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(Thomas J. Norton in Stereophile, September, 1990, Vol. 13, No. 9)

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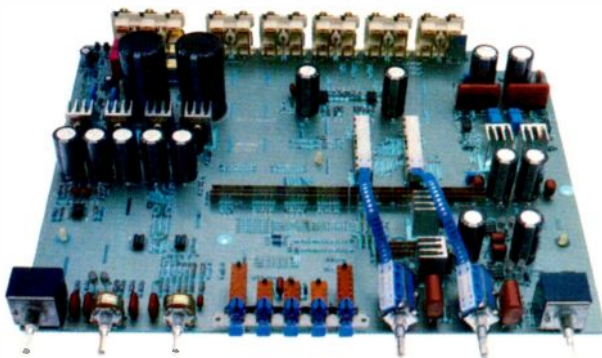
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Audio

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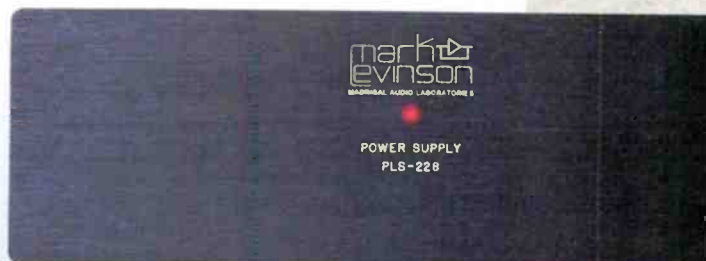


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Mark Levinson products have offered the advantages of balanced interconnection for many years. The N°28 introduces a new execution of balanced circuitry called a DIDO (Differential In/Differential Out) that provides fully balanced operation throughout (not converting to single-ended for internal processing) while still rejecting common-mode noise from source inputs or arising within the unit itself. All versions of the N°28 have 2 balanced (XLR) inputs as well as balanced output connections. Even single-ended signals benefit from the DIDO, since it rejects common-mode ground noise as it converts single-ended signals to differential at the input.

Your local Mark Levinson Dealer can provide complete details on these and many other refinements in the design of the N°28.

More important, you can hear for yourself how this preamplifier tips the balance in your favor.



mark
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Crossover Networks

Q. In loudspeaker specifications, the term "crossover network" is often used, and various frequencies are mentioned in this connection. Would you please explain this?—Eric Wong, New York, N.Y.

A. It would be nice if one loudspeaker could reproduce the full audio frequency spectrum, but this is usually not possible. It is because of this that a complete speaker "system" almost always includes at least two different kinds of loudspeaker drivers—a woofer for producing bass tones and a tweeter for producing treble tones.

The tweeter is very delicate. If bass tones were permitted to enter it, the tweeter would be damaged. Further, it is undesirable from an audio standpoint to have the woofer and tweeter reproduce the same groups of frequencies. It is the job of the crossover network to route the frequencies needed by the woofer into the woofer and those needed by the tweeter into the tweeter. The point of transition between the frequencies required by the woofer and those required by the tweeter is called the crossover frequency.

CD Players Without Preamplifiers

Q. I recall reading somewhere that CD players can be used without preamplifiers. Because my preamplifier was in need of repair, I decided to experiment. I connected the output of the player into my two power amplifiers, using the remotely controlled volume adjustments built into the player. It worked, but am I ruining my sound system? Am I perhaps eliminating an unnecessary piece of equipment? Please help!—Kenneth Rosenbaum, Woodmere, N.Y.

A. There is no problem with using your CD player connected to the inputs of your two power amplifiers. No damage will occur to any of your equipment, I promise! Your amplifiers won't "know" what's connected to their inputs; for all they know or care, they are being fed from a preamplifier.

As to whether or not a preamplifier is an unnecessary piece of equipment, this depends on what else you have in your system. If CD is not your only source, you'll need some means of selecting the one you want to hear at any


moment and feeding it to your power amplifiers. If these sources have no volume controls, you'll want that function too. A preamp will serve these purposes as well as provide gain to make up for any possibly insufficient signal levels from some devices. (Signals from phono cartridges, for example, need a lot of extra gain plus RIAA equalization.) Preamps also give you the convenience of a centralized volume control for all components and such features as extra outputs and monitor switches for tape recorders.

