

The
Authoritative
Magazine
About
High Fidelity

Audio

FEBRUARY 1982 • \$1.50 • E06030



**TESTED
SANSUI'S SUPER
FEEDFORWARD AU-D11**

**UNDERSTAND
EQ AND TIME
CONSTANTS**

**HOW IT WORKS
CX NOISE
REDUCTION**

**VCR DECISION:
HOME TAPING
ILLEGAL?**



REVIEWED

- KEF 105
LOUDSPEAKER**
- AMBER SERIES
70AMP**
- GOLDRING
920 CARTRIDGE**
- AUDIOPHILE DISCS**
- MOBILE FIDELITY'S
UHQR**
- NAUTILUS'
POLICE/GHOST**

460350 MXW 67126099 A4 6 JUL82
MR FRED B MAXWELL
16712 GOLDSBOROUGH
LAUREL



27100 06030

High Fidelity for Humans:

IT EVEN FINDS STATIONS WH



Finding your favorite station isn't always as easy as tuning to 123.

For example, now that digital station readouts are standard on most receivers you have to memorize the precise call numbers of all your favorite stations. Not an easy job if you have a dozen or so stations you tune in regularly.

That, however, is just one of the many unpleasant-ries you have to deal with if you own one of today's conventional receivers. On the other hand, it's just one of the many reasons you should own Pioneer's new SX-7 receiver.

The SX-7 is a product of Pioneer's unique new concept in component design and engineering called *High Fidelity for Humans*. The result is a line of com-

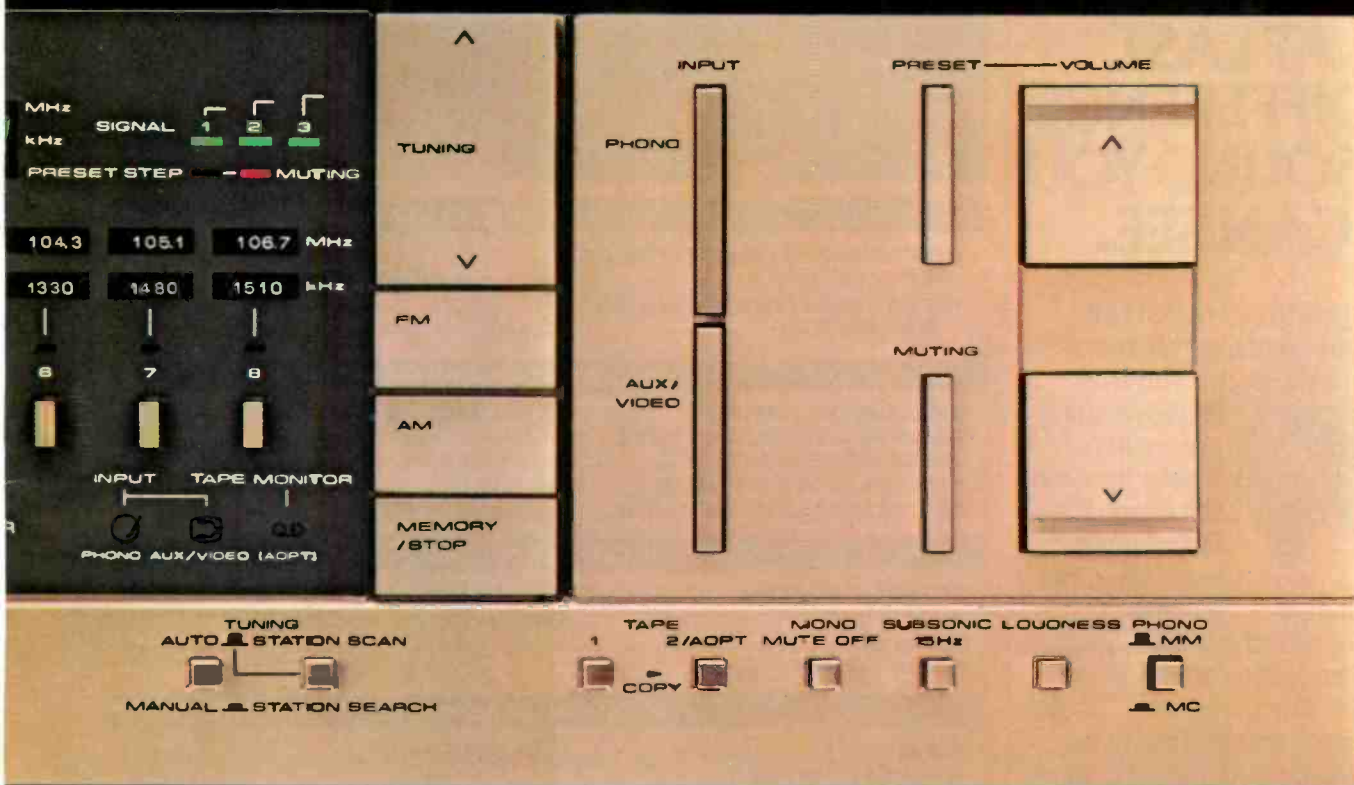
ponents that are as pleasant to live with as they are to listen to.

For instance, our receiver will commit to memory all your favorite stations. You can preset up to eight AM and eight FM stations. The moment you want to hear one you can recall it instantly.

Should you want to sample a variety of stations without any manual effort, simply press Station Scan. You'll hear five seconds of every strong station on the entire tuning band. If you discover a station you like you simply stop scanning.

Needless to say, not all stations have strong signal strengths. In the past you've had to struggle to tune in those stations with weak signals. The struggle's over. Due to the SX-7's ID Mosfet transistors you can

YOUR FAVORITE EN YOU CAN'T.



tune in weak stations as quickly and clearly as you can strong stations.

Drift, of course, is another way in which distortion has been allowed to sneak in and prevail where there once was music. The only remedy has been to simply get up and readjust your station. But with the SX-7 you won't have to bother. Because our Quartz PLL Synthesized tuning is designed to make drift totally impossible.

While these technological achievements make our components easy to live with, others just plain make your music sound better.

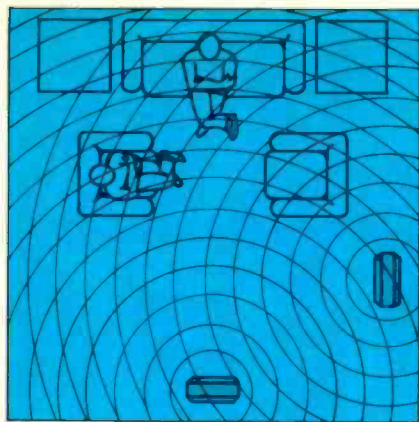
Our patented Non-Switching Push-Pull circuitry is a prime example. It eliminates the distortion created by output transistors as they click on and off,

thousands of times a second, in response to music signals. The SX-7's Non-Switching circuits keep our transistors from ever completely switching off, so they don't have to click back on.

If it seems as though the SX-7 has many features you just don't find on other receivers, it's because it does. Which is why we invite you to visit your nearest Pioneer dealer. He'll show you the SX-7, and an entire line of new Pioneer receivers.

They're all designed to let you spend more time enjoying music and less time simply trying to find it.

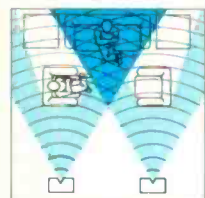
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Other speakers

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If your ears had eyes...



With ordinary stylus



With HE stylus

...this is what they'd see

Distortion is tough to explain—but you can see it, and you can hear it. For instance, if a poor lens on a fine camera distorts the original image, you end up with a bad picture, even though the rest of the camera does its job. The same with a stereo system: if the stylus creates distortion, the rest of the system can't make up for it, no matter how good the other components might be.

Shure's Hyperelliptical (HE) stylus tip reduces distortion dramatically because it has longer, narrower contact areas (the two areas where the stylus tip actually touches the record groove walls) which closely simulate the shape of the stylus used to cut the master record. The HE tip provides an audible advantage over spherical and elliptical stylus tips, giving you pure natural musical sound *without the distortion.*

Ask your local Shure audio dealer for a demonstration of the HE difference. It'll bring your music back into focus.

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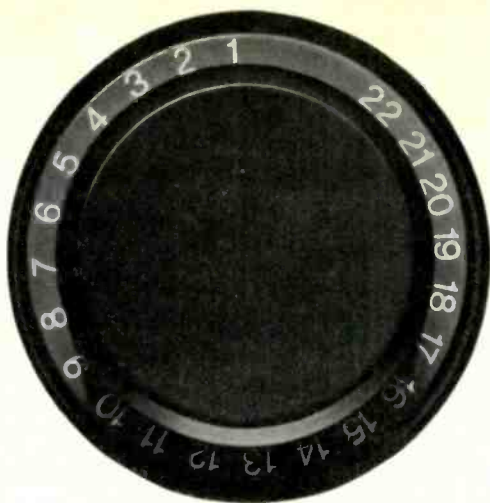
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If If everything were perfect . . . a control unit would consist of a volume control and a program selector switch.

Unfortunately this is not the case as any prospective high fidelity buyer—be he neophyte or hardened campaigner—quickly discovers.

everything He is faced with a choice. . . .

He can attempt to sift the vast quantities of conflicting information gathered from high fidelity magazines, retailers and “my friend who is an electronics engineer and knows quite a bit about high fidelity” . . .

were . . . or he can buy a Quad 44.

In the latter case he can be confident that whatever the program sources, he will be able to match them correctly, and apply tonal correction when necessary to obtain optimum results.

perfect... Moreover he can be confident that he need not change his preamplifier to meet future developments.

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New TDK AD-X is the first normal bias audio cassette to use TDK's Avilyn magnetic particle—based on the renowned Super Avilyn formulation that has kept TDK the leader in audio and videotape technology.

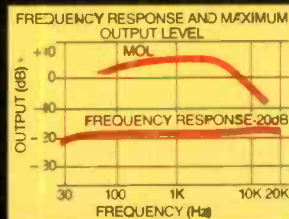
The Avilyn advantage offered in AD-X is demonstrably clear. You now can record and play back—in the normal bias/EQ position with complete compatibility for any cassette deck over a wider dynamic range and with far less distortion. Even at higher recording levels, the increased headroom in

new AD-X can easily handle strong signal input without over-saturation.

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MOL and lower bias noise you won't believe that your deck can "improve" so much.

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Avilyn magnetic particle achieves higher saturation and lower noise.



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So for high quality recordings in the normal bias/EQ position, snap in the new TDK AD-X. You'll discover that the Avilyn advantage means superior overall performance for you.

TDK
THE MACHINE FOR YOUR MACHINE



As noted here in my last installment (December 1980) my audio life history on paper is still decelerating; it has now practically passed real time and I'm beginning to lose ground. That would end up in a curious kind of infinity, I fear.

You may remember that I left you with that incredible and massive early hi-fi system of 1936, out of Federal Telegraph, presented to schools and colleges by Carnegie along with an enormous collection of 78-rpm records. I arrived at Princeton University almost the day this thing began to come in, and we spent weeks unpacking the huge boxes of breakable discs and filing them away on reinforced shelves. The hi-fi itself — then called merely a "phonograph" — was set up in a sizable lecture hall, all concrete, top, bottom and sides, with a stage in front and an upslope of study-type seats, the ones with the (right-handed) arm platform for taking notes and writing exams in blue books. If you can imagine a more dreadful place to listen to "grrreat music," I can't. It was poisonous. But music pros in those days (and now?) didn't think much about listening acoustics, as I have noted before. Point the speaker straight at the student, open up the volume, then start searching for the Second Theme or whatever, via the well-known squawk method. No wonder most of our students abandoned music five minutes after the final exams.

That 1936 machine really should be somewhere in an audio museum. It was astonishing. The turntable was a 16-inch professional heavyweight, a Rek-O-Kut, maybe, or forerunner of same. Massive platter, huge swinging pulleys that disengaged via a screw-down handle, with power switch. On it was mounted a long 16-inch professional straight tonearm (straight arms are the latest thing in 1982?) which allowed leeway for professional transcriptions, those huge discs, both lacquers and pressings, which preceded the days of tape. This, of course, made for superior tracking angles on the ordinary twelves and tens of the shellac 78-rpm repertory. An RCA horseshoe magnet pickup provided an adequate point pressure of seven or eight ounces or more. If you accidentally dragged that thing over the surface of a shellac disc, you not only left a gouge of Grand Canyon proportions but you produced, unless the vast speaker and its amp were



first turned way down, a roar and a gigantic rasp like three old-fashioned boiler factories. The walls shook, the ears curled, faces blanched — it was an absolutely new and terrifying sonic experience for all of us. I had occasion, over the next three years, to hear that horrible noise far more often than I wished.

I don't remember much about the (tube) amp, but it was plenty potent enough to power the 18-inch woofer (in 1936!) and the two heavy tweeters, the first I had ever seen or heard. The machine was marked as flat to 15,000 cycles although, not knowing of Bell Labs et al., we had no material of any sort which would test that remarkable sonic range. The magnetic cartridge broke off at around 4000, and when we later added an AM tuner (no FM then) things were even worse. Somebody didn't know enough to build us a wide-band TRF tuner, which just might have brought Toscanini and the famed NBC Orchestra to us with genuine highs. No such luck.

The speaker box was no open-back. The structure, if I remember correctly, was an enclosed bass reflex affair and stood as high as a man, weighing hundreds of pounds. Carnegie was out to provide state-of-the-art, you may be sure. It took three or four of us to move that thing, on the few occasions when it

was necessary. My very first act, however, was to tip the thing over on its back and shoot the enormous sound straight upwards at the concrete ceiling. Much more listenable that way, though people were shocked at the impropriety of it.

Alas, my class sections, small groups out of the hundreds that took our "music appreciation" course, were held in a small room equipped with an ordinary phonograph, i.e. a two-foot box complete with three-watt amp and mini-speaker. I did my best, but music via records was not then exactly a delight to hear, especially for students who couldn't have cared less in the first place. At least, I had learned long since NEVER to squawk. I produced only nice noises, let me tell you, and if I had to search for a tune or a special place, I did it with almost inaudible volume, as a matter of course. That helped.

Not so our distinguished Professor and Head of the Music Department, who gave the main lectures in that dreadful concrete lined hall. He never failed to turn the volume up to the top BEFORE starting to look for the music he wanted — and then was sorely affronted at the hideous noises forthcoming. He HATED the phonograph. It was surely the bane of his daily life. And it never seemed to occur to him that he himself had anything to do with it. I tried, respectfully, to

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Of course, the ultimate criteria is in listening. Visit your KEF dealer and listen to the new Reference Series Model 105.4.

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KEF

The Speaker Engineers



WHAT TYPE ARE YOU?

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It was a time when most people were immune to the thought that the listening area might be important for musical results.

educate him; it was no use. He drove that machine the way people drove autos in the "git a hoss!" era. Whenever he could, he turned to the grand piano that was always handy; he was a sometime pianist and that machine, at least, he could keep under control.

One year, this Professor had the bad luck to get himself mixed up with some of his Physics Department senior colleagues who were into building amps and the like — almost everybody of a scientific sort did it. These gents, alas, told him that what he really needed was a better control unit (that is what we today would call it) and they would be happy to build him one with their own hands. Plus superpower amp. The Prof. didn't ask my advice. I was merely a small mouse, a nobody; these were, after all, Full Professors.

I think you can guess what happened. They went to town and built the damndest piece of gadgetry you ever saw, with 50 incomprehensible controls and a couple of square feet of messy wiring, surrounded by vicious razor-edge hunks of chassis material. Moreover, in their joyous enthusiasm, they rushed the thing over, hot off the soldering iron, for the Professor's weekly big lecture to a packed house (required attendance). Testing? That could wait.

The lecture started and after a suitable build-up (he was good at that), the Professor turned dramatically to the new equipment, in the use of which he had had five minutes of coaching. The switch went on and out came a horrendous blat such as you have never heard, if you merely buy your own hi-fi and do not make it yourself. Startled, the poor Prof jumped at the nearest control which, of course, was the volume. A roar went out that could be heard for miles and at this point he lost his head, dropped the arm on a record, and recoiled to the sound of an agonized screech. (Open circuit, men. That's what started the trouble. No doubt a resin ground in the pickup department.) It was mayhem. Absolute disaster.

To my certain knowledge, that machine was never turned on again in our presence. We reverted to the lesser but safer terrors of Federal Telegraph's original construction. The enthusiastic physics profs retired to their labs and never came forth. Live and learn.

So you wonder why I am occasionally

Our biggest collective problem in hi-fi usage is that we do not know how to make the best sonic use of the equipment we own.

a bit bothered by our new turntables with automatic remote-control arms? They, too, can emit blats, if you drop the stylus on an unintended loud passage. And these days we have the power to surpass even that 1936 roar. Nevertheless, I loved that old, big machine. Because I tamed it and made it mine. It would do wonderful things, I assure you, and it did them for me.

When, after three years of teaching "appreciation," I removed to a new job in New York City as one-man music department in a tony female junior college, I ran into an amazing and helpful coincidence: Just as I arrived for my new duties, the Carnegie Collection, complete with an updated 1939 model phonograph system even better than the earlier one, arrived at the college for me to play with. And this time I was my own boss. My only problem was the students. Alas, they got to use the big machine for study purposes. They kept its volume suitably low — it was in the school library! — but I quickly found that they usually played the Carnegie records with "needles" that had no points, only jagged shards of metal. So, needles aside, another four years of advanced hi-fi opened out to me via that endlessly rewarding monster which again treated me to its best, in response to my own concern for getting the best out of it.

As you can guess, I was not ever going to be satisfied with mere classroom hi-fi. I loved records. I was fascinated by reproduced music and, as already related, had studied the "phenomenon" of this new way of music listening for many years, during a time when most people, and virtually all music professors, were immune to the thought that the listening area, the "room situation," might be of some importance for musical results. Like the electronic music lab today, the phonograph was the latest music teaching "must." But it was still a nasty machine that you pointed at people and then turned on. Canned music.

Fortunately, most phonographs were really not very loud, including the ordinary console or "sit-down" models that were used in classrooms. Even at full distorted volume, the sound, though unpleasant, did not cause acute agony. Only when the extremely rare 1930s hi-fi came into play, state-of-the-art equipment with real power and tonal range, did we find ourselves deep into trouble.

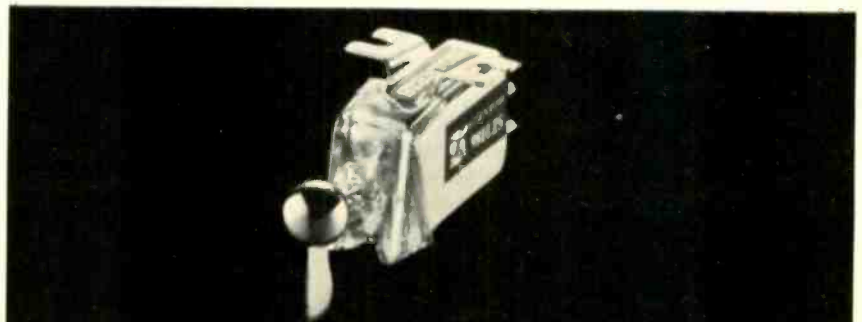
It was shocking, distressing in the extreme, to hear one of those monsters misused, and most people instantly jumped to the inevitable wrong conclusion — give me my small home phonograph! You couldn't really blame them.

It was surely the most difficult aspect of our entire early hi-fi, this problem of coping with larger, wider range sounds. The aftereffects of disasters such as I have described went on for years and persist even now. How about the early High Fidelity Shows? Incredible cacophony. Are we much better today? Sometimes. Not always. I am grateful every time Bert Whyte chides a CES demonstrator for badly managed sound. There are plenty of us who still do not understand.

Even today, if I may draw the moral, our biggest collective problem in actual hi-fi usage is that still, all too often, we do not know how to make the best sonic use of the equipment we own — or sell. We have every aid, from top-quality sound itself and the immensely helpful

spreading out of two-channel stereo and its various extenders via extra channels, all the way through NR and companders and down to old-fashioned tone controls and new-fashioned equalizers for room adjustments. We are geometrically close to perfection in the actual chain of reproduction. But to what avail?

Well, even so, never forget that the sound of reproduced music was astonishingly popular in the 1930s and we loved it. Just as we loved our cars, which never seemed more wonderful than in those heady days. Do you think I needed super-fi to enjoy my budding record collection? Though I learned how to use it when I had it. Do you think I needed a heater and snow tires to go skiing in the White Mountains of New Hampshire in mid-winter? Never heard of such things. But I got there and back with few complaints and much pleasure. So it was with audio. We enjoyed as many good experiences then as we do now, I assure you. I should know. Along with CBS, I was there. As they say, it's all relative. *A*



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games, etc. Circuitry allows recording from pay TV while watching cable or, for example, dubbing from one tape recorder while watching another. Price: \$199.95.

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Akai Stereo Microphone

The ACM-11V allows home video enthusiasts to surpass the sound quality of commercial TV broadcasts when making their own video productions. The mike is designed to attach to Akai's VC-X1 auto-focus video camera and VP-7350 VCR, and it incorporates two unidirectional pickups, which cover most of the audio band. Rolling off below 100 Hz to prevent obtrusive rumble, the mikes have a response up to 15 kHz for accurate recording of voices and ambience. Standard options include a mount for attachment to most video



cameras, a stand for remote use, a wind screen, and a conversion plug for use with other cameras. Price: \$49.95.

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on Reader Service Card

Nortronics Video Head Cleaner

VCR 130 and VCR 135 video tape head cleaners are nonabrasive, drop-in types for VHS and Beta formats, respectively. This wet system cleaner covers the entire tape path using a lint-free, static-free



cellular cloth which presents a fresh, continuously changing porous surface with each use. In addition to the cassette, each system includes a 1.3-oz. can of cleaning solution. Price: \$29.95.

Enter No. 102
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Hitachi Color Video Camera

The VK-C1000 is the first color video camera to use no tubes and is also said to be the smallest and lightest in weight. Doing away with the vidicon tube allows the camera to offer a no-smear picture, one without the traditional problems of burn-in and after-image associated with tube-type cameras. The improved picture results from employment of a new MOS image sensor, which also performs more efficiently and has a longer life than traditional "tube" sensors. Price: \$2,000.

Enter No. 103
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JVC Video Recorder

The HR-2200U videocassette recorder weighs only 11.4 lbs., complete with battery pack, yet offers many advanced features including three-way power-source options, solenoid pushbuttons, full-logic micro-processor-controlled tape transport, and edit-start control which automatically aligns the start of the segment being recorded with the end of the one previously recorded to eliminate

visual gaps and noise. Other features include slow-motion playback which can be varied from 1/6 to 1/30 of normal speed, single-frame freeze, and single-frame advance. The low-power consumption LCD electronic tape counter has a memory function which automatically stops the tape at "0" in rewind or fast-forward modes. LEDs are used to indicate tape running, battery warning, and moisture condensation. Price: \$1,100.

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Altec Car Speaker

The SK1 5¼-inch extended-range speaker has a nominal frequency response of 100 Hz to 10 kHz, ±5 dB, and requires only two inches of depth behind the mounting panel. Sensitivity is 92 dB SPL for one watt at one meter, while nominal input impedance is 4 ohms. Price: \$112.95 per pair.

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Electro-Voice Microphones

The 647CH, 647CL, and 647CLS microphones have a rated frequency response of 60 Hz to 10 kHz and are designed to match the range of the human voice. The three mikes, respectively, are high impedance, low impedance, and low impedance with a locking on/off switch. Each measures 3⅞ inches by ¾ inch in diameter and can be hand-held, used with a neck cord as a lavalier, or mounted to a gooseneck stand by means of the standard thread. Prices: 647CH, \$100.00; 647CL, \$97.00, and 647CLS, \$105.00.

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Visonik Car Amplifier

The A201E delivers 35 watts per channel into 2 ohms and 20 watts per channel into 4 ohms, 20 Hz to 20 kHz, at 0.5 percent THD. A switched integral noise filter helps eliminate alternator and other electrical engine noise, while a bass equalization circuit provides a 6-dB boost at 60 Hz. The input sensitivity is switchable, 180 or 500 mV, and installation is made easier through the use of RCA plug and Molex connector inputs. Price: \$95.00.

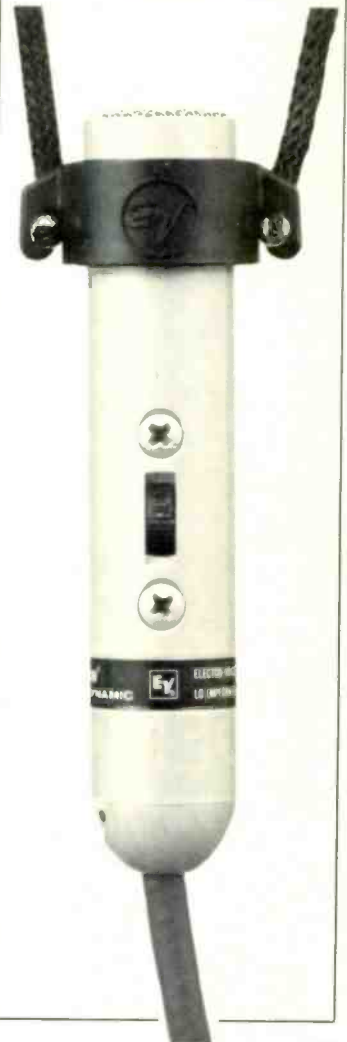
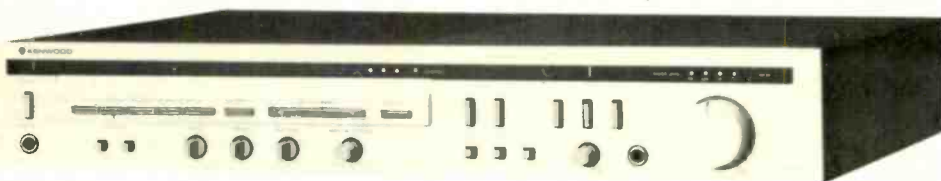
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Kenwood Receiver

The KR-80 receiver is a slimline d.c.-amplified design that features an auto-scan tuning system with digital frequency read-out and a programmable memory for up to five FM and five AM stations. Two pairs of

speakers and two tape decks can be connected. Power output is 27 watts/channel into 8 ohms from 20 Hz to 20 kHz with less than 0.05 percent THD. Price: \$399.00.

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THE DL-300 SERIES



DL-300 This may well be one of the most significant cartridges in Denon's history, because it brings the price of Denon Moving Coils under \$100. Yet, it offers all of Denon's significant moving coil technological developments; such as a two piece cantilever and dual-damping rings for optimum resonance control, and no pole pieces for lower mass and more efficient manufacturing.

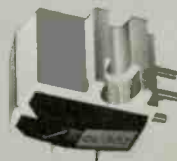
(Shown with stylus guard removed.)



DL-301 To control resonances, the cantilever fulcrum of all Denon MC cartridges is independent of the damping rings. The DL-301 uses two damping rings, each optimized for its portion of the frequency range.

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AUDIOCLINIC

JOSEPH GIOVANELLI

Disc Fulfillment

Q. Why will one record, say with 3.5 inches of groove radius, have perhaps a 13-minute playing time, whereas another record with the same amount of groove radius will have 26 minutes per side? Certainly spacing between bands is a factor, but there must be something else. — Rodolf Schmid, Berkeley, Cal.

A. When a record company produces a disc, the engineer knows that the program material will run X minutes per side. He also knows that, at least for cosmetic purposes, he must fill the disc completely. Thus, whether a side is 13 or 26 minutes long, the last modulated groove should be at approximately the same diameter for both discs. (All measurements are made in terms of diameter rather than in terms of radius.)

In order to make it possible to finish at a chosen diameter, the cutter is programmed for the number of grooves per inch which will bring about that result. This is not difficult when the engineer knows the distance between finishing diameter and the starting diameter, the time needed to traverse this distance and the speed of turntable rotation. However, there are complicating factors. The number of grooves or "lines" per inch also varies in accordance with the dynamics of the program. This allows the recording engineer to put many lines very close together when the music is soft, because there is little groove displacement during soft musical passages. This in turn, means that there is little chance of groove overlap. During highly modulated passages, on the other hand, groove spacing is widened and grooves are deepened to allow for both greater lateral and vertical groove swings.

