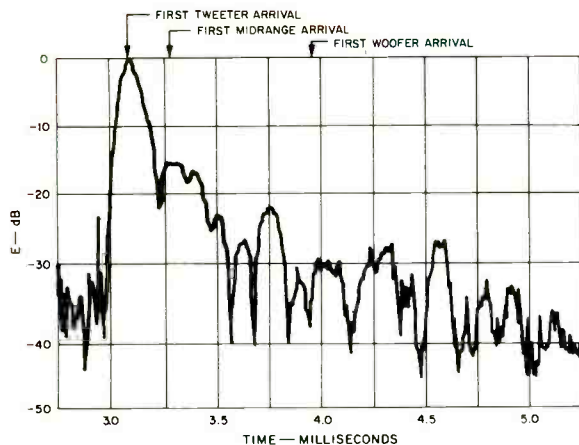


Fig. 10 — Energy-time curve.

and A₄ hold up well. This indicates that the Signifer may tend to soften orchestral dynamics at high sound levels, but should cause very few timbral changes during such passages.

The one-meter energy-time curve is shown in Fig. 10. The first sound from the tweeter arrives at 3.03 milliseconds and accounts for the substantial peak of early energy. The mid-range driver contributes most of the energy which is seen from 3.2 to 4 milliseconds. Subsequent energy peaks are due to sound reflecting off edges on the front of the enclosure. All in all, this is a respectably good energy response and supports the smoothness of frequency response measured under anechoic conditions.

Listening Test

The listening tests were performed prior to measurement with the Signifers placed approximately 25 centimeters in front of a draped wall. Spacing between the speakers was such that they subtended a 60-degree listening angle at a distance of 3 meters.

The Signifers were quickly shown to have a moderate amount of horizontal beaming in the highest registers. It became necessary, in my opinion, to rotate each speaker toward the listening position in order to provide best spectral balance and most realistic stereo image.

The 5-position rotary switch labelled "acoustic environment balance control," on the front panel of each speaker system, is subtle in operation and affects only the highest registers. After considerable experimentation with various types of program material, I came to the conclusion that the central position provided the best compromise for the room in which the listening test was performed.

These speakers also evidenced a moderate amount of vertical beaming of high frequencies. Good stereo imaging could not be consistently maintained as I moved about the general listening area. Timbral changes and spatial image shift are problems caused by any large changes in listening position.

The bass is well balanced, although there is no super low end. Response extends smoothly down the register to somewhere near low E, then gracefully exits to inaudibility.

The top end is somewhat bright, but clean and free of audible distortion at moderate sound levels, but becomes somewhat harsh at high drive. The upper midrange, in the octave above middle C, sounds harsh, to my ears, even at moderate level. In way of explanation, when I say moderate level, I mean loud; when I say high level, I mean darn loud.

Vocals, both solo and choral, are reproduced with good stereo illusion of presence. Stereo imaging, both in lateralization and depth, comes off well for this class of material.

In my opinion, there is a tendency for some instruments, notably horns, to smear in spatial position when reproduced at high level. Thus, while simple orchestral dynamics are well reproduced, certain loud passages showed distress. In view of the nature of impedance (which was measured after the listening test is performed), a second listening test was made to determine if the power amplifier was getting into trouble. Careful check showed that it was not the amplifier.

The Signifer does a good job of reproducing piano, which is a tough test. While one would never be fooled into believing he were listening to a live piano, the sonic accuracy is quite good, above average for speakers in this price range.

Percussive sounds are also handled well by this system. Cymbals, blocks, and hand claps come through a bit bright, but accurately located in the stereo stage.

On the average, I feel that this system provides excellent value for those who want accurate sound at less than lease-shattering acoustic levels.

Richard C. Heyser

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In this series we are discussing the various aspects of preamplifier performance which vitally affect the overall sound of your high-fidelity music system.

The sixth of these is absolute polarity. At the beginning of a sound such as a tympani drum beat, a singer's voice, or a hand clap the moving air may be first compressed, then rarefied. The *absolute polarity* of such signals is audible: somehow the ear expects the compression first. But many available preamplifiers have their outputs out-of-polarity (out of phase by 180°) with their inputs and the polarity often changes when, for example, tone controls are added to the circuit. (Note we are not talking about differences between two stereo channels which is clearly audible, but to the *absolute* polarity—matching the signal pressure perceived by the ear to the original signal.)

Only recently has the audibility of absolute polarity been noticed widely. The Apt/Holman Preamplifier, unlike many others, is designed to maintain absolute polarity under all conditions. This includes to and from all the inputs and outputs such as the send and receive lines for the tape and external processor loops, and all the control functions. Most tone control circuits do invert polarity when they are engaged because they are based on the Baxandall negative feedback type which does invert. In the Holman Preamp each internal signal polarity reversal has been matched with another reversing stage to ensure that the criteria of no overall polarity reversals is always met.

The Apt 1 Amplifier also meets the criteria of having no net polarity reversal, whether used in conventional stereo or in bridged mono modes. Therefore an overall system from Apt is free from this "distortion" under all modes of operation.

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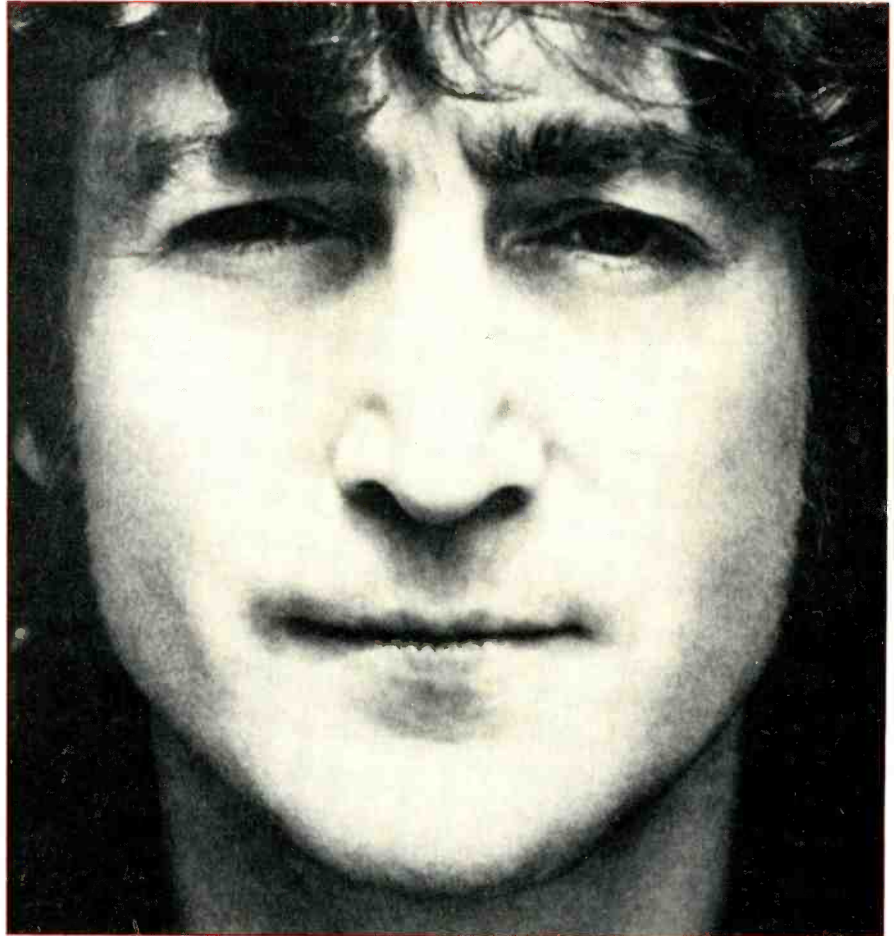
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Jon Tiven

Michael Tearson

The column



Double Fantasy: John Lennon/Yoko Ono
Geffen Records GHS 2001, stereo,
\$8.98.

Radio's predictable instant reaction to this disc was to ignore Yoko Ono completely and in the wake of the shock, DJ's tend to refer to it as seemingly the last *John Lennon* album. But that is not all it is. John and Yoko shared this project *completely* — going to the extreme of alternating songs between them, first one of John's and then one of Yoko's.

As a format, this is a bold and potentially exciting departure; in reality it sounds like a forcing together of two separate projects with little in common. Sure, each person has written a lullaby called *Beautiful Boy* and the songs thematically effect dialogue, but the whole rarely achieves a sense of

unity. The notable exception is the ironically titled *I'm Losing You/I'm Moving On* segue, since both sets of lyrics are written over the same rhythm and changes and act as flip sides to the same story.