Preamplifiers provide flexibility not only in terms of source selection and volume adjustment but also in accommodating different listening preferences. For example, their tone controls are useful in tailoring the audio quality to suit your ears and room acoustics. Some people believe that these controls degrade the overall sound of a system, but some preamplifiers have switches which bypass the circuitry, and other preamplifiers are made without tone controls at all. "Passive preamps" have no active circuitry whatever, just switching and volume control.

In summary, if you are happy with things as you have described them, there is no harm in continuing as you have been.

Audio Out to Video In

Q. If the tape out jack is connected to the video input of a VCR, can any damage occur to either the audio or the video gear?—Joseph Barbera, Cheektowage, N.Y.

A. No damage to either device will occur when making this connection. There are no voltages present at the input of a video stage, any more than there are at the input of an audio device. Of course, the video circuits cannot accept audio for later playback. The video input circuit normally expects 75-ohm loads. If these circuits are terminated as I think they are, the audio stage driving them will be overloaded, but I do not believe this overload can result in circuit damage to the audio device. 

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1633 Broadway, New York, N.Y. 10019. All letters are answered. Please enclose a stamped, self-addressed envelope.

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Class A amplifiers ain't what they used to be.

For the sake of signal purity, audio buffs have long put up with Class A amplifiers — powerful, pricey amplifiers the size and weight of cinder blocks.

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a low-impedance load.

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And there's more. Much too much to describe in detail here.

Drop by your nearest Yamaha dealer for a demonstration of the new MX-830. The first Class A amplifier it doesn't take a fire permit to operate.

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TAPE GUIDE

HERMAN BURSTEIN

Readers' Thoughts on Sonic Smear

In the May 1990 issue, reader Bob Villa of Winnipeg, Man., Canada complained of sonic smear when using dbx noise reduction with an open-reel deck at 3¾ ips; sound was fine at 7½ ips with dbx NR and at 3¾ ips without it. I ventured that the noise-reduction unit might be responding to the level and pitch changes produced by wow and flutter, which are greater at 3¾ than at 7½ ips. Readers were invited to submit their comments.

Paul F. Hennessey of Bradenton, Fla. writes: "My guess is that Mr. Villa has calibrated his dbx NR unit at the tape speed of 7½ ips. At 3¾ ips, however, not only is there an amplitude difference, but treble rolls off and, to some degree, is replaced by noise exaggerated by the playback equalization. Therefore, Mr. Villa seems to be experiencing an artifact of NR mistracking. My recommendation is that he calibrate his dbx unit while operating the deck at 3¾ ips. Although there


may still be some mistracking, the results may be less offensive."

Mr. Donald Bisbee of Columbus, Ohio writes: "I am disappointed in your answer about sonic smear. Has no one heard of modulation noise? The dbx system is great at accentuating tape modulation noise, which is one of the most severe problems of analog tape, especially at slow speed. While flutter will increase as one goes from 7½ to 3¾ ips, it is modulation noise that really increases, and with cassettes it can be louder than the signal above about 5 to 10 kHz. So, naturally, dbx NR makes this worse."

It is well known that noise-reduction circuits—whether dbx or other types—tend to exaggerate imperfections in frequency response. Mr. Bisbee's point appears to be that in similar manner, dbx NR exaggerates modulation noise.

Leo Beckman of Helsinki, Finland attributes the problem, which is usually called "breathing" or "pumping," to

"diminished dynamic range due to the lower tape speed. Breathing usually results when a dbx-type compander is used with tape decks having S/N of less than about 55 dB."

Reg Williamson of Staffordshire, England similarly associates Villa's problem with the reduced S/N as tape speed is decreased: "One hears the noise envelope around the sound all the time, and pianos and solo sopranos are the worst." To escape pumping at low tape speed, if it's possible, Williamson points out that the recording level must be as high as possible, short of audible distortion, in order to maximize S/N. Says Williamson, "I can always hear Dolby C pumping, and find Dolby B much more acceptable, increased hiss and all."—H.B. 

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1633 Broadway, New York, N.Y. 10019. All letters are answered. Please enclose a stamped, self-addressed envelope.

