Crown's Self-Analyzing Power Amplifiers

INTERVIEW: KLH's von Recklinghausen
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Imagine you could sit down in front of your TV set and see virtually any movie or concert you wanted to see when you wanted to see it.

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SC-2 Fluid enhances and speeds cleaning and yet protects diamond adhesives, cartridge mounting polymers and fine-metal cantilevers against the corrosive effects of many other "cleaners". The Discwasher SC-2 System. Stylus care with which your cartridge and records can live.
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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Meters have been replaced by Instant-response fluorescent peak level indicators with a special, 3dB added scale for metal tape.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.

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 (+3dB), 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 K500 professional deck with 3 heads, 3 motors and dual DC amplification; K12, 2-head, 2-motor deck with dual DC amps; K5A with 2 heads and Lux bridge motor drive; K1, 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.
Steremote brings total entertainment into every room of your home. Until now you could listen to music in only one or two rooms at a time. Now you can enjoy music throughout the house. Steremote integrates all your existing components (including your speakers), giving you remote control over them from anywhere in your home. It's control at a touch. From any room. The kind of control you've never had before. All through the portable Steremote control unit that plugs into any AC outlet. 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 performance. With Steremote control, you can switch rooms and change music. Keep different tunes for different rooms. Or fill the house with one beautiful performance. The Steremote choice is limitless.

How many modules make a Steremote?

You decide. Steremote offers you a selection of modules (six shown), each with a specific remote control capability. By combining them you can control every component in your system. You can record, play back, walk around, lay back. Change rooms and moods at will. For more flexibility just add a module and you can expand your musical environment to as many as nine rooms. Basically, it will be your system. Plus Steremote. Plus a lot of fun.

How to join.

Call any of the better high fidelity stores in your area. They'll help you select the Steremote modules best suited to your needs and show you how to install them in minutes. Call now. Don't fight it. Join it.

YOUR SYSTEM PLUS
The continuing story of TDK sound achievement.

Part Seven.

You are looking at the moment of truth. If every other part in a TDK cassette has played its role perfectly, the tape will move between the pressure pad and the recording head with remarkable precision. There will be no fluctuation. High frequencies won't be lost. Hiss and distortion won't enter in. Music will be reproduced unfailingly.

Part Seven, the TDK dual spring pressure pad, is an innovation. Its double “Y” structure distributes pressure evenly on the total pad surface, allowing full tape-to-head contact. Total sound. In designing it, TDK engineers used a metal alloy of nickel, copper, and zinc which has a perfect balance of resiliency and strength. Then they searched for the perfect pad. They found urethane has a tendency to stick, slip and tilt in the direction of tape travel. Tape loses contact at the dead center of the head core. Sound is lost. Felt also has its problems. It often causes rough 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.

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.

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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 harmonic 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.

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 A2, is returned to the input through the NFB loop (b) and added, out of phase, to amp stage A1. The out-of-phase distortion is amplified by A1 and added to A2. 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 A2 and sends the distortion component to error correction amp A3 from which it is routed to the output of A2 to cancel any distortion that may have been generated in A2 and any distortion overlooked by the NFB loop.

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.
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 circuit 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.

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
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.

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hundreds 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 IEE-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 little 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, bushes 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 buts, 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.
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AUDIOCLINIC

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?

A. We generally interpose an equalizer between the tape out jacks and the tape monitor jacks. Therefore, just too close to one another to have it any other way.

Q. 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 connect 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. 10 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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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.

Incredible Sound/Affordable Price "Our advice is not to buy speakers until you've heard the Polks." Musician Magazine

Reviewers and Critics Agree
Polk speakers will give you the highest sound quality and the most listening pleasure for your money. They will deliver amazingly life-like, boxless, three dimensional sound with breathtaking clarity and detail in your listening room from your hifi system.

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Better sound in your home — Polk Audio loudspeakers will give you more listening pleasure and greater long term satisfaction from your music, your records and your hifi system. They offer the best sound for the money available on the market and are affordably priced from less than $125 each to less than $400 each. Simply use the free reader service card to receive detailed information, copies of the expert's rave reviews and the location nearest you for auditioning the incredible, affordable Polks.
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Test labs now use an extraordinary new instrument to evaluate record playback performance. A warped record.