Much of the material is dull, unexciting or so precious that one may feel like an intruder on private thoughts not intended for public consumption. I didn't like the first single, *(Just Like) Starting Over*, the first time I heard it and lots of wear hasn't changed my opinion. Yoko's vocals on *Kiss Kiss Kiss* sounded pretentious to me 10 years ago. I'm not sure I can appreciate *Cleanup Time*, which appears to be John's account of house-husbanding. Yoko's concept of cabaret, *I'm Your Angel*, is hopelessly cutesie-pie.

John's best moment may be *Watching the Wheels*, a surprisingly spirited

In this series we are discussing the various aspects of power amplifier performance which vitally affect the overall sound of your high-fidelity music system.

defense of his having done nothing musical for so long. Yoko's best is the deliciously bitchy *Give Me Something*. And they share the triumph of achieving solidarity in *I'm Losing You/I'm Moving On*.

Double Fantasy is nothing special in the production arena ... pretty

straightforward except for several bits of conversation inserted at very low levels for effect's sake. The playing is standard New York session stuff.

Although it wasn't quite the album I'd anticipated after waiting five years, at least the lad (and the lady) gave it one good try. M.T.

Autoamerican: Blondie
Chrysalis CHE 1290, stereo, \$8.98.

One of two things is going on here ... either the group is trying to break with type and widen their appeal because the **Autoamerican** material is oddly skewed toward nightclub and

cabaret stuff — a concept they simply do not pull off convincingly. Tinny sound undermines whatever chance this weak material ever had. Or Blondie just made a total clunker. M.T.

Sound: D+

Performance: D



Taking Liberties: Elvis Costello
CBS JC 36839, stereo, \$8.98.

Musically speaking, there's not much to complain about with this record, since many of Elvis' more interesting moments have surfaced on the flip sides of singles and extended-play records which are either difficult or totally impossible to come by. On **Taking Liberties**, we find them assembled in one neat package. To fans of Costello, most of this stuff is the veritable unearthed treasure of which they dream; all others are sure to find this as esoteric as anything else he's done.

The sequencing is a little random, as the 20 tracks don't appear according to chronology, rarity, or in order of which girl they've been written about.

Radio Sweetheart and *Stranger in the House* are the earliest works and demonstrate not only the country &

western side of Elvis, but that The Attractions are greatly responsible for Elvis sounding as unconventional as he does. (We realize there are negatives and positives to this argument, but we'll reserve judgment until he makes an entire album without them.)

Night Rally, *I Don't Want To Go To Chelsea*, and *Crawling to the U.S.A.* aren't exactly unfamiliar, having been part of his live set and were FM radio favorites. *Big Tears* and *Tiny Steps* were both excellent flip sides, with the former track demonstrating what The Attractions might sound like if they had Mick Ronson playing guitar with them.

The most recent material is all Elvis-produced, including his tribute to Elton John entitled *Just A Memory* and an earlier composition called *Hoover Factory* demonstrating how much pro-

The sixth of these is that it is difficult to change rapidly the voltage across a capacitive load—a capacitor resists instantaneous voltage change as an inductor does current change. But many protection circuits and output stage designs limit the maximum instantaneous current which can be delivered. The high peak current demands caused by such a load may not be met because of several factors: there may not be enough drive available for the output transistors, the output stage may employ self-current-limiting FETs, or the protection circuit may clamp the maximum current allowed. Many specifications may be affected—high-frequency distortion is an obvious one, but others may be too. One amplifier which is rated at a slew rate of 50 V/microsec in fact slews at only 7 V/microsec when faced with only a 2 microfarad capacitive load (which is 8 ohms at 10 kHz) due to a 14 ampere absolute current limit.

The Apt 1 Amplifier, on the other hand, has no instantaneous current limit—instead the protection circuit examines the conditions of voltage, current, and time which appear across the output stage and disconnects the load when necessary with a relay to prevent a fault. And since such large demands occur only infrequently, the Apt 1 does not even shut down under program conditions which require 30 amperes or more of peak current. Thus such important matters as the slew rate of the amplifier and distortion performance remain unperturbed by even difficult capacitive load impedances.

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duction can alter a song.

Although there's stuff here like *Dr. Luther's Assistant* and *Ghost Train*, there's still more to surface, but these selections should keep you held-over until his next album. This is the kind of record that's released when an artist leaves a label, so why is **Taking Liberties** out now? So the record company can increase its Christmas sales, that's why! So don't expect any artistic sense out of this LP. It's about half filler

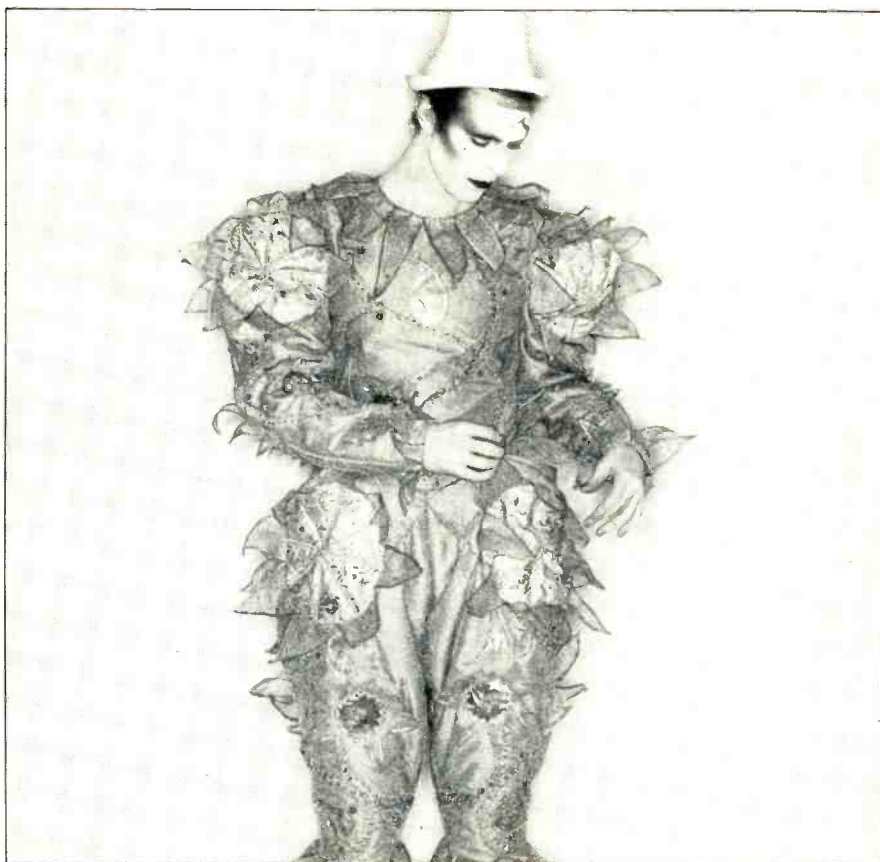
(which is way better than the average artist nowadays), and the most recent material to be found here shows E.C. at his most eccentric, if not at his best.

Now we're waiting for him to make a record that's as well-produced, rhythmically-grounded, and yet still as off-the-wall as he's demonstrated himself capable of being in the past.

Jon & Sally Tiven

Sound: B-

Performance: B



Scary Monsters: David Bowie
RCA/AQL 1-3647, stereo, \$8.98.

Scary Monsters is not a pleasant album, and it is not about pleasant things. It is a serious and disturbing album full of cold and metallic songs set over a thick, very Germanic beat. The voice is most often heard through treatments that make it sound like something other than human, something disorienting and alien. The guitar and keyboard sounds, also heavily treated, define the songs by lurching all over the beat like clumsy junkie Frankenstein monsters feeling their narcotic hunger eating their stomachs.

The characters who populate David Bowie's **Scary Monster** songs don't come to nice ends. They don't have nice middles either. And we don't find

out very much about how they got there.

The album begins and ends with the grim *It's No Game*. The opening, part one, alternates tandem English and Japanese versions of the same words over that desperate, leaden beat. The closing, part two, is the more straightforward and calmer, if no less terrifying, version. Each one ends with a bullet to the brain. The title song *Scary Monsters* autopsies a hideous living death of a love story. *Ashes to Ashes* resurrects the long missing and presumed lost Major Tom. When we last heard from him at the end of *Space Oddity* over 10 years ago, he was just drifting through space. That's how we find him now. Still ice-encased and hopelessly blissed out. *Fashion* is the

album's dance number. He looks at the world of style from the view of a disgusted punk who couldn't care less.