"Quite simply, the MC-101 is a superb preamplifier."

Highlights of *Hi-Fi Heretic*, Summer 1989 review.

B&K's Sonata Series is a new line of upmarket electronics, consisting of two preamplifiers: the MC-101 (on test here) and the Pro-10MC, \$698; two power amplifiers, the M200 monoblock (200 watts into 8 ohms, \$898 each) and the EX-442 stereo amplifier (200 watts per channel into 8 ohms, \$948).

As with B&K's other preamplifiers, the MC-101 is a full-featured design. Included are (take a deep breath) two source selectors for "listen" and "record" functions, a tape monitor function, an external processor loop, high-quality Noble volume and balance controls, a mono switch, a line amplifier bypass switch, bass and treble controls (defeatable), a high frequency filter, and a headphone socket. There are inputs provided for a turntable (selection between MM and MC stages via a switch mounted on the main circuit board) DAT recorder, CD player, VCR, tuner, and tape recorder. (Obviously, any auxiliary source can be connected to the DAT and VCR inputs.)

One thing is certain: the B&K MC-101 is without a doubt the best full-featured amplifier I have heard in this price range.

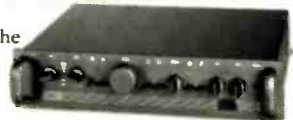
Resistance and capacitance on the phono input can be adjusted by inserting resistors or capacitors in gold-plated sockets on the main circuit board. Moving to the rear of the unit, all inputs and outputs utilize Premium RCA jacks. There are two sets of main outputs. For only \$200 extra, the MC-101 is available with balanced outputs. The unit's power switch is,

As such, it easily qualified for "BEST BUY" status.

in fact, an output muting circuit, as the preamplifier is always energized when connected to an AC outlet. The headphone output is only activated when the power switch is turned off.

A rather impressive list of features, eh? Construction quality is equally noteworthy. Built into an exceptionally sturdy steel case, the MC-101's circuitry is laid out on a single glass-fibre board, with an auxiliary board carrying the input/output jacks. Parts quality is extremely high, with all controls and selectors of premium quality. 1% metal film resistors and polypropylene film capacitors are liberally used throughout. The active circuitry is completely discrete, with ICs used only in the servo circuits to control DC offset. The B&K utilizes a remote power supply, with connection to the preamp via a high-quality Cannon

plug. All told, the MC-101 is remarkably well made for the price.



The MC-101 is quite attractive, though a bit bulky when compared to the slimline Forte and PS Audio units. New silk screening on the front panel makes the MC-101 far more attractive than B&K's other preamps. Both the control knobs and obligatory rack mount handles are black rather than B&K's usual gold, another cosmetic bonus. Overall, a worthwhile improvement over earlier B&K efforts.

Quite simply, the MC-101 is a superb preamplifier. I had expected it to offer the traditional B&K virtue of smooth tonal balance, but I was not prepared for its amazing sense of detail and clarity. Through the MC-101, music has a combination of warmth and immediacy that is all but unprecedented in this price range.

One thing is certain: the B&K MC-101 is without a doubt the best full-featured preamplifier I have heard in this price range. As such, it easily qualified for "BEST BUY" status.

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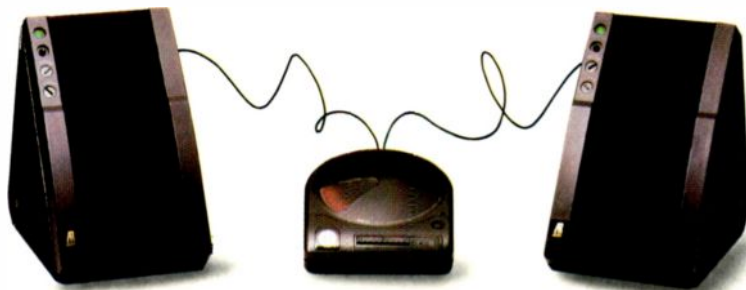
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BERT WHYTE

FANFARE FOR AN UNCOMMON MAN



Aaron Copland, the acclaimed dean of American composers, celebrated his 90th birthday in November 1990. His easily accessible and tuneful music has ensured the enduring popularity of his works, including *Fanfare for the Common Man*, *Billy the Kid*, *Rodeo*, and *Appalachian Spring*. Copland's birthday has been appropriately marked by the record companies with new releases of his music. Among them is Telarc's CD of his Third Symphony and "Music for the Theater." Philips has issued a CD transfer of the Third Symphony and *Billy the Kid* suite I recorded with Copland and the London Symphony Orchestra. There will also be a CD of *Rodeo* and *Billy the Kid* recorded by colleague John Eargle for Delos.