If this variable grooves-per-inch system were not used, the loudest volumes possible for long sides would be considerably less.

Detects Deflect

Q. Lately I have noticed that when the selectivity switch for the FM section of my receiver is in its "Narrow" position, the signal strength meter deflects somewhat, in proportion to the audio of the program. Why should this be? — Larry Cook, Albany, Ga.

A. When an FM station is modulated, the effect is much like that produced when tuning slowly past it. Here, however, the signal frequency itself is shifting,

and not that of the local oscillator within the tuner. The tuner frequency is moving back and forth, above and below its center frequency. It is this movement of the station's carrier frequency which produces the desired program.

Just as a signal can disappear if one tunes off to one side or the other, so it can tend to disappear if the signal moves from one side of center to the other. The narrower the bandwidth of the i.f. strip in the tuner, the more this effect will be observed. Because of this decrease in signal strength as the signal frequency shifts away from its assigned center frequency, there is some loss in fidelity because the i.f. bandwidth is not linear.

In the wide-band position the selectivity of the tuner is such that the meter will not show changes in signal strength, even though the signal itself is still shifting above and below its assigned center frequency. Notice that when you tune off a signal you must move the dial a greater distance (when in the wide-band position) before the signal becomes noticeably distorted than when the tuner is in its narrow-band position.

Therefore, the narrow-band position of your tuner should be used only in those instances where there is alternate channel interference to the desired signal or where multipath distortion takes place.


Lowest Frequency

Q. How low can a pipe organ play? — James D. Gibbs, Cedar Rapids, Iowa

A. The lowest frequency produced by most pipe organs is 32 Hz—corresponding to what are known as "16-foot" pipes. Some pipe organs have what are known as "32-foot" pipes; their lowest note is 16 Hz.

Straight and S-Shaped Tonearms

Q. Does the use of a straight tonearm on a turntable have any advantages over the use of an S-shaped one? — Michael Lemieux, Rouses Point, N.Y.

A. The straight arm does not have any intrinsic advantages over an S-shaped tonearm. 

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.

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EQ Quandary

Q. I have several classic performances recorded during the 1940s and 1950s by Horowitz, Toscanini, et al. and would like to do my own remastering before putting them on tape. I hope to improve the frequency range, remove coloration, etc. For my purposes, which type of equalizer would you recommend: Graphic, graphic with adjustable center frequencies, or full parametric? — John Oster, Sacramento, Cal.

A. Inasmuch as the full parametric equalizer offers the greatest flexibility — permitting adjustment of amplitude, center frequency, and bandwidth of selected portions of the audio spectrum — I tend to favor this choice.

What's Your Bias?

Q. I want to adjust the bias of my open-reel tape deck for optimum performance. According to the service manual, this requires that a 10-kHz signal be injected at a -20 dB level, with the bias then being adjusted according to a table in the manual. How critical is this frequency? — Howard Sanner, Jr., Hyattsville, Md.

A. Accuracy of the signal frequency is fairly critical, so that you should have an accurate signal generator. You should probably be within 100 Hz of 10 kHz, because slight bias changes have a fairly pronounced effect on high-end response.

Steeling Signal?

Q. I have a Scandinavian-style audio and record storage system. It is designed so that I can place cassettes directly below or beside my receiver and tape deck. Although I'd like to do this, I never have because of concern that the magnetic fields of the power transformers of my equipment would slowly destroy the signals on the tape. A friend suggested that I obtain some steel sheet, cut it to fit, and place it below or beside my equipment to shield the tapes. Is this likely to do the job? Is it necessary? — Robert Ericson, Cicero, Ill.

A. I believe that your fears are groundless and that you may do more harm than good if you introduce steel sheeting that cuts off air flow around your equipment. It could cause overheating of the equipment.

For a powerful magnetic field, such as that of a bulk eraser, to have perceptible effect on audio tape, it would have to be

brought within three inches or less from the tape. The magnetic fields emanating from your equipment are much less powerful than that. You probably have more than three inches of spacing between your cassettes and your audio equipment — or at least you should in order to permit adequate air flow. Chances are very great that your cassettes would be safe even if there were only an inch of spacing.

Limiters Limits

Q. My cassette deck incorporates a limiter to prevent signals from going above the 0-dB level and thereby causing distortion. Is the limiter that beneficial? Or could it be that the record level meters are inaccurate, so that I am unnecessarily limiting a signal not so large as to cause distortion or of too brief a duration to cause noticeable distortion? — Charles Hopson, Madison, Ala.

A. The quality of limiters found in cassette decks varies from one design to another. For high fidelity, few serious recordists employ such a limiter. Therefore, it is advisable that you switch out the limiter when making music recordings from which you expect maximum fidelity. If your deck does not permit you to shut off the limiter, then be careful in recording not to let the record level meter go above 0 VU.

To tell how good a job your deck is doing, make a tape of a phono disc and play back the two in synchronization, alternating between them. If you hear little or no difference, things are working well.

Mike-to-Deck Matching

Q. I would like to use a microphone with an output impedance of 250 ohms for recording on a tape deck that has a mike input impedance of 30,000 ohms. Is this a problem? — Robert Shepard, Elk Grove, Cal.

A. Ordinarily there is no problem when you feed a low-impedance source into a high-impedance load, provided that the source delivers enough signal voltage to drive the load adequately. In your specific case, there is no problem if your mike furnishes enough signal to drive the deck to full recording level. If it does not, you will need a line transformer to step up the signal voltage. The transformer should be at the end of the cable nearest to the deck to prevent a possible loss of high frequencies.

Garage-Sale Find

Q. I recently purchased an old-model open-reel deck at a garage sale for a surprisingly low price of \$45. When the monitor switch is in the "tape" mode, I hear a strange noise from the right channel; it sounds like someone blowing continuously into a microphone. This sound gets recorded onto the tape, and I would like to get rid of it. What might the problem be? — Ron Salmon, Moorestown, N.J.

A. The strange noise from the right channel is probably why the former owner parted with the deck. This could be due to a noisy resistor, capacitor, or transistor. The cost of repair at an authorized service shop might run under \$50; more likely it would approach \$100 or more, as these things go these days.

Input Inclination

Q. More and more I see ads for receivers which feature mike inputs and mike/line mixing. If a recordist has a tape deck as part of his system, what considerations might make him decide to use the mike inputs of the receiver rather than those of the tape deck? — Melvin Spencer, San Juan Capistrano, Cal.

A. One reason for preferring the receiver's mike facilities might be that it has a higher signal-to-noise ratio for mike input. Another reason might be higher gain when dealing with a weak mike signal, and a third might be convenience of access.

Trigger Unhappy

Q. My cassette deck has an automatic shut-off device that is very "quick-triggered." When the line voltage drops (for example when my air conditioner goes on), it clicks off. Sometimes it operates fine for 10 or 12 hours but then shuts off several times in a row, which is very inconvenient if it happens during recording. I took my deck to the factory twice, but to no avail. Several other cassette decks are used in our house, and none of them have this problem. I am planning to get rid of my deck and buy a different one. But how can I know in advance that the new one will not end up doing the same thing? — N.A. Bruscolini, Philadelphia, Pa.

A. Yours appears to be an unusual problem; no other reader has reported a

similar one (yet). If you buy another deck, the odds are that the problem will not recur, although of course I can't promise.


It seems a shame to replace an otherwise satisfactory deck for the reason given. Have you tried taking your complaint to the manager of the factory, or to someone else *at or near the top*? Have you called your electric company to check whether your line voltage is unusually low even at "normal" times? Have you consulted an authorized service shop instead of the factory?

If you are intent on a new deck, discuss your problem with the dealer. If he maintains a service shop, he will probably have a Variac which can vary the voltage supply and thus check for performance under low-voltage conditions.

Shopping Around

Q. I am in the process of shopping for a cassette deck. Is there a good way to compare decks? One store owner asked me what my taste in music is, but does this really matter? — David Hellman, Suffern, N.Y.

A. It seems to me that your taste in music is irrelevant to your choice of tape deck.

Your first step in selecting a deck may be on the basis of equipment reviews, price, and specifications, which should give you a group of, say, half a dozen from which to choose. Next, you should listen to the decks you have listed as possibilities, and limit yourself to those which seem most accurate when comparing the playback signal with the source (for example, using FM noise as the source), and which seem to be the least noisy in playback. Operating features and conveniences would be secondary considerations, although not necessarily unimportant. Stay with well-known and reputable brand names, and inquire as to where you will have to go for service if the need arises. If all other factors are about equal, it is great to have an authorized service station nearby instead of having to settle for an unauthorized shop or having to ship one's deck to the manufacturer for service. 

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.

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EDWARD TATNALL CANBY



P.D.Q. Bach: Liebeslieder Polkas; Twelve Quite Heavenly Songs. Ferrante, Schickele, Swarthmore College Chorus, Swing.

Vanguard VSD 79438, stereo, \$7.98.

Sound: B+ Recording: B+ Surfaces: B+

The annual P.D.Q. Bach recording is out again, as usual composed by the indefatigable Prof. Peter Schickele. The first side of this one is as fresh and funny as any of them and just as musical, with the very young Swarthmore College students rapturously entering into the fun — they love it. Side 2, alas, is a lesser effort though they try hard, a batch of 12 rather labored songs for solos on the signs of the zodiac, sung by the overly cultured voice of John Ferrante and the grossly untutored and hideously out-of-tune instrument of the Master himself, who should keep out of harm's way. He's awful. He should shut up, I say. And let his music speak for him, not out of him.

There are two pianists plus voices on side 1, just like the prototype Brahms *Liebeslieder* waltzes, and even a few touches of Brahms here and there. But mostly we are treated to hilarious flashes of all sorts of familiar composers and music, from Mozart to blues, Offenbach to Sousa. And the vocal tricks, so enthu-

siastically sung by these college kids, will turn your ears upside down! The texts are good old poems by such as Robert Herrick and William Shakespeare but the settings are something else again — wow. Shakespeare's "Who is Sylvia?" (so primly set by Schubert!) has two startling extra verses added and a lot of dizzy questioning — who the heck IS Sylvia? and so on. And there's an ad-dled adaptation of the old tear-jerker, "Drink to Me Only with Thine Eyes" which begins "Eye Me Only with Thy Drink." Ugh. Faugh. But lotsa fun.

I think in future the Professor had better stick to one-siders and leave the other side blank.

Handel: 7 Concerti Grossi (with oboe), Op. 3. Smithsonian Chamber Players, James Weaver.

Smithsonian Collection N-023, two discs, stereo, \$15.08. (Smithsonian Customer Service, P.O. Box 10230, Des Moines, Iowa 50336.)

Sound: A- Recording: A Surfaces: A-

This is one of the most joyous Handel instrumental recordings I've heard in years, full of life, rhythm and verve and — miraculously — also played with musicological correctness on actual period instruments, mostly out of the Smithsonian's own collection. Was I surprised!

Somehow, I expected the good old Smithsonian to come out with a proper and stuffy product, no doubt boring for the likes of us hi-fi listeners. Far from it.

This particular set of concerti grossi (not solo concertos but with groups of solo instruments) came before the familiar Op. 6 works for strings alone and was indeed pretty much of a commercial venture; half of the movements are borrowed from earlier Handel and may even have been "arranged" by some of Handel's musical slaveys, the copyists who were his working secretaries. No matter! Handel regularly borrowed his own work, to our delight each time, and even used that of other composers when he so fancied. These are in truth a kind of patched-up composite collection but you would never know it in the listening. Expertly done.

The concerti feature oboes — here, of course, the old "Baroque" oboe — also a "Baroque" flute and an organ, plus "authentic" strings as of Handel's day, with a noticeably different sound, more stringy. Lots of sonic variety to listen to. The excellent recording backs up the rhythmic verve and excitement of the playing, and my only reservations were a number of uncomfortable pre-echoes at susceptible spots. Minor complaint.

Johann Caspar Ferdinand Fischer: Le Parnasse Musical (1738); Pieces de Clavecin (1696). William Christie, harpsichord.

Harmonia Mundi HM 1026, stereo, \$9.95. (Mail orders, contact Brilly Imports, 155 N. San Vicente Blvd., Beverly Hills, Cal. 90211.)

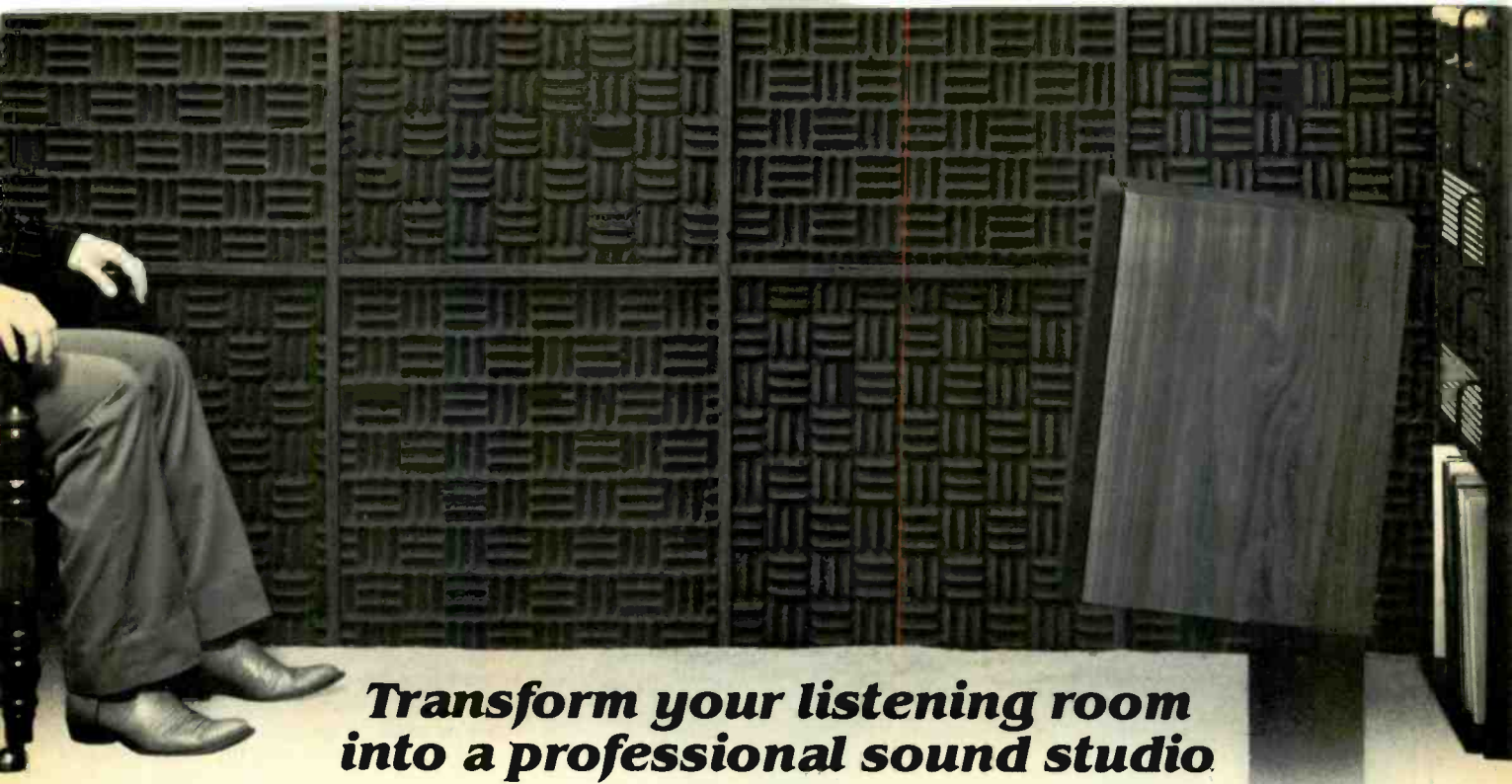
Sound: A- Recording: B+ Surface: A

Henry Purcell: The Complete Music for Harpsichord. Robert Woolley.

Nonesuch HB 73033, two discs, stereo, \$17.96.

Sound: A- Recording: A- Surface: B+

Here are two excellent harpsichord composers, neither one French, both clearly French-influenced. If you have heard Couperin and Rameau, that smooth, highly ornamented music with the fanciful titles throughout, you'll know what I mean. William Christie plays with a good sense of drama, while Robert Woolley is impressive in his excellent rhythm, phrasing and ornamentation.



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"I recommend SONEX to all of my customers that have room problems. SONEX can improve the sound of systems ranging in cost from several hun-

dred to several thousand dollars." Mike Shotts, Owner, The Soundtrack, Auburn, AL.

"SONEX has been the missing link in home audio reproduction. It is the one product desperately needed by home audio enthusiasts. We recommend it highly." Doug Johnson, Executive Vice President, Sound Connections Intl., Tampa, FL.

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THE COLUMN

MICHAEL TEARSON
JON & SALLY TIVEN



4: Foreigner
Atlantic SD 16999, stereo, \$8.98.
Sound: B+ Performance: B

Foreigner's first two albums were "must haves," strictly due to the presence of one or two blockbuster hit singles. By the time their third one rolled out, it appeared that they had arrived as an album band. Unfortunately, the consistency of *Head Games* is not present on *4*, and with the whittling down of their personnel to the point where only three of the original members remain, at times Foreigner sounds like it's on its last legs. There are a few cuts on *4* which stand as strong rock 'n' rollers — most notably "Luanne" and "Don't Let Go" — but the bulk of their fourth album is wasted on reprises of familiar territory.

"Break It Up" sounds like "Feels Like the First Time" meets "Blue Morning, Blue Day" in a minor key dominated by synthesizers, and it's a cliché that the group's already worn out. "Nightlife," which kicks off the album, sounds remarkably like a reworking of a Ritchie Blackmore/Deep Purple riff. And "Juke Box Hero" features lyrics that are awfully reminiscent of Bad Company's "Shooting Star," a dangerous road for Foreigner to tread considering that they've been criticized right and left for sounding too much like Bad Company throughout their career.

Perhaps with the other guys gone, the remainder of the group feels they have to make up for said loss, thus breeding the excesses on *4*. One misses the subtleties in Mick Jones' writing that were starting to emerge on the last album, and he refrains from singing this time around, which is also unfortunate. Lou Gramm's voice is starting to wear thin, as it has been recorded with fewer effects here and its natural qualities are somewhat lacking at times (check out the improvisational part at the end of their single "Urgent"). They're still more powerful and melodic than Boston, who are their only real competitors for the megaplatinum, heavy metal/mass appeal crowd, but as a four-piece unit Foreigner is quickly losing ground. Dubbing *4* a transitional album and reserving judgment until next time might be well advised, as it is at best a three-song album.

Jon & Sally Tiven

Bella Donna: Stevie Nicks
Modern MR-38-139, stereo, \$8.98.
Sound: B Performance: B

With all the advance talk about *Bella Donna*, one could have expected something either incredibly off-the-wall brilliant or a huge failure, but in actuality Stevie Nicks' first solo outing strays little from the style she's established with Fleet-

wood Mac. There are no raunchy electric guitars, no crazed rhythms, not even a heavyhanded production job to make Ms. Nicks sound much different from "Rhiannon." In fact, if anything, the musicians on this album are making a conscious effort to emulate the spacious and clean backing that one is used to hearing behind Stevie, which makes for an album that is never unpleasant but no great barrel of surprises.

"Stop Dragging My Heart Around," the single from *Bella Donna*, was touted as the kind of rock 'n' roll number that we're used to hearing from Tom Petty (who wrote it). This tune does sound like a cross between "Refugee" and "Breakdown," but neither of these is exactly a rip-roaring Chuck Berryism either. "Stop Dragging . . ." more resembles what you're used to hearing from Stevie than your typical Tom Petty tune, and this is about as forceful as the album gets. Whereas Lindsey Buckingham (Stevie's ex) is more or less the musical director with Mac, Petty's organist, Ben Tench, is the musician in charge here, adding his tasteful touch on all the tracks but one. The musicians chosen to support Nicks are culled from Tom Petty's Heartbreakers, The Eagles, and the Lost



Angels session regulars — fairly right-wing fellas, and not a new waver in the bunch to mess with the low-key tone of things. From "Outside the Rain" (which sounds just like an outtake from *Rumours*) to "Edge of Seventeen" (which was inspired by Tom Petty's wife) there's not a thing here which could possibly offend a Stevie Nicks fan, but nothing that would convince a Ramones fan to buy *Bella Donna* either.

One must give Stevie credit where credit is due — she is a unique singer and a musical stylist who has stayed completely within that given style, and disputed any claims that she doesn't have a coherent vision of her music. And while *Bella Donna* may not be a particularly adventurous album, it is musically sound and idiomatically distinctive, which is nothing to scoff at in an age where blandness and amusicality are the trend.

Jon & Sally Tiven

Songs in the Attic: Billy Joel
Columbia TC 37461, stereo, \$8.98.

Sound: A Performance: B+

It is not uncommon for established artists to want to rewrite history, i.e. remix or re-record those tracks they made before they developed a "successful" approach to the studio. This is the basis of many live albums, and the reason why many of them are so abysmal is that the quality of the artist's performance actually deteriorated with age. The more they play their old standbys, the more mediocre they start to sound until they reach the point where all the life is drained from them, i.e. *Frampton Comes Alive*.

Billy Joel is an exception to many of the rules, as he has actually improved with his rise to fame. The early Billy Joel was a minor irritation, a smug, self-pitying brat who bitched and whined and sold only a few records. The mass-market Billy Joel comes off more as a punk McCartney, slightly more cloying but genuinely melancholy at times. The derivative nature of his approach is less irritating knowing that his *Glass Houses* New Wavisms bring the larger record-buying public one step closer to accepting John Cooper Clarke, and he carries fewer pretensions with him now that he's got a few bucks in his pocket.

With this in mind, it is easy to understand how *Songs in the Attic* is a legit album, and a marked improvement over

Tear It Up: Johnny Burnette & The Rock & Roll Trio

Solid Smoke SS-8001, mono, \$6.98.

Sound: B Performance: A

Any guitar aficionado who wonders what the inspiration was for Jeff Beck's riff-crazy Yardbirds soloing, or who thought that Scotty Moore (Elvis' axeman) was strictly one of a kind, must pick up this record. This was the band that set fingerboards aflame across the globe, even though in its day The Rock & Roll Trio achieved only cult-hero status. Johnny Burnette sings like the biggest hick that ever stepped in a cowpie, and the support by his brother Dorsey (on bass) and particularly lead guitarist Paul Burlison kicks the proverbial mule's behind. Robert Gordon has championed the Burnettes by recording some of these tunes on his records ("Rockabilly

Boogie," most notably), but no one has been able to replicate the stinging approach these guys had.

The album kicks off with the chestnut "The Train Kept A-Rollin'" (a.k.a. "Stroll On") and ends with "Honey Hush." The Yardbirds incorporated both into one tune and achieved great notoriety on stage and in the film "Blow Up." Songs best known as Elvis Presley tunes are given a rousing treatment here, songs like "Lonesome Train" and "Baby, Let's Play House." But even though the songs are definitely crucial, what makes these tracks so precious is Burlison's incredible guitar stylings which have only been approximated, never duplicated. Perhaps someone like Robert Gordon can pull Burlison out of retirement to continue along the path on which he started; few modern players can play with such abandon yet maintain this level of precision and intensity.

Jon & Sally Tiven

the earlier versions of said tunes from *Cold Spring Harbor*, *Piano Man*, and *Turnstiles*. When he recorded these ditties originally, Billy was more of a songwriter than a complete artist. He had no mastery of the recording process, his career was being controlled by people who didn't have his interests at heart, and the Billy Joel persona as we have come to know it was still in its formative stages. The idea of taking each song from the performance where it came off best seems to have worked in his favor, and by not going for the typical two-record live set format he's avoided making this stopgap record a burden. But when you get down to it, this album — which was actually recorded quite some time ago — is a stalling tactic, a record to put out so he's got time to work on the next one. This is a decent move that shouldn't knock anyone out but will keep the fans happy meantime.

Jon & Sally Tiven



Almost Blue: Elvis Costello & The Attractions

Columbia FC 37562, stereo, \$8.98.

Sound: A

Performance: B-

Why country? Elvis' record label hasn't had much success in the United States selling him to an audience outside of the FM rock cultists, which is good for 200,000 or 300,000 in sales but is nothing compared to Journey, Styx, or Foreigner. He has not been able to connect with a hit single via the normal pop route, and as country music seems to have as much space on the AM band as rock, it could be interpreted as a shrewd move for Elvis to have recorded an album of country standards and not-so-standards. But let us not ignore the fact that Elvis' early demos and recordings had a strong C&W tinge to them, and he is able to approach the genre with the genuine passion of an alkie.

Thus we have *Almost Blue*, Mr. Costello's first album featuring all non-original compositions and a producer other than Nick Lowe. It also marks the return of Doobie Bro' John McFee guesting on lead guitar and pedal steel, and though his contribution may not be as awe-inspiring as his playing on *My Aim Is True*, it certainly adds a nice touch. But let's not beat around the bush. While *Almost Blue* may not be as downright awful as Costello's last LP, *Hurt*, it isn't the kind of record that you're bound to come back to time and again. It's got some nice things on it, and Elvis sings well on this sort of stuff, but it's a curiosity item — much like the single "Stranger in the House" except longer.

When Bob Dylan went country on *Nashville Skyline* it was more or less a mindblowing oddity, but Dylan wrote his own cornpone rather than reaching into Hank Williams' and George Jones' catalogs. What's more, that precedent was set a long time ago, and since then many artists have crossed over the line from country to rock and vice versa; there's simply no great surprise here. So what you keep reminding yourself is that this is a marketing gimmick rather than a definitive work. A good country album, perhaps, but for Elvis Costello — allegedly one of the great songwriters of our day currently in a slump — this is simply an all-too-obvious digression.

Jon & Sally Tiven



Precious Time: Pat Benatar
Chrysalis CHR 1346, stereo, \$8.98.

Sound: B

Performance: D-

Granted that there is a need for female heavy-metal performers, and taking into account that it is very difficult for anyone to come off as being genuine in the middle of a bombast, Pat Benatar vibes like the Queen of Insincerity on her latest album, *Precious Time*. She sounds like she'd rather be doing anything else, but what the heck — the money's good and it's only a step, right? Next year, the Broadway stage, then movies, and eventually you'll be in front of your television and watch "The Pat Benatar Show!" Cher should be so lucky.

This girl has been packaged. Put a femme fatale in front of the Rick Deringer Group (where guitarist/producer Neil Geraldo and drummer Myron Grombacher got their training), play them to houses of drooling teenage boys, and just sit back watching the royalties roll in.

You could almost take Pat at her word when she says that she spent all her years singing torch songs in cabaret clubs because no one wanted to hear rock 'n' roll.

Almost. Her patented delivery leaves no room for surprises, she never phrases differently than you'd expect, and every move is telegraphed beforehand. You can't fault her band — they've got every guitar trick down pat (Pat?), and even though their licks are familiar, you can't pin them down exactly. They even take time out from their metallurgy for a reggae number, "It's a Tuff Life," which sounds less like a song of Jamaican origin than any white reggae tune you've ever heard. Mind you, all of this is par for the course, and you shouldn't have expected any less.

But when they mess with classic rock tunes, that's a different story entirely; crucifying "Helter Skelter" and sloppily regurgitating Paul Revere & The Raiders' "Just Like Me" (and misspelling com-

poser Terry Melcher's name in the process) is inexcusable. By the way, is there a connection between these two tunes? "Helter Skelter" was the song that inspired the Charles Manson gang to commit their dastardly deeds, and Terry Melcher owned the house where Sharon Tate got it. Could it be that Pat is a secret member of the Charles Manson Appreciation Society? Is there an intimation of a fascination with the occult here? Not a chance — that would mean that Pat was somehow connected emotionally with the music on this album, and that, friends, is hardly likely. *Jon & Sally Tiven*

Discipline: King Crimson
Warner Bros./EG BSK 3629, stereo, \$8.98.