The melody of *Teenage Wildlife* is too close to that of "Heroes" to be coincidental, especially with a guitar lead by Robert Fripp that is very similar to what he played on that earlier song. Here Bowie, named in the song, sings with unexpected disdain to the young dudes as he cops to having been a "Don't ask me, I don't know any hallways" bloke.

Scream Like a Baby, a song sung from the middle looking out while locked in, uses twin Bowie voices. At spots during the song, one of the voices speeds up rising in pitch while the other slows down as it lowers in pitch. That both tracks keep apace is an unusual and startling technique. The rueful anthem *Because You're Young* is as close as anything on *Scary Monsters* gets to optimism. It looks back to twin icons of a slightly earlier time, the flower child and the battle-scarred vet of the Asian wars, and how they've aged together. And then it is back to *It's No Game*.

Bowie's co-producer on *Scary Monsters* is once again Tony Visconti who has worked on a big majority of Bowie's albums from *Space Oddity* on. Tony historically has had a keen ear for unusual and unlikely sounds, which is a critical necessity when dealing with as mercurial a talent as David Bowie. The band consists of people who have also been with David for some time. Carlos Alomar on guitar, Dennis Davis on drums, and bass player George Murray have been a unit consistently since *Station to Station*. Robert Fripp appearing on most tracks also guested on "Heroes" with his crazed lead guitar. Roy Bittan, from Springsteen's *E Street Band*, adds piano to three tracks. The unexpected guest is Peter Townshend who adds a very *Tommy*-esque guitar part to *Because You're Young*.

Scary Monsters is difficult stuff of obvious depth and deliberation. It is not a very easy pill to swallow, but coming from a quick-change artist like Bowie, one should never expect anything to be too easy. He has always been a challenging artist who has more than once demonstrated his penchant for commercial suicide. Oddly, *Scary Monsters*, despite its complexities and aggressive posturing, is surely the most commercial album he's made since *Station to Station*. The main reason is his return to a song format from the modern mood sounds of *Low* and "Heroes." M.T.

Sound: B+

Performance: B+

Hold Out: Jackson Browne
Asylum 5E-511, stereo, 8.98.

Hold Out is Jackson Browne's sequel to *The Pretender*. That album's despair and grim resignation have evolved into gritty, relatively optimistic determination. Jackson has survived his trials, found a new love, and written about it in his new songs. The outer sign is the album's cover, as colorful and vibrant as *The Pretender* was gray and muted.

Jackson's writing is as strong as ever despite some clearly lesser songs, but the high points are lofty indeed: The thumping ironic *Disco Apocalypse*,

the rocking *Boulevard*, the self-awareness of *That Girl Could Sing*, and the rambling *Hold On Hold Out*.

The album has some of the best recorded sound I've heard this year on a non-audiophile release. Unusually clean and clear. Cinemascope mix. The sonic quality and production is a triumph for Browne and Greg Ladanyi.

Above everything else Jackson Browne is one of the most sincere and real people I know. He is incapable of false commitment. Of this, *Hold Out* is a reaffirmation. M.T.

Sound: A

Performance: B

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Jazz & blues



Love at First Sight: Sonny Rollins Milestone M-9098, stereo, \$7.98.

Tenor saxophonist Sonny Rollins is arguably among our greatest living improvising musicians — certainly he is one of the most naturally and prodigiously gifted. His very best solos are nearly omniscient in scope, surveying the summit achievements of the first 70 years of the jazz soloist's art — Armstrong's brash beginnings, Parker's harmonic sophistication, Monk's melodic integrity, Coleman's rhythmic and sonic probes — from a still loftier vantage point. Perhaps the most as-

tonishing aspect of such performances is that they are casual in everything but impact.

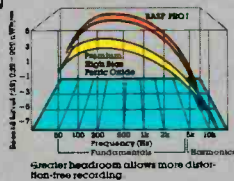
Yet rarely is hearing Rollins the unequivocal pleasure it ought to be, for he is both the most unpredictable of artists and the most perverse. More recently, and especially on record, it is not unusual to hear him straining after mundane effects that a lesser saxophonist would accomplish with ease or flatly reject. Worse, he will sometimes bring a potentially excellent solo to a sputtering finish after only a few tentative choruses.

The Tape Guide

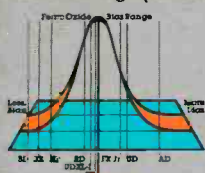
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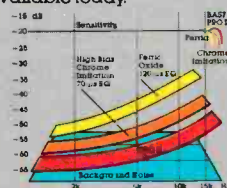


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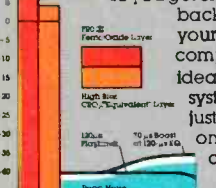
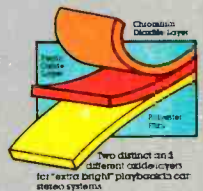


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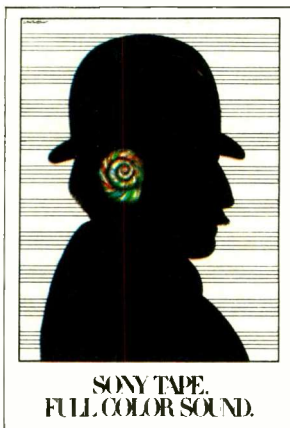


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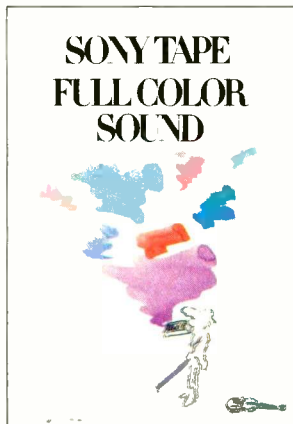
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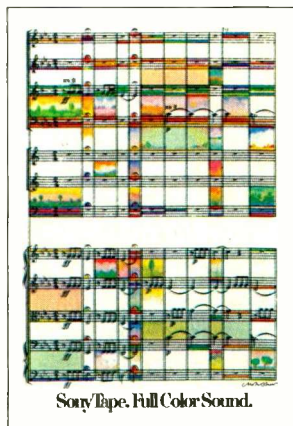
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Part of Rollins' problem is that he has never found the larger context his music sorely needs; he has never been able to form a band in his own likeness. Over the last five years, he has toured and recorded for the most part with younger musicians whose first allegiance is to amplified fusion jazz — a happy one-time-only exception was *The Milestone Jazzstars* tour and double album with McCoy Tyner and Ron Carter, musicians more nearly Rollins' equal. If Rollins' initial motives for embracing electronics smacked of avarice, it seems clear now that, for better or worse, this setting is simply the one in which he now feels most confident.

For all these reasons, I approached *Love at First Sight* with some trepidation, especially considering that the accompanying group includes bass guitarist Stanley Clarke and that pianist George Duke plays an electric model more than half the time. Even by his own exacting standards, however, Rollins, after some hedging on *Little Lu*, a stuttering St. Thomas-like calypso which is the album's opening cut, plays magnificently here, with gruff humor and a cello-like purity of tone.

Yet if the album is a personal triumph for Rollins, it is hardly a total success. On *The Dream That We Fell Out Of* and on *Caress*, the tinkering approach Duke and Clarke bring to their electric instruments conceals and rounds off the sharper edges of Rollins' noblest and most vehement sonorities. Even on *Double Feature*, a mossy blues duet with Clark, and noticeably on *The Very Thought of You*, where Duke plays the grand piano, Rollins sounds oddly distanced from the environments his sidemen construct for him. In these solos, Duke and Clarke are aggressively banal. Al Foster's drumming is distinguished only on *Strode Rode*, where he takes Rollins for a giddy ride. Bill Summers, a conga player, is scarcely noticeable on the three numbers where he plays.

Rollins never sinks to the level of the others, but neither does he make an effort to pull them up to his. So what we are left with are isolated passages of tenor almost perfect in essence. We might wish for more than that, but for now, that is all we are likely to be offered. Probably the best way to listen to Sonny Rollins at this point is the way we listen to the mature Louis Armstrong: With enthusiastic ambivalence and exasperated awe.