In his 91st year, Aaron Copland is understandably a bit frail and largely confined to his home in upstate New York. However, on the occasion of his 85th birthday, he managed to get to Avery Fisher Hall in New York, where his dear friend, Leonard Bernstein, conducted the New York Philharmonic Orchestra in a performance of his First Symphony. The event was televised by PBS. Ironically, Copland had to revise the score of his First Symphony specifically for this occasion. Originally entitled the Organ Symphony, the organ part was deleted and a few other changes made because, in the reconstruction of the old Philharmonic Hall

into Avery Fisher Hall, the great Aeolian-Skinner pipe organ had been removed, and currently Avery Fisher Hall does not have an organ. (Incidentally, I wanted to record Copland conducting his First Symphony in its original form, but Walthamstow Town Hall in London did not have a pipe organ, and I refused to compromise by using an electronic organ.)

Copland and Bernstein both studied with Nadia Boulanger in Paris in the early '20s. In fact, Copland returned to the U.S. in 1924, and about all he had was a commission from Boulanger for an organ symphony. To eke out a living, Aaron played piano at a resort hotel in Milford, Pa. Copland finally completed his Organ Symphony, and it premiered in New York on January 11, 1925. In the audience was Serge Koussevitsky, famed conductor of the Boston Symphony Orchestra, who was so impressed with the symphony that he promptly programmed it for the BSO. He also saw to it that Copland got a commission for a new work from the League of Composers, and the result was "Music for the Theater," which Koussevitsky and the BSO premiered on November 20, 1925.

In 1970, I met with Aaron Copland at the Harvard Club in New York and taped a conversation with him for a series of radio programs that, unfortunately, never materialized. The following is an abridged transcript of that

conversation. Although some of it is obviously dated, I think you will find it interesting nonetheless.

Aaron, it is great to see you again; it's been far too long. If I remember, in 1958 we discussed the possibility of recording some of your works with you conducting them. At that time you had considered increasing your conducting activities beyond the occasional guest appearance.

Yes, that is right.

Finally, later that year we recorded your Third Symphony and the Billy the Kid suite coupled with your fascinating "Statements for Orchestra." Now, more than 10 years later, do you still like to make recordings?

Well, it's an activity that is fraught with peril, but after all, now it's just one of the facts of life. One would feel very miserable if one's pieces didn't find their way onto records. You know, you have to take the good with the bad. You hope what you do will be accepted. Unfortunately, very rarely do you get the perfect situation where you are entirely happy with the whole thing, from first note to last.

Well, as an old A & R man, I know what problems there can be. You are always wondering if you could have done a better job of editing. I understand that some producers have a tendency to try and achieve a note-perfect performance with a great deal of tape splicing. I believe Toscanini particularly hated this practice and also remember that you didn't like it, feeling that it destroyed spontaneity. Unfortunately, it is something you have to live with in order to correct really glaring errors.

My impression is that less splicing is done these days.

To a certain degree, yes. But splicing is a valuable tool when used with discretion. For example, recording costs are so high now, both here and abroad, that when a difficult piece—may I name your "Statements for Orchestra"?—is to be recorded, and the orchestra is not familiar with it or has not adequately rehearsed it, the ability to shorten recording time by using the best of a number of takes to achieve a satisfactory recording is a considerable advantage. I understand that there is now a tendency to record in larger blocks, whole movements, for

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In recording, you rarely get the perfect situation where you are entirely happy with the whole thing, from first note to last.

example, without stopping for every little mistake.

Yes, that's right. Sometimes we attempt to record a piece from start to finish to give us—what do you call it?—a safety, I guess.

Aaron, when did you actually start conducting as a more or less parallel activity with your composing?