Sound: A Performance: B+

Having ended his flirtation with the contemporary music movement and realizing the only difference between the old music business and the new is a few decimal places, Robert Fripp has revived that old dinosaur King Crimson to give himself a commercial vehicle to make noise with. He still hasn't learned to play the blues, the lyrics on this latest record are as pretentious as on any Crimson record past, and he hasn't lost his flair for surrounding himself with fine musicians. In other words, Fripp's latest record is his best in seven years, not counting *Another Green World*.

As one would expect, the King Crimson of 1981 is somewhat of a continua-



tion of the group last seen on *Red*, with the same excellent drummer Bill Bruford once again lending his talents to the project. Studio whiz Tony Levin (ex-Carly Simon, Peter Gabriel, et al.) and former Bowie/T-Heads accompanist Adrian Belew add their talents on bass and guitar/vocals respectively, and the King Crimson predilection for pyrotechnics is left pretty well intact. The most successful pieces on the record are the ones which sound like jam sessions, where the vocals are an afterthought and kept to a minimum. The strains of Mahavishnu Orchestra, Jeff Beckisms, and other "influences" pop up but not to distraction, and at last Fripp seems to have settled down into the groove of playing. This time around, no more pop-music biz existentialism, no guitar flagellation, just four people playing together and making interesting music. *Jon & Sally Tiven*



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Help Yourself: Larry Gatlin & The Gatlin Brothers Band
Columbia JC 36582, stereo, \$7.98.

Sound: A Performance: A

Although the record industry classifies Larry Gatlin as a "commercial" country star, there is more integrity and creativity to his music than that of virtually any other singer-songwriter in Nashville today. While the country-music press hacks away at what are perceived as his many foibles and idiosyncrasies (such as his refusal to sign autographs), Gatlin manages to maintain consistent levels of artistic excellence and growth in the face of constant criticism.

Whereas many Nashville superstars who began as songwriters have all but given up writing their own material (the commonly cited example being Mel Tillis), Gatlin continues to write songs that are increasingly more perceptive, more thoughtful, more unflinching in their depiction of real-life characters in authentic situations, no matter how unpleasant they may sometimes appear. (Witness the flap over a Gatlin hit about winos, with the memorable chorus, "Will there be Mogen David in heaven/If not, who the hell wants to go?")

Help Yourself may not be the overall strongest collection of Larry Gatlin songs to date, yet not one track is below par,

while several rank alongside his finest compositions. "Must Be All the Same to You" engages in some of his most subtle wordplay yet, a Gatlin trademark. "I Still Don't Love You Anymore" is a near perfect integration of words, music, and arrangement, beginning as a rapid country rocker before slowing down for a dramatic second half, thus musically mirroring the shift in emotions expressed by the lyrics. "Daytime Heroes" portrays a housewife whose life has gone sour, who depends on pills and soap operas to get her through the day — "Prince Valium and her daytime heroes/Have saved her again." "Songwriters Trilogy," a solo performance recorded live, describes three songwriters; the first two are trying to make it, while the third is Gatlin himself giving thanks for his success. Somehow the genuine humility of the third section of this song doesn't jibe with Gatlin's image as an egotist.

The instrumental backing by Gatlin's road band is polished and knowing. The smoothly harmonized vocal blend of Larry and his brothers Steve and Rudy has rarely sounded more lushly alluring than on "It Don't Get No Better Than This," "Until She Said Goodbye" (a quasi-bluegrass tune on the order of Gatlin's 1977 hit, "I Wish You Were Someone I Love"), and the gospel quartet-flavored "Wind Is Bound to Change."

Okay, so maybe this isn't "pure" country (to which I say, so what?), and maybe he won't scribe his name on every scrap of paper thrust in his face, but Larry Gatlin is one of the great singer-songwriters of our time, regardless of category. For those who buy records for the music and not because of the performer's public personality, that's what really matters.
Tom Bingham

Electricity: Bob Lucas, Bill Schwarz, Miriam Sturm
Redbud Records 1003, stereo, \$7.00.

Sound: A- Performance: A

Electricity is a group from the heartlands of Indiana who have released their album on a home-fried label. Their music is vibrant and melodic and diverse played on assorted instruments much in the manner, if not style, of the early Incredible String Band.

Their songs sum to a rich tapestry with strands of humorous accordion-driven polkas (!) about such topics as midnight jamborees, driving too long a stretch overnight, and President Ford, plus some luscious melodies that the fiddle and viola make into romantic gypsy tunes, some that are pure frailing ("Paul McCartney"), and some that are pure country music. Their writing is thoughtful and literate and downright excellent, the performances sparkling with uncommonly beautiful recorded sound, especially for a homemade project. Best yet, the group never becomes ponderous or too self-serious. They never lose the light touch.

You can mail order *Electricity* for \$7.00 from Redbud Records, c/o Raw Talent, Inc., Box 1704, Bloomington, Indiana 47402. I think you'll be glad you did.
Michael Tearson

Livin' on Honky Tonk Time: Joe Sun with Shotgun
Ovation OV 1755, stereo, \$7.98.

Sound: A Performance: A-

Joe Sun has had several hits in the past couple years, including the original "Old Flames Can't Hold a Candle to You" (to which Dolly Parton's remake can't hold a candle), "Shotgun Rider" (which crossed over from country to pop), and the recent "Bombed, Boozed and Busted." Somehow, though, he re-

mains just below the threshold of stardom. With any luck, this situation should be remedied by this, his third album, and by the current single from it, a remake of Crystal Gayle's "Ready for the Times to Get Better."

For one thing, the selection of material is as strong as any album to come out of Nashville in awhile. "We're a Bunch of Outlaws" is an uncompromising declaration of where Sun stands in regard to traditional country-music propriety. "Bottom Line" is unvarnished blues-oriented country along lines similar to Hank Williams' "Ramblin' Man." "Alabama Rose" is a sorely under-regarded Gary Stewart piece which well deserves the tremulously soulful treatment accorded it here. Veteran Boston writer John Lincoln Wright's "Please Pull Away from Me" is the honky-tonk ballad of the year, with one of the most heart-tugging melodies and heartbroken lyrics I've heard in a long, long time. Sam Weedman's "Hobo

on a Freight Train to Heaven" (with Onie Wheeler of Roy Acuff fame doing his patented train-whistle imitation) is given a more lowdown interpretation than John Starling's version. The aforementioned "Bombed, Boozed and Busted," a Sun original, is a true barroom singalong classic.

But great material requires top-notch singing to put it across. Aside from the feeble yodel on "Bombed," that's exactly what Sun delivers. His bluesy, earthy baritone digs into a song, extracting all the emotion that went into the writing of it. While he's at his best expressing pain and sorrow at midtempo and slow-grind, "I'd Better Go Home (While I Still Got a Home)" shows him adept at more lighthearted upbeat songs as well. What's more, his reading of Bob Dylan's "Knocking on Heaven's Door" is sui generis.

Perfectly complementing Sun's vocals is his regular road band, Shotgun

(not to be confused with the R&B band of the same name), who supply just the grit and punch Sun and the songs require. Especially noteworthy is steel guitarist Neil Flanz, who has a very distinctive manner of pinching and extending phrases and multi-stopped chords. Instantly recognizable! And I do believe I hear the big, gutsy voice of fellow Ovation artist Sheila Andrews harmonizing with Sun on Delbert McClinton's "Honky Tonkin'."

By now it's become a truism that there isn't that great a difference between "hard" country and the "progressive" sounds of the so-called outlaws. Nowhere is the connection between the two clearer than in the music of Joe Sun. With an appeal that spans a broad range of the country-music audience and well into rock, it shouldn't be long before Joe Sun is right up there alongside Waylon and Willie, not to mention Merle and George.

Tom Bingham

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Understanding Equalization and Time Constants

Equalization is used in many, many parts of the audio chain as a standard practice, and indeed there are several equalization standards which *must* be followed closely by manufacturers if their equipment is to interface properly with other pieces of gear and with software. While we think of the "normal" response of this gear as "flat," in many cases we are comparing the unit against a standard which is not at all flat. One example of such a standard is the RIAA response curve established by the Recording Industry Association of America for phono stage response in preamplifiers, integrated amplifiers, and receivers.

Broadly defined, equalization is the changing of a frequency band or range upwards or downwards in level, that is, changing its voltage level up or down. The precise industry definitions, which insure compatibility between parts of the audio chain, go much further in their ac-

curacy, specifying exactly what the equalization must accomplish and using terms such as time constant and turn-over frequency. A filter is the "how" of this equation, the way in which the equalization is accomplished, and filters are composed of resistors and capacitors, Rs and Cs.

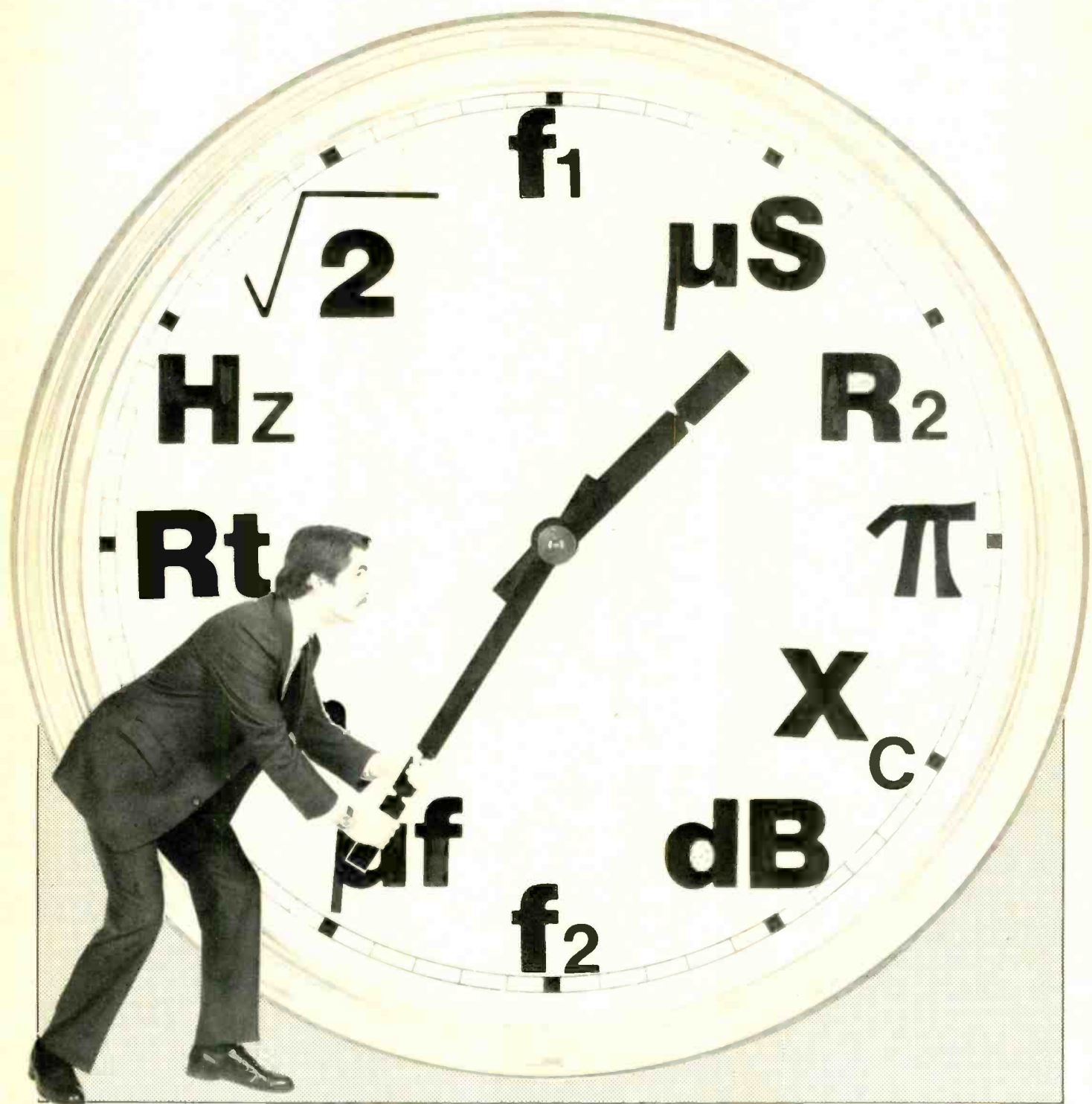
For background, let us review the basics of equalization in home audio equipment — tape, phono, and FM. Two essential reasons for equalization are to improve S/N (signal-to-noise ratio), and to compensate for losses in a reproducing medium. Minimization of distortion is a further consideration in deciding how much equalization to apply and at what frequencies.

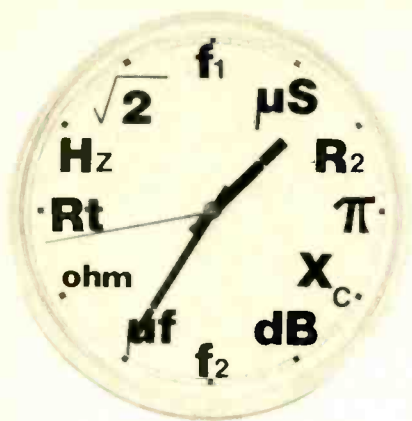
Industry standards for tape, phono, and FM call for specific playback equalization curves, usually defined in terms of those mysterious μ S (microseconds) but also often defined in terms of turn-over frequencies (sometimes called tran-

sition or corner frequencies).

Without any equalization, record-playback response of a tape would exhibit pronounced bass and treble losses. Factors responsible include the tendency of the output of a magnetic playback head to drop at the rate of 6 dB per octave as frequency declines. Treble losses on the tape are also due to the magnetic phenomenon of self-demagnetization, and due to application of bias in recording; such losses increase with frequency, with reduction in tape speed, with bias; and they vary with tape formulation. Treble losses, usually relatively small, also occur in the record and playback heads.

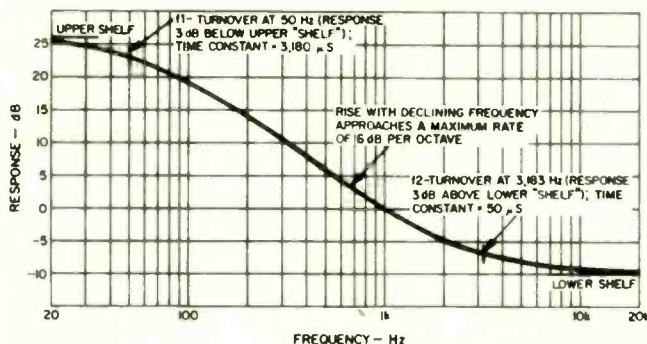
Therefore, a tape system requires compensating bass boost and treble boost to achieve flat response. Bass boost is supplied largely in playback, and should conform to a standard playback curve stipulated by the industry — which curve depends on tape speed.





Broadly defined, equalization is the changing of a frequency band or range upwards or downwards in level.

Fig. 1 — Standard playback equalization at 7 1/2 ips, before correction for playback head losses. The 0-dB reference is the level at 1 kHz.



Treble boost is provided largely in recording. There are no standard treble equalization curves because the required treble boost varies with bias and tape formulation. Hence, the industry standard simply requires that recording equalization, when coupled with standard playback equalization, shall produce flat record-playback response within a specified tolerance.

For a given tape speed and tape formulation (ferric oxide, chrome or chrome equivalent, and metal), the industry's choice of a standard playback curve is largely dictated not only by the loss factors described above, but also by the objective of minimizing both noise and distortion.

In the case of the phono disc, a standard amount of bass cut is applied in recording to avoid excessively wide groove excursions, which would limit the amount of recording time and would result in distorted output of the phono pickup at low frequencies. True, the groove excursions could be limited by recording a lower signal level, but this would reduce S/N. Further, to make possible an

imizing distortion due to excessive FM modulation at high frequencies.

Turnover Frequencies

Equalization for a tape deck operating at 7 1/2 ips serves to illustrate the meaning of turnover frequencies.

Figure 1 shows standard playback equalization, as prescribed by the NAB and the RIAA in the U.S., for a 7 1/2-ips tape system. This curve may be described as either bass boost or treble cut, depending on whether we read it from right to left or from left to right. It is customary to refer to this, and other tape playback curves, as bass boost.

In Fig. 1 bass boost "starts" at 3,183 Hz, where it is 3 dB up. And it "ends" at 50 Hz, where it is 3 dB below maximum. As frequency declines, the curve rises at a rate approaching 6 dB per octave. Total bass boost is 36 dB.

We refer to 3,183 Hz and 50 Hz as the turnover frequencies, respectively f1 and f2, which define the equalization curve. This is coupled with the understanding that the curve rises at a rate approaching 6 dB per octave. For other

Table 1 — Time constants, *t*, and corresponding turnover frequencies, *f*.

T, μ s	f, Hz
25	6366
50	3183
70	2274
75	2122
90	1768
120	1326
318	500
1590	100
3180	50

improvement in S/N, a standard amount of treble boost is applied in recording; an equal amount of treble cut in playback not only restores flat response but also attenuates noise, which is predominant in the treble region.

The simplest case is that of FM, where stations are required to provide a specified amount of treble boost in order to permit an improvement in S/N — in the same way as for phono discs. The FM tuner should therefore provide standard treble cut, which restores flat response and reduces noise. Standard treble boost (at the station) and cut (at the tuner) are less for a Dolby signal than for a non-Dolby one, with a view to min-

tape speeds, the turnover frequencies — where response is 3 dB above or 3 dB below a stated level — may differ from those for 7 1/2 ips. At 3 3/4 ips, bass boost begins at 1,768 Hz (f2) and ends at 50 Hz (f1); at 1 1/2 ips, it begins at either 1,326 Hz (ferric oxide tapes) or 2,274 Hz (chrome, chrome equivalent, and metal tapes), and ends at 100 Hz.

From Turnovers To Time Constants

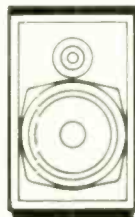
At the preference of engineers, standard playback curves are more often defined in terms of time constants than turnover frequencies. However, one definition is easily convertible into the other.

Truth...

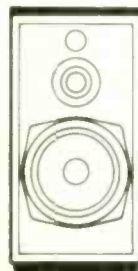
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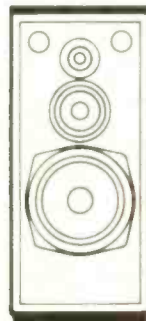
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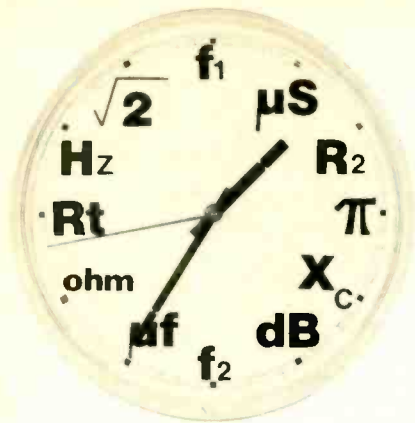
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Two essential reasons for equalization are to improve S/N and to compensate for losses in a reproducing medium.

The physical meaning of time constant will be explored later. Here we will just state the simple mathematical relationship between turnover frequencies and time constants, enabling the audiophile to readily convert one into the other:

$$f = 159,155/t, \quad (1)$$

$$t = 159,155/f, \quad (2)$$

where f is frequency in Hz and t is time constant in μS .

The equalization curve of Fig. 1 is defined as having time constants of $t_1 = 3,180 \mu\text{S}$ and $t_2 = 50 \mu\text{S}$. From Equation 1 we obtain:

$$f_1 = 159,155/3,180$$

$$= 50 \text{ Hz},$$

$$f_2 = 159,155/50$$

$$= 3,183 \text{ Hz}.$$

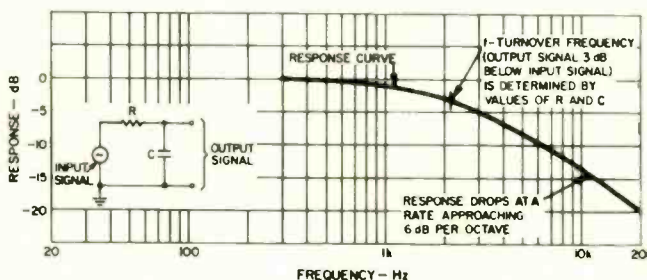
To take an inverse example, the standard FM de-emphasis curve for non-Dolby signals has a turnover frequency of 2,122 Hz (treble response 3 dB down at this frequency, and continuing to decline at a rate approaching 6 dB per octave). Equation 2 converts this into a time constant:

$$t = 159,155/2,122$$

$$= 75 \mu\text{S}.$$

Table 1 shows the relationship between t and f for the time constants and turnover frequencies generally encountered in home audio systems.

Fig. 2 — Treble loss produced by an RC circuit. (It is assumed that the source impedance of the input signal and load impedance of the output signal have negligible effects.)



Equalization Circuits

Tape, phono, and FM playback equalization customarily employ combinations of resistance (R) and capacitance (C) in what are therefore called RC circuits. To illustrate, Fig. 2 shows a simple but basic circuit containing one resistor and one capacitor. This circuit produces treble cut, such as needed for FM de-emphasis.

Before continuing we should review the terms impedance, resistance, and reactance. Impedance is a general term,

denoting opposition to current flow in an electrical circuit. Resistance is the impedance presented by a resistor, while reactance is the impedance presented by a capacitor (or by an inductor, which will not be further discussed here inasmuch as inductors are seldom used for standard playback equalization, although are often used for other audio purposes such as equalizers, speaker crossover networks, etc.). The combined effect of a resistor and capacitor is called impedance; all types of impedance are measured in ohms.

A resistor presents equal resistance at all audio frequencies, while a capacitor presents decreasing reactance as frequency rises. Therefore C in Fig. 2 behaves more and more like a short circuit of the output signal as frequency rises; in other words, treble response declines. By choosing suitable values of R and C , a designer can achieve a desired turnover frequency at which response will be down 3 dB. In the case of a non-Dolby FM signal, the desired turnover is 2,122 Hz (or time constant of 75 μS). For a Dolby signal, the turnover is 6,366 Hz (25 μS).

By adding one resistor to Fig. 2, the designer can produce bass boost, for example that of Fig. 1. The revised circuit appears in Fig. 3. The added resistor, R_2 , is much smaller than R_1 ; its purpose is to limit the extent to which the output signal can decline owing to the short-circuiting action of C as frequency rises. Instead of an endless decline in output signal with rising frequency (as in Fig. 2), the decline is halted within the desired part of the audio range. To produce the curve of Fig. 1, the R_1 , R_2 , and C components would be chosen to produce turnover frequency f_1 at 50 Hz, and turnover f_2 at 3,183 Hz; the respective time constants are 3,180 and 50 μS . (It may be noted that the circuit of Fig. 3 is only one of several ways of achieving bass boost.)

Time Constants

Let's refer again to the basic equalization circuit of Fig. 2, which produces treble cut. The turnover frequency — at which response is 3 dB down — occurs when the reactance of C equals the resistance of R . Why this is so is explained in the final section.

Capacitive reactance in ohms is $X_c = 1/2\pi fC$, where f is in Hz, C is in farads,

and $\pi = 3.1416$. At the turnover frequency, since $X_c = R$, we thus have $R = 1/2\pi fC$. Transposing C , we obtain $RC = 1/2\pi f$ at the turnover frequency.

The time constant, t , is RC . We may simplify by substituting 3.1416 for π , yielding:

$$t = RC = 0.159155/f \quad (3)$$

In the circuit of Fig. 2, the input signal charges C through R . It can be shown mathematically or by experiment that RC is the time in seconds required for a constant voltage to charge C to 63.2% of this voltage. For example, if $R = 10$ ohms, $C = 1$ farad, and 100 volts d.c. is applied across the series combination of R and C , it would take 10 seconds to develop 63.2 volts across C .

In audio we generally use capacitances far smaller than one farad. A more convenient unit of capacitance is the microfarad (μF) —one millionth of one farad. Since the numerical value of C , and therefore of t , is then increased by a factor of 1,000,000, we must compensate by changing our unit of time from one second to one-millionth second (μS). Thus we obtain:

$$t = RC = 159,155/f, \quad (4)$$

with t in μS and C in μF , but with R still in ohms and f still in Hz.

In audio the time constant is generally expressed as in Equation 4. To illustrate, if the circuit of Fig. 2 consists of a 75,000-ohm resistor and a 0.001- μF capacitor, the RC product is 75, and the time constant is 75 μS . It takes 75 millionths of one second to charge the capacitor to 63.2% of a constant applied voltage.

Of what importance is this to the audiophile? Well... the intent of this article is only to explain, not defend, the use of time constants in defining equalization circuits.

As previously pointed out, standard 7 1/2-ips playback equalization, shown in Fig. 1, can be produced by a circuit such as Fig. 3. Turnover frequency f_2 — 3,183 Hz, where response is up 3 dB — is determined by R_2 and C in Fig. 3. At that frequency the reactance of C must equal the resistance of R_2 , and the product of $R_2 \times C$ must be 50, with R_2 in ohms and C in μF . If a constant voltage were applied to R_2 and C in series, it would require 50 millionths of one second to charge C to 63.2% of the applied voltage.

R_1 , C , and R_2 are all in series with

the input signal. We may refer to $R_1 + R_2$ as R_t . Turnover frequency f_1 — 50 Hz, where response is 3 dB below maximum — is determined by R_t and C . If a constant voltage were applied to R_t and C in series, it would require 3,180 millionths of one second to charge C to 63.2% of the applied voltage.

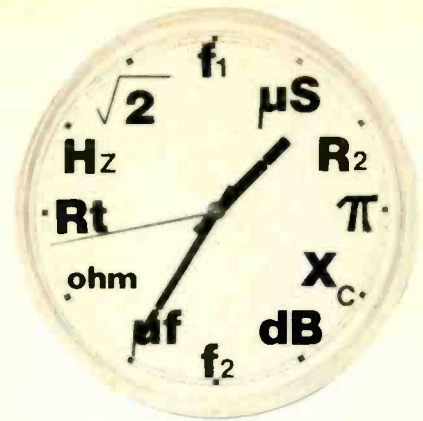
Turnover Response

Referring to Fig. 2, we stated earlier that the turnover frequency f occurs when the impedances of C and R are equal. Accordingly, the signal voltages across C and R are equal. It may seem that half of the input voltage appears at the output, namely across C . If this were true, there would be a 6 dB drop in response at f . Actually, though, the drop in response at f is 3 dB.

The proportion of the input signal appearing across C in Fig. 2 depends on the ratio between the reactance of C and the combined impedance of R and C ; in short, on the ratio X_c/Z , where Z is the combined impedance. We cannot simply add R and X_c to obtain Z , because the voltages across R and C are out of phase. Instead we must use vector addition (akin to the manner in which we obtain the hypotenuse from the legs of a right triangle). That is, $Z = \sqrt{R^2 + X_c^2}$. Since $X_c = R$ at turnover, we obtain $Z = \sqrt{X_c^2 + X_c^2} = \sqrt{2X_c^2} = X_c\sqrt{2}$. At turnover, the signal across C is proportional to $X_c/X_c\sqrt{2} = 1/\sqrt{2} = 0.7071$. And 0.7071 of the input signal represents a drop of 3 dB.

Referring to R_t and C in Fig. 3, for the same reason we obtain a 3 dB drop in response at turnover f_1 , when the reactance of C equals the resistance of R_t . And for similar reasons we obtain a 3 dB rise in response at turnover f_2 , when the reactance of C equals the resistance of R_2 .

A review of high school math is not at all what was intended here; rather, we've gone through some of the basic formulas to show how engineers can determine how their circuits will respond with very good accuracy — before they ever put the circuit on the test bench. Whether or not you ever work out one of these problems for yourself, a basic knowledge of what the circuit designer intends, as well as the tools he actually uses in a circuit, goes a long way towards providing a good understanding of many parts of the audio chain. Δ



A basic knowledge of what the circuit designer intends goes a long way towards understanding many parts of the audio chain.