Magazine test reports are usually based on measurements made with professional equipment and under ideal laboratory conditions. None of which matches the real-life situation you face at home. Virtually all records manufactured today are warped. And even records that are slightly warped can make conventional tonearm and cartridge combinations (typically 18 grams effective mass) distort badly and even leave the record groove. The test labs know this, of course, which is why they tried something different with Dual’s 8-gram Ultra Low Mass tonearm and cartridge system. They added an innovative test instrument to their scopes and meters. A badly warped record.

The results of this new test are not reported as percentages, decibels, or other technical jargon, but in clear and unmistakable language: 

"Navigating the worst warps we could find, the Dual/Ortofon combination proved very agile indeed, with nary a mistrack." 

High Fidelity

"...tracked the most severely warped records in our collection, usually so well that we heard nothing wrong." Stereo Review

"Even a severe warp that would normally throw the pickup into the air will usually give no more than a slight "thump", and most warps are undetectable by ear" Pop Electronics

"The Dual takes dead aim at the fiend of disc reproduction—the warped record—and response to record warps practically is eliminated at the source." Stereo

One test lab, after making the usual measurements, chose to just listen to music reproduced by ULM.

"There is no way measurements, or mere words, can describe the acoustic presence of this record player... highs are crystalline, with a purity we haven't heard before. The bass is so clean that one can hear new sounds from records, such as the harmonic vibration of unplayed strings on the double bass... overall definition and transient response were outstanding." HiFi Stereophile Buyer's Guide

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A major breakthrough in record playback technology. Write for our brochure describing all nine Dual ULM turntables. Prices start at less than $190. United Audio, 120 So. Columbus Ave., Mt. Vernon, N.Y. 10553.
Ie have proven that very narrow response peaks are audible.

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.
"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 difference." And few loudspeakers make as big a sonic difference as ESS loudspeaker systems incorporating the revolutionary Heil air-motion transformer™ (U.S. Patent no. 3,832,499).

The superiority of a loudspeaker cannot be explained in a few words. But it can be experienced in a few minutes.

Last year, in a demonstration of the superiority of its speakers to untrained listeners, ESS ran direct comparisons between ESS speakers and those of its leading competitors. In 42 out of 43 blind listening tests conducted under the supervision of an independent national testing laboratory, students attending U.C.L.A., the University of Wisconsin and Georgia Tech judged ESS speakers superior to those of JBL, Bose, AR, Pioneer, Advent, Cerwin-Vega and Infinity — sometimes by margins of 3 to 1 over far more expensive competitive models.

This year, ESS has developed an even more simple test that dramatically proves ESS's superiority in transient response and "dynamic linearity"™.

Demonstration clinics will be conducted at participating ESS dealers throughout the country.

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Transar/td II Full Range Heil air-motion loudspeaker system.

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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.

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**Tweeter**
- Bose 301*: One, fixed.
- Micro-Acoustics FRM-3ax: One, rotatable, rim-damped.

**Tweeter mounting**
- Bose 301*: Attached directly to baffle.
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- Bose 301*: 929 cubic inches.
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**Bass loading**
- Bose 301*: Single ducted, port directly under tweeter.
- Micro-Acoustics FRM-3ax: Twin-ducted port positioned on opposite sides of woofer.

**Cabinet panel thickness**
- Bose 301*: 1/4" throughout.
- Micro-Acoustics FRM-3ax: 3/4" sides and rear; 1/2" tweeter compartment.

**Dimensions**
- Bose 301*: 17" W x 10" H x 9" D.
- Micro-Acoustics FRM-3ax: 21 1/2" W x 12 1/2" H x 9" D.

**Weight**
- Bose 301*: 515 lbs.
- Micro-Acoustics FRM-3ax: 24 lbs.

**Warranty**
- Bose 301*: 5 years (full).
- Micro-Acoustics FRM-3ax: 10 years (full).

**Mfr's. sugg. list**
- Bose 301*: $260.00 per pair
- Micro-Acoustics FRM-3ax: $299.00 per pair

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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 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—which 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.
Here's how to make a standard $5 tape outperform a $10 metal tape.

Record a standard $5 tape on one of the new Harman Kardon High Technology cassette decks with Dolby HX*. And a $10 metal tape on a conventional deck. Any conventional deck.

Now compare. The Harman Kardon deck with Dolby HX will give you substantially better performance from the standard tape. More dynamic headroom. And better signal-to-noise ratio.