The sound is generally fine, even if the mix is a little too "hot" for good jazz.

Francis Davis

Sound: B

Performance: B-

Illusions: Arthur Blythe
Columbia JC 36583, stereo, \$8.98.

Arthur Blythe continues to rework old forms and to appropriate and create new ones. On *Illusions* he begins to synthesize the two trends of his most recent albums, the avant-garde funk of *Lenox Avenue Breakdown* and the re-creating of past jazz forms from *In the Tradition*. Rather than actually breaking the barriers down, Blythe attempts to show that they were not there to begin with. The album alternates two groups of musicians. One is the traditional bass, piano and drums quartet with Fred Hopkins, John Hicks and Steve McCall respectively, while the other is a more unusual quintet grouping of Abdul Wadud on cello, James Blood Ulmer on guitar, Bob Stewart on tuba, and Bob Battles on drums.

Bush Baby opens the album in a much richer arrangement than its original form on Blythe's album of the same name. Pushing across Stewart's steady ostinato tuba line, Blythe charges through with his singing, lyrical alto that always seems to be grinning. Wadud's cello lines seem to fall around Blythe, more as overtones to Blythe's alto. Rising star James Blood Ulmer plays punctuations rather than lines. His solos are like fleeting glimpses from a speeding train.

The programming of the album intentionally places *Miss Nancy* as the next cut. The quartet takes over with no loss of momentum. McCall and Hopkins are a formidable rhythm section managing to play in and out of time simultaneously, moving freely, yet swinging. While there's no mistaking these two units, the similarities of feeling and intent become more evident through their juxtaposition, as the album alternates the groups every other cut. Blythe's alto swings and dances whether charging through the odd stop/start rhythms of the title piece or vamping across the turbulent fields of *As of Yet*.

Illusions also continues the crisp recording style of *In the Tradition*. There is a three-dimensionality to the sound that makes the individuals stand out in the mix, as on John Hick's delicate piano solo on *My Son Ra* that seems to be hanging suspended in the air. The sensitive recording is especially notable in recording the quintet with the subtle shadings between the tuba, alto, and cello.

Arthur Blythe is a musician who is clearly on the cutting edge in his ability to hone his distinctive solo style and merge it with both the past and the future of the music.

John Diliberto

Sound: A

Performance: A

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You also can't hear Sony's unique SP mechanism, one of the carefully balanced elements in every Sony tape. It's a perfect example of Sony technical achievement. The SP mechanism is what makes the tape run so smoothly inside the cassette. And smoothly running tape is critical for total, perfect tape performance.

Smooth running means less friction. So some of the most popular tape makers give the tape as much clearance inside the cassette as possible. (We used to do the same thing.) But this method results in uneven or too tight winding and actually increases friction as you wind and rewind the tape. Jamming and even a stopping of the tape in its tracks can result.

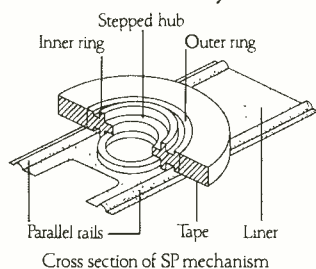
It was clear to Sony that even, uniform winding was the key. So Sony reversed the basic thinking about friction completely and invented the SP mechanism, the first positive guidance system on the market. Instead of giving the tape lots of room, it gently guides the tape smoothly and precisely through the cassette, and onto the reels, with a maximum of positive precision support, yet with an absolute minimum of friction. This is a perfect example of Sony

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Gozeme! Pero Ya . . .: Cal Tjader
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Vibraphonist Cal Tjader has made an honorable name for himself in Latin music. One of the first jazz musicians to borrow elements of salsa and the mambo in the '50s, he has covered his debt many times over by cross-influencing wave after wave of younger Latin players.

Despite this influence, Tjader is not a major figure either in Afro-Cuban music or in jazz. His ensembles never strut with the big-bellied machismo of the best salsa bands. As befits an ex-drummer, he is a percussive vibraphonist in the manner of Lionel Hampton rather than a pianistically inclined player such as Milt Jackson, but his solos never dance with the internal rhythmic complexity of really good jazz.

On this LP, Tjader is joined by his current band, flutist and percussionist Roger Glenn, keyboardist Mark Levine, bassist Rob Fisher and percussionists Vince Lateano and Poncho Sanchez. The disc is remarkably similar to the many popular LPs he has made over the years on a variety of different labels and offers a pleasant mix of standards and originals at varied tempos. But the fast tunes never boil to a

steam, and the ballads — in which craftsman guitarist Mundel Lowe is added to the sextet — never get above the level of a trinket-like prettiness.

As with most Concord's, the sound here is vivid. Unlike most recent Concord's, this pressing was not warped.

Francis Davis

Sound: A-

Performance: C-



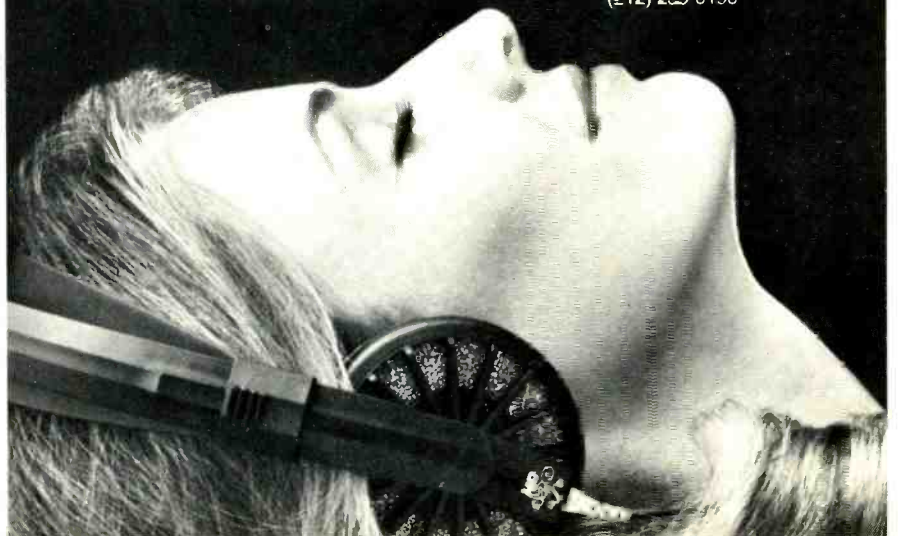
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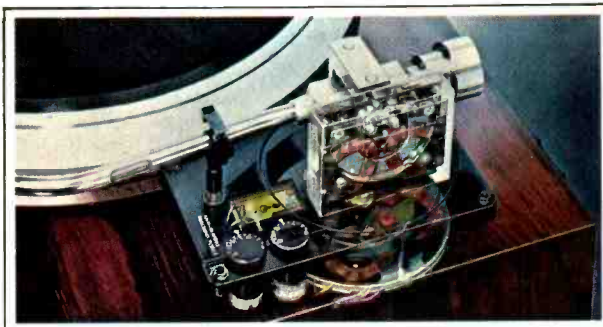
That, unfortunately, has been a tall order for tonearm designers. Because minimizing one kind of resonance makes the arm susceptible to other kinds.