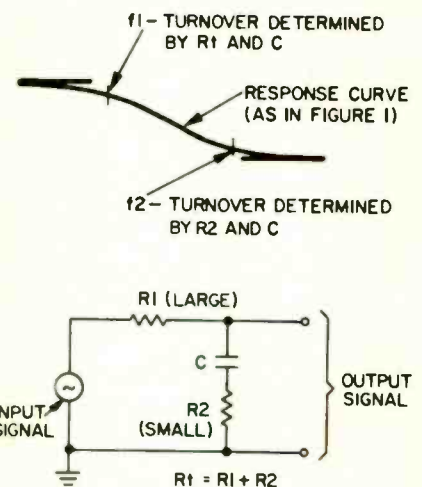
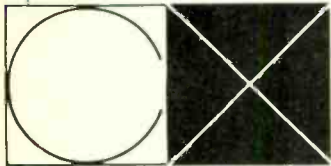


Fig. 3 — Bass boost produced by an RC circuit. (Assumptions about source and load impedances as in Fig. 2.)



LOUIS A.
ABBAGNARO *

The CX Noise Reduction System For Records



With the advent of digital technology in recording studios, the balance between the dynamic range of studio tapes and records has been upset. Prior to digital, a professional analog tape recorder with Dolby A playing at a speed of 15 ips had an average signal-to-noise ratio of about 73 dB with an allowable peak headroom of approximately 12 dB, yielding a total dynamic range of 85 dB. Multi-track mixdown often added some noise which reduced this dynamic range by a few dB.

* Director of Sound Reproduction
Technology, CBS Technology
Center, Stamford, Conn.

The 16-bit digital tape recorders have an average signal-to-noise ratio of about 80 to 85 dB which becomes 97 dB when one allows for peak factors. By comparison, today's phonograph records have an average signal-to-noise ratio of only 60 to 65 dB, which is approximately 20 dB poorer than the new digital tapes. Thus, while the record is reasonably well matched to analog tapes, it is limited when used with digital software. What this means is that if one aligns a digital tape and a record with the same music, the loud musical passages will sound similar but the soft musical passages which are noise-free on the tape will be cluttered with noise on the record.



Our goal was to achieve an essentially noise-free record costing no more than conventional records.

The thrust of this mismatch is to force improvements in the quality of records to provide a better match to digital studio tapes. Indeed, the so-called "audiophile records" which are available today are an attempt to provide a better match between the two media. The digital disc of the future is another means of providing this match. In both of these instances, however, premium costs for records and, in the case of the digital disc, for a new player do not make these approaches easy solutions for the mass of the record-buying public at this time.

At the CBS Technology Center we have often investigated methods of improving the dynamic range of records in an attempt to offer a record which could reproduce the dynamic range of digital music at no increase in record cost. Since the dynamic range of the record is limited by surface noise, our goal was to achieve an essentially "noise-free" record. This led us to re-examine the use of compansion (i.e., signal compression during recording and expansion during playback) on records, an old idea but one whose time had now arrived for records. The result of these efforts led to the development of a compatible noise-reduction system for records which we call CX.

The goals set for CX were simple but challenging, namely:

Expand the dynamic range of conventional records by 20 dB to equal that of professional digital source tapes;

Compatibility — i.e., the CX record must sound like an average record when

CBS Record Releases in CX Format

Title	Artist	Number
Hats Off Step Lively	Jo Jo Zep & The Falcons	NFC 37047
Black Tie	The Manhattans	FC 37156
Sanctuary	New Musik	NFE 37314
Pet Rock	The Sinceros	NFC 37349
Whitford/St. Holmes	Brad Whitford/Derek St. Holmes	NFC 37365
Everything in Place	Tyrone Davis	FC 37366
Orchestral Manoeuvres in the Dark	O.M.D.	FE 37411
Get Shakin'	Shakin' Stevens	FE 37415
Double Rainbow	Terumasa Hino	FC 37420
The Last Words of the Great Explorer	TV Smith	FE 37432
Silver Anniversary Album	Johnny Mathis	C2X 37440
Roberto Carlos	Roberto Carlos	ARC 37450
Torn Together	The Hitmen	NFC 37453
Tennessee Whiskey	David Allan Coe	FC 37454
Loving You Is Where I Belong	Harry Belafonte	FC 37489
Ravel, Satie	Régine Crespin	IM 36665 (1101)
Guitar Miniatures	Leona Boyd	M 36732 (1103)
Still the Same Ole Me	George Jones	FE 37106

The other present software licensees are the Warner/Elektra/Asylum/Atlantic group of labels, RCA Records, and Teldec.

played on existing stereo equipment, and

Low-cost design since CX records should cost no more than conventional records and CX decoders should be low in cost.

In the following sections the design which allows us to meet these goals is described.



In order to gain a feeling for the CX process, examine the graphic illustration in Fig. 1. In Fig. 1A, the dynamic range of a digital master tape is shown. Here we see the average level of the loud music, the average level of the soft music, and the tape noise floor. The range from loud music to tape noise is 85 dB. Assuming the tape has been well mastered, the soft music passages are recorded sufficiently above the tape noise. Thus, when soft passages are re-played the music is heard but not the noise. For explanation purposes, a sound level scale is shown in Fig. 1. If the loudest average music is adjusted to be reproduced at a sound level of 110 dB in the home, the tape noise floor is

only 25 dB! In nearly all instances, the tape noise is below the average background noise of the listening room and becomes inaudible. The digital recorder thus allows playback of music at levels achieved in live performances while eliminating tape noise from the listening process.

When the same music is transferred to a conventional record with a smaller dynamic range, the music is no longer heard in a noise-free manner. In Fig. 1B, the dynamic range of a regular record is indicated as 65 dB from the loudest average music to the record surface noise.

Table 1

Average signal-to-noise ratio of tapes and records. (Add 12 dB to these figures to obtain peak signal-to-noise ratios).

Professional analog tape with Dolby A	70 - 75 dB
16-bit digital tape	80 - 85 dB
Modern stereo record	60 - 65 dB
Future digital record	80 - 85 dB
CX-decoded record	80 - 85 dB

If the music on the digital tape is transferred directly to this record, the soft music passages lie at or below the level of the record surface noise. Upon playback, this music is contaminated with the familiar but unwanted sounds of the vinyl surface. This noise appears as myriad sounds including a low-frequency component generally called "rumble"; a swishing mid-frequency noise known as "ocean roar," since it often resembles the sound of ocean surf, and a steady high-frequency hiss often accompanied by a gritty sound and discrete ticks and pops. The noise encompasses the entire audio frequency range, and a typical spectrum of this noise is shown in Fig. 2.

On a sound level basis, when the loud music is at 110 dB, the record noise is now at 45 dB and can generally be heard in a listening room environment. To avoid this noise, the producer may increase the level of the soft program material relative to the loud music. What the producer really accomplishes in this instance is an arbitrary form of compression which reduces the dynamics of the music on the original digital tape. While the result may still be musically acceptable, the original dynamics cannot be accurately recaptured. The other choice until now has been to leave the dynamics unaltered and accept record noise in the soft music passages.

The CX-encoded record solves this dilemma as is shown in Fig. 1C. The softest music passages are increased by 20 dB which allows them to be placed on the record comfortably above the record surface noise. Although the dynamics are reduced from the original tape, the process is directly reversible, as will be shown. Notice that the tape noise is also increased by 20 dB with the CX encoding process. Since tape noise was originally 20 dB lower in level than the record surface noise, the CX encoding merely makes the two noise levels equal. What this means is that a CX-encoded record played back without a decoder will not have greater background noise than a conventional record. An arbitrary selection of noise reduction of, say, 30 dB or more would raise the tape noise above the record noise. Such a record could not claim compatibility and in fact would be objectionably noisy to most listeners. The record in Fig. 1C is the compatibly encoded CX format.

Fig. 1—Dynamic range of professional digital tape (A), conventional record (B), CX-encoded record (C), and CX-decoded record (D).

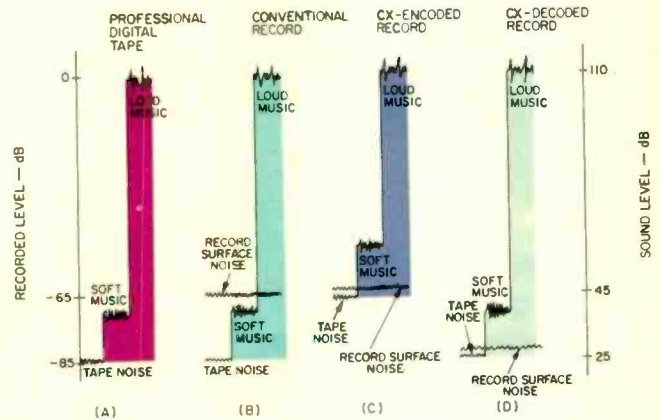
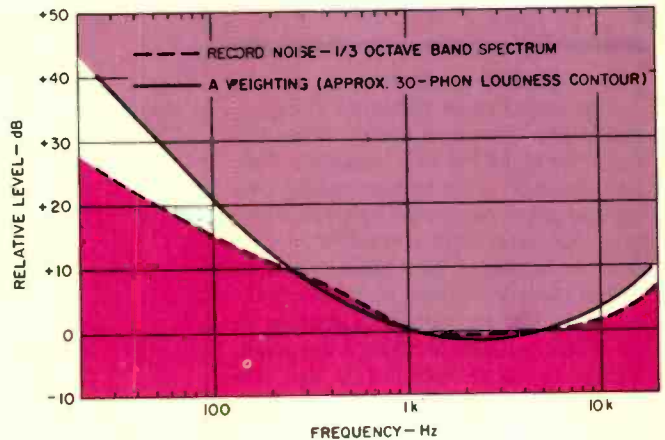


Fig. 2—Frequency spectrum of record surface noise.



The decoded CX format is shown in Fig. 1D and is obtained by playing a CX-encoded record through a CX decoder. Notice that the reversible nature of the CX process has placed the loud and soft music and tape noise at precisely the same levels as on the original master tape. Moreover, the record surface noise is reduced by the CX decoder by 20 dB. The final decoded CX record now has the full dynamic capability of the original digital source tape.



One of the advantages of the CX record is that the encoding is achieved in a compatible manner so that CX records will yield average record quality when played on existing stereo

equipment. In the design of the CX system, compatibility required satisfying four objectives: No alteration of frequency response, smooth dynamic performance, no increase in record noise (as discussed), and dynamic range reduction suitable for encoding most program material.

Notice that compatibility is not identical, that is, the CX-encoded record has modified the program dynamics but in a manner which is not obvious with most music material. Furthermore, since the process is reversible, the CX record can be decoded to provide an exact replica of the original source tape and elimination of record noise. Thus, listeners can buy and enjoy CX-encoded records today without a decoder or add a decoder to their existing stereo systems to obtain music dynamics equal to those



We didn't introduce CX to get into the noise-reduction race, but to give the consumer the best record possible.

on the best studio master tapes.

The record noise spectrum of Fig. 2 was briefly discussed earlier. Note that this noise is not flat with frequency. Neither, however, is the human hearing process which is described by equal loudness contours. This phenomenon was first investigated in the 1930s by Fletcher and Munson of Bell Labs. Their studies show that for signals listened to at low levels, such as record or tape noise, the ear is not as sensitive to low- and high-frequency sounds as it is to mid-frequency sounds. For example, a low-level tone at 1 kHz will sound equally as loud as a 100-Hz tone with a 15 dB greater sound level. For low-level sounds, the equal loudness function is approximated by the "A-weighted" sound level meter curve which is plotted for reference in Fig. 2.

Actually, an electrical circuit duplicating the ear's loudness function would use the inverse of the A-weighted response as an attenuation characteristic. Note that the A-weighted curve and the record noise spectrum are nearly equal at all frequencies. Thus, passing this noise spectrum through an A-weighted filter will produce nearly constant output at all frequencies. This explains why we hear noise of all frequencies on records and why an effective record noise-reduction system must operate at all frequencies in the audio bandwidth. A noise-reduction system for tape such as Dolby B, which works predominantly at high frequencies, would only solve part of the problem on records, even though it pro-

Fig. 3—CX compression and expansion functions.

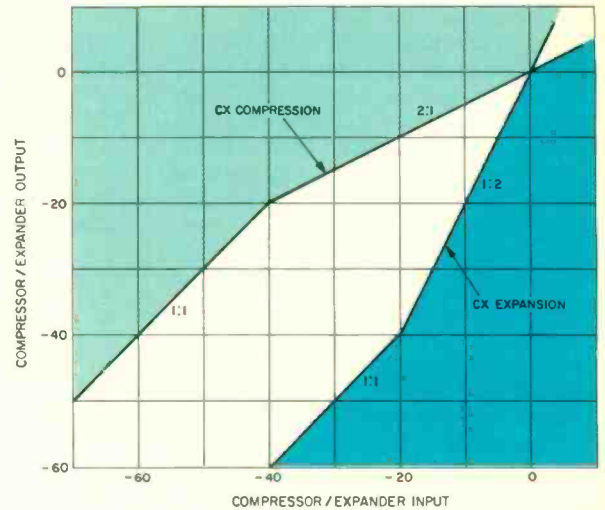
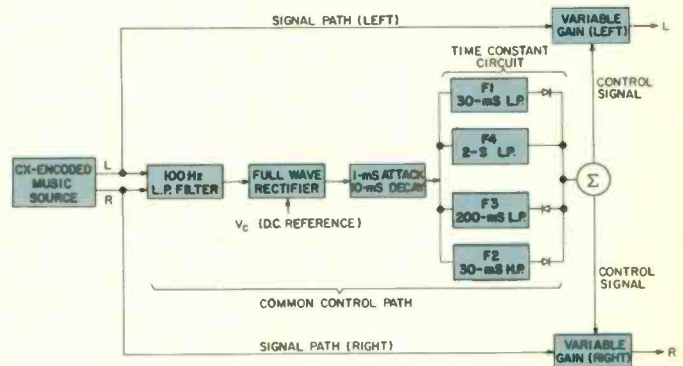


Fig. 4—Block diagram of CX decoder.



duces quite acceptable results on tape.

If the noise spectrum on records were not so ideally shaped, it would have to be equalized to produce a hearing-shaped noise spectrum during recording which is re-equalized upon playback to obtain an overall flat record/playback frequency response. This process is known as pre-emphasis during recording and de-emphasis on playback and is used in many common compander systems. Unfortunately, pre-emphasis alters the frequency content of the program material as well as the noise in the encoded-only format, making it incompatible for listening. Only upon decoding is the correct frequency balance restored. Since CX was developed specifically for records, we could take advantage of the nearly optimum shape of the record noise spectrum and avoid pre-emphasis and de-emphasis networks which are

not necessary. Thus, CX provides no alteration of frequency response when listened to in either the encoded or decoded state.

It should also be obvious from this discussion that CX is required to be a wide-bandwidth noise-reduction system to effectively eliminate all the components of record noise defined earlier. Elimination of only the hiss or rumble, for example, would still leave audible noise components.



Figure 3 shows the CX compression/expansion function. To make up for the mismatch between records and digital tapes, 20 dB of noise reduction is required. The CX encoding compresses the input range by 20 dB in

a selective manner in which all high-level signals are compressed at a 2:1 rate while low-level signals are not compressed. In the compression curve of Fig. 3, an input signal at 0-dB level has an identical output level, i.e., 0-dB gain, while an input signal of -40 dB has an output level of -20 dB, for a 20-dB gain. This nonlinear gain function provides a relative increase of 20 dB between soft and loud music sounds as indicated previously in Fig. 1. Below -40 dB, no further gain increase occurs; however, low-level signals are still boosted by 20 dB, i.e., -60 dB input becomes -40 dB output, etc.

The CX expander provides for a complementary process which expands high-level signals at a 1:2 rate and provides no expansion of low-level signals. Note that the expansion curve is a mirror image of the compression curve. Thus, a signal at -30 dB when compressed becomes -15 dB; when the -15 dB signal is expanded, it returns to -30 dB.

The choice of the CX compression and expansion slopes is based on psychoacoustic considerations which are fairly obvious to anyone listening to records, namely, that the noise on records is audible during silent or soft music passages but is not generally heard during medium to loud passages. Our studies indicated that any slope at low levels other than 1:1 would cause a modulation of both record surface and tape noise which could often be detected when listening to the record both with and without the decoder. Since 20 dB of noise reduction was required, we chose the 2:1 rate for high-level signals and returned to 1:1 for low-level signals. This choice aids in providing the required smooth dynamic performance essential to this system and yielding the desired 20 dB of noise reduction.

Because of the "knee" in the compression and expansion curves, they should ideally be matched. This requires standardization during recording and playback. Such standardization is achieved by defining the 0-reference level in Fig. 3 such that it corresponds to a velocity on the record at 1 kHz of 3.54 cm/S rms. All records are mastered around this reference point to insure that every manufacturer's records will play equally well on all playback equipment. This recording specification, however, does not limit in any manner the levels

The Men Behind The CX System

Rather than rely on rumors and unknowledgeable comments, we felt it best to go straight to the source and ask some tough questions of the man who wrote the main portion of this article, Lou Abbagnaro, and of Bob Jamieson, Vice President, Marketing and Creative Operations, for the CBS Records Group.

Audio: There has been a lot of talk in the trade about the CX system's compatibility claim, since it is a sort of Holy Grail for noise-reduction system designers. I think that most folks are listening for an identical sound between an unprocessed or non-CX disc and a CX disc played without the decoder. In my own listening tests, the most pronounced thing — for a CX disc played undecoded vs. decoded — is a dropping away of the noise floor. However, on the CX releases so far there seems to be less dynamic range than I find on direct-cut discs or digitally mastered records, though I admit that it is certainly not the same program on each of the discs. It's my understanding that some of the mastering guys at the cutting houses are complaining about two items, that they feel there is an unacceptable loss of dynamic range and changes in the frequency response with the undecoded CX disc. Who wants to comment on this?

Abbagnaro: You're really asking two questions, and I'd like to answer them

both. First, about compatibility. We have never stated that a CX-processed disc, played undecoded, is identical to, say, a direct-to-disc recording or to a digitally mastered recording. We do say that the undecoded CX disc is acceptably good, and we make three points about this undecoded state. One is that there is no change in the relative balance of the operational music frequencies, and two, we have smooth dynamic performance, both with and without the decoder, so that one isn't aware of listening to a compressed record. Third, while we do bring up the low-level material, which does reduce dynamic range overall, such a reduction is suitable to the material from a listener's standpoint.

But let me get back to the producer's end of things on this identicality question. Some of the things which were quoted in the press were attributed to people who had at that time not heard the system, and I think that a big question is . . .

Audio: Pardon me here. There are at least three big stories in the trade press which quote some big names in mastering — one guy says "disaster, not compatible," while another says "pure, unadulterated junk." And these are well-known names; what you're saying is that guys were shooting from the hip, that they had not listened to the system?

Abbagnaro: That's right, exactly right. It is my understanding that they had not had a chance to fully evaluate the system. But it is important to put this into perspective. The compatibility issue, we believe, won't be as important if the CX system takes hold as strongly as we believe it will. But in the meantime, we don't want consumers without CX equipment to have any problems, to react to a CX-encoded disc as if it were an inferior quality record. We think that much of the new equipment, still to be introduced, will incorporate CX decoding. Until then, it's important to us to have the consumer feel the records



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Unprecedented and unequalled in our time —
the complete and definitive collection of America's
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- The best of 75,000 records from the Foundation archives and the vaults of every country music label.
- The first collection to include *all* the great country artists.
- Featuring all the great hits, the milestone performances, out-of-issue pressings and unreleased recordings.

For the first time in history, the greatest recorded performances of country music's greatest artists will be brought together in a single, definitive collection. It will include the most important recordings by the leading country artists of today ... landmark performances by legendary greats ... and all the diverse and varied musical styles that have enriched America's country music.

This remarkable collection is the official issue of the Country Music Foundation — home of the Country Music Hall of Fame and Museum, and the world's largest library of recorded country music. And it is the first complete collection that the Foundation

has ever issued honoring *The Greatest Country Music Recordings of All Time*.

A unique collection that only the Country Music Foundation could assemble

To assemble this collection, the staff of the Country Music Foundation carefully reviewed the Foundation's own archives of 75,000 records. In addition, they enlisted the support of all the country music record companies — whose vaults hold many of the master recordings selected for this collection. And they were able to obtain rare recordings from private collectors and country music artists themselves.

As a result, the Country Music Foundation Official Archive



"Country is the music of the people. Songs of the soil, forsaken and fulfilled love. Story songs whose music is both contemporary and timeless ... I love it, and I am proud to be part of the first collection to tell the whole country music story."
— Johnny Cash

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Collection is unique both in scope and importance. A collection that would be difficult – or impossible – for any individual to duplicate.

All the great performers

The collection will feature milestone recordings from the careers of country music's most important artists. Such *great contemporaries* as Loretta Lynn, with 'Blue Kentucky Girl' and 'Coal Miner's Daughter.' Kenny Rogers and The First Edition, with 'Ruby, Don't Take Your Love to Town.' Johnny Cash with 'I Walk The Line' and 'Sunday Morning Coming Down.' Dolly Parton, with 'Coat Of Many Colors' and 'My Tennessee Mountain Home.' The "outlaw" music of Willie Nelson. The Nashville sound of Chet Atkins and Eddy Arnold. Country rock, with The Charlie Daniels Band. And country classics by popular music artists Linda Ronstadt, Glen Campbell and Anne Murray.

Also included will be the unforgettable recordings of such long-time favorites as Hank Snow, Ernest Tubb and Merle Travis. The *legendary giants*: Hank Williams, Patsy Cline, Jim Reeves, Flatt and Scruggs, and Jimmie Rodgers. And recordings that reflect regional influences and evolving musical styles – *bluegrass, Cajun, country gospel, western swing, honky tonk and rockabilly.*

The collection will include such *rare recordings* as Vernon Dalhart's 1924 recording of 'The Prisoner's Song' – country music's first million selling record, and Loretta Lynn's early classic 'Honky Tonk Girl' – now out of issue. And from the Foundation's archives will come *previously unreleased recordings* – studio "takes" never before made generally available.

Records of superior quality

Every step has been taken to ensure the *technical excellence* of the collection. Thus, all of the *early recordings* will first undergo a painstaking restoration process in the Country Music Foundation's newly opened Audio Restoration Laboratory. Here, recordings of classic performances will be electronically "cleaned" groove-by-groove to eliminate extraneous surface noise and preserve the original sound.

To produce the records, the Foundation has appointed The Franklin Mint Record Society – judged by audio experts to be a leader in producing records of superior quality. The vinyl used will be of a special formula containing its own anti-static element. This material, together with the careful process by which the pressing is made, results in a record that is more rigid, durable and resistant to dust. A true *proof-quality record* – providing exceptional



In the Foundation's audio laboratory, the latest electronic techniques are used to restore the original sound quality of early recordings. Then, the records are pressed in a dust-free "clean room," where strict production standards, and audio and visual inspection, assure high quality.

tonal fidelity and clear, clean sound when played through any of today's audio systems.

Fascinating musical "program" in each album

Custom hardbound albums have been designed to house and protect all 100 proof-quality records in this collection.

Each album will contain four long-playing records, presenting a program of artists and recordings carefully selected by the Foundation, and unique to this collection. And each album will be accompanied by specially prepared program notes, illustrated with photographs from the Foundation's permanent collection.

Available by subscription only

If you have a long-standing interest in America's country music . . . or are just discovering its rich and exciting sound . . . this Official Archive Collection is an indispensable treasure. A complete, comprehensive and authoritative collection of the greatest recordings in country music – on records of exceptional fidelity.

The collection may be acquired only by direct subscription to The Franklin Mint Record Society, Franklin Center, Pennsylvania 19091. It will not be sold through record stores. To enter your subscription, simply complete and return the accompanying application. Please note it should be mailed by February 28, 1982.



he's purchasing are reasonably acceptable in the undecoded state.

Jamieson: Our projection is that in five years or so, virtually every record on the market will be CX encoded — that just about the only type of record you'll be able to get will be a CX type. We base this on what happened with the stereo record, and we think it's the only time in history that a record company made such a major improvement in the sound quality of its records without charging the customer more. We offer CX discs at no additional charge. And this is quite different from what happened with stereo's introduction, when people had to pay about \$1.00 more to buy the new discs. And further they had to also buy a double set of equipment — a second amplifier, a second speaker, a special phono cartridge. . . .

Audio: Okay, you're getting over into hardware costs now, so it might be good just to review how the royalty arrangement and how the costs to the consumer situations actually do work out. You announced in May of last year that you weren't going to charge more for your CX-encoded discs and that the technology was going to be available to the rest of the record industry on a royalty-free basis. The hardware presently costs from about \$50.00 or so to \$100.00, all in outboard black box format (with one exception), though this will obviously change quite rapidly once the IC chips from National Semiconductor start coming through. So, then, what will the cost be to the buyer of a receiver, for example, during the fall of 1982? How much will 20 dB of noise reduction for, say, the 150 records available then cost him?

Jamieson: You might be able to get the price tag down to about \$10.00 but that's about it. And this cost projection is based on the Dolby B noise-reduction experience. And that's what we expect to happen. We expect it to be built into every receiver and preamp.

Audio: Pioneer has just adopted the CX system for use in their videodisc system, and they make much the same point. However, they say that all of their new releases, as well as all of their new video hardware, will be CX. Why, then, doesn't CBS, with all of its muscle, simply say to these artists and producers that everything that comes out of this record company will be CX encoded? And why aren't the CBS/Sony discs from Japan being encoded?

Jamieson: The reason is quite basic to our relationship with the artists and producers — that it is simply wrong to crack down in such a fashion. We feel that the best way to introduce this system is to win acceptance by showing these people its advantages. I have had no comments from anybody that the system degrades the program when the CX disc is played in decoded fashion. Even those folks who are detractors say that the decoded record is superior to the record system we now regularly deal with.

The CX system isn't so simple to implement that you just decide to use it and then just flip a switch. It takes expertise to handle it in the right way. We feel we owe the producers of records the courtesy of sharing our knowledge of the system, because once they have this knowledge, and become aware of what the system can do, we think they will become convinced that the CX disc is an improvement over existing records.

Audio: Is this, then, a matter of artist and manager option, of contractual obligation?

Jamieson: In some cases, there may be a contractual obligation involved, but more basically, we are not going to put out any CX records which are a surprise to the artists. We are going to all of our artists and asking them to listen to test pressings. Certainly, we would like them all to adopt the CX system, but if they have any doubts or any

problems, we want to discuss these things with them.

Audio: Let's go back to the question of expertise. You mentioned that it isn't a "flip a switch" process. Is there some special knowledge involved?

Jamieson: Not exactly. We obviously have more experience with the system and we want to share this with the various artists, producers, and mastering engineers. This doesn't involve a special or higher level of training, but it does take knowing how to adjust the overall levels of sound on a recording to make the disc the best it can be when it finally comes out.

Audio: Why is this whole system taking so long to get off the ground? I first heard about it late in 1980, and as we do this interview during late October 1981, there are about a dozen licenses on the hardware side and two or three software makers. But the list of records so far released is only 17 titles long, and all of these are from CBS. What's taking so long, particularly in the classical area where there seems to be only one release so far? When are the other guys going to release discs?

Abagnaro: Let me come to Bob Jamieson's defense on this one. First I have to point out that he is the third man to have charge of this project during that year period, and that's going to slow anything down. Also, we didn't officially introduce the system to the press until May of 1981, so that you first heard about it somewhat early. Now, I assume you know something about the leadtime required between the initial announcement of a system such as CX and the actual widespread incorporation of the system into the hardware. The same applies to disc production.

Jamieson: We really can't answer for the plans of any other software maker, just as we wouldn't want them making commitments for us. However, I can say on our own behalf that about the time this article appears you will have seen an obvious step-up in the rate of CX releases, so that by the end of March there will be about 60 to 70 titles available. Also, we have just heard that RCA is going to be putting the CX system into their SelectaVision.

Audio: Okay, one more question. One



of the products of the rumor mill is that there is going to be a double inventory situation on the CX discs, just as there was with the various types of quad records. My highly placed source at The Mill also says that there were some "test releases" early last year to see if the CX disc was truly compatible, that is, undetectable from an ordinary unencoded record, and that one of these discs was the Korngold *Violanta*. One of *Audio's* esteemed competitors gave this disc a "Recording of Special Merit" award but found the "recorded sound compressed, lacking in warmth, and unkind to the singers." Could you comment on this?