I think it was around the end of the '50s. I first sort of practiced on orchestras outside the United States. South America was very nice from that standpoint. The orchestras in Argentina, Brazil, and Uruguay—also Chile—invited me to conduct there when I really didn't fully know the job. So I practiced with them, and it was really very helpful. I did this in Mexico, too.

What kind of reviews did you get?

Well, they really had a tendency to be kind, you know.

I presume that, for the most part, you conducted your own compositions.

Yes, that's right.

Without seeming to be impertinent, would that be true today? Do you still conduct mainly your own works?

No, that isn't true any longer. Generally, when people ask me to conduct they ask me to do something of my own, sometimes several pieces of my

own, but I generally like to give them a varied repertoire unless they specifically ask for an all one-man show.

What kind of repertoire do you program other than your own for these concerts?

I try to keep away from the old war-horses as much as I can. I haven't done any Beethoven. I do an occasional Brahms, especially the Variations on a Theme by Haydn, a favorite of mine. I try to play as many other American works as I can, which is a little difficult because my own pieces generally fill that category. I have been doing Ives.

The Fourth Symphony?

Oh, no! [Note: Charles Ives' Fourth Symphony is a very complex work, requiring one conductor to handle a front orchestra and another conductor to handle a rear orchestra. Shades of quadraphonic!—B.W.] I have done his "Decoration Day" as well as "Unanswered Question," and I have tried to do less familiar things like the Roussel symphonies. I'm going to do the Third Symphony in Detroit next week.

How about a Roussel semi-warhorse like his Spider's Feast?

They don't play that much anymore.

Some people still think Stravinsky is a "modern." Do you essay any of his works?

Yes, out in Israel this year I did the Stravinsky Symphony in C eight times. You know, you have to give the same concert eight times in Tel Aviv, because they have eight audiences of 3,000 each for each subscription concert. The orchestra gets tired repeating the same piece, even a difficult piece like the Stravinsky. We did the concerts four nights a week for two weeks, and that didn't include the same concert one night in Jerusalem.

Have you conducted any of the more avant-garde modern works?

Yes. In London I did [Iannis] Xenakis' "Pithoprakta" and some [Tōru] Takemitsu too! Do you know Takemitsu?

Oh, yes, like the "Coral Island" or "November Steps."

I think he is one of Japan's most gifted composers. I like his things. I know him; he is a charming man. I was in Japan two years ago, and the RCA people there gave me his collected works in a beautiful album.

I know your output has been diminishing in recent years. Has conducting

more or less supplanted your composing activities?

I hope not! But it does eat into one's time, and the way you are booked well in advance for conducting appearances can reduce time for composing. *I think you had a flirtation with serialism and 12-tone-row works. Have you done any more of that?*

Yes, I've done several works with my version of 12-tone.

I have a feeling you don't really care for it that much.

Well, it would depend on the musical materials I start with. If it suggests 12-tone treatment, I wouldn't hesitate to use it.

When you have made recordings, do you go back to the control room and try to second-guess the engineer in changing balances and equalization?

No, I do little of that. Perhaps a little tonal adjustment.

Do you still visit the control room between takes, as you did when we were recording together, to check the sound after mike changes and so forth?

Oh, yes. I pay close attention to that sort of thing. This can be an upsetting time, because the playback can be mercilessly revealing.

The playback does illuminate a lot of things, and to be frank, if a conductor is on his toes, he catches sloppy ensemble and poor playing and intonation. He knows he must deal with it promptly.

I've found it depends on the orchestra. For example, the London Symphony players seem to take a very serious attitude toward recording, and they are marvelous to work with.

What kind of playback equipment are you using now?

Oh, my god, man! You are asking me questions that are difficult. A friend of mine who knows about these things has installed what sounds like a very fine stereo system for me. But I've never read the labels!

Do you listen in a fairly large room?

Yes, it is quite large. The speakers are concealed behind decorative grilles that don't interfere with the sound.

Obviously, you are satisfied with your stereo playback, but I think you will agree that we are still quite a way from the dimensionality and naturalness of the sound in the concert hall.

Oh, that is true.