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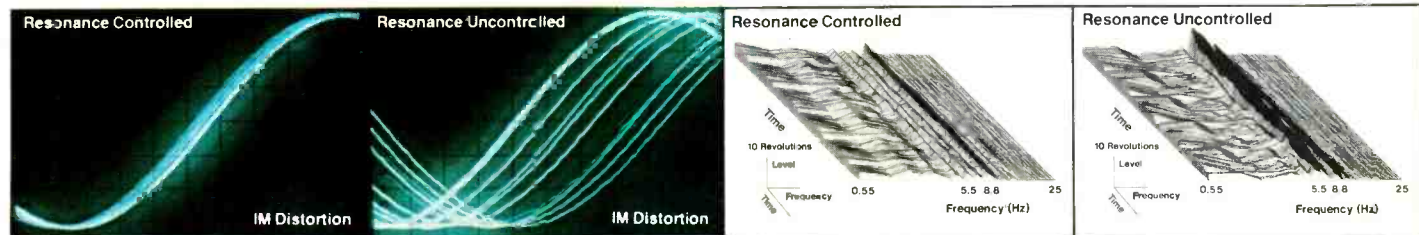


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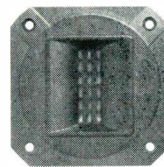
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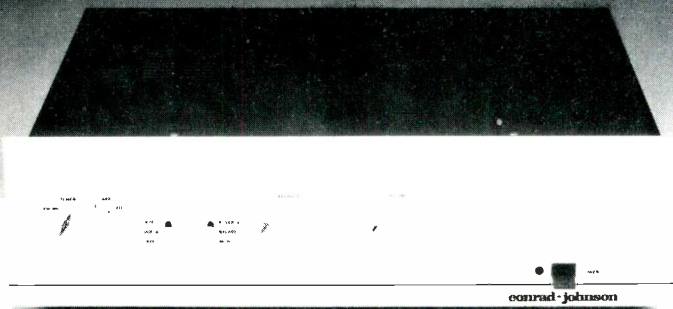
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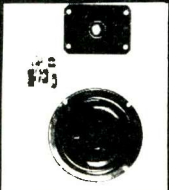
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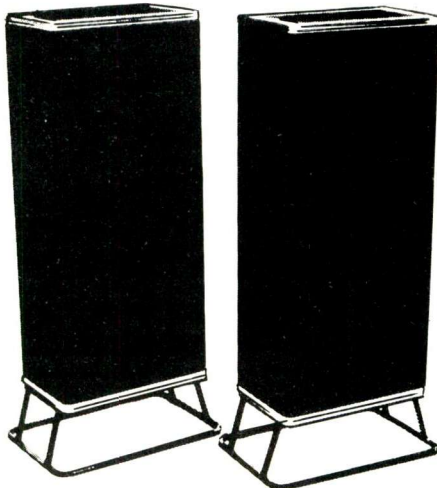
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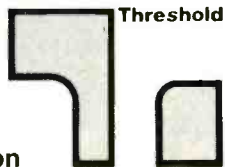
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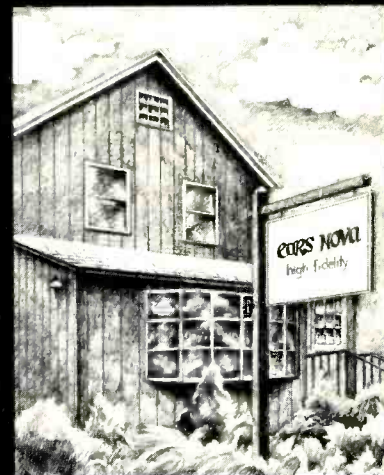
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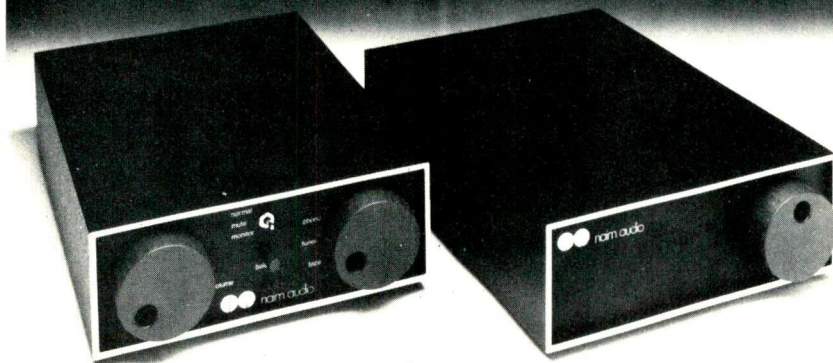
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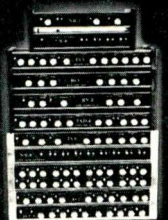
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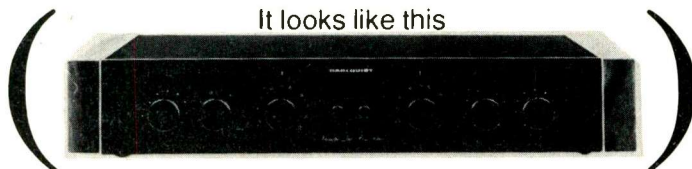
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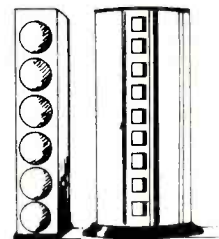
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BULLETIN

You the audio consumer should know that there is very little under the sun that is really better than what has gone before, and some of the best equipment is that which you may have just traded in for an inferior technological wonder. After all, the Linn Sondek turntable is 10 years old, Quad electrostatics and the classic equipment built by Saul Marantz are 15 years old, and 95% of the electronics components on the market today are based on designs which date back to the 1940s.

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Based on a review of one of the first Berning preamplifiers, Stereophile Magazine has suggested this is the finest preamplifier that will ever be built. Well we have more good news: David Berning has made a few small improvements in the wiring, the TF-10 sounds better than ever, and the David Berning Company is making the next 100 preamplifiers available for \$1,495 — a price which fails to reflect the doubling of parts and production costs since the TF-10 was designed two years ago.

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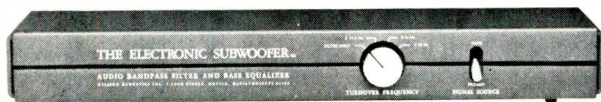
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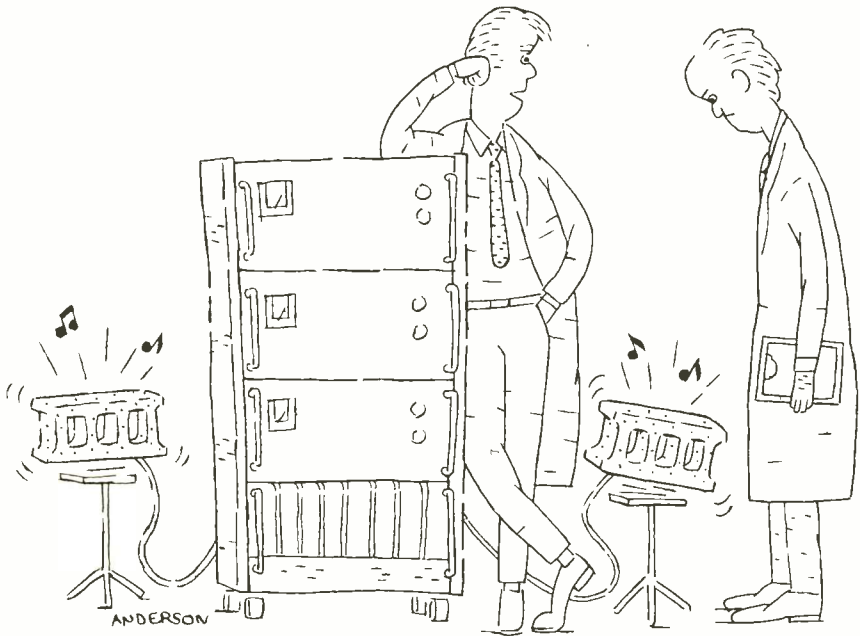
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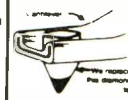
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Video scenes

As almost everyone is aware, one of the most hotly contested issues in recent years has been the battle between the various videodisc systems for recognition as the industry standard. Hardly a day goes by without news of technological and marketing developments from one or another proponent of one of the three competing systems. Dutch electronics giant N.V. Philips espouses their laser/optical videodisc, RCA is firmly convinced their CED (groove and stylus capacitance videodisc) is the way to go, while Matsushita/JVC feels their VHD (video high density grooveless capacitance disc) should be the ultimate choice. Each of these corporate giants is backing its videodisc system with millions of dollars, and in spite of all efforts to negotiate a videodisc standard, this issue has not been resolved nor is it likely to be for some time. The intransigence and hidebound attitudes of these companies in respect to standardization simply reflects their opinion of the vast income potential of the videodisc market.