Abbagnaro: This gets back to the compatibility question again. It's our belief that the CX disc, played unencoded, exhibits no frequency response changes from the recording pressed in the standard way, and that there are no changes in the dynamics which will be objectionable or, in most cases, noticeable to the user. However, with the particular recording you mention, there were some test pressings made, and unfortunately it was one of these which appears to have gone out to that reviewer. As I say, however, when the system is set up correctly, we believe there are no anomalies or difficulties that would be objectionable.

Audio: One last question. With your major investment in studio equipment of the analog persuasion, are you simply introducing the CX system to stall off conversion to digital? Or at least until there is a viable system that's digital all the way through from the disc and pick-up to amplifier, if not the speaker?

Jamieson: If I understand it correctly, CBS is in the music business, so that whatever the consumer wants, whatever the configuration, we will be there. We didn't introduce the CX system to get into a noise-reduction race or competition, but rather to improve the technology of recording, to give the consumer the best record possible. We simply have the technology to make a better record and we're going to make it available. But whatever that technology, it is the consumer who's going to make the final decision, and we will deal with that decision whenever it comes and whatever it is.

used to record CX records. Thus, CX records can be mastered at levels equal to non-encoded records with the same program material.

Since a playback calibration is also required, a small CX calibration record containing 3.54 cm/S reference tones is supplied with the decoders. When the decoder is first installed, the record is played through the decoder and the 0-reference level is adjusted. The entire calibration process takes less than one minute and is required only upon installation of the decoder or when a cartridge is changed. Once calibrated, all CX records are played without any further adjustments.

When non-CX records are played, the decoder should be switched out. While playing a non-CX record through a decoder will reduce its noise, the resulting music program may not be acceptable from a listening standpoint.

The reduction of noise with a companding system is a dynamic function: When the music is soft, maximum compression and re-expansion occur to provide the maximum noise reduction. With loud music, very little compression and expansion are required since the noise is naturally masked by the music. As this implies, the noise floor is continuously moving depending upon the level of the music program material. A good companding system must handle this motion smoothly so that noise modulation is not audible. With the CX system, this presented a dual design problem since the program material is listened to both with and without an expander.

One obvious solution is to allow only very slow transitions of the noise as a function of time, which would not be noticeable to listeners. This requires the design of a system with a very long time constant in the control path. The problem with such a system is that it will also respond slowly to rapid changes in musical program dynamics, rendering it unable to follow the typical attacks and decays of the music. Alternately, if one proceeds to design a system to respond quickly to music dynamics, a fast attack and relatively fast decay are required. The drawback with this system is that it will move the noise floor about in a rapid manner and produce noticeable noise modulation which is heard as a "swishing" sound. In addition, it can be shown that a continuously fast-acting circuit will



CX-encoded records will yield average record quality when played on existing stereo equipment without decoding.

also track small changes in the musical program rather than reaching an acceptable average level. This produces a modulation distortion of the audio program material. What appears to be needed is a circuit which can alternate between fast and slow operation in response to changes in music dynamics and also ignore small changes which could induce modulation distortion. This is what CX circuitry provides.



The CX decoder or expansion circuit is shown in Fig. 4. It's comprised of left and right variable-gain amplifiers (VGA) whose gain is determined by a common control path arranged in a feed-forward loop. The CX compressor is identical except the control path is arranged in a feedback loop.

To discuss operation of the CX expander, assume a properly CX-encoded source of music is driving the decoder. Note that the left and right channels proceed directly to the VGAs, whose gain is determined by the central control path. Thus, except for the variable gain function, no other alteration of the audio signal occurs.

In the control path, the left and right signals pass through a 100-Hz high-pass filter which lets the main portion of the audio program control the gain but eliminates very low frequency signals. Its primary purpose is to ensure that low-frequency rumble components on the

Hardware Licensees For the CX System

Advanced Audio Systems Int'l.
Applied Technology
Audio Teck Industries
Audionics
Backes & Muller
CM Labs
MXR
Micro-Trak
Nakamichi
Phase Linear
Phoenix Industries
Sound Concepts
Soundcraftsmen
Superscope/Marantz
Telefunken

Three additional licensees are applying the CX noise-reduction system to video technology: MGM/CBS Home Video, RCA SelectaVision, and Universal Pioneer.

record cannot activate the control path. Next, the left and right channel signals are full-wave rectified, creating a d.c. control signal which is compared against a d.c. reference (V_c). If neither the left nor right signal is greater than V_c , the control path gain is fixed as is the gain of the two VGAs. The system thus operates with a 1:1 gain over this region. When either the left or right channel inputs exceed V_c , the control path gain increases directly with the input. At the VGAs both the signal and control path gain increase together. The output signal thus increases at twice the rate as the input signal on a logarithmic basis; i.e. a 6-dB change in the input produces a 12-dB change in the output. This is the 1:2 gain portion of the expansion curve in Fig. 3.

The signal next passes through a fast attack (1 mS) and decay (10 mS) circuit. As explained earlier, such a circuit, if used alone, provides good response for rapid transitions but also produces audible noise motion and modulation distortion. To handle these transitions, a multiple-time-constant circuit is used which operates rapidly for large changes in music dynamics and slowly during steady portions of the program.

The multiple-time-constant circuit comprises four filter paths with specially selected time constants. Two of these filter paths, F_1 , the 30-mS low pass, and F_2 , the 30-mS high pass, operate only

on large increasing forward changes in the control signal and, hence, work on signal attacks. The diodes shown with these filters serve two functions: For forward-biased signals, they provide a dead band which inhibits operation until a large signal change occurs, and for reverse biased signals, they inhibit operation for all signal levels. Filter F_2 , the 30-mS high pass, allows a rapid response to the attack signal. This attack signal, however, often contains unwanted ripple components associated with small changes in the music dynamics which can produce a modulation distortion. Filter F_2 thus is cut off rapidly and filter F_1 takes over. Because F_1 is a low-pass filter, the unwanted ripple is removed. Since the summation of the outputs of F_1 and F_2 provides the final control, the fast attack is handled smoothly and ripple components are removed after a few milliseconds. While the ripple can be present momentarily, the time is too short for the ear to detect any distortion. This provides clean response to any music transients which occur.

Filter F_4 is continuously in operation but provides primary control only when no major changes are occurring in music dynamics; its time constant is 2 S. Filter F_3 works only on signal decays, and the reverse-biased diode again serves two functions: Namely, it prevents any response for forward-biased signals (attacks) and it allows response only for large changes in reverse-biased signals

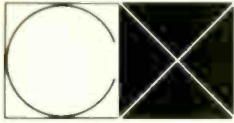
(decays). As a signal decays from a loud to a soft level, the ear will readjust its listening after about 200 mS and begin to focus attention on the soft portion of the music. If a fast decay persists after 200 mS, it will continue to adjust the gain rapidly during a time when the music no longer masks any tape or record noise. This noise change may then become audible as an undesirable breathing or swishing sound. With the CX circuit, F_3 allows a rapid decrease in signal level during the period when the ear has not readjusted to the soft music. After 200 mS, F_3 no longer functions and F_4 , the 2-S filter, handles the remaining decay. Even if noise is now perceived, it will appear as a steady component and undesirable breathing effects will be eliminated from the output signal.

The multipath CX control circuit was the result of extensive engineering design and psychoacoustic evaluations which provided an optimum determination of time constants, and the same network operates in both the CX compressor and expander yielding smooth dynamic performance for both the encoded and decoded music. This is a must for compatibility. Moreover, the control circuit can be embodied in a simple circuit configuration which is amenable to large-scale integration, and can be realized with a single integrated circuit and a few external resistors and capacitors. This means CX decoders will be low in cost as an add-on to existing stereo sys-

Table II

Overall album ratings. Reviewers were asked "How would you rate this album overall?"				
	Pictures At An Exhibition	Brahms' Fourth (CX Encoded)	Rampal's Great Hits	Bolling/ Zuckerman (CX Encoded)
Rating	100%	100%	100%	100%
1 (Worst)	—	—	—	—
2	—	—	—	5%
3	—	—	5%	5
4	—	5%	10	5
5	10%	10	10	10
6	10	10	15	19
7	25	15	15	15
8	25	25	20	20
9	10	20	15	20
10 (Best)	10	15	10	10
Mean	7.6	7.7	7.0	6.8

tems or as an added feature for stereo receivers or preamps.



Prior to releasing the CX system, extensive testing was done to ensure

that both the encoded and decoded versions of the record would be acceptable to discriminating music listeners. In one of these tests, four classical recordings were distributed to 500 consumers. Two of these records were CX encoded and two were standard CBS Masterworks releases. All four records were in standard jackets and contained no markings to indicate any special encoding. Consumers listened to the four records on their home systems without any CX decoding equipment. Their systems were above average in quality, with an average retail cost of about \$1400. The listeners were classical music buffs who purchased more than 25 record albums per year on average.

These listeners were asked to fill out questionnaires summarizing their opinions after auditioning each record. They rated each category on a scale of 1 to 10. Table I shows the overall consumer rating of these four albums. The results

indicate that the CX-encoded records were rated equally to the non-encoded records. In Table II, the scores for many attributes are shown, and again the CX-encoded and conventional records received equal ratings. Notice that in the dynamic range category the CX record compression did not appear to be obvious to these listeners. While we cannot guarantee that every record will encode compatibly with CX, the results of these tests led us to believe that compatibility was possible for a wide range of records and that the compatible product would be acceptable to the majority of listeners. Moreover, critical listeners will probably be the first to buy decoders and obtain the full CX benefit of a noise-free record.

As has often been reported, proper record care is important to maintain continued low-noise playback. While it might seem that a CX noise-reducing decoder would eliminate this need, the answer is not strictly true. Because of the manner in which CX (and many other noise-reduction systems) operates, it reduces the residual surface noise and other low-level signals by 20 dB. High-level signals are reduced by smaller amounts until finally a 0-dB (3.54 cm/S) signal receives no gain reduction.



CX does not eliminate the need for proper record care but ensures many more noise-free plays if proper care is taken.

What this means is that large noise signals on a record, such as those which would be produced by a deep scratch of the record surface, will be audible even when played back through a CX decoder. Dirty records can also accumulate large dust globules which will produce impulse noise sounds which are also audible through the decoder. Thus, CX does not eliminate the need for proper record care, but it does ensure that properly cared for records will provide many more noise-free plays than will non-CX records.

CBS has initiated the release of CX albums and will continue to enlarge the CX-encoded library. All encoded records are marked with the CX logo on the label and jacket for consumer identification and cost no more than conventional records. Initial releases have received good acceptance from consumers and audio reviewers even though most listeners do not yet own CX decoders. This would appear to support the claimed compatibility of the CX system.


CX decoders are available from several companies, and the opening of this article displays several units. The CX logo is placed on the front panel of each decoder for consumer identification. Both the number of decoders and CX-encoded records will be increasing in the next few months. In 1982 several preamps and receivers containing CX circuitry will also be in the marketplace. Thus, CX will soon be available for all consumers who wish to listen to music in the absence of record noise. 

Table III

Ratings on album attributes; 1 is worst and 10 is best.

Attributes	Pictures At An Exhibition	Brahms' Fourth (CX Encoded)	Rampal's Great Hits	Bolling/Zuckerman (CX Encoded)
Type of music	8.2	8.6	6.9	6.7
Placement (separation) of the instruments	8.2	8.2	7.8	7.7
Quality of sound reproduction	8.2	8.1	7.7	7.8
Uniqueness of the sound	7.2	7.3	7.0	7.4
Orchestral arrangement	8.2	8.2	7.0	7.3
Tone quality	8.1	7.9	7.7	7.6
Surface quality	7.3	7.6	7.3	7.6
Elimination of background interference	7.9	7.9	7.8	7.9
Musical (Instrumental) blend	8.1	8.1	7.7	7.7
Assortment of musical selections	7.8	8.2	6.8	7.1
Dynamic range	8.0	7.9	7.4	7.5

1

SANSUI AU-D11 INTEGRATED AMPLIFIER

Manufacturer's Specifications

Power Output: 120 watts per channel, 8-ohm loads, 10 Hz to 20 kHz.

Rated THD: 0.005%.

SMPTE IMD: 0.005%.

Overall Frequency Response: 0 to 300 kHz, -3.0 dB, high level.

Phono Response: RIAA within 0.2 dB.

Damping Factor: 150 into 8 ohms at 1 kHz.

Rise Time: 0.8 μ S.

Slew Rate: ± 350 V/ μ S.

Input Sensitivity: MC phono, 100 or 200 μ V; MM phono, 2.5 mV for rated output; high level, 250 mV.

Phono Overload: MC, 16 mV at 1 kHz; MM, 200 mV at 1 kHz.

S/N Ratio: MC, 74 dB; MM, 90 dB; high level, 110 dB.

Bass Control Range: ± 8 dB at 50 Hz (selectable turnover at 150 or 300 Hz).

Treble Control Range: ± 8 dB at 15 kHz (selectable turnover at 3 or 6 kHz).

Subsonic Filter: -3 dB at 16 Hz (6 dB/octave).

High-Cut Filter: -3 dB at 20 kHz.

Muting Action: 20 dB.

Power Requirements: 120 V, 60 Hz a.c., 600 watts (rated).

Dimensions: 17-9/16 in. (44.61 cm) W x 6-7/16 in. (16.35 cm) H x 17 1/2 in. (44.45 cm) D.

Weight: 38.5 lb. (17.37 kg).

Price: \$1,000.00.



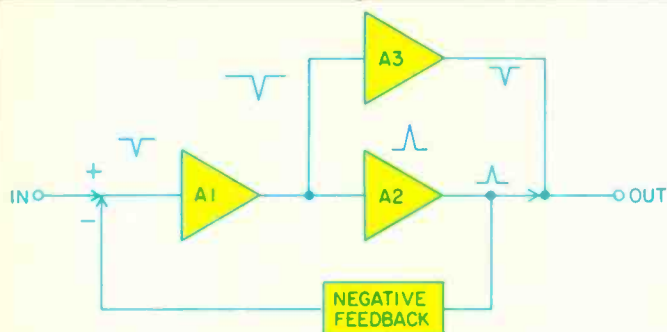


Fig. 1—Simplified block diagram of Sansui's SuperFeedforward circuitry found in their AU-D11 amplifier.

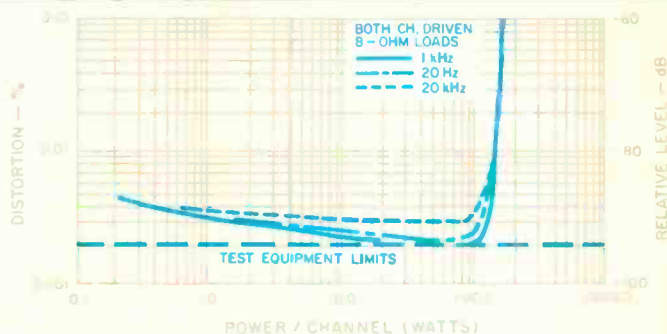


Fig. 2—THD vs power output, Sansui AU-D11.

Sansui has always been a company dedicated to researching new approaches to audio product design and construction. In their AU-D11 integrated amplifier they have incorporated a practical embodiment of an idea that has actually been around longer than the concept of negative feedback. The concept is called "feedforward," and Sansui's version of it in their AU-D11 is called "SuperFeedforward." It is a combination of the conventional negative feedback concept and the old, but never practically executed, "feedforward" idea. Figure 1 is a simplified block diagram of the SuperFeedforward idea. Distortion, generated in A_2 , is fed back to the input, reversed in phase, where it is added to A_1 . This reverse-phased signal is then amplified by A_1 and sent on to A_2 . In this way, distortion is reduced at the output of A_2 . So far, what we've described is ordinary loop negative feedback. In the SuperFeedforward system, however, an additional out-of-phase signal at the output of A_1 , is also fed to an error-correction amplifier, A_3 , where it is amplified and fed on to the output (rather than the input) of A_2 . In this way, the feedforward circuit eliminates or greatly reduces what little distortion the negative feedback loop has failed to eliminate. While no direct claims are made for the SuperFeedforward circuit relative to certain dynamic forms of distortion (such as TIM, IM, etc.), Sansui's earlier-developed Diamond Differential DC circuitry (which results in an ultra-fast rise-time and a high slew rate) is, according to Sansui, directly responsible for the reduction or elimination of these other forms of audible distortion.

The front panel of the AU-D11 has a matte-black finish and highly legible off-white control designations. A rotary speaker selector switch and a power switch are at the extreme left of the panel. Nearby, we find the usual phone jack plus calibrated bass and treble controls, each augmented by two pushbuttons which select the crossover frequency for each of these tone controls (300 or 150 Hz for the bass control; 3 or 6 kHz for the treble). Tone defeat, high-cut and subsonic filters, muting switches and associated indicator lights occupy the center section of the panel. To the right are a passive, accurately calibrated, step-type master volume control and a smaller, center-detent channel bal-



The Sansui AU-D11 does everything a top-grade amp should do and does it as well as any product I have ever tested.

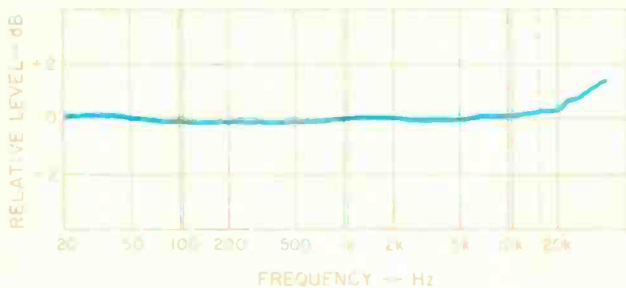


Fig. 3—Equalized RIAA response, AU-D11 amplifier. Maximum deviation from RIAA was +0.2 dB at 15.5 kHz.

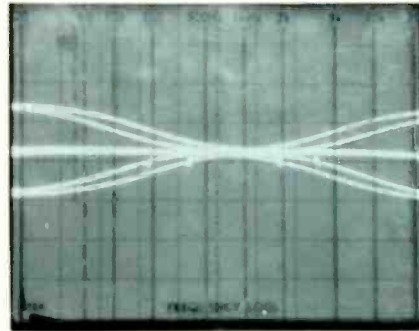


Fig. 4—Bass and treble control range for each turnover frequency.

ance control. The two tape monitor circuits of the AU-D11 are controlled by means of two slim switches with indicator lights, and next to these is a record selector switch which allows you to feed one program source (such as tuner or another tape deck) to your recording deck while listening to any other source. Above this switch are a pair of tiny pushbuttons which select either MC or MM phono preamplification and, if MC is selected, a choice of two gain levels (sensitivities of either 100 or 200 μ V for rated output). Finally, the main input selector switch, replete with tiny indicator lights, is located at the upper right corner.

The rear panel of the AU-D11 contains the usual array of phono-tip input and tape-out jacks, two pairs of color-coded speaker terminals, and a total of three a.c. convenience receptacles (one switched, two unswitched). There are no external fuses or circuit breaker reset buttons accessible to the user at the rear panel.

Besides the pre-preamp for MC cartridges, there are basically only two amplifier sections in the AU-D11, the phono equalizer and the power amp. When the tone controls are defeated, the output of the equalizer section goes directly to the power amp and then on to the speaker systems without encountering any coupling capacitors in the signal path.

The equalizer is of the high-gain d.c.-servo type. It features a differential input formed of a dual FET, followed by Sansui's previously mentioned DD/DC circuit and a true complementary single-ended push-pull output. As for the power amplifier section, in its driver stage a pair of differential circuits in a symmetrical design are connected to each other as dual-complementary differentials. The power output stage has a differential input, fed with a constant current source, formed by a low-noise, high current dual FET.

Power Amplifier Measurements

The AU-D11 delivered 136 watts per channel before clipping. At rated output (120 watts per channel, 8 ohms), harmonic distortion and SMPTE-IM distortion were both equal to 0.002% or lower (that level of distortion being the limit imposed by the signal generating source itself). Power output versus harmonic

distortion for signal frequencies of 1 kHz, 10 Hz and 20 kHz are plotted in Fig. 2. Damping factor, referred to 8-ohm loads and using a 50-Hz test signal, measured 140. I also measured CCIR-IM distortion, using a variety of twin-tone test signals of equal amplitude equivalent to rated output (each of the two twin tones is 3 dB below rated output so that their combination adds up to the rms voltage equivalent of full rated output). Worst-case results for this form of IM distortion measured 0.0029%, or barely measurable. The twin-tone IM measurement method was extended to include an IHF-IM measurement. This involves taking into consideration any and all IM components that appear within the audio spectrum, from 20 Hz to 20 kHz. The analysis is made on the basis of a spectrum analyzer display whose dynamic range is limited to 80 dB. I can therefore report only that the IHF-IM for this amplifier was less than 0.01%, as low as I am able to measure in my lab. Slew factor, as specified in the EIA Amplifier Measurement Standards, was greater than 5 (the highest I can measure) and is, in my opinion, a more easily measured (and, therefore, more meaningful) specification than slew rate or square-wave rise-time.

Preamplifier Measurements

Input sensitivities for the various input terminals of the AU-D11 were measured with respect to 1-watt output (as prescribed in the EIA Amplifier Standards), putting them approximately 21 dB lower than specified by Sansui, who still refers these measurements to rated output. Input sensitivity for MM phono measured 0.24 mV, while for the two settings (high and low gain) of the MC phono inputs, I measured 9 and 18 microvolts respectively. The high-level (tuner, AUX, tape) inputs required 27 millivolts of input to produce 1-watt output with the volume control set to maximum.

Phono overload in the MM phono mode measured 200 millivolts for a 1-kHz signal, while in the MC mode it measured 18 millivolts, or a bit better than the 16 mV claimed by Sansui. My signal-to-noise results are not directly comparable to those published by Sansui since, again, I am using the method endorsed in the EIA Amplifier Measurement Standards (a fixed input of 5

As for sound quality,
I can't think of anything
Sansui might have done to
make the AU-D11
any better.

mV to the MM phono, 0.5 mV to MC, and 0.5 volt for high-level inputs, with the volume control adjusted to produce one watt of output from the amplifier). In this case, no direct comparison can be made with Sansui's published specs. MM phono S/N measured a very high 86 dB, while the MC inputs offered a signal-to-noise ratio of 72 dB. Signal-to-noise for the high-level inputs measured 88 dB, while hum and noise of the power amp section alone (with the master volume control turned down to minimum) measured 96 dB. This last figure can be translated to Sansui's type of S/N measurement by simply adding 21 dB to my result, to obtain a figure of 117 dB relative to rated output.

By using a highly accurate inverted RIAA signal fed to the phono section of this amplifier and with the record-out terminal connected to a Sound Technology 1500 audio analyzer, I came up with the "almost ruler flat" phono response curve shown in Fig. 3. The plot is from 20 Hz to 20 kHz, and vertical sensitivity of the display has been expanded to 2 dB per division. The "cursor" (vertical dotted line) has been set to the "worst" deviation from RIAA, which occurred at 15.5 kHz and amounted to no more than +0.2 dB error.

Particularly pleasing was the action of the bass and treble tone controls of the AU-D11. As you can see from Fig. 4, even when the "inner" turnover points of 300 Hz and 3 kHz are chosen, the midrange frequency area remains relatively unaltered. In my view, this is an arrangement that is far preferable to having the controls "hinged" about a common point at

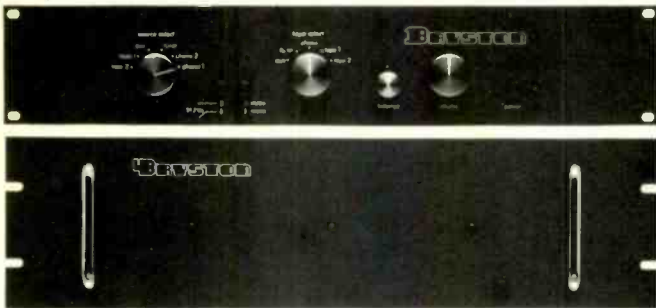
500 Hz or 1 kHz. Since both the subsonic and the low-pass filter circuits of the AU-D11 are set at or beyond the audio range extremes (16 Hz for the subsonic filter, 20 kHz for the high-cut circuit), it was not possible to graphically illustrate their action. Suffice it to say that both filters began to cut response exactly as specified and at the slope specified by Sansui.

Use and Listening Tests

It is difficult to say whether or not Sansui's unique Super-Feedforward and DD/DC circuitry actually contributes directly to sound reproduction. However, the AU-D11 delivered totally transparent and accurate sound reproduction when hooked up to reference speakers and fed with a variety of source material from my latest collection of digitally mastered classical and jazz discs. Actually, aside from being curious about such possible correlation, the question becomes academic. The Sansui AU-D11, in my opinion, does everything that a top-grade integrated amplifier should do and does it as well as any product I have ever tested. A few more frills might have been incorporated on the back panel, such as selectable MM phono input loads (choice of capacitance values, etc.), but these are matters that the knowledgeable audio enthusiast can easily take care of externally. As for sound quality, I can't think of anything that Sansui might have done to make the AU-D11 any better.

Leonard Feldman

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2

GOLDRING G-920 IGC CARTRIDGE

Manufacturer's Specifications

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

Channel Balance: Within 2 dB at 1 kHz.

Channel Separation: 25 dB at 1 kHz.

Sensitivity: 6.5 mV ± 1.5 dB at 5 cm per second.

Static Compliance: Lateral, 24 mm/N; vertical, 16 mm/N.

Vertical Tracking Angle: 24 degrees.

Recommended Load Impedance: 47 kilohms.

Recommended Tracking Force: 1.0 to 2.5 grams.

Price: \$125.00.



Goldring was among the first manufacturers to use the van den Hul stylus type, a chisel-shape design shown in Fig. 1. It bears a certain resemblance to the well-known Shibata configuration, but instead of facets, the surfaces contacting the record are ground into smooth curves. The actual contact area

is stated to be 3.5 microns, which is pretty close to the radius of a typical record cutter stylus. The inventor, Alk Jouk van den Hul, used an IBM 370 computer to optimize the design, which has to take into account tip mass and tracing distortion, among other factors.

The first Goldring cartridge to use a

van den Hul type stylus was the G-900 IGC, which is still at the top of the line at \$240.00. The model selected for reviewing here is the G-920 IGC, which is a later version using a modified stylus which they call the van den Hul II. According to Goldring, this stylus shape has the major axis reduced and the mi-

nor radius enlarged to "produce a less radical shape compatible with a wider range of tonearms and is simpler to make." The price has certainly been reduced, as the G-920 lists at only \$125.00 — slightly more than half the G-900's price. The G-920 employs the same basic construction as the G-900, with the four coils wound as double pairs without joins. Weight of the cartridge is only 4.25 grams and there is a neat detachable stylus guard. Inductance is stated as being 570 mH, and the rated output is higher than average at 6.5 mV at 5 cm/S velocity. Equivalent tip mass is stated to be 0.45 mg — a little higher than the G-900's 0.32 but still lower than most top-quality cartridges these days.

Measurements

For test purposes, the cartridge was mounted on a Sony PS-X800 SLT turntable, and the tracking force was set at 1.25 grams. The first test was frequency response and separation, and the results can be seen in Fig. 2. Note that there is 30 dB of separation through the mid-band, from just below 400 Hz to about 2500 Hz, decreasing to 15 dB at 10 kHz. The optimum load capacity is stated to be 180 pF total, which would include both the tonearm wiring and the preamp input. This value was confirmed; increasing the capacity to 350 pF caused a rise in the response at 13 kHz and a falling off at 17 kHz. It appears wise, therefore, to pay some attention to the cables used with this cartridge to make certain they are low-capacitance types. The square-wave response characteristics can be seen in Fig. 3; after the initial overshoot, the G-920's response is very well damped. Channel matching was within 0.5 dB, which is good performance, and output measured 3 mV at 3.54 cm/S velocity.