CODA

Sadly, as this issue went to press, I learned of the death of Aaron Copland on Sunday, December 2, 1990. A measure of the respect and esteem in which he was held was evident in the considerable TV news coverage of his passing. Ironically, although there was a 20-year difference in age, two of Nadia Boulanger's most famous students, Leonard Bernstein and Copland, died within weeks of each other.

It was a great pleasure and a privilege to have known Copland and to record some of his most popular works with him. He is gone, but we will continue to enjoy his truly unique music. His creativity and inspiration combined derivations of native folk music with elements of jazz and blues into a quintessentially American musical idiom. B.W.

Copland visited the control room between takes, but he found that to be an upsetting time because playback was so revealing.

You've done some work with Vanguard. Last week they gave me a demonstration in which a normal pair of stereo speakers in the front of the listening room was augmented by two speakers in the rear of the room. These rear speakers conveyed the ambient information and helped simulate the

spaciousness of the hall. It was quite amazing. I heard the Berlioz Requiem with the brass band in each corner of the hall, sounding quite similar to what you hear in a live performance. So get your living room ready for four speakers, Aaron! It isn't a fantasy; they are actually going to market this!

It sounds like I'll have to get into it. I think it's fair to say that Serge Koussevitsky of the Boston Symphony Orchestra had a large role in supporting your music and bringing it to the attention of the public.

Oh, absolutely. I owe a great deal to him for his early and ongoing interest in my music.

What do you think of all this loud rock music today?

Well, I think The Beatles do some interesting things. One thing that disturbs me, though, is this craze for great amplification. I was up at Dartmouth College and heard this rock group performing. I was curious to find out what the group thought about the risks to their hearing. The leader of the group said that he was getting a bit hard of hearing in his left ear! I asked him if he wasn't afraid of losing his hearing, and he replied that everyone knows smoking is bad for you but everyone just keeps on smoking anyway. It was a clever reply, but that doesn't lessen the danger.

All sad, but true. But how do you respond when one of these people says that you stand in front of 105 men when Billy the Kid is firing away at a very loud, high-decibel sound?

Well, okay, what is the answer?

The classical conductor is saved by dynamic range. The loudest fortissimo sections are usually just momentary peaks. It is intermittent, not the constant high level of rock, which can often have a dynamic range of less than 12 to 18 dB.

I'm also curious about the playback levels you use in your home when you are listening to your own or others' recordings.

If I want to hear something just to remind me of the music, or in playing my own music, I tend to play it at fairly moderate levels. If I want to hear some music sheerly for pleasure, then I usually play back at louder levels. You know, Bert, composers are really not that fussy about sound.

We all feel they are poor judges of sound quality!

Yes, but in addition to that, we, after all, hear the music in our heads when we compose it. So often the reality of the actual sound seems less than what we hear in our heads during the composing process.

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Few test records have explored stereo localization as thoroughly as *Demonstration of Stereo Microphone Technique*, a new CD issued by Performance Recordings (PR-6-CD) and distributed in the U.S. by Harmonia Mundi. Many *Audio* readers will know this small label as the brainchild of James Boyk, pianist and lecturer at the California Institute of Technology. In this 19-minute CD, Boyk demonstrates 18 stereo microphone arrays, ranging from coincident (microphones one atop the other), through near-coincident (microphones separated 7 to 10 inches), to spaced arrays (microphones separated up to 6 feet). Five different capacitor (condenser) microphones are used, along with two kinds of dynamic microphones and one ribbon type. The reason for this variety of microphone types is to demonstrate the differences in stereo pickup which can result from the microphone geometry itself—most notably, the tendency of some microphones' off-axis high-frequency response to fall off.

The signal source was uniform for all microphone arrays and consisted of a group of 2-inch loudspeakers placed in a line spanning a distance of 10½ feet. With the exception of the spaced microphone arrays, the stereo microphone arrays were located on the median plane of the loudspeaker array at a distance of 5 feet, 4 inches from the line of the speakers. At this location, the multiple loudspeakers subtended an angle of slightly less than 90° with respect to each microphone array. These conditions approximate the normal range of microphone positioning and distances for recording chamber music or solo instruments.