Yet the recording made on our Harman Kardon High Technology deck costs about half as much. Which can save you a small fortune if you plan a tape library of any size.

Of course our new High Technology decks are metal capable, too. So you can use Dolby HX and metal tape for performance that can't be topped by anything less than a professional quality open reel deck.

But Dolby HX is only part of the performance story. Our heads cost more. And they deliver more.

The heads used in a cassette deck probably dictate the performance you'll get more than any other single component. That's why at Harman Kardon, we spent a lot more time and money on our head designs and materials. We started with Super Sendust Alloy, the costliest and most advanced material available. In manufacturing, we machine our head gaps to incredibly precise tolerances, and align them with equal care. Obviously, this process takes more time and costs more money. But it results in frequency response unheard of in a single speed cassette deck at any price.

Even our most economical deck, for instance, gives you ruler-flat frequency response from 15 Hz to an incredible 19,000 Hz from a conventional tape. You also get features like Dolby NR, a front panel bias fine trim, MPX filter and memory.

As you move on up the line, the specs just get better. And so do the features. Like the world's first headroom safety indicator to prevent tape saturation far more accurately than any peak level indicators. You'll also find built-in Dolby and bias test tones. Normal and slow meter ballistics. A fader control. Plus our exclusive Auto Program Search System that scans a tape automatically, sampling the beginning of each cut until you've located the one you want.

Yet the new Harman Kardon High Technology cassette decks do share one thing in common with the conventional decks. A conventional price tag.

So before you settle for a deck that will set you back $10 or more every time you want a quality recording, audition the new Harman Kardon Decks with Dolby HX.

For the location of the Harman Kardon dealer nearest you, call toll-free: 1-800-528-6050, ext. 870.

*Dolby and the double-D symbol are trademarks of Dolby Laboratories. Dolby HX is a standard feature on all Harman Kardon High Technology decks except the 100M.
Record Care, Part 2: A Record Life Study

How long will your phonograph records last?
How many times can you safely play records without degrading sound quality?

Using quality playback equipment, the factors of Record Longevity are twofold and closely interrelated: the record must be kept free of contamination, and the stylus must be kept clean during playback.

Scanning electron microscopy clearly shows the need and contribution of both record cleaning and stylus care.

Exhaustive research shows that with proper record/stylus care, an entire "life span" of 200 play events will not damage record surface quality or fidelity. (Most albums are played a total of 50 times or less.)

---

Results of D4 Record Care:
- Clean central radius due to capillary attraction of D4 Fluid into D4 pad fabric.
- Microdust-free stylus path due to exclusive D4 "spiral fiber" particle holding.
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Results of SC-2 Stylus Care:
- Reduced wall abrasion due to uncontaminated diamond face.
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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 operating 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 Vce (the output transistors' collector-to-emitter voltage) and a signal proportional to lc (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 Vce 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 Vce 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. C1 of Fig. 1 is such a capacitor. This assumes 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.
Without it, an amplifier simply isn't good enough for the Purist.

While everyone else was bogged down in the same old concept, Kenwood's engineers were busy developing a totally new way to look at amplifier performance.

SIGMA DRIVE

Traditionally, audio engineers have tended to approach amplifier design from the same misconception: that an amplifier and speaker should function as separate entities; when in reality they function together.

After years of extensive research, our engineers have solved the problem with a radical departure in amplifier design. It's incorporated for the first time in our new KA-1000 Purist Amplifier.

Kenwood's exclusive patented SIGMA DRIVE ignores traditional amplifier-speaker relationships by extending the KA-1000's negative feedback loop past the output terminals, all the way to the speaker terminals. SIGMA DRIVE ties a speaker's behavior directly to the amplifier's performance, which produces an unprecedented damping factor in excess of 600 at the speaker terminals and literally forces a speaker to behave in perfect sync with the amplifier.

Just as impressive are the other Kenwood advanced audio technologies which helped pave the way for SIGMA DRIVE.

For instance, an exclusive non-magnetic chassis. Dual power supplies, totally separate from the main chassis to further minimize magnetic interference.

And DC amplification for crystal clear tonal response down to 0Hz. Plus a built-in preamp for moving coil cartridges.