The Goldring G-920's trackability performance was rather good overall and would have to be rated as one of the best in its price class. The low-frequency performance in this area was excellent, as the cartridge was able to track all bands on the big drum test on Shure's *Obstacle Course* — Era III even when the tracking force was reduced to 1 gram. However, to cleanly track the *Deutsches Hi-Fi No. 2* test disc's 300-Hz 80- μ m band, the tracking force had to be increased to 2.5 grams. It must be

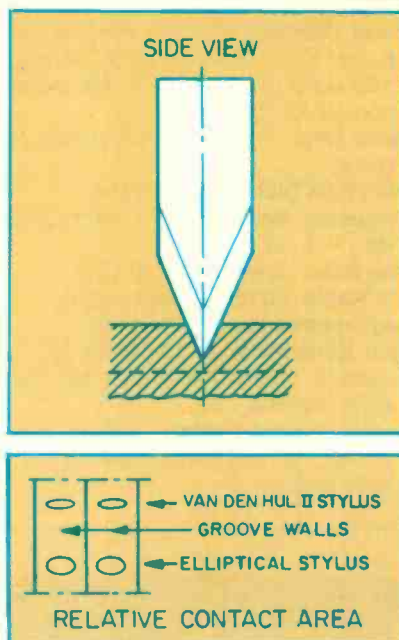


Fig. 1 — Goldring's van den Hul II stylus profile and its contact area relative to an elliptical stylus.

pointed out, however, that this is a tough test. Going on to Shure's Era IV record, some hardness was audible on level three of the orchestral bell test along with some distortion on band 5 of the flute and bell test, which very few cartridges can play at all. High-frequency trackability with 10.8-kHz tone bursts was 25 cm/S, and IM (with 400 Hz and 4 kHz) was well below 2 percent up to 15 cm/S velocity, increasing rapidly above 25 cm/S.

Use and Listening Tests

As usual, a fairly large selection of records was used for the listening tests, and some difficult-to-track discs were naturally included. One of these latter records was the new *Sheffield Tower of Power*, which has some particularly high modulation levels. No trouble was experienced with mistracking, though I must admit that I did keep the tracking force set at 1.75 grams just to be on the safe side. Best results will be had with low- to medium-mass arms.

The sound quality of the Goldring Model G-920 was notable for a tight bass, and there is an almost analytical character of the response in the treble

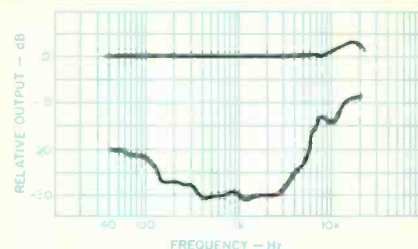


Fig. 2 — Frequency response and separation with a 180-pF load (see text).

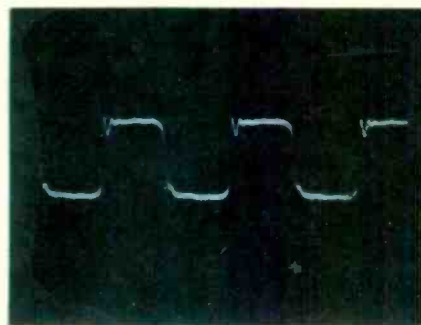


Fig. 3 — Response to a 1-kHz square wave.

range, which is sometimes associated with moving-coil phono cartridges. Whether this apparent extra clarity and definition is due to the van den Hul stylus and its tracking abilities or to the mild rise in the high-frequency response is a moot point. While the effect is fairly subtle, it is definitely there upon close listening. One very nice aspect of the G-920's sound is that there was no trace of harshness or stridency in the listening tests.

Not so long ago, \$125.00 was a great deal of money to pay for a phono cartridge, but looking at last October's *Annual Equipment Directory I* find that this figure is now somewhere in the middle of the range. My judgment must therefore be that the G-920 offers very good value indeed, and will be of particular interest to those who face budget limitations and also desire a cartridge with a van den Hul stylus.

George W. Tillett

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3

AMBER ELECTRONICS SERIES 70 AMPLIFIER

Manufacturer's Specifications

Power Output: 70 watts per channel, 8-ohm loads, from 20 Hz to 20 kHz; 100 watts per channel, 4-ohm loads, from 20 Hz to 20 kHz.

Rated THD: 0.1% (8 ohms), 0.25% (4 ohms).

SMPTM IM Distortion: 0.03%.

Frequency Response: 5 Hz to 100 kHz, +0, -3.0 dB.

Slew Rate: Greater than 20 V/ μ S.

S/N Ratio: 90 dB re: rated output.

Input Impedance: 100 kilohms.

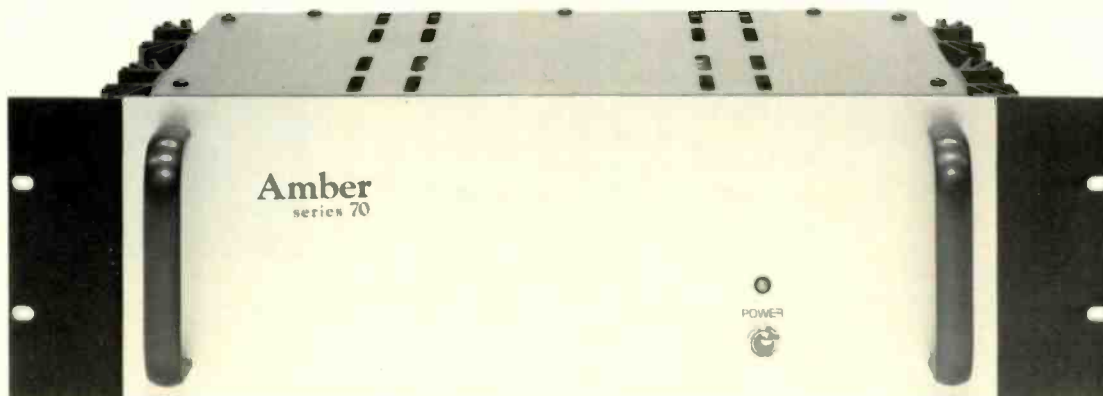
Input Sensitivity: 1.15 V rms for 70 watts/8 ohms; 1.0 V rms for 100 watts/4 ohms.

Power Requirements: 120 V a.c., 50/60 Hz, 350 watts maximum (25 watts idle).

Dimensions: 19 in. (48.3 cm) W x 5 1/4 in. (13.3 cm) H x 11 1/2 in. (29.2 cm) D.

Weight: 35 lbs. (15.75 kg).

Price: \$549.00.



Amber Electronics, an audio equipment manufacturer located in Charlottesville, Virginia, informs us that this amplifier, as well as all of their other products, has been completely designed and manufactured in the United States. The Series 70 amp is a basic power amplifier that operates with either 8- or 4-ohm loads in stereo and can also be operated in a bridged or mono mode, under which conditions its rated power output increases to 200 watts into an 8-ohm load with no more than 0.25% harmonic or IM distortion.

The front panel of the amplifier contains no controls other than a power on/off switch and an indicator light which illuminates when power is turned on. The back panel is equipped with all of the necessary input and output terminals. Phono tip jacks are used as input termi-

nals, while five-way, 3/4-inch spaced binding posts, color coded for polarity, are used for speaker connections. These will accept standard double banana plugs, but stripped ends of speaker cables can easily be connected directly to the terminals. There are no fewer than seven fuse holders on this surface as well. Four of these take care of the positive and negative legs of each channel's high voltage (B+ and B-) supplies, another pair is in the positive lines of the speaker outputs, while the final fuse is a 4-ampere, slow-blow line fuse. The speaker fuses, as supplied by Amber, are 3-ampere types, although the brief, four-page owner's booklet which accompanies the amplifier includes a table of fuse values that may be substituted, depending upon speaker impedance and power handling capacity.

No schematic diagram was included with the Series 70 amplifier, but according to the owner's booklet and from observation of the amp's construction, there are no capacitors in feedback loops and no parallel output devices. A low-pass filter excludes signals above 100 kHz, thereby eliminating the possibility of slew-limiting distortion and TIM. (There are those who have argued that bandwidth limiting is not the way to reduce these problems, but we'll leave that to the audio philosophers.) A high-pass filter is used to block d.c. transients from being amplified, and I don't think anyone will argue against keeping d.c. away from speaker voice-coils if at all possible! The amplifier is constructed in a modular fashion so that all circuit components, with the exception of the power supply, are mounted on replaceable p.c.

boards measuring about four inches square. The chassis is made of 16-gauge steel and has, I am told, over six square feet of heat-sink area. Components seemed to be of the highest quality and were, in general, close-tolerance types wherever such tolerances are needed.

Measurements

Figure 1 is a plot of power output versus THD, for both 8- and 4-ohm loads. With 8-ohm loads, using a 1-kHz signal, the amplifier delivered 73.2 watts per channel at the rated THD level of 0.1%, while with 4-ohm loads, the rated THD level of 0.25% was reached when output power was 108 watts per channel. Figure 2 plots SMPTE-IM distortion as a function of output power and results were quite similar, with 78 watts per channel delivered for the rated IM level with 8-ohm loads and 108 watts per channel obtained under 4-ohm load conditions. Using the FTC power rule as a criterion, I agree with Amber that the rated power output (under 8-ohm load conditions) for this amplifier could not have exceeded 70 watts per channel, for at 20 kHz, as we see in Fig. 3, 70 watts of output *did* produce the rated THD level of 0.1%. Harmonic distortion at 20 kHz is a meaningless term as far as human hearing is concerned — but that's the rule, and Amber is abiding by it. In fact, under musical conditions, the Series 70 exhibited a full 1.0 dB of dynamic headroom, which is not a very big headroom number but nevertheless means that for short, musical transient signals operating into 8-ohm loads, the amplifier can deliver as much as 88 watts or so per channel without audible clipping.

Damping factor (again using 8-ohm loads as a reference) measured around 90 for a 50-Hz test signal. Input sensitivity for rated output was exactly 1.1 volt, while A-weighted signal-to-noise ratio, referred to the 70-watt rated output, measured 105 dB — considerably better than the 90 dB claimed by Amber. I wonder if they are measuring S/N according to IHF standards, since 90 dB for a power amp is hardly anything to brag about these days. Slew rate did measure approximately 20 volts per microsecond, as claimed. As for frequency response, it extended from 6 Hz to 30 kHz for a -1.0 dB roll-off point or from

3.0 Hz to 100 kHz for the -3 dB roll-off point. CCIF IM distortion (the production of a 1-kHz IM tone when two high-frequency tones separated by that frequency are applied to the amp simultaneously) measured a very low 0.0014%, but IHF IM, though still quite low, was measurable at 0.06% when the twin tones used were at 9 kHz and 10 kHz as shown in Fig. 4. In this display, sweep is linear from 20 Hz to 20 kHz (ignore the log-type frequency notations at the top of the display). The large spikes near the center are the desired output signals at frequencies of 9 and 10 kHz, and their amplitude is the equivalent (added together) of 70 watts rated output. The unwanted components generated at the right of the display at 16, 17 and 18 kHz are summed mathematically (the square root of the sum of the squares of their amplitudes) and expressed as a percentage of the reference rated output level to arrive at an IHF IM figure of 0.06%.

Use and Listening Tests

The sounds delivered via reference speakers when driven by the Amber Series 70 power amplifier were altogether neutral in character, and, despite the bandwidth restrictions imposed by the designers, I could detect no problems with musical transient reproduction or with any sort of dynamic forms of intermodulation. I listened to the amplifier at low power output levels in an effort to detect any evidence of notch or switching distortion and could detect none of these effects either. The amplifier ran quite cool, even after several hours of reproducing program material in my listening room at fairly loud volume levels using reference speakers not particularly noted for their high efficiency.

It's nice to find a young company turning out good audio equipment in as unlikely a place as Charlottesville, Virginia, and I certainly wish them every success with this product as well as with future ones. If I might make one suggestion — an amplifier expected to retail for nearly \$500.00 deserves more than the little four-page 8½ x 5½ pamphlet as an owner's manual. There's a lot more they could have told the user about the amplifier that would have instilled confidence in its use. After all, not everyone buying it will put it through the tough lab tests that I did.

Leonard Feldman

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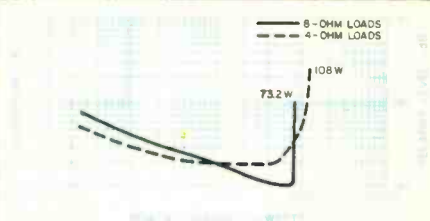


Fig. 1—Harmonic distortion vs. power output at 1 kHz.

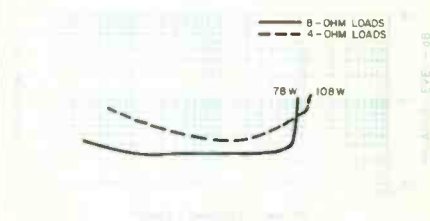


Fig. 2—SMPTE IM distortion vs. power output.

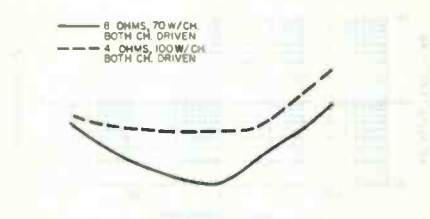


Fig. 3—Distortion vs. frequency.

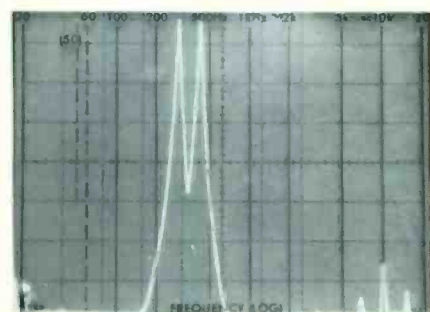


Fig. 4—Twin-tone IM measurement revealing a small amount of IHF IM distortion within the audible spectrum. Note: Sweep is linear, from 20 Hz to 20 kHz, so log scale at top of display should be ignored (see text).

4

STANTON 980LZS CARTRIDGE

Manufacturer's Specifications

Type: Moving magnet, low impedance.
Stylus Type: Nude stereohedron.
Tip Dimensions: 8 x 71 microns.
Tracking Force: 1 gram ± 0.5 .
Setting with Brush: 2 grams ± 0.5 .
Resulting Tracking Force: 1 gram ± 0.5 .
Frequency Response: 10 Hz to 50 kHz.
Output: 0.06 mV/cm/S.

Channel Balance: Within 1 dB at 1 kHz.

Channel Separation: 35 dB at 1 kHz.

D.c. Resistance: 3 ohms.

Inductance: 1 mH.

Weight: 5.5 grams.

Load Resistance: 100 ohms or more.

Load Capacitance: 1000 pF or less.

Replacement Stylus: D98S.

Price: \$220.00; replacement stylus, \$90.00.



In the Model 980LZS phono cartridge, Stanton Magnetics has introduced an entirely new type of design — a *low-impedance moving-magnet* (MM) type. And, as important, aficionados of moving-coil (MC) cartridges will be surprised and pleased to learn that the 980LZS is indistinguishable from the very best moving-coil types in the most rigorous laboratory and aural tests. Stanton's is an impressive dual achievement.

The 980LZS is designed to be used in stereo systems which already have a high-gain, low-impedance moving-coil input or use outboard pre-preamps or step-up matching transformer. These units should have an input impedance of 100 ohms or more, and because of the very low output voltage of the 980LZS, a gain stage at this point of not less than 20 dB is necessary to step up the voltage to the level of the usual magnetic phono cartridge input. Other design features of the 980LZS are an extremely low dynamic tip mass (0.2 mg), high compliance (30×10^{-6} cm/dyne at the resonant frequency), and a user-replaceable stylus assembly with a samarium cobalt magnet. It is, indeed, a rare MC cartridge that has a user-replaceable stylus assembly. The 980LZS is a lightweight cartridge in contrast to the usual heavy MC cartridges, thus increasing its tracking ability on warped records. Because of its low-impedance coils, the 980LZS moving-magnet cartridge permits the use of long cables, being insensitive to capacitive loading. The usual removable Stanton "longhair" brush is a part of the cartridge body, cleaning the groove surfaces just before playing, and, at the same time, is intended to stabilize the tonearm.

The body of the 980LZS consists of a chrome-finished housing and a clear plastic stylus assembly housing. As usual, the

stylus guard is wholly removable. The cartridge is packaged in a black-velvet case which contains the usual mounting hardware in a "pillbox," a small screwdriver, and an instruction manual.

For those needing a pre-preamplifier, the Stanton BA-26 has been specially designed for the 980LZS. It operates on three "C" batteries and has a pushbutton switch which either turns the unit on or else puts it in bypass mode.

Measurements

The Stanton 980LZS was mounted in a Technics headshell and used with the Technics EPA-100 tonearm mounted on a Technics SP-10 Mk II turntable. The cartridge was oriented in the headshell and tonearm with the Dennesen Geometric Soundtracktor. All measurements, where appropriate, were made using the Stanton BA-26 pre-preamplifier.

Laboratory tests were conducted at an ambient temperature of $70^\circ \text{F} \pm 1^\circ$ (21.11°C) and a relative humidity of 62%, $\pm 3\%$. The tracking force for all reported tests was at 1.5 grams (brush removed), with an anti-skating force of 1.8 grams. The cartridge, when lightly tapped, was found to be slightly microphonic. As is my practice, measurements were made on both channels, but only the left channel is reported unless there is a significant difference between the two channels, in which case both channels are reported for a given measurement.

Frequency response, using Columbia's STR-170, was +0.5 dB, -0.75 dB from 40 Hz to 7.5 kHz and -0.5 dB to +3.75 dB from 8 to 20 kHz, with +3.75 dB measured at 19 kHz. Separation was 25.5 dB at 1 kHz, 23.8 dB at 10 kHz, 28 dB at 15 kHz, and 25.8 dB at 20 kHz. Using the JVC TRS-1005 test

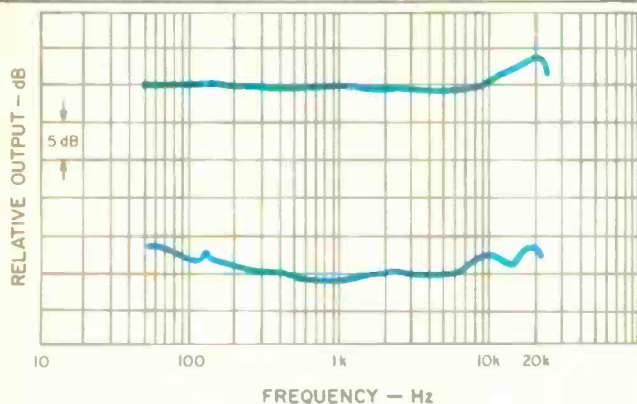


Fig 1 — Frequency response.

record, the left-channel frequency response was +0, -0.5 dB from 1 to 10 kHz, +1 dB at 15 kHz, +1.2 dB at 20 kHz, -0.5 dB at 30 kHz, -2.5 dB at 40 kHz, and -5.5 dB at 50 kHz. The right-channel frequency response was +0, -0.2 dB from 1 to 8 kHz, +0.25 dB at 10 kHz, +0.75 dB at 15 kHz, +0.5 dB at 20 kHz, -2 dB at 30 kHz, -1 dB at 40 kHz, and -3.25 dB at 50 kHz. Left-channel separation was 21.5 dB at 1 kHz, 23.5 dB at 15 kHz, and 16 dB at 50 kHz, while the right-channel separation was 28.25 dB at 1 kHz, 24 dB at 15 kHz, 18.8 dB at 30 kHz, and 20.8 dB at 50 kHz. From these data it is evident that the frequency response of the 980LZS cartridge is excellent despite some output differences between the two channels beyond 20 kHz, and the high-frequency separation is most satisfactory across the entire measured audio spectrum.

The 1-kHz square-wave response shows a large overshoot followed by rapidly decaying, high-frequency ringing, a typical square-wave response for a moving-coil phono cartridge; this is the square-wave response, of course, of an MM type. The cartridge-arm low-frequency lateral resonance was a bit low at 6.5 Hz at an amplitude of +1 dB; vertical resonance was also 6.5 Hz. The effect of this rather low resonance was not evident when playing records.

The following test records were used in making the reported measurements: Columbia STR-170, STR-100, STR-112; Shure TTR-103, TTR-109, TTR-110, TTR-115; Deutsches Hi-Fi No. 2; JVC TRS-1005; Nippon Columbia Audio Technical Record (PCM) XL-7004; B & K QR-2010, and the Ortofon Direct-Cut Pickup Test Record 0001.

Wt., 5.4 g; tracking force, 1.5 g; anti-skating, 1.8 g; direct output, 167 μ V (0.05 mV/cm/S), output through the BA-26 head amplifier, 0.83 mV/cm/S; IM distortion: (4:1) +9 dB lateral, 200/4000 Hz, 1.1%; +6 dB vertical, 200/4000 Hz, 4.3%; crosstalk (using Shure TTR-109), 30 dB; channel balance, 0.3 dB; trackability: high freq. (10.8 kHz, pulsed), 30 cm/S; mid-freq. (1000 and 1500 Hz, lat. cut), 31.5 cm/S; low freq. (400 and 4000 Hz, lat. cut), 24 cm/S; Deutsches Hi-Fi No. 2 300-Hz test band was tracked cleanly to 95 microns (0.0095 cm), lateral at 17.9 cm/S at +10.33 dB and 43 microns (0.0043 cm), vertical at 8.12 cm/S at +3.64 dB. These last measurements made with the German record are quite remarkable, inasmuch as it is an extremely rare phono cartridge that is able to track more than about 86 microns on this test record.

The 980LZS phono cartridge cleanly played all the test

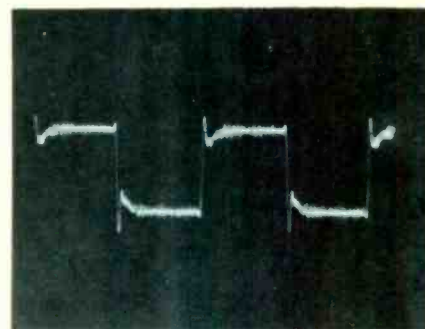


Fig. 2 — Response to a 1-kHz square wave.

bands on the Shure Obstacle Course — Era III. The cartridge did not sound bright despite the rise in frequency response at the 12 to 20 kHz region. On the Shure Obstacle Course — Era IV, the cartridge presented a hint of possible break-up on level 5 of the flute passage and an intermodulation type of distortion was becoming evident at level 5 of the harp-and-flute and flute-and-orchestral bells test bands. Level 5 bands of these two combinations are recorded at velocities greater than 45 and 54 cm/S, respectively. It is, indeed, a rare phono cartridge that can reproduce these bands cleanly. Overall, the Stanton 980LZS performed superbly in being able to track such difficult test records. It should be pointed out, however, that it is a rare commercially available phonograph record that has musical signals with a recorded velocity greater than 20 cm/S.

Use and Listening Tests

As usual, I performed many hours of listening tests both before and after measurements. During the period after measurements I felt that the BA-26 pre-preamplifier, though excellent, was a bit too noisy for my listening taste, so I continued the listening evaluation using the Audio Standards MX-10A pre-preamplifier or the Ortofon T-30 wide-band transformer in the 48-ohm switch position. While listening to a wide variety of records, I was continually aware that the 980LZS sounded like a moving-coil cartridge. The bass was well defined and tight with good sonic clarity, as well as transient response and applause definition. Transparency of sound was excellent when reproducing the high recorded levels present on most direct-to-disc recordings. At no time did I notice any coloration of the music. The 980LZS is also, one of the very few phono cartridges that can cleanly reproduce the cannon fire on the Telarc DG-10041 recording of Tchaikovsky's 1812.

My final aural assessment of the 980LZS was made listening to dbx-encoded records, thus eliminating the record-surface noise that constantly competes with the recorded music. During this listening period, it became quite evident that the cartridge was reproducing instrument definition to an even greater degree than I had noticed in the past.

The 980LZS may open a new era in phono cartridge design philosophy. Certainly, the 980LZS merits serious consideration by all music lovers and, in particular, by those who espouse the merits and philosophy of the MC phono cartridge. *B. V. Pisha*

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5

**KEF 105
SERIES II
LOUDSPEAKER**

Manufacturer's Specifications

System Type: Three way, coherent phase.

Drivers: Three; 12-inch (300-mm) bass; 5-inch (110-mm) cone midrange, and 2-inch (50-mm) dome tweeter.

Nominal Impedance: 8 ohms.

Frequency Response: 38 Hz to 22 kHz, ± 2 dB.

Dimensions: 38 inches (96.5 cm) x 16.3 inches (40.6 cm) x 17.9 inches (45.5 cm).

Weight: 80 lbs. (36.3 kg).

Price: \$1400.00.



The Model 105 Series II, hereafter referred to as 105.2, is an improved version of the very successful KEF Model 105. Extensive computer analysis, backed up by an equally extensive program of subjective listening, has led to this second-generation, top-of-the-line system from KEF Electronics Limited.

A three-way loudspeaker system, the drive units are positioned so as to retain the subjectively important time relationships of the original sound, and the enclosures are contoured to reduce sound field disturbances. The bass chamber has been extensively braced to eliminate residual resonances which were discovered by computer-assisted analysis, and the woofer itself is mechanically isolated from the enclosure by vibration isolators to reduce coloration in the lower midrange frequencies.

A 300-mm (12-inch) woofer covers the range from 38 Hz to 400 Hz. A 110-mm (5-inch) cone unit carries the frequencies from 400 Hz to 2500 Hz, while a 50-mm (2-inch) dome tweeter radiates frequencies above 2500 Hz. The crossover network is of extremely advanced design, providing not only correction for the acoustic amplitude and phase response of the drivers but the impedance presented to the power amplifier. In addition a particular response, fourth-order Linkwitz-Riley filter was chosen to keep the main acoustic lobe of the polar pattern coincident with the design axis of the loudspeaker at all frequencies. This necessitates computer matching of all driver units used in a stereo pair of systems.

The separate head assembly, which houses the midrange and tweeter units, can be rotated and tilted to position the optimum acoustic axis toward the preferred listening position. A ± 7 degree vertical tilt and ± 30 degree horizontal rotation is provided by the housing assembly. A light-emitting diode (LED) can be energized by moderate level audio when a switch on the rear of the housing is set to "listening window" position. The glow is visible only within the optimum listening areas. This ingenious assembly allows rapid setup for the most uniform direct sound from the midrange and tweeter. Once adjusted for best listening position, the switch can then be used to convert the light to a peak level indicator, which glows when the peak-to-peak amplifier voltage exceeds that required to deliver its rated output power into 8 ohms. Peak level settings of 50, 60, 80, 100, 125, 150 and 200 watts adequately cover most amplifiers that might be used with this speaker.

Connection is made to well-marked terminals on the rear of the enclosure. An excellent set of installation instructions leads the user through a step-by-step procedure, and even the least technically oriented user should be able to set up the system for optimum sound quality.

Measurements

The impedance at the terminals of the KEF 105.2 is plotted in Fig. 1, and the corresponding complex impedance, which includes the phase angle, is shown in Fig. 2. The lowest value of impedance through the audio band is 7.5 ohms and occurs at 12 kHz. Since this is a transition from capacitive to inductive reactance, the high-frequency impedance will present no amplifier loading problems. Even the worst-case loading, which occurs around 3.1 kHz with a 43 degree capacitive reactive angle, is high enough to present no difficulty. It is technically interesting to note that the KEF impedance rises below 20 Hz to approach the properties of a capacitor, and this is caused by a network within the electronic crossover. The system does not conduct

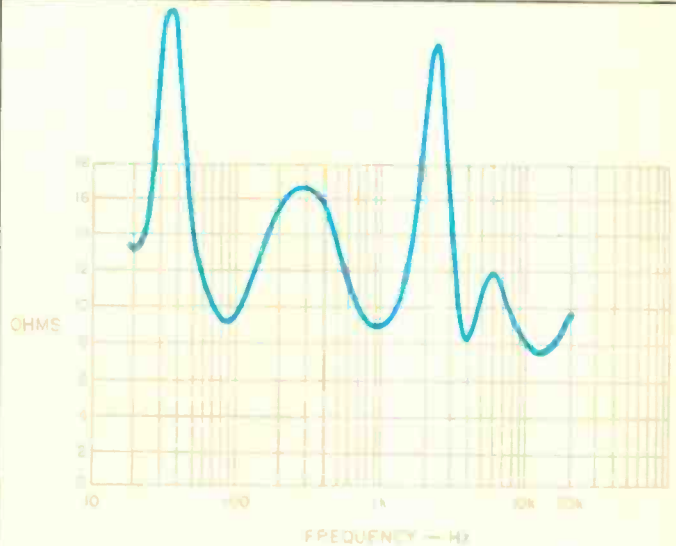


Fig. 1 — Magnitude of impedance.