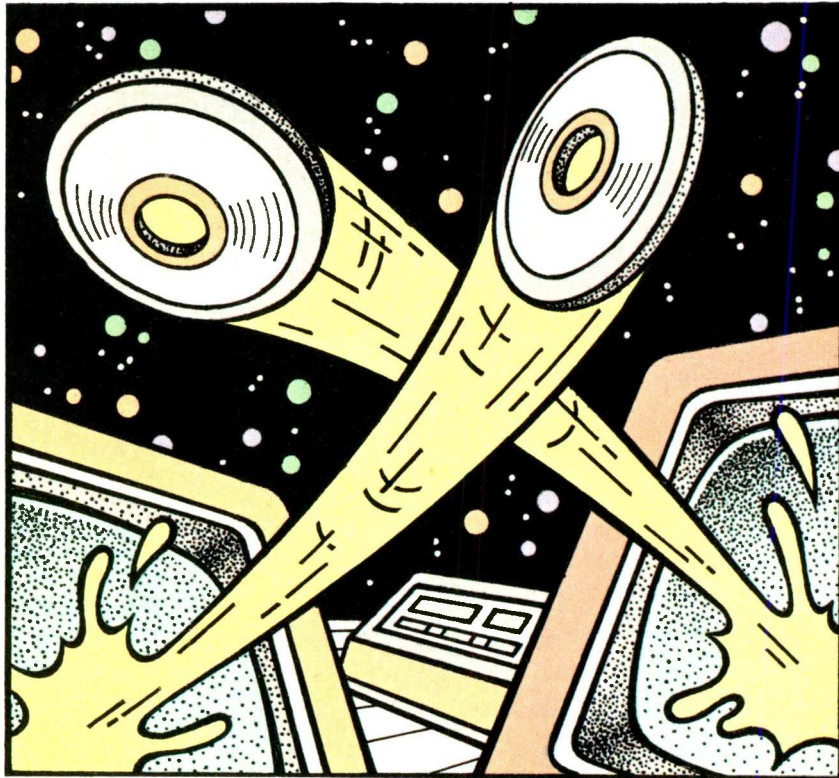
In the light of all this videodisc activity, a recent statement from Sony Corporation is all the more shocking. Akio Morita, the dynamic chairman of Sony, is quoted as saying that present videodiscs are not ready for the consumer market! He followed this bombshell by commenting that videodisc technology would be better applied to the digital audio disc, which would be a more viable item with the consumer. Mr. Morita also feels that recent price reductions to about \$600.00 for VCRs, plus significant price reductions on blank video cassettes and less expensive color cameras with subsequent home movie potential, all combine to make today's VCR more attractive to

the consumer than the videodisc. To further emphasize Sony's attitudes, Kazuo Iwama, president of the corporation, says that "The point where the high-quality videodisc is as viable as the digital audio disc is quite a way off." Dr. Doi, Sony's chief of digital operations, states that advances in LSI (large scale integrated) chip technology will make digital audio inexpensive enough to dominate audio within ten

wall-sized flat-screen television with the image in three-dimensional stereo or holographic format, replete with some sort of multi-dimensional audio ... far beyond mere stereo!

An item caught my eye the other day which has echoes of the past, but also harkens to possible wonders of the future. It seems MCA has released video-cassette tapes of two classic science-fiction films, "The Creature from

the Black Lagoon" and "It Came from Outer Space." Originally released in 1953/54, these films were presented in three-dimensional stereo format. By wearing special glasses of either the Polaroid variety or with red and blue lenses, the movies had dramatic and startling effects. Needless to say, this attribute was exploited and exaggerated ... for example, a monstrous scaly hand would appear to come out of the movie screen and reach toward you in your seat. Objects—rocks, knives, spears, etc.—would be flung in your direction, and it was fun to watch people instinctively ducking



years. The Sony/Philips compact laser-optical, digital audio disc is said to be "on target" for introduction in 1982. Sony has always been noted as a venturesome company, often exploring the outer reaches of audio and video technology, and their accomplishments hardly make them vulnerable to cries of "sour grapes" in respect to their attitudes on the videodisc. Maybe they know something we don't—in any case, it is obvious that one should keep a close watch on developments at Sony.

You have all heard prognostications about the "brave new world" of the future, where science will be the dominating factor in our lives. Almost always, it is predicted that we will have a

these menacing illusions. Quite a few of these films were made. The very first one, "Bwana Devil" starring an incredibly youthful Robert Stack, was made about 1951, and I had the pleasure of working on the stereo sound track with producer Arch Oboler. MCA is issuing these 3-D video cassettes with four pairs of the special viewing glasses included in the package. These 3-D movies might have survived beyond their relatively short vogue, but apparently some people didn't like wearing the viewing glasses and, unfortunately, the 3-D process considerably diminished screen brightness. Over the years, various methods of viewing films in 3-D without the necessity of wearing glasses have been

devised, but none has had any notable success.

Now comes word that at the recent Japan Audio Fair, Matsushita introduced what they called "Spectravision," using a special adaptor which fits over a conventional TV screen and affords three-dimensional stereo viewing without the use of glasses. Details on screen brightness, etc. were not given, but one assumes the product would not be marketed if the picture was degraded. Such 3-D TV is a natural adjunct to the TV stereo sound that already exists in Japan. It's fascinating and fun, and given the right 3-D system, I think it would become popular again. I'm certainly going to follow up and as a first step will try to obtain the

MCA 3-D video cassettes.

In the videodisc sweepstakes I mentioned earlier, the Philips laser/optical videodisc has gained an edge of sorts on the competition by having the Magnavox Magnavision and Pioneer LaserDisc actually on the market. However, apropos the Sony story (and my report in last month's VideoScenes), defective videodiscs are common enough to worry the Magnavision executives, and now Pioneer apparently is experiencing returns of defective discs on the order of 10 to 20 percent. Sales of the Pioneer LaserDisc player are reported excellent in all their current markets, but if defective discs continue to appear, this could have a depressing effect on sales. As I

pointed out, the Pioneer LaserDiscs I have are flawless; I just hope they were not cherry picked for my benefit. It also appears that some of Magnavision's problems lie in their playback machine, but the units can be modified.

Again referring to last month's VideoScenes, the report of 3M setting up a plant to replicate the Philips laser/optical discs should help the situation, but now comes word that their production costs are going to be higher than those of DiscoVision. With feature-length films currently selling at \$24.95, I think if there is any significant increase in price above this figure, they are bound to encounter sales resistance. However, if the 3M videodiscs are of consistently high quality, this may offset the higher prices.

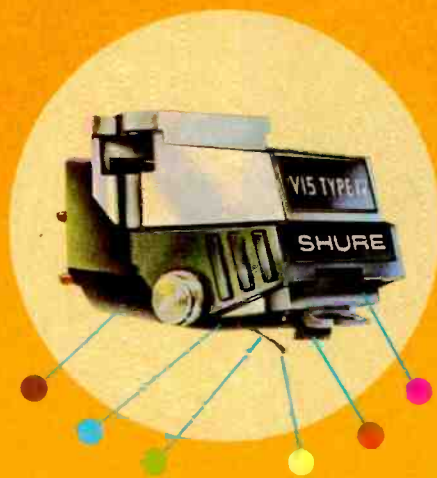
Another strange phenomenon on the videodisc scene is the alignments various Japanese companies have made with manufacturers of the three videodisc systems, not merely situations where a Japanese company announces it will support the Philips or RCA or VHD videodisc. The relationships can be extremely complex and apparently reflect a Japanese corporate assessment of the degree of sophistication and sales potential in a given market.

The attitudes of the Japanese manufacturers toward all three videodisc systems also show that many of them have decided that any standardization of videodisc format is a long way off, so many have opted to cover all bases and manufacture all three videodisc systems. Toshiba, for example, has announced it will do just that. Sharp has decided to manufacture the RCA system for the American market, but make the Philips optical discs for their home market. At press time, it was announced that Sharp will also make the VHD system for the Japanese market. On the other hand, Matsushita will make the VHD videodiscs for the American market. Possibly because of loyalty to Japanese products, many Japanese manufacturers apparently will use the VHD system for their home market. Or perhaps they feel that the Japanese consumer will better appreciate the more technically sophisticated VHD system.

The admittedly formidable array of software that RCA has lined up for their capacitance videodisc appears to be the deciding factor for many companies in backing the RCA system. Radio Shack, with its 4000 stores and 2000 more associate stores, has announced it will sell the RCA CED videodiscs. This is a significant boost for the RCA system, and Radio Shack stated that, in addition to being influenced by the RCA software, the ease of repair of the RCA system was an im-

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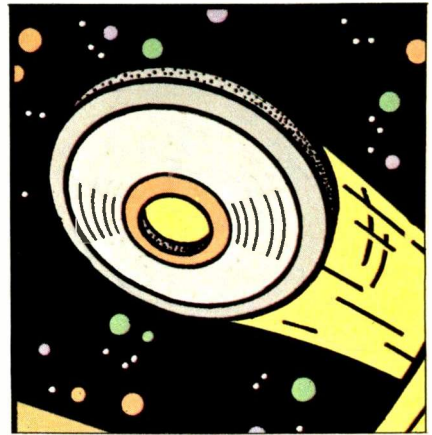
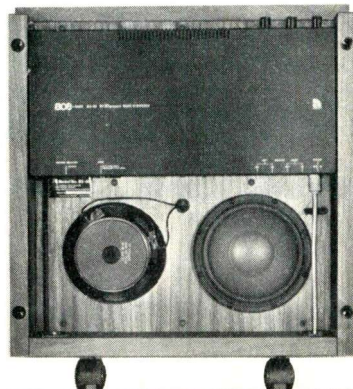
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portant consideration in their choice.