We've also included our famous HI-SPEED circuitry, which allows the KA-1000 to react much faster to dynamic music changes. And an ingenious touch-sensor volume control that increases to any preset volume level or fades to silence.

Of course, there's even more to the KA-1000 than we can possibly mention in this limited space. For the complete story, visit your nearest Kenwood Audio Purist Dealer. And find out for yourself why anything less simply isn't for the Purist.

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| Specifications measured at speaker terminals: 100 watts per channel, minimum RMS into 8 ohms from 20Hz to 20kHz with less than 0.005% total harmonic distortion. Transient Response: Rise Time 0.9 microsecond; Slew Rate ±120 volts per microsecond. Phone SN-M 93dB; MC 67dB. Special 10 meter speaker cables included. |

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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 Vce, 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-current 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
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If tape is the only sound that's right for you, to maximize your taping requirements, an ADC Sound Shaper® Two MK III frequency equalizer is a must.

When they designed the Sound Shaper Two, they had you in mind. Because, aside from being a superb all-around equalizer, it lets you work with tape the way you want. For example, now you have two-way tape-dubbing capability, a feature many receivers don't offer. You can "custom-tailor" a record and then record it the way you would have engineered it. And that includes your golden oldies because, with the Sound Shaper Two, you can virtually eliminate the surface noise which has accumulated over the years.

The entire ADC Sound Shaper line is impressive. The basic Sound Shaper One is a great introduction to frequency equalizers. And the top-of-the-line Sound Shaper Three, the Paragraphic™ equalizer, combines the ease and control of a graphic equalizer with the precision and versatility of a parametric. And, all Sound Shaper equalizers, except the Sound Shaper One, feature LED-lit slide controls, allowing for visual plotting of the equalization curve.

With the Sound Shaper Two MK III, you can appreciate the difference custom-tailored sound makes—over and over again.
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 (Vcb) 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 Vcb.

The data gathered from each device was captured in records in the computer’s disc data files for reduction at a later
NEW HIGHS. The 500ID defines hard-to-get high frequencies because it comes with a cantilever that doesn't easily distort them.

It's boron-vapor hardened to track under “G”-forces that would buckle ordinary cantilevers.

NEW FIDELITY. In addition to hearing more highs you're going to hear less noise from a 500ID.

There's nothing complex about the benefits of Samarium-Cobalt magnets. They are simply less massive and higher in output than conventional ones.

So, if we had to give a reason for our signal-to-noise ratio being better than most, it's because the materials we use are better than most.

NEW TECHNOLOGY. Because the 500ID features Empire's inertially damped tuned stylus system, its performance is consistent—even when the capacitance varies from one system to the next.

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EVERYONE WHO WANTS THEIR OLD SYSTEM TO SOUND LIKE NEW, RAISE YOUR ARM.

EMPIRE

There's a new sound waiting in your system.
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 $l_c$ 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.
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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 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.

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

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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 Gaspare 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, Tychobrahe, 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 *Traité 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 phono-tactica* (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*.
Realistic Model STA-2200
Stereo FM/AM Receiver

Manufacturer's Specifications
FM Tuner Section
Mono Usable Sensitivity: 10.3 dBf (1.8 μV/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 μV.
Image Rejection: 45 dB.
I.F. Rejection: 47 dB.
Distortion: 1.0 percent.
AM Frequency Response: 40 Hz to 3 kHz, 36 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 10 Hz.
Treble Control Range: ±10 dB at 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 designations 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 display 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.
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 μV), actually a bit better than claimed. Stereo sensitivity was an impressive 17.2 dBf, or 4 μV 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 μV or 13 dBf. In stereo, the 50-dB quieting point was reached with input signals strengths of 36.5 dBf or 36.8 μV. 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 μV or so, the LEDs used in the STA-2200 to indicate signal strength were sensibly calibrated, as follows: 70 μV, 100 μV, 230 μV, 500 μV, 1600 μV, 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.

INCREASED ACCURACY AND PROVEN RELIABILITY

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 (80Hz: 7kHz:2-4:1).

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.
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 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 subcarrier (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 µV (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.
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-IM 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 230 mV.

Always a welcome feature in an all-in-one receiver, the action of the selecttable 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
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-
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, HDL, 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).