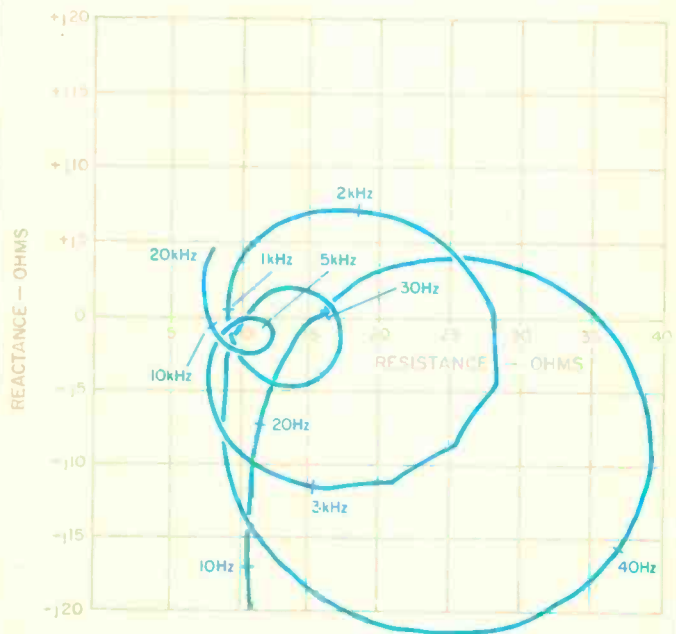


Fig. 2 — Complex terminal impedance.

My overall impression of tonal quality was of general smoothness throughout the audible frequency range.

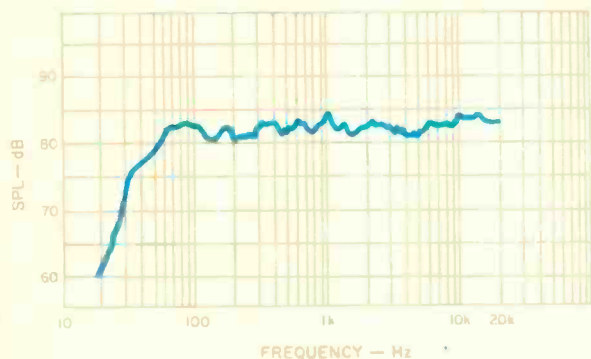


Fig. 3 — Anechoic amplitude response at one meter with constant voltage drive corresponding to one average watt into 8 ohms.

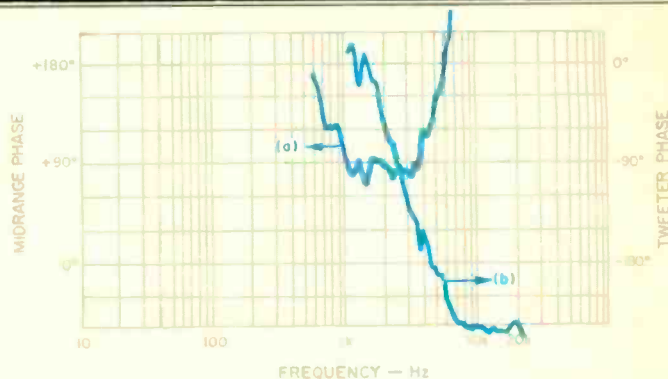


Fig. 4 — Anechoic phase response at one meter corrected for (a) the midrange's air-path delay of 3.5103 ms and (b) the tweeter's air-path delay of 3.3057 ms.

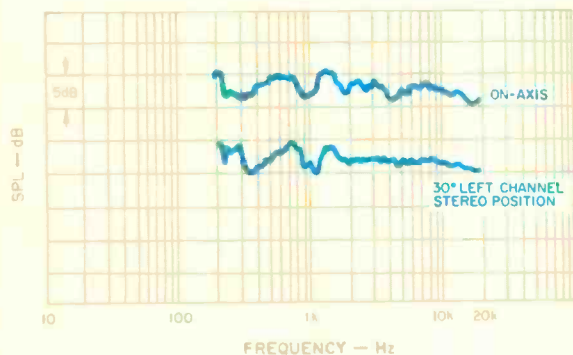


Fig. 5 — Three-meter room response.

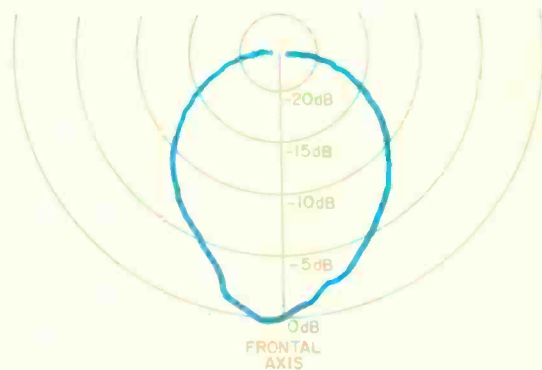


Fig. 6 — Horizontal polar energy response.

current at zero frequency, so a d.c. offset in a power amplifier cannot pull the woofer cone away from the center of the driver's magnetic gap. This is a desirable feature because subsonic amplifier signals, excited by asymmetric music conditions, cannot cause woofer "breathing" that might create a peculiar form of crossmodulation distortion at robust sound levels.

The amplitude and phase parts of the frequency response are shown in Figs. 3 and 4 respectively. KEF is very specific in defining the listening geometry for the optimum direct sound response, using the built-in indicator light to define the optimum listening axis. These anechoic measurements, which correspond to the direct sound, were accordingly made with the measuring microphone bore-sighted with this indicator light. The amplitude response is, indeed, the most uniform in this position. The arrival times do not precisely coincide for sound from the tweeter and midrange units, which are contained within the head assembly that mounts on the top of the woofer enclosure. The phase response, Fig. 4, shows that the time delay for the tweeter is 3.3057 milliseconds, and that of the midrange is 3.5103 milliseconds when the microphone is positioned one meter from the front of the KEF enclosure. The phase response

transition, which indicates the apparent crossover frequency, occurs at around 5 kHz. The phase measurements are presented as two plots, one corrected for tweeter air-path delay and the other corrected for midrange air-path delay.

The three-meter room response is plotted in Fig. 5. The microphone is positioned in a conventional listening location three meters from the speaker and one meter above a carpeted floor. The KEF 105.2 was positioned 50 centimeters from a back wall, according to KEF recommendations, and the frequency spectrum of the first 13 milliseconds of sound to arrive at the measuring position is shown. Later sound arrivals, due to room reflections, are screened out of this measurement.

The direct sound is quite uniform over the full frequency range. Response variations below about 1500 Hz are principally due to reflections from the carpeted floor and amount to only ± 2 dB. This measurement indicates that spectral balance of dynamic program material should be quite good. The uniformity of front position as well as stereo position (30 degrees off front axis with the high-frequency head pointed toward the measuring microphone) indicates a good stereo lateralization capability for the KEF 105.2.

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The KEF 105.2 scored extremely well on all types of material, including piano, a difficult test.

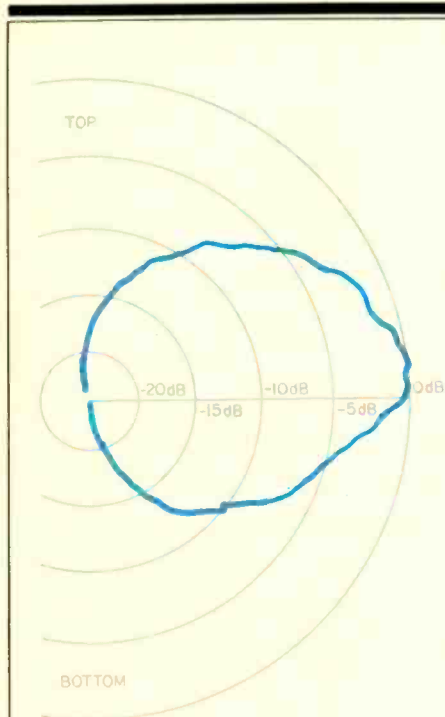


Fig. 7 — Vertical polar energy response.

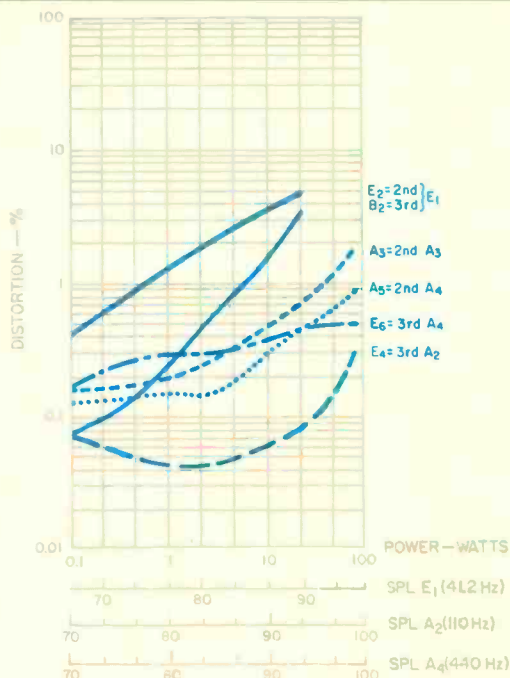


Fig. 8 — Harmonic distortion for the musical tones of E₁, or 41.2 Hz, A₂ or 110 Hz, and A₄ or 440 Hz.

The horizontal and vertical polar response plots are shown in Figs. 6 and 7 respectively. What's shown is the total acoustic energy for direct sound over the frequency range from 20 Hz to 20 kHz as a function of azimuth (Fig. 6) and elevation (Fig. 7) relative to the front of the speaker.

Horizontal dispersion is sufficiently narrow at the -3 dB level (± 16 degrees) that the high-frequency head must definitely be pointed toward the listening position for most accurate stereo imaging. The corresponding -3 dB vertical angles are 33 degrees elevation and 14 degrees depression from geometric center. This indicates that the KEF 105.2 should be positioned away from overhanging shelves and similar objects that could reflect sound toward the listening position.

Harmonic distortion for the music tones E₁ (41.2 Hz), A₂ (110 Hz) and A₄ (440 Hz) is shown in Fig. 8. KEF protection circuitry cut off the E₁ test tone bursts at levels above 25 average watts, but did allow bursts of A₂ and A₄ up to 100 average watts (assuming constant voltage across 8 ohms). Harmonic distortion for the higher tones is quite low up to the maximum sound levels one could reasonably ask for home music reproduction; however, the low bass E distortion is a little higher than I would like to see in a loudspeaker system of this high a quality. The second harmonic level of E₁ is 2 percent at 10 average watts and drops to 0.5 percent at 10 milliwatts.

Intermodulation of 440 Hz by 41.2 Hz, when both are mixed in equal portion, is shown in Fig. 9. Up to 10 average watts, the IM is principally composed of amplitude modulation of 440 Hz

by 41.2 Hz. At 10 average watts there is three percent peak-to-peak amplitude modulation and 6 degrees peak-to-peak phase modulation of 440 Hz. This rises uniformly to 10 percent amplitude modulation and 12 degrees phase modulation at 100 average watts. This is quite a low level of IM distortion by loudspeaker standards.

For a linear speaker system, a one-decibel increase in drive voltage should produce a corresponding one-decibel increase in sound pressure level. If the change of sound pressure does not follow this pattern, then certain distortions may be created in stereo listening. For example, if this ratio of transfer drops with increasing drive power, then the resultant sound will be somewhat compressed in dynamics; loud passages will not be as loud as they should be, relative to soft passages. In the case of the KEF 105.2, the 440-Hz transfer ratio drops 0.5 dB at 10 average watts, compared with its level at 10 milliwatts. Middle C (262 Hz) transfer remains constant up to 100 average watts, and A₂ (110 Hz) roughly follows the pattern of 440 Hz. This implies a small change in timbre for very loud passages compared with those same passages played at much softer level.

The crescendo test, which checks the masking influence of loud orchestral passages on a single inner tone, shows that the KEF 105.2 slightly softens such an inner voice. A tone of 440 Hz is reduced by approximately 0.7 dB when broad-band noise, at 20 dB higher level, is superimposed on the tone. This softening is essentially independent of level, even up to peak levels of 600 watts. This suggests a slight lateral and depth shift of solo

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I can definitely recommend the 105.2 for serious music reproduction. The price is high, but so is its quality.

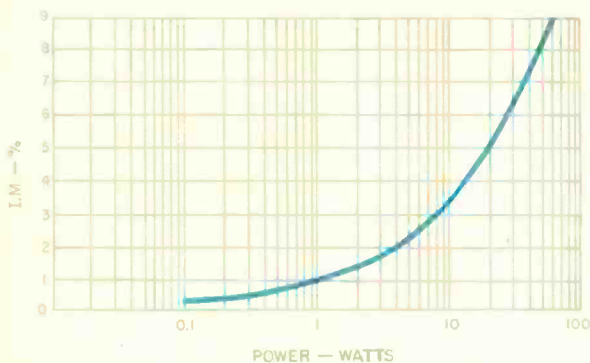


Fig. 9 — IM distortion on 440 Hz produced by 41.2 Hz when mixed in one-to-one proportion.

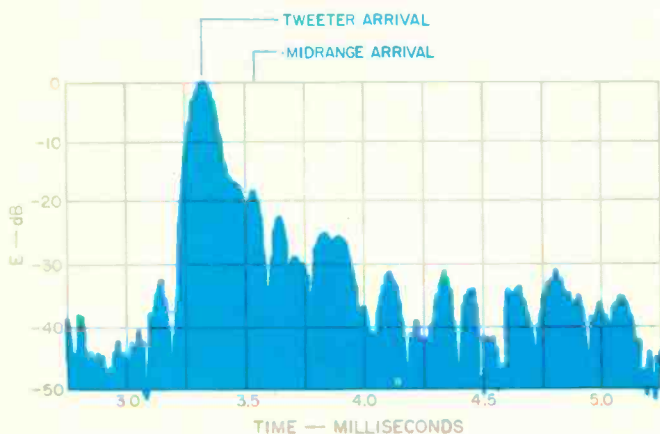


Fig. 10 — Energy-time curve.

instruments in the stereo illusion when broad-band peaks, such as due to brass, occur predominantly in one channel.

The energy-time response is shown in Fig. 10. This is the envelope of the impulse response, measured one meter in front of the enclosure. The first sound peak occurs at 3.3 milliseconds and is due to the tweeter. The first midrange sound blends quickly with the rapidly decaying tweeter sound to produce an elongated, but well-behaved, drop off of sound after 3.5 milliseconds. Small response irregularities beyond 3.5 milliseconds are due to residual reverberation and scatter from the tweeter/midrange housing. All in all, this is a good transient response and suggests excellent acoustic imaging.

Use and Listening Tests

Listening was performed before measurement, with the speakers positioned according to KEF recommendations. The backs of the enclosures were placed greater than 50 cm away

from the back wall, with more than 2 meters distance from either speaker to its adjacent side wall. The speakers were separated by 3 meters, and listening was performed at a distance of 3 meters. No difficulty was encountered in determining the optimum listening window, and the LED indicator functioned well, not only as locator but as peak power indicator.

I tried to determine whether any audible distortion was produced if the LED indicators were left in the "listening window" function while listening to music. After all, the energy to activate the unit must come from the music signal and represents some small dynamic load for the power amplifier. I could not discern any audible distortion when the indicator was misused in this way, but to be safe, the proper music listening function should be selected, as KEF recommends.

My overall impression of tonal quality was of general smoothness throughout the frequency range. I sensed a slight mid-bass dominance and an extreme top end brightness which gave the impression of a slightly suppressed midrange. Piano music is reproduced accurately, one of the most difficult tests, and the KEF does not have the timbral problems in the octave of middle C which seem to plague many three-way speaker systems.

The KEF is substantially free of narrow-band resonances through the audible range. A very old and reliable way of checking system smoothness is to play older recorded material which is known to have ticks, scratches, and swishes. These aberrations are substantially suppressed on a smooth system, because the smooth system accurately reproduces the transients and does not add tonal coloration of its own. I must admit to many hours of pleasurable listening to old but musically good recordings which were made enjoyable by the KEF.

The KEF 105.2 scored extremely well on all types of program material. If I were forced to find fault, it would be with the extreme low bass response. On several of the extra wide range recordings I sensed that the extreme high frequencies were always there, but that the extreme low frequencies were deficient. To check the bass, I hooked up a good quality subwoofer and after careful balance was able to restore the spectral balance which, to my ears, was missing. However, on the majority of recorded material, I could sense little or no difference with and without the subwoofer. But a few recent releases, such as Sheffield's "Drum Record," came alive with the added octave of bass.

The KEF 105.2 can take enormous peaks of amplifier power without audible distress, though it's not suitable for continuous high-level electronic music reproduction unless several systems are used to limit peak power per reproducer. However, as with many clean systems, the 105.2 does not sound loud when reproducing 200-plus peak watts of clean transient material. If one's too free with the amp's gain control, the peak sensing mode provides adequate protection against speaker damage, even if one's ear senses no problems. If the level is too high for safety, the sound simply goes off for a brief moment and the red eye of the LED glaringly asserts that control has been taken away from you. This can be a bit disconcerting, especially in the middle of a forte passage, but once warned, it is easy to back off the volume to a safe level.

I can definitely recommend the KEF 105.2 for serious music and sound reproduction. The price is high, but the quality is equally high.

Richard C. Heysler

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Mobile Fidelity UHQR
Finger Paintings: Earl Klugh
MFSL 1-025, stereo, \$50.00.

Just as analog magnetic recording is seeing its finest hours as digital bids to take over, the standard stereo disc, thanks largely to audiophile-oriented record companies, has never been better than it is at present. Even as the compact digital disc prepares its assault, we are witnessing dramatic improvements in the quality of stereo discs. The Japanese Victor Company has been in the forefront of digital development, but as a major producer of records in Japan, they have seen fit not just to maintain their high quality standards, but rather to improve them. Their new UHQR (Ultra-High Quality Record) disc shows just how high the quality level of the stereo LP can be.

Some months ago, Mobile Fidelity announced that they would make certain releases available in UHQR pressings. At a list price of \$50.00, they were probably wise to test the market with only a few thousand pressings. Before getting on with a review of one of these discs, I will describe some of the processes which set these discs apart from others.

The replication of a disc begins with plating the master lacquer disc, with subsequent replating of metal parts yielding successive generations, including the actual stampers used in the record presses. JVC has slowed down the plating processes to avoid stresses

in the build-up of metal. With faster plating, these stresses can lead to groove echo, the familiar and nagging "pre-view" of a loud attack one or two revolutions ahead of time.

A subsequent operation on the metal parts is the grinding of the backs of the stampers to make them fit snugly to the dies of the record press. Too rapid grinding of the stampers results in deformations in the playing surface which show up as low-frequency rumble and even a minute loss of channel separation. If you hold these new discs up to a light, you will see not a trace of the familiar "orange peel" mottling of the surface. In fact, the UHQR disc bears an uncanny resemblance to a master lacquer in this regard.

The pressing cycle itself normally takes about 30 or 40 seconds. In the process of compression molding, a shot of hot vinyl is forced between the faces of the press to expand outward, filling in all of the minute spaces between the ridges in the stampers, which of course are record grooves in reverse. The slower the molding cycle is, the more accurate and free of ticks and pops the resulting disc will be. In the UHQR disc, the molding process has been extended to about four minutes. The result is almost total elimination of ticks and pops as well as a record free of stress.

The UHQR disc profile is what records used to have back before the days of "Grooveguard." The disc weighs in at

200 grams, compared with the standard profile JVC product at about 110 grams. Effectively, the playing area is twice as thick as most current production. This difference is shown in Fig. 1.

The heavier disc is absolutely flat. You will not see your woofer cones "breathing" every 1.9 seconds in response to once-around warps that are characteristic of standard discs. Another benefit here is the elimination of mid-range resonances in the disc itself, which can result from the thin, unsupported playing area of the standard disc.

All of this time and care has been lavished on one of Mobile Fidelity's previous releases: *Finger Paintings* by Earl



Fig. 1 — Disc shapes.



Fig. 2 — Lead-in noise spectra (A-weighted at low frequencies; 0 dB is 5 cm/S at 1 kHz).

Klugh. Dave Grusin's light, airy arrangements make use of a variety of percussion highlights against bass and guitars in quasi-Latin style. String sweetening is tasteful, and overall balances are natural. As good as Mobile Fidelity's standard release of this album is, the UHQR version is *even better*. With the UHQR, you feel most of the time that you are listening to the master tape. Every 30 or 40 seconds you may hear a tiny click, but for the most part — and especially between bands — the usual array of disc noises is completely absent. By comparison, the standard Mobile Fidelity release does let you know, especially between bands, that it is a disc.

Another area of improvement should



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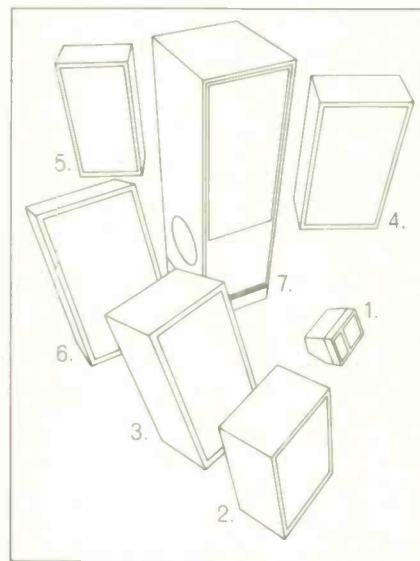
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be cited: The level on the UHQ disc is about 1 dB greater than the standard, yet the ending diameters on the UHQ disc are significantly larger. What this means is that the variable pitch and depth system on Mobile Fidelity's lacquer transfer system has been upgraded or refined to make more efficient use of space. A call to Stan Ricker at Mobile Fidelity verified that their new Zuma pitch and depth system was doing what was expected of it.

While on the subject of level, let it be said that Mobile Fidelity product is always cut at moderate levels. Since the noise floor on their product is so low, they can well afford to turn things down and enjoy distortion-free transfers. The UHQ Klugh album has occasional peaks which are 3 dB below normal reference level (7 cm/S lateral velocity at 1 kHz), providing more detail and clarity from beginning to end of a side.

To show the reader just how good both UHQ and normal JVC production are in terms of noise, I measured the noise spectra of the lead-in grooves of the two discs (Fig. 2). Because of the relatively high tangential velocity of the outer grooves, the lead-in portion of a disc is usually quite noisy. Note that both standard and UHQ discs are excellent.

At \$50.00 a copy, the UHQ disc is not likely to become a standard. Its greatest utility may be to manufacturers, who are often hard-pressed to come up with decent program material. Obviously, its virtues would be more apparent on classical music than with Earl Klugh. The severest test of all would, of course, be on piano music. Anybody for a UHQ version of Liszt's b-minor Sonata — on one side?

John M. Eargle

Ghost in the Machine: The Police Nautilus NR40, stereo, \$17.00.

Sound: A Pressing: A Performance: A

What makes The Police special is how they constantly break all the rules of pop music and make it work for them. Their songs have inventive shapes and content with often provocative subject matter. Hand in hand with their aggressive songmaking, they are a high-tech recording group who don't like to spend a lot of time to make an album. Low overhead and quality product have both been market advantages in their success.

Ghost in the Machine, their fourth album, is the very first pop release simultaneously made available in a half-speed mastered version as well as the "standard" version on A&M (SP-3730). The A&M album is an uncommonly fine sounding album: Clear sound, fine detailing of effects, good flat pressing. The half-speed mastered version adds whole dimensions.

The added presence and clarity in the high end that we have come to expect is a real plus. Stewart Copeland's percussion is a principal benefactor. The stick-on-cymbal sound is much sharper. The album picks up an added depth of field and pinpoint placement with apparently wider separation.

There have been artists ill-served by the added clarity of super fidelity albums (Carole King and James Taylor spring to mind). However, The Police's *Ghost in the Machine* is one of those rarer albums that you really haven't heard right until you've heard the high priced spread.

Michael Tearson

Beethoven: Piano Concerto No. 5 in E Flat ("Emperor"). Rudolf Serkin, Boston Symphony, Ozawa. Telarc DG 10065, digital, stereo, \$17.98.

Let us now take digital for granted as one technique for producing tapes that result in first-line state-of-the-art commercial LP discs (or, for that matter, cassettes). Thus, Telarc's monumental "Emperor" concerto, with the orchestra which was once RCA's and the first-line elder-statesman pianist who was once Columbia's for much of his output, is purely and simply the best current version of this difficult and endlessly long work and one of the finest ever performed in any period. The digital aspect simply needs no comment. It's there, and at its best. The musical value of this recording is far more important.

The "Emperor," last and longest of Beethoven's five for piano and one of those enormous works in the key of E flat which include the unprecedentedly long "Eroica" symphony too (and numerous unusually long works by Mozart as well), is structurally a tough problem for any piano-orchestra team. To keep this monumental music going, especially through the central portions of the side-long first movement, is nearly impossible. For too many pianists, the thing degenerates into a lot of scales and chord passages; the tension breaks, the shape collapses of its own sheer weight. I had come to think, after many years, that this was perhaps the weakest of Beethoven's concerti and virtually unplayable in a dramatic sense.

But old Papa Serkin (father of Peter Serkin) tells it another way. Miraculously, and without extra fuss, the huge first movement keeps going and does not bog down. Extraordinary! I really have never heard it this way before. I hate to say so, but it would be 99 percent the same for me in an analog recording. So much for our present state of the art.

The Telarc microphoning is ideal, with a clearly articulated piano that is, thank God, neither too close nor too loud but blends and contrasts with the orchestra exactly as the music demands. (This definitely has to do with the excellent musical continuity, the less important piano parts taking their proper subordinate place in the overall sound.) The sonics of Symphony Hall are so well recorded as

to be recognizable to anyone who has actually been in that hall in person. That's good too. And again, none of this has anything to do with digital technique! So be it. Let us hail good music well recorded, whatever the producing technique may be. E.T.C.

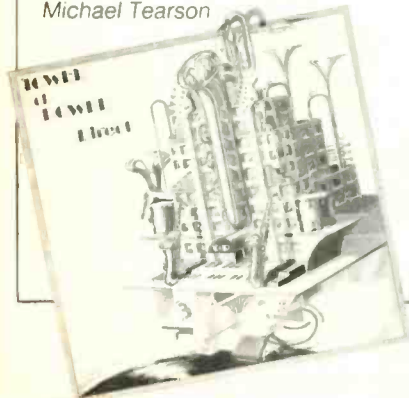
Direct: Tower of Power
Sheffield Lab 17, direct disc, \$16.95.
Performance: B+ **Sound:** A **Surfaces:** A

The big funk sound of Tower of Power is a mighty challenge for a direct-disc session, especially at one that hits up to 125 dB in concert. The wizards at Sheffield have certainly been up to the task. The TP sound is complex and very dense with the big, big horns six strong up front. They are the star element of the band and can easily overshadow the guitar and organ-dominated keyboards. Sometimes, in fact, just this happens. The bass has a lively, popping punch, while the drums and percussion are defined and very warm. For raw sound, producer/engineer Larry Brown has admirably handled a tricky, potentially no-win situation.

Tower of Power's strength is their great playing. Their material is standard blues/funk fare, with their best shots the instrumental "Squib Cakes" and a live version of their hit "What Is Hip." These are the special ones. The essence of direct-disc sessions is to capture performances absolutely live for the best possible sound, hoping to get a magical performance. That's the ideal.

Well, the sound on *Direct* is exceptional, quibble noted. The horns ensemble as well as Greg Adams' and Lenny Pickett's solos are brilliant. The live energy works for Tower of Power, making the pieces sound better than you'd expect. Cutting hot puts the best they've got onto the album and that's why *Direct* is one of their finest moments.