The test signal was a "rim shot" generated by a drum machine and then sequentially switched to all loudspeakers, beginning in the center and moving to far right, far left, far right, and back again to the center. The impulsive nature of the signal provides clear cues for localization and allows the listener to judge the various stereo microphone arrays' ability to convey clear and unambiguous imaging.

Digressing for a moment, let's discuss how we detect source positions in the first place. If you were standing where the microphones were located, you would have no problem pinpoint-

ing the lateral bearing of each loudspeaker within a few degrees. This is done by your ears and some remarkable processing in the brain. Essentially, the cues at the ears are phase-related at frequencies up to about 700 Hz; above about 2 kHz, the cues at the ears are amplitude-related, due to the shadowing of the head. Each loudspeaker, of course, is a *real image*, and you localize it as such.

In stereo recording with coincident microphones, only amplitude differences will be picked up from the various real sources. When these are played back in stereo, there are only two real images—the left and right loudspeakers. Other images you perceive between the two loudspeakers are called *phantom images*, and they are produced by phasor summation of the stereo loudspeaker signals at each ear, which will give rise to leading and lagging phase relationships at the ears. For example, when there is a center phantom image, equal phasors are present at the ears, and this is perceived as an image located straight ahead. For a phantom image left of center, the summed phasors at the left end lead those at the right ear, and this is perceived as an image located somewhere between center and the

left stereo loudspeaker. These phasor cues in stereo listening work only at lower frequencies, again, up to about 700 Hz, and they work best for a listener seated equidistant from the two loudspeakers. (If you find this hard to believe, get a copy of another test CD, *Auditory Demonstrations*, issued by the Acoustical Society of America and reviewed in the July 1989 *Audio*.)

Thus, in Boyk's tests, the various coincident microphone arrays provide the more unambiguous localization of the rim shots. In particular, the crossed figure-eights, the so-called Blumlein array, perform the best. With this array you will hear each rim shot clearly as it steps across the stereo stage. The positioning will be clear and smooth, and you will note little change in timbre. Other coincident arrays, of cardioid and hypercardioid patterns, provide more center-stage dominance, but splay angles and pickup patterns can be adjusted for more spread of sound.

If image specificity were all there was to stereo, then everyone would be happy with just a handful of coincident microphone arrays. But there are other considerations. In general, spaced omnidirectional microphones provide confused phasor reconstruction at the listener's ears and, as such, perform



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Twin Peaks—*Original Sound Track* (Music Composed By Angelo Badalamenti) (Warner Bros.) 413-641

Mussorgsky; *Pictures At An Exhibition*; **Stravinsky**; *The Firebird*, Carlo Maria Giulini, Berliner Phil. Royal Concertgebouw Orch. (Sony Classical) 413-625

Freddie Jackson—*Do Me Again* (Capitol) 413-542

Randy Travis—*Heroes And Friends* (Warner Bros.) 413-328

Reba McEntire—*Rumor Has It* (MCA) 411-538

The Rippingtons—*Welcome To The St. James' Club* Featuring Russ Freeman (GRP) 410-498

Kronos Quartet—*Black Angels* (Eino) 409-912

Carly Simon—*Have You Seen Me Lately?* (Arista) 411-066

Nelson—*After The Rain* (DGC) 411-009

Brahms: *Sonata No. 3; 3 Intermezzi*, Op. 117. Emanuel Ax, piano (Sony Classical) 409-375

Stravinsky: *Rite Of Spring; Symphony In Three Movements*. Salonen, Philharmonia (Sony Classical) 409-342

Tchaikovsky: *Piano Concertos Nos. 1 & 3*. Feltsman; Rostropovich, National Symphony Orch. (Sony Classical) 409-227

Bob James—*Grand Piano Canyon* (Warner Bros.) 408-906

Mozart: *Requiem*. Giulini, Philharmonia Orch. (Sony Classical) 408-575

Michael Franks—*Blue Pacific* (Reprise) 408-328

Keith Sweat—*I'll Give All My Love To You* (Elektra) 407-791

Jeff Healy Band—*Hell To Pay* (Arista) 407-569

New Year's Concert 1990. Mehta, Vienna Phil. (Sony Classical) 407-189

Handel; *Arias*. Sung By Kathleen Battle (Angel) 407-155

Jane's Addiction—*Ritual De Lo Habitual* (Warner Bros.) 407-098

Branford Marsalis—*Music From Mo' Better Blues* Featuring Terence Blanchard (Columbia) 410-928