Sansui, after manufacturing audio products exclusively for 33 years, entered the video market with its new laser diode pickup for optical videodiscs. The laser diode is much lighter and smaller — 1/40th the size of a conventional pickup. The diode pickup shortens the path of the laser from pickup to disc. Most importantly with the laser diode, "jitter," a kind of oscillation that can cause aberrations in the image and degrade sharpness, can be corrected electronically rather than by mechanical means, which is the present method. Sansui also feels the new laser diode will be of benefit in the playback of PCM audio discs.

Lastly, RCA, after demonstrations before more than 20 Japanese licensees which proved their CED videodisc was capable of stereophonic sound, also showed it was possible to have slow motion, stop action, and random access with their system. Most intriguing of all (and little noticed) is that down the road the CED system may offer the possibilities of recording! As you know, one of the criticisms leveled at all videodiscs by proponents of video-cassette recorders is that videodiscs are playback-only systems. RCA feels that recording may be feasible, and this facility would be made available first to industrial users and then ultimately to home consumers. To say that this would shake up the videodisc market is to put it mildly!

There have been rumors that Philips might have a method that would permit consumer recording of videodiscs — but thus far, no official word. It must be kept in mind that although a recordable videodisc would undoubtedly be an attractive and important item, such discs would probably have a one-time-only use, whereas video cassettes can be erased and newly recorded many times. Having said this, I hear a small voice which says, "Hey wise-guy, haven't you ever heard of magnetic discs?"

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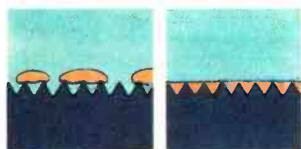
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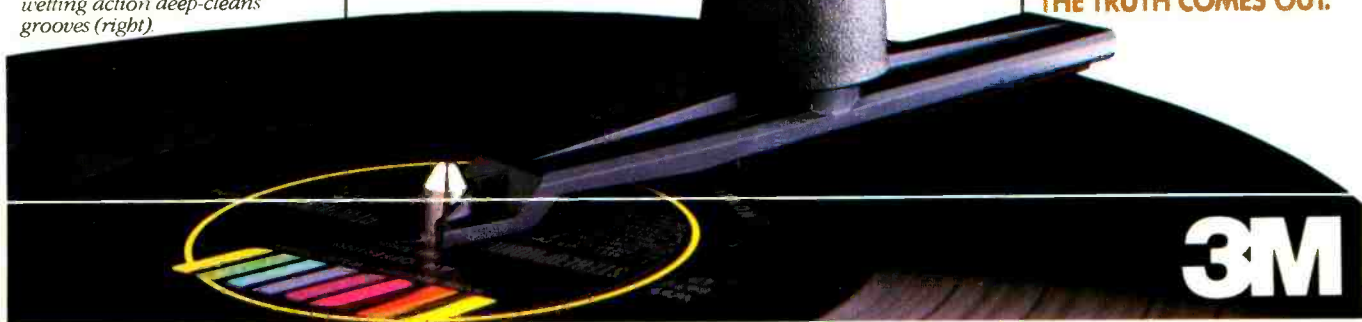
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Behind the scenes

Bert Whyte

Autumn in New York, and the 67th Convention of the Audio Engineering Society opened on October 31st and concluded on November 3rd, the day before the Presidential elections. Perhaps the imminence of the election and the anticipation of a change in the political climate had some influence on the convention. While attendance was down somewhat, there were a record number of exhibits and although quite a few companies admitted to slow summer sales, there seemed to be a pervasive "bullish" enthusiasm for their business prospects in the coming months.

On the other hand, it must be noted there were quite a few comments that there "wasn't much that was really new." Of course, this expression is heard at every convention, but it did appear that quite a few companies are waiting until the May AES Convention in Los Angeles to showcase their new developments.

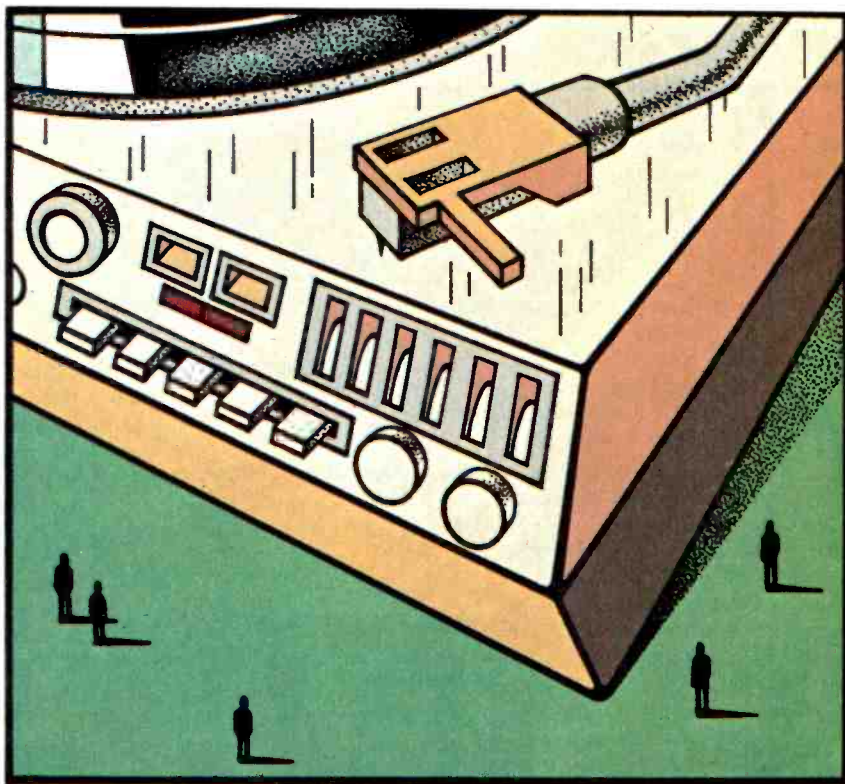
Needless to say, at any recent AES Convention, digital recording occupies center stage. Mitsubishi, which heretofore had shown a quarter-inch fixed-head recorder, sort of surprised everyone by showing an operational model of a 32-channel digital tape recorder. Using one-inch tape at a speed of 30 ips, the unit features a transport that does not use a pinch roller. Not much detail on the system other than it is a 16-bit, linear encoding format with sampling rates of 44.056 and 50.1 k. This fixed-head recorder is said to employ a new encoding format, and a paper describing the system was presented at the convention.

3M continues to make progress with their pioneering 32-channel digital tape recorder. Thirty-nine recorders are now installed worldwide, with

twenty-two available in the U.S. Quite a number of pop albums have been recorded with the 3M system, as well as a growing number of classical productions. CBS Records has recorded the New York Philharmonic, the Cleveland Orchestra, and, in an unusual alignment, Isaac Stern and the Boston Symphony. RCA has recorded Ormandy and the Philadelphia Orchestra, while Polygram has recorded

showing its DAE-1100 digital audio editor, which after a long period of gestation is said to be "immediately available." This unit features cross-fade capability, SMPTE time-code generation, edit preview, and a large search knob for edit-point trial, and an accuracy of 362 microseconds is claimed. The DAE-1100 digital editor can be yours for a somewhat breathtaking \$45,000! Sony also introduced the DRE-2000

Digital Reverberator. To my way of thinking, the appearance of this kind of equipment is vitally important to the whole concept of digital recording. After all, what is the point of having digital recorders with 90-dB signal-to-noise ratios and dynamic range and ultra-low distortion, and then having to interface them with analog mixing consoles, delay and reverb units, and other items in the recording chain which will considerably degrade the digital signal with noise and distortion? This Sony reverberator has a 10-program memory-variable, multi-mode delay and reverberation



Herbert von Karajan in a complete version of *Parsifal*.