Michael Tearson



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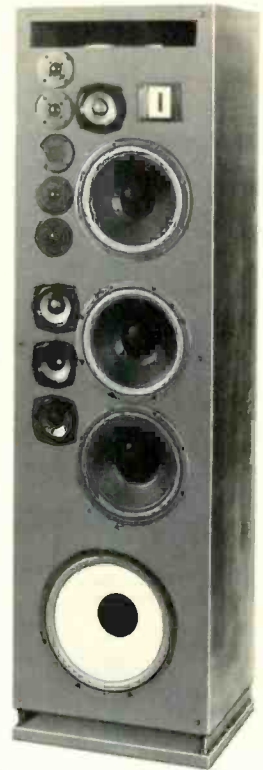
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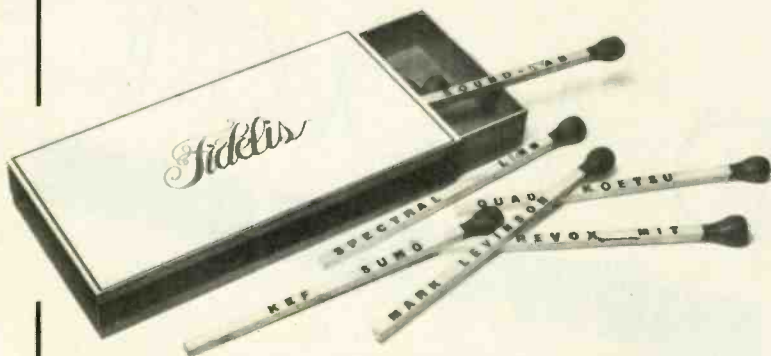
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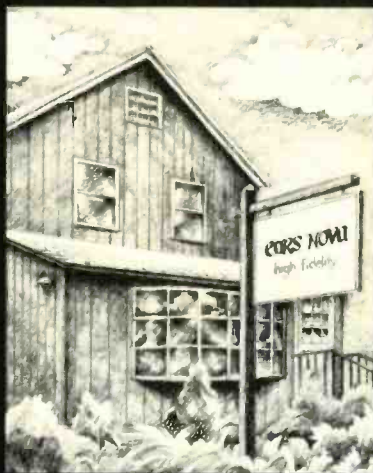
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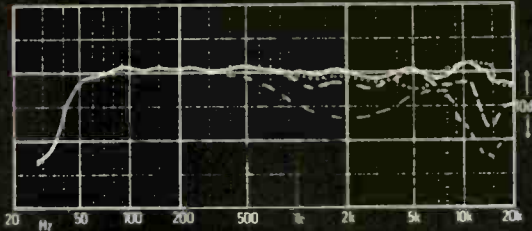
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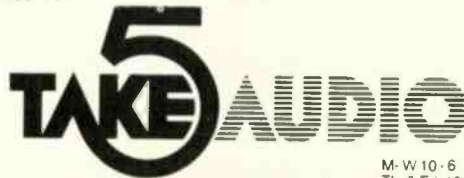
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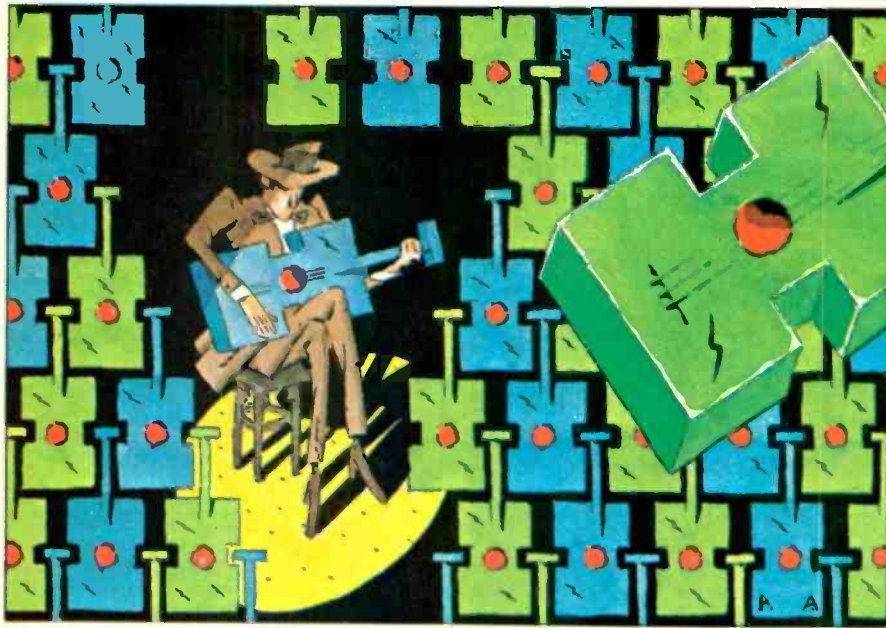


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The 70th Convention of the Audio Engineering Society was held at the Waldorf Astoria in New York from October 30th through November 2nd and may well be remembered as having historic significance. Quite coincidentally, that Grande Dame of hotels, the Waldorf, was celebrating its Golden Jubilee 50th anniversary, as a huge, elaborately decorated, multi-tiered cake proclaimed from its display in the lobby.

This 70th AES Convention marked the last in the three conventions-per-year format which the AES has been following for some years now. The next AES Convention is set for Montreux, Switzerland in March 1982. Then instead of the usual May convention at the Hilton in Los Angeles, there will be a convention in October 1982 at the Disneyland convention facilities in Anaheim, California. After that it will be another foreign venue, with the next New York convention in the fall of 1983, and not necessarily at the Waldorf.

The truly historic highlight of this AES Convention is that at long last we are about to establish standards for digital recording. At a very heavily attended meeting of the Digital Standards Committee (with AES legal counsel standing by to advise on any "sticky" points), a draft proposal was formulated which recommends 16-bit linear encoding at a sampling rate of 48 kHz per second for "fixed head" digital recorders, and a

sampling rate of 44.1 kHz per second for helical-scan, slant-azimuth digital recorders. Essentially, this is the standard that eventually will be established in conjunction with such groups as ANSI. There are certain oddball cases. For example, the British Decca digital recorder uses a 1-inch helical-scan format but has always employed a 48-kHz sampling rate. In conforming to the new standards, existing digital recorders will have to be retrofitted with circuits and switches to permit selectable sampling frequencies. This must be done, because if a recorder which had an original sampling rate of 44.056 kHz (a common figure in most Japanese helical slant recorders) is used to play back a tape with a 44.1-kHz sampling rate, there will be a very slight pitch change, possibly detectable by someone with perfect pitch. Conversely, there would have to be adjustments made for the playback of 44.056-kHz tapes on a 44.1-kHz digital recorder.

A 48-kHz sampling rate will permit a frequency bandwidth extending beyond 20 kHz. Those who would prefer an even higher top end will not be happy about all this — but the next applicable multiple for sampling rate is 60 kHz which is deemed too technically difficult and too expensive in implementation. There are other points to clear up, of course, but once the Committee's work is completed we will indeed have a digi-

tal standard! It was generally felt at the Convention that the establishment of a digital standard will stimulate a number of companies and give them the impetus to become involved in digital technology.

Needless to say, there was plenty of digital activity at the AES Convention. JVC demonstrated their PCM digital audio cassette recorder, which I described in last month's column. The system certainly is compact, comparable to the typical analog cassette deck, and the sound quality I heard from the metal-tape cassette was excellent, with no discernible wow or flutter, or distortion. Dynamic range was most impressively wide, and the music was unscathed by any tape hiss. The odd sampling rate of 33.6 kHz is said to permit a frequency response beyond 16 kHz, which some critics point out is less than is available from many analog cassette decks. However, JVC notes that this sampling rate is necessary in order to obtain one hour of recording time. They also point out that the frequency response curves of most analog cassette recorders are not nearly as flat as on the PCM unit and that the signal from an analog unit lacks the other desirable attributes available with the PCM recorder. JVC also showed their DAS Series 90 professional digital recorder, complete with digital editor and digital delay unit for disc cutting. I have been using this system with absolutely superb results. For the Smithsonian Institution, I recorded Victor Herbert's complete operetta, "Naughty Marietta."

3M showed their 32-channel and 2/4 channel digital recorders, which no doubt will soon be retrofitted for the new 48-kHz sampling rate. They demonstrated how a tenth generation digital dub is indistinguishable in sound from the original master, especially in terms of signal-to-noise ratio. This point is somewhat controversial, with some experts claiming subsequent dubs are structured differently from the original. Perhaps so, but most people certainly *can't hear* any difference between copies.

Sony offered new digital equipment in several areas. Under development for some time, the PCM 3324 24-channel digital recorder will be available for delivery by the time you read this report. It is a fixed-head recorder, using half-inch tape at a speed of 15 ips and providing 60 minutes of recording on a 14-inch reel. Quantization is 16-bit linear encod-

The truly historic highlight of the AES Convention is that we are about to establish standards for digital recording.

ing, and sampling rate is selectable for various frequencies up to 55 kHz. The 3324 features separate SMPTE time-code generation, which allows synchronous recording of up to 72 tracks, and the SMPTE track permits compatibility with video recorders. The PCM 3324 also provides two additional analog

tracks which allow conventional razor-blade cut-and-splice editing. Sony emphasized that their special analog-to-digital and digital-to-analog converters use Sony-developed integrated circuits rather than complex discrete circuitry which requires very precise adjustments. Sony claims their new ICs assure 16-bit

accuracy without the need for adjustments and that their new Cross Interleave Code error correction system, used on the PCM 3324, is so effective that it prevents loss of the music source even if up to 88% of signal is interrupted within a constrained length of tape! The usual digital specs for dynamic range (90 dB), unmeasurable wow and flutter, etc. apply to the PCM 3324.

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results speak for themselves.

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Sony PCM 3324 digital recorder.

Sony also showed their PCM 1610, an updated version of their original PCM 1600 helical slant recorder. This unit also uses 16-bit linear quantization, and one assumes it too will be retrofitted with the 48-kHz sampling rate. The 1610 now has an SMPTE time-code generator which permits immediate editing on the new Sony DAE-1100 digital editor or with a video editing console. The PCM 1610 uses Sony's error correction scheme, the Cyclic Redundancy Check Code, which is said to guard against any dropout and eliminates pulse-noise or crossword error. Tapes made on the older PCM 1600 are totally compatible with this new PCM 1610, whose price has been set at \$28,000.

More on new digital equipment and other AES equipment next month. 

Bob Carver tells you (briefly) how Sonic Holography works. (Others tell you how it sounds.)



Q. Exactly what is Sonic Holography?

A. It's a term I use to point up the similarity of the sonic illusion that enables one to hear a stereo recording in three dimensions, and the *optical* holographic illusion that allows one to see a flat photograph in three dimensions.

Q. What does Sonic Holography sound like?

A. I'll let others answer that for me. Hal Rodgers, Senior Editor of Popular Electronics: "When the lights were turned out we could almost have sworn that we were in the presence of a real live orchestra."

Julian Hirsch of Hirsch-Houck Labs: "The effect strains credibility—had I not experienced it, I probably would not believe it...the 'miracle' is that it uses only the two normal front speakers."

Larry Klein, Technical Director of Stereo Review: "...it brings the listener substantially closer to that elusive sonic illusion of being in the presence of a live performance."

And High Fidelity put it this way: "...seems to open a curtain and reveal a deployment of musical forces extending behind, between and beyond the speakers... terrific."

Q. How many speakers are needed for Sonic Holography?

A. Just your usual two. But for optimum Sonic Holography, the speakers *must* be equidistant from the listening position, and somewhat closer together than is usually required for stereo.

Q. What do I hear when I'm not in the middle?

A. We'll let Julian Hirsch describe what he heard: "still noticeably better than normal stereo, particularly in respect to a greater sense of 'warmth' such as is experienced in a concert hall."

Q. How does Sonic Holography differ from stereo reproduction?

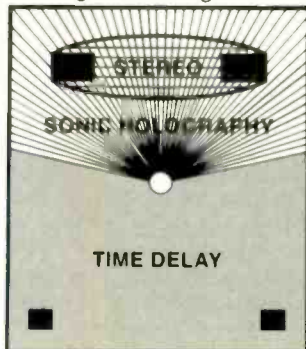
A. Very significantly. Simply put, in a live performance, each instrument is a source of sound that reaches your ears as two sound arrivals—one for each ear.

The difference in strength and arrival times at each ear provides the primary cues that your brain uses to localize and create all the sonic images.

In stereo reproduction, *four* sound arrivals produced by each instrument reach your ears—two arrivals from each speaker for each ear.

That's precisely two too many for accuracy. And that's why directionality in stereo is limited by the positions of the speakers.

Sonic Holography eliminates those unwanted extra arrivals by carefully calculated and controlled electronic techniques, including complex cross-fed interference signals. These signals combine in space with the primary signals, creating sonic images outside



and beyond the boundaries of the two speakers.

There is a clear sense of the acoustic space, and the spatial information (phase and timing) of the original performance is deployed naturally over a broad, deep arc in front of you.

That's why Larry Klein described Sonic Holography in Stereo Review as producing "a far more plausible

sonic illusion of space and localization than is produced by normal stereo."

Q. Isn't Sonic Holography something like time delay?

A. Not at all. The goal of time delay is to recreate only the spatial *ambience* of the original recording environment. And to do that it requires additional amplifiers and rear speakers.

Q. How can I add Sonic Holography to my system?

A. Three different ways.



The C-4000 Control Console includes the Sonic Hologram Generator plus: a full-function stereo preamplifier, a time-delay system with built-in 40 watt (total) power amplifier for time delay speakers, the Autocorrelator system that reduces noise up to 8 dB with any source material, and a peak limiter/downward expander that nearly doubles dynamic range.



The C-1 combines the Sonic Hologram Generator with a full-function preamplifier.



The C-9 Sonic Hologram Generator allows you to add Sonic Holography to any system, including one with a receiver.

Q. How can I get more information?

A. Easily. Just write to us.

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VIDEO SCENES

BERT WHYTE

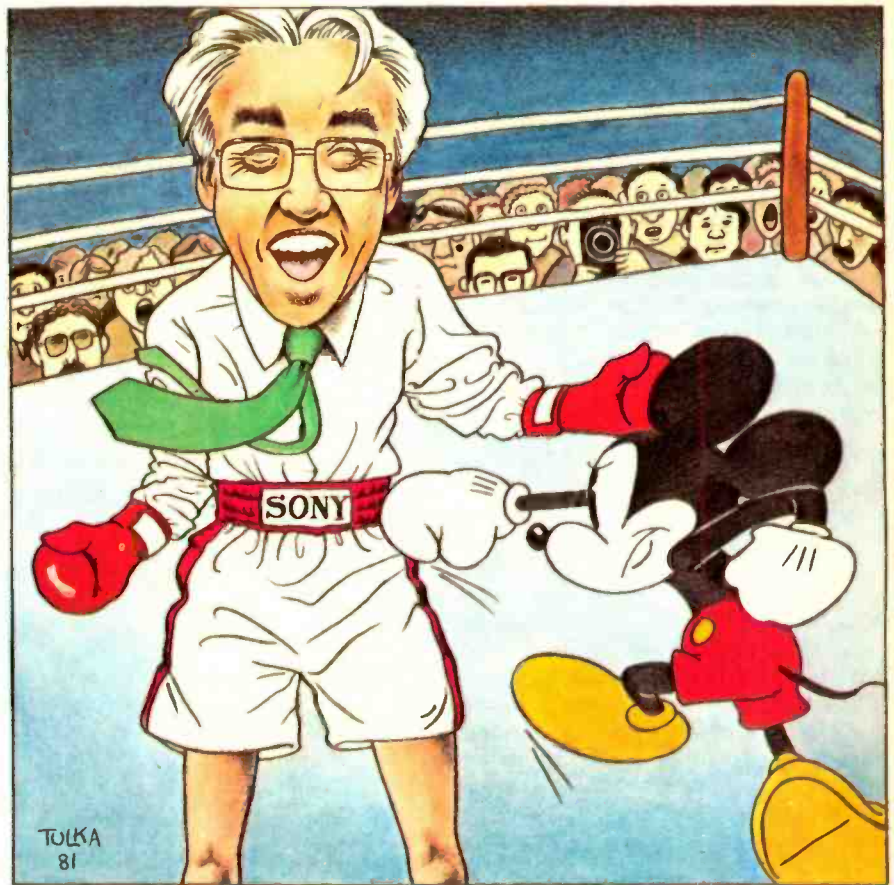
In the June 1979 issue of *Audio*, I reported why Walt Disney Productions and MCA, Inc. (parent company of Universal Pictures) were suing Sony Corp. of America, Sony Japan, Sony's American advertising agency, and four Betamax retailers. The allegation against Sony was that the manufacture and sale of Betamax videocassette recorders is a threat to Disney/MCA business because home videotaping of their films broadcast on television constitutes a breach of their copyright protection. Not only did Disney/MCA ask for damages, but more importantly, they wanted an injunction restraining Sony from any further importation and sale of Betamax VCRs!

Sony's basic defense was that the home use of the Betamax for off-TV recording comes under the "fair use" stipulation of the federal copyright law. Sony's viewpoint was that home videotaping is no different from off-the-air home audiotaping. Recording is recording, whether it be from the airwaves or from phonograph records, tapes or whatever. It must be understood that audiotaping has long been a legal hot potato; there has never been a "cast in concrete" edict in respect to audiotaping. From a strictly legal viewpoint, the issue of audiotaping is still not fully resolved — but that is why the fair use clause is in the copyright act. Implicit in it is the "opinion" and "understanding" that as long as the audio material recorded is for the private use of the individual, and is not subsequently offered for sale, the copyright law has not been violated.

There is absolutely no reason legally, technically or morally to categorize home video recording of TV programs as a special circumstance different from the home audio recording practices of private individuals. Every day, many thousands of audio recordings are made of copyright material from radio broadcasts and commercial recordings within the ground rules of the fair use stipulation of the copyright act.

Be that as it may, there is a great deal more to this case. Sony quite rightly pointed out that Disney/MCA had known about the development of Betamax since the early 1960s, yet had made no objections until recently.

The outcome of the first trial was predictable — no decision, and the case was referred to the Ninth Circuit Court of



Appeals in San Francisco. In October of 1981, the VCR industry was stunned when the appellate court ruled that off-TV videotaping — even for private use — is a violation of the copyright act. From a technical legal viewpoint, this means that all of the 3 million or so consumers owning videocassette recorders would be liable to lawsuits, as would Sony and other VCR manufacturers, all VCR retailers, and even the agencies involved in VCR promotion and advertising. Although the Disney/MCA suit was specifically against Sony and the Betamax, their next move would obviously be against the VHS forces. It is also obvious that enforcement of a ban against off-TV recording on the owners of 3 million VCRs is impossible. Coincidentally, because of this ruling by the appellate court making off-TV videotaping a copyright infringement, the practice of off-the-air audiotaping must now be regarded as a similar infringement. While direct action against the VCR owners is unlikely,

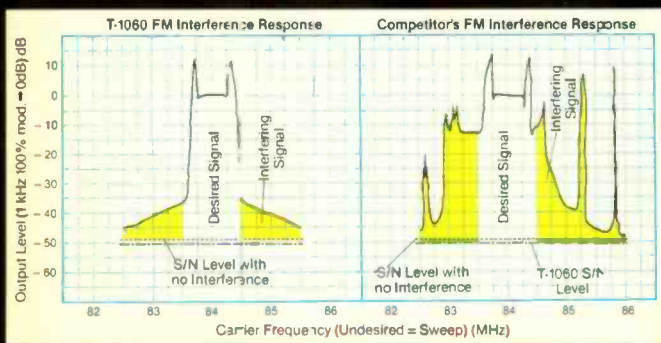
if the VCR manufacturers are enjoined from importing any more recorders into this country, the VCR business would soon perish. VCRs in the hands of the public would sooner or later need repairs, and without the necessary parts, off-TV recording would grind to a halt by sheer attrition.

There are some ironies in this case. Disney and MCA are making money selling prerecorded videocassettes of their productions. Obviously, this business is dependent on the existence of a large number of VCR units. Are they so naive that they think the present 3 million VCRs would have been purchased if their only function was the playback of prerecorded videocassettes? Pure nonsense! Certainly, prerecorded videocassettes are enjoying good sales — in fact far better than most industry observers had predicted. But make no mistake — most VCRs are purchased for their recording capabilities and the "time-shift" benefits this permits. Another irony is

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that the present laser/optical and RCA CED videodiscs as playback-only mediums can only use copyrighted material on which royalties are paid. It is their very lack of recording capabilities which has turned many people away from purchasing a videodisc system.

Strange things appear to go on in appellate courts. The law cannot be held in much "majesty" when apparent ignorance of a subject results in poor decisions which can ultimately have a profoundly disturbing effect on society. For example, many years ago an appeals court ruled against the Crosby FM stereo multiplex system, thus saddling us with a stereo FM system that has a 16-dB poorer signal-to-noise ratio. Ponder, too, what legal maneuvering was involved so that Sony was unable to use the fact that Disney/MCA had longstanding prior knowledge of the Betamax system, and had in no manner ever complained to Sony until Betamax was a *fait accompli*.

I must make it clear that I am not against copyright protection per se, and most especially where it concerns the products of our most creative minds. Composers and artists need that kind of protection, and as this protection is presently constituted, it works fine. In the course of my professional recording activities, most artists I have queried on the fair use clause of the copyright act have little or no objection to it, especially as it applies to home recording.

The court has made its decision, and an entire industry trembles on the brink of extinction. Needless to say, Sony spokesmen tell me they will carry this battle all the way to the Supreme Court. By no means should it be assumed that their decision will rule in favor of Sony. The copyright laws are full of confusion and ambiguities. There are reasonable people and there are greedy people who would subvert the basic protection of copyright laws to extract the maximum of money from this presently chaotic situation. Many issues in the copyright laws — especially in respect to any kind of home recording for the private use of individuals — have never been clarified "chapter and verse" so that a clear and legal statement on the subject is available. The widespread and ever growing practice of audio- and videotaping in the home has now reached such dimensions that a vague "understanding" of a fair use clause in the copyright act will no longer suffice. There must be a precise, specific, unambiguous law permitting home recording for personal use. If you own a reel-to-reel, audio cassette, or videocassette recorder it is in your own best interest to write your Congressman and let him know you want the copyright laws changed to permit home recording.

One last word. Although there are

some very hard-nosed types who are against any form of use fee or a one-time levy of a modest payment at the point of purchase, these ideas should be considered in order to satisfy the copyright holders. Trouble is, in this present Sony-Disney/MCA situation, the idea of settling the dispute in such a manner has thus far not been allowed to be placed in consideration. It's a real mess, friends. **A**

Flash . . . Flash . . . Flash

The Electronic Industries Assn. has petitioned the Court of Appeals in San Francisco that its three-judge panel ignored or misinterpreted both fact and law in its analysis and conclusions that home taping of copyrighted television material is not fair use. The panel ignored the benefits to copyright holders of VCR use, according to the EIA's petition. Three Congressmen, Rep. Stan Parris, Sen. Dennis DeConcini and Sen. Al D'Amato, have introduced legislation in the House and Senate to amend the copyright law to stipulate that it is not an infringement for a consumer to record copyrighted materials on a VCR if 1) the recording is made for private use, and 2) the recording is not used in a commercial nature.

Flash . . . Flash . . . Flash

West Germany's television manufacturers were all ready with a wide variety of models equipped for stereo sound at the Berlin *Funkausstellung* Show. The system, used by some 29 stations, has two separate carrier frequencies for the audio program, and features automatic switching between mono, stereo, and two-channel or bilingual reception at the receiving end. The system cannot be adopted to the NTSC broadcasts used in the U.S., though the stereo system used in Japan, which uses a multiplex technique, could be adopted.

Flash . . . Flash . . . Flash

The present 10-kHz channel spacing between AM radio stations of the Western Hemisphere has been retained by a vote of the Region 2 countries at the mid-November meeting of the International Frequency Registration Board. The position taken by the United States reverses the FCC's backing of one year ago to permit more stations on the AM dial by narrowing the inter-station spacing to 9 kHz, as is the practice in the Eastern Hemisphere. Additional studies, lobbying by the National Association of Broadcasters, and a change in Administrations and in the membership of the FCC all led to the turnaround in this country's stance. The decision will save broadcasters millions of dollars in conversion costs.

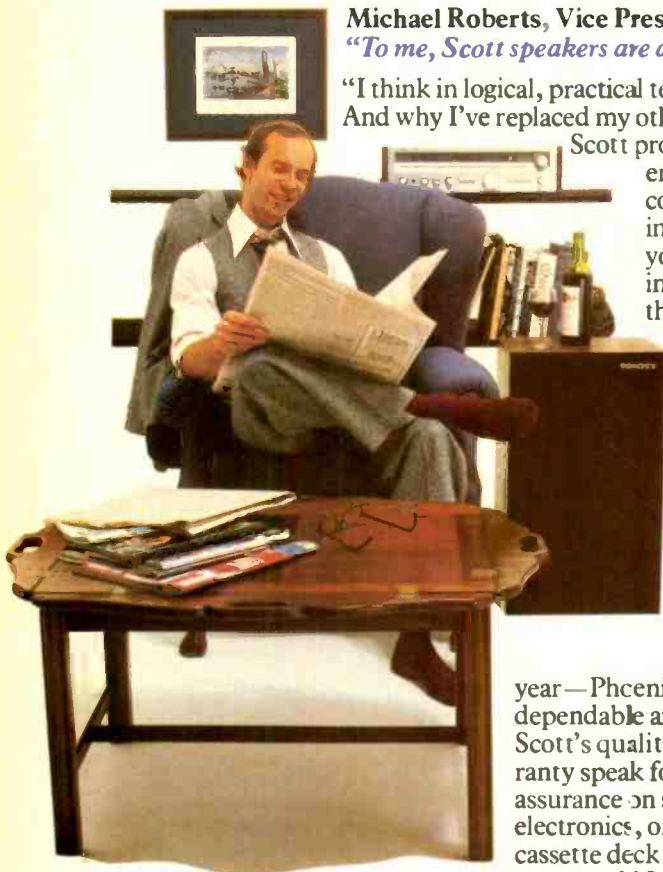
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Dr. Peter Goldmark between two stacks of 78-rpm record albums which were "reduced" to the 33 1/3-rpm LP records shown in the center stack. The two 78 stacks contain no more music than does the single, short LP stack. This photo was passed out as part of a press kit at the June 1948 introduction of the LP disc by Columbia.

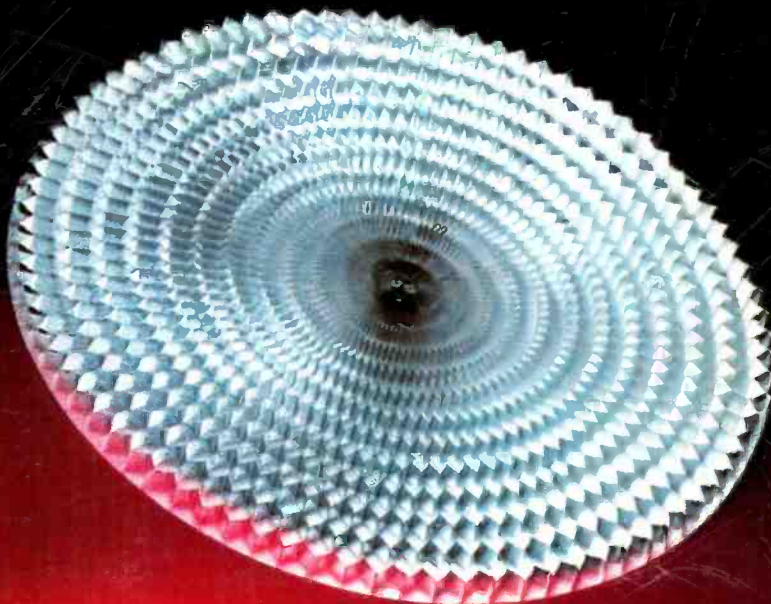
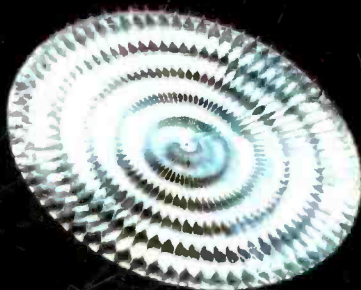


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now perfectly aligned across the flat driver surfaces.

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To complete the system, Technics Honeycomb Disc tweeter with special front-mounted acoustic equalizer extends frequency response to a remarkable 35 kHz.

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