On The Cutting Edge

Brian Eno & John Cale—*Wrong Way Up* (Warner Bros./Opal) 414-177

The Replacements—*All Shook Down* (Sire/Reprise) 412-668

Pump Up The Volume—*Original Soundtrack* (MCA) 412-593

Soul Asylum—*And The Horse They Rode In On* (A&M) 411-678

Pixies—*Bossanova* (Elektra) 410-753

Bob Mould—*Black Sheets Of Rain* (Virgin) 410-464

Iggy Pop—*Brick By Brick* (Virgin) 409-854

Concrete Blonde—*Bloodletting* (I.R.S.) 409-706

Revenge—*One True Passion* (Capitol) 408-880

Gene Loves Jezebel—*Kiss Of Life* (Geffen) 408-377

Sonic Youth—*GOO* (DGC) 408-294

The Sundays—*Reading, Writing And Arithmetic* (DGC) 408-062

The Lightning Seeds—*Cloudcuckooland* (MCA) 407-718

Depeche Mode—*Violator* (Sire/Reprise) 405-423

World Party—*Goodbye Jumbo* (Chrysalis) 405-027

Sinead O'Connor—*I Do Not Want What I Haven't Got* (Chrysalis) 405-001

Winger—*In The Heart Of The Young* (Atlantic) 406-678

Harry Connick, Jr.—*We Are In Love* (Columbia) 406-645

Wynton Marsalis—*The Resolution Of Romance* (Standard Time, Vol.3) (Columbia) 406-637

Rosanne Cash—*Interiors* (Columbia) 406-397

Paula Abdul—*Shut Up And Dance* (The Dance Mixes) (Virgin) 406-264

"Henry V" (Original Soundtrack Recording). Music By Patrick Doyle. Rattle, Birmingham Sym. (Angel) 406-199

Music Of The Night—Pops On Broadway 1990. From "Phantom Of The Opera," etc. John Williams, Boston Pops (Sony Classical) 405-993

New Kids On The Block—*Step By Step* (Columbia) 405-415

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Chopin: *Piano Concertos Nos. 1 & 2*. Murray Perahia; Mehta, Israel Philharmonic (Sony Classical) 403-337

Duran Duran—*Decade* (Capitol) 401-869

Basia—*London Warsaw* (New York Epic) 401-752

Dionne Warwick—*Greatest Hits (1979-1990)* (Arista) 401-679

Pat Benatar—*Best Shots* (Chrysalis) 401-646

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Kenny G Live (Arista) 401-505

Chicago—*Greatest Hits 1982-1989* (Reprise) 401-166

Barbra Streisand—*A Collection: Greatest Hits and more* (Columbia) 401-141

Robert Palmer—*Additions, Volume One* (Island) 400-937

Madonna—*I'm Breathless* (Sire/Warner Bros.) 407-213

Bell Biv DeVoe—*Poison* (MCA) 406-819

Paul Simon—*Negotiations And Love Songs 1971-1986* (Warner Bros.) 400-721

Eric Clapton—*Journeyman* (Reprise) 400-457



Wilson Phillips (SBK) 406-793

Brahms: *Violin Concerto; Bruch: Concerto No. 1*. Nadja Salerno-Sonnenberg; De Waart, Minnesota Orch. (Angel) 400-135

Linda Ronstadt—*Cry Like A Rainstorm, Howl Like The Wind* (Elektra) 389-874

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With the Blumlein array on Boyk's microphone CD, you can hear all rim shots clearly as they step across the stereo stage.

poorly in these tests. However, the technique remains very popular with many successful recording engineers. What spaced omnis provide is a heightened sense of space by introducing added (artificial) time cues that differentiate, or "de-correlate," the two channels. This is sensed as "spaciousness" and is considered a valuable attribute by many engineers and listeners. In less than ideal recording spaces, the technique may be useful, especially when used with a coincident or near-coincident array.

The near-coincident arrays (ORTF in particular) offer most of the advantages of coincidence but with just a hint of added spaciousness, which even small degrees of microphone separation seem to produce.