<table>
<thead>
<tr>
<th>Tape Type</th>
<th>Dolby Lvl -20 dB</th>
<th>Dolby Lvl -20 dB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hz</td>
<td>kHz</td>
</tr>
<tr>
<td>Maxell UD-XL I</td>
<td>30</td>
<td>7.2</td>
</tr>
<tr>
<td>BASF Studio II</td>
<td>30</td>
<td>7.0</td>
</tr>
<tr>
<td>TDK MA-R</td>
<td>30</td>
<td>12.8</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Tape Type</th>
<th>IEC A Wtd. (dBA)</th>
<th>CCIR/ARM (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W/Dolby NR</td>
<td>Without NR</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Maxell UD-XL I</td>
<td>62.0</td>
<td>53.4</td>
</tr>
<tr>
<td>BASF Studio II</td>
<td>63.0</td>
<td>54.7</td>
</tr>
<tr>
<td>TDK MA-R</td>
<td>63.9</td>
<td>55.3</td>
</tr>
</tbody>
</table>

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).
The logic behind the Revox B77.

The logic is the logic which is built-in.

It's an ingenious and highly sophisticated system—much like the human nervous system—which controls the deck's functions.

You can push any button in any order with no chance of damaging your tapes. Our motion sensing system constantly feeds status reports to the logic circuitry which activates your commands in proper sequence.

The logic also permits full-function remote control, and an editing mode that keeps the playback circuitry live, even when the motors are stopped. You can make your splices right on-the-beat, and our built-in splicing block makes it easy.

The design and construction of the Revox B77 further guarantee smooth and accurate operation. To get the long-life advantage of ferrite without static build-up or heat degradation, we use Revox's exclusive Revodur heads, made of metal to dispel heat and static, and vacuum-coated with permalloy for durability.

The B77 has a unique capstan motor that's monitored by a tacho head to precisely control speed and limit wow and flutter to professional studio standards.

Revox offers many options with the B77 including a full range of speed configurations from 15/16 IPS to 15 IPS, variable speed control, 1/4 track record/playback and more.

All this professional quality is neatly engineered to fit in a deck you can carry. After all, if you own a machine this good, it's logical to take it with you.

Experience the B77 and the full line of Revox audio components at your franchised Revox dealer today.
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.

Fluent 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 0.07 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
Will you still respect your speakers in the morning?

Sure, they sounded great last night.

But the real test of a speaker system is the morning after.

Will your speakers sweeten your morning coffee with Vivaldi, or will they make you wish you'd never turned your stereo on?

Do your speakers make you glad you're alive, or do they only serve to remind you of last night's excesses?

Some speakers are impressive when played loudly. But a truly great speaker is equally, if not more, impressive at low listening levels. "Loud" is desirable at times, but a speaker to be lived with must do much more.

For years, and without fanfare, ADS has been building monitor speaker systems for some of the most demanding sound engineers in the music industry. ADS technology is uniquely able to accommodate their diverse and challenging requirements. This same technology, not surprisingly, produces some of the finest speaker systems available for home use.

The new ADS L730, for example, is a direct outgrowth of ADS' continuing involvement in digital recording technology. An unusual combination of extended frequency range, uncanny sonic accuracy, razor-sharp stereo imaging and true-to-life dynamic range, the L730 delivers untiring musical performance. Although the system is capable of shaking walls with clean, undistorted sound, you'll appreciate it most on those mornings when quality counts more than quantity.

The L730 is only one of many ADS speakers, all meticulously engineered and superbly crafted. Your ADS dealer will be happy to help you select the model which best suits your purposes. For more information and the name of the ADS dealer nearest you, please write ADS, Dept. AU23, or call 1-800-824-7888 (California 1-800-852-7777) toll free and ask for Operator 483.

ADS Audio for the critically demanding

Analog & Digital Systems, Inc., One Progress Way, Wilmington, MA 01887 (617) 658-5100
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 personally 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 Signifiers 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
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 woover 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 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 E₁, A₂, and A₄ is shown in Fig. 8. Distortion components remain moderately low up to an average power of 60 watts. Above this level, the tones of E₁ and A₂ show some acoustic distress.

Intermodulation on A₄ (440 Hz) by low E₁ (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 A₄.

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 kangaaroo 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
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 reasonably 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.

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*
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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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...
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 slewed 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 amperes 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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Apt 1-6 Audio 2/81
production 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 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." 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. Cinemascopic 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.