JVC was showing their DAS Series 90 Digital Audio Mastering System. An upgraded editing system is featured which has a claimed accuracy of 180 microseconds, time address codes, and cross-fade capability. A large control knob on the editing console permits location of an edit point by the rocking motion so familiar in analog tape editing. This 16-bit, linear quantization system is now being used in a number of record productions, among them RCA's new musical, "42nd Street," a recording of the Pittsburgh Symphony, and a number of European symphonic recordings.

Speaking of editing units, Sony was

and, with its built-in A/D and D/A converters, will interface directly with 16-bit digital recorders as well as analog tape recorders. The unit also has hand-held controls and features a nonvolatile memory, in which stored programs are not erased in the event of an accidental power failure.

Among other digital news, Sony and Studer revealed more details on their proposed joint format, which among other things specifies up to 48 channels on one-inch tape! Strong rumors were circulating that the long-awaited Ampex digital tape recorder might debut at the May AES Convention in Los Angeles.

In the area of the digital audio disc, JVC presented its AHD (audio high

density) digital disc in one of the most fascinating demonstrations in years. Using a 12-inch disc, which was played on their VHD (video high density) video disc machine plus a PCM converter, they demonstrated their contention that the one playback machine can handle both video discs and digital audio discs. The mind-blowing part is that their AHD disc featured four channels of information, three of which were genuine, honest-to-God, frontal-array, three-channel stereophonic sound, with the fourth channel operating as a "picture" channel! There it was — left, center and right loudspeakers arrayed in front of your listening position, with a TV monitor mounted above the center speaker. The music, some pop and classical works, had been specifically recorded in the three-channel format. What a sonic thrill it is to hear music in this manner. The AHD recording was pristine clean, with super wide dynamics, and was utterly noiseless. Best of all — the absolute integrity of the stereo presentation. No imaging ambiguities here! The whole ensemble is presented in a panoramic array with the rock-solid stable discrete center-channel sound, making possible exact localization of all instruments across the sound stage. The picture channel presents a series of still photos and, while it can have some relevance to the music program, has some other uses. In my opinion this fourth channel would be far better utilized as an ambience channel. My preferred format would be to keep the ambience channel within the 35 millisecond "fusion" limit of the brain and feed this channel to two loudspeakers to the side or slightly to the rear of the listening position. As I pointed out to JVC, the validity and desirability of the up-front three-channel stereo presentation was proven in the historic Bell Telephone-Stokowski experiments in 1933. (As an aside, one of the most heavily attended sessions at the AES was Arthur Keller's; he was present on that 1933 occasion and conducted many other early stereo experiments with Stokowski.)

Readers who have followed my writings over the years may remember my championing of three-channel stereo. I actually had Mercury Records agree to issue three-channel stereo programs on quarter-inch tape with a playback machine to be made by the old Viking Company in Minneapolis, but the deal fell through. Again in 1960, Harry Bellock agreed to let me issue three-channel stereo on quarter-inch tapes on our own Everest label, but the company was sold before we could get this

project underway. Once you've heard real three-channel stereophonic sound, you'll never want to return to the two-channel stereo format with its often vague phantom center channel. Even the best of coincident-mike two-channel stereo just can't compete with the realism afforded by true three-channel stereo. JVC is to be highly commended for its attempt to resurrect this great sonic format. There is little doubt that presentation of three-channel stereo via the digital disc is the best of all possible worlds — but consider, if you will, how well three-channel stereo would work on analog cassette or open-reel formats. With Dolby or dbx encoding, this would be an attractive long-term alternative to the gradual decline of the two-channel stereo analog tape formats. In any case, JVC has my fervent best wishes as well as my full support for their three-channel stereo activities.

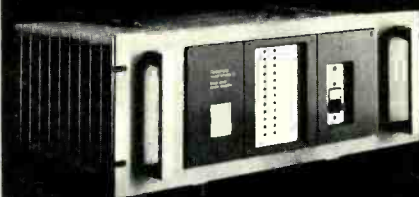
Lest we forget that analog tape recorders are still very much with us, Ampex tells me they are enjoying great success with their big, new 24-channel ATR 124 recorder. The well-known Record Plant studios on the West Coast have ordered a dozen of these elaborate units. The Lyrec Company of Denmark, a long-time manufacturer of tape machines, introduced the new TR 532, a 24-channel analog tape recorder. The unit features a very complete remote control with 32-position memory which weighs only seven pounds. The transport has variable-wind, 7 to 60 ips, and spot erasing is possible.

Panasonic has a new Recording and Broadcast-Professional Audio Division. Their products cover a wide range. At the convention they were showing such items as their EPA-500 tonearm featuring interchangeable arm tubes to cover a wide range of cartridge masses and compliances, new mixing consoles from their "Ramsa" company, a new 120-watt/channel "New Class A" amplifier and companion preamplifier, and an updated and refined version of the isolated-loop 1520 open-reel recorder, the RS 10A02. This last unit has new SX (Sendust Extra) heads for extended response. A most intriguing device was the Ramsa Localization Processor. This system can be applied to eight tracks of a master, and four tracks are controlled by a four-pot "joystick" for continuous mixing. The remaining four tracks are preset and remain fixed during the mix-down. To control such factors as sound distance and spaciousness, the system allows as many as six early reflections and latter reverberations to be controlled separately. The direction and sound pressure level of the sound reflections are

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
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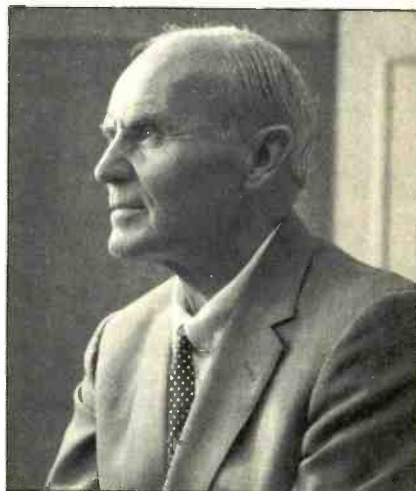
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also preadjustable. In the hands of a creative producer and engineer, this system can generate some interesting effects indeed. In the normal two-speaker stereo listening situation, you can be quite startled by hearing music apparently emanating from "phantom" speakers located at the side or even slightly to the rear of your listening position. Remember . . . this is *without* the use of any "black box" decoding device. The phantom sounds are created in the mix by the Localization Processor.

It goes without saying that there were many fine and interesting papers presented at this 67th AES Convention, along with enough new products to keep attendees from yawning! 


Obituary



Alexander M. Poniatoff

The founder of Ampex Corp., Alexander M. Poniatoff, died on October 24, 1980 at the age of 88. He was born in Kazan, Russia and obtained degrees in mechanical and electrical engineering from the University of Kazan, the Imperial College in Moscow, and the Technical College in Karlsruhe, Germany before emigrating to this country in 1927.

Poniatoff founded Ampex in 1944; the company's name is from his initials plus "ex" for excellence. He served as the firm's President until 1955 and then was elected Chairman of the Board. He resigned this position in 1970 and was named Chairman Emeritus. In the last few years, Poniatoff participated in the affairs of several foundations devoted to research in health and preventive medicine.

The two major developments for which Ampex became known were the introductions of the first practical magnetic audio recorder to America in 1947 and the first practical video-tape recorder in 1956. 

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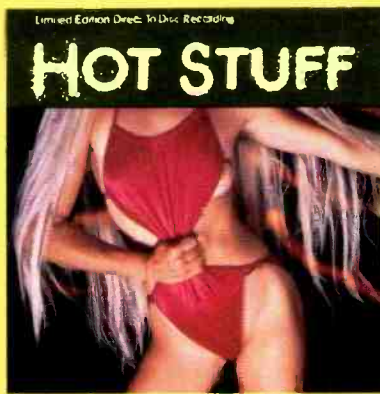


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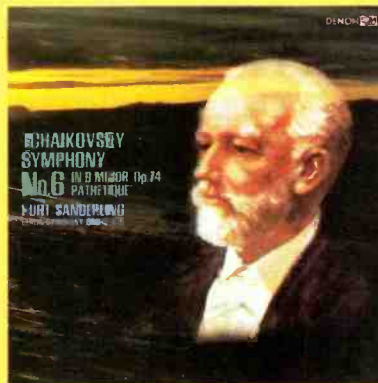
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