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,
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John Diliberto

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 astonishing 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 strain 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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Ferrichrome tapes combine the benefits of chromium dioxide and ferric oxide tapes for superior performance in car stereos. The top layer: a pure chromium dioxide for unsurpassed highs and low background noise. The bottom layer: ferric oxide for superior lows and great middle frequencies. And it also gives you higher recording levels so you get cleaner louder playback without cranking up your volume control to compensate. PRO III is the ideal tape for car stereo systems and performs just as well in the home on the Type III/ferrichrome position.

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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’ equals. 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 Lou, 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
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Gozemel Pero Ya... Cal Tjader
Concord Jazz Picante CJP-133, stereo, $7.98.
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 extrummer, 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 Concords, the sound here is vivid. Unlike most recent Concords, this pressing was not warped.

Francis Davis
Sound: A- Performance: C-

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Sound: A- Performance: C-
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February, 1981  This card expires May 31, 1981
JVC introduces a tonearm that out-thinks warps and resonances.

Ideally, a stylus should operate in a resonance-free environment where it can respond to groove modulations and nothing else.

That, unfortunately, has been a tall order for tonearm designers. Because minimizing one kind of resonance makes the arm susceptible to other kinds. Low-mass arms are the least susceptible to warp-induced resonances. But they’re the most likely to have structural resonances which color the sound of the music.

Higher-mass arms are less likely to have structural resonances. But they may have trouble negotiating warps and large groove modulations, especially with high-compliance cartridges.

JVC engineers have attacked this problem by developing a tonearm that “thinks”. Called the Electro-Dynamic tonearm, it causes the stylus to “see” ideal effective mass, even though the arm itself is medium-mass and very rigid.

Whenever a surface warp or eccentricity begins to create abnormal arm movement, two motors provide instant dynamic compensation. So the arm is not “thrown” by forces of inertia, momentum and gravity. The stylus remains properly seated in the groove. As a result, you hear stunning clarity (because of reduced IM distortion), stable stereo imaging and superb tracking of even the most difficult groove modulations.

As exciting as our E-D system is, you should not overlook the qualities of the turntables that feature it.

The QL-Y5F, for example, includes a double-servo quartz system which regulates platter rotation with greater accuracy than single-servo systems. The heavy platter and high-torque, coreless DC direct drive motor sustain a very high moment of inertia, avoiding the transient speed variations that can color sound timbres. Front-panel switches control the up/down and left/right movement of the arm, without the user ever having to touch the arm itself.

If your system can benefit from a turntable of this caliber, you will undoubtedly want to evaluate the QL-Y5F and its E-D tonearm for yourself. Please dial 800-221-7502 for the location of your nearest JVC dealer (in New York State 212-476-8300).

58-75 Queens Midtown Expressway, Maspeth N.Y. 11378.

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In the January issue, the advertisement for the Audio En- dorment should have read as follows: AMBER
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And as at Audio Amateur get reader's rave feedback on Nelson's work. Readers have a fine time constructing the Pass-40 because circuit boards, parts, the 381b. transformer and nearly everything else they need (except a chassis) is available from Audio Amateur's handy subsidiary Old Colony Sound Lab.

The Audio Amateur has published eleven other power amp construction projects in its 44 quarterly, on schedule issues. And all back sets are available too.

This year Contributing Editor Pass has done it again. He's updated Harmon-Kardon's Citation 12 using MOSFET outputs, lowering its 60W distortion again. He's updated Harmon-Kardon's Citation 12.

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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 electrostats 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 1940's. High C Stereo is not against progress, when it really occurs, and we now have some very exciting news. Due to the forma- tion last fall of the David Berning Company, the Legendary TF-10 preamplifier is now available to the audiophile com- munity.

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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/IVC 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 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 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 wall-sized flat-screen television with the image in three-dimensional stereo or holographic format, replete with some sort of multi-dimensional audio. As遥远 as 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 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...
designed, 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, it might 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 how 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 videos 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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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 pick-up 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 every heard of magnetic discs?”
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All of the tech data we've used to back up these statements is available free. Write to Home Entertainment Products Department, 3M Company, 3M Center, St. Paul, MN 55144. Ask for report C-242.

SCOTCH® RECORD CARE SYSTEM. THE TRUTH COMES OUT.

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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 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 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 reverberation 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 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 Becklock 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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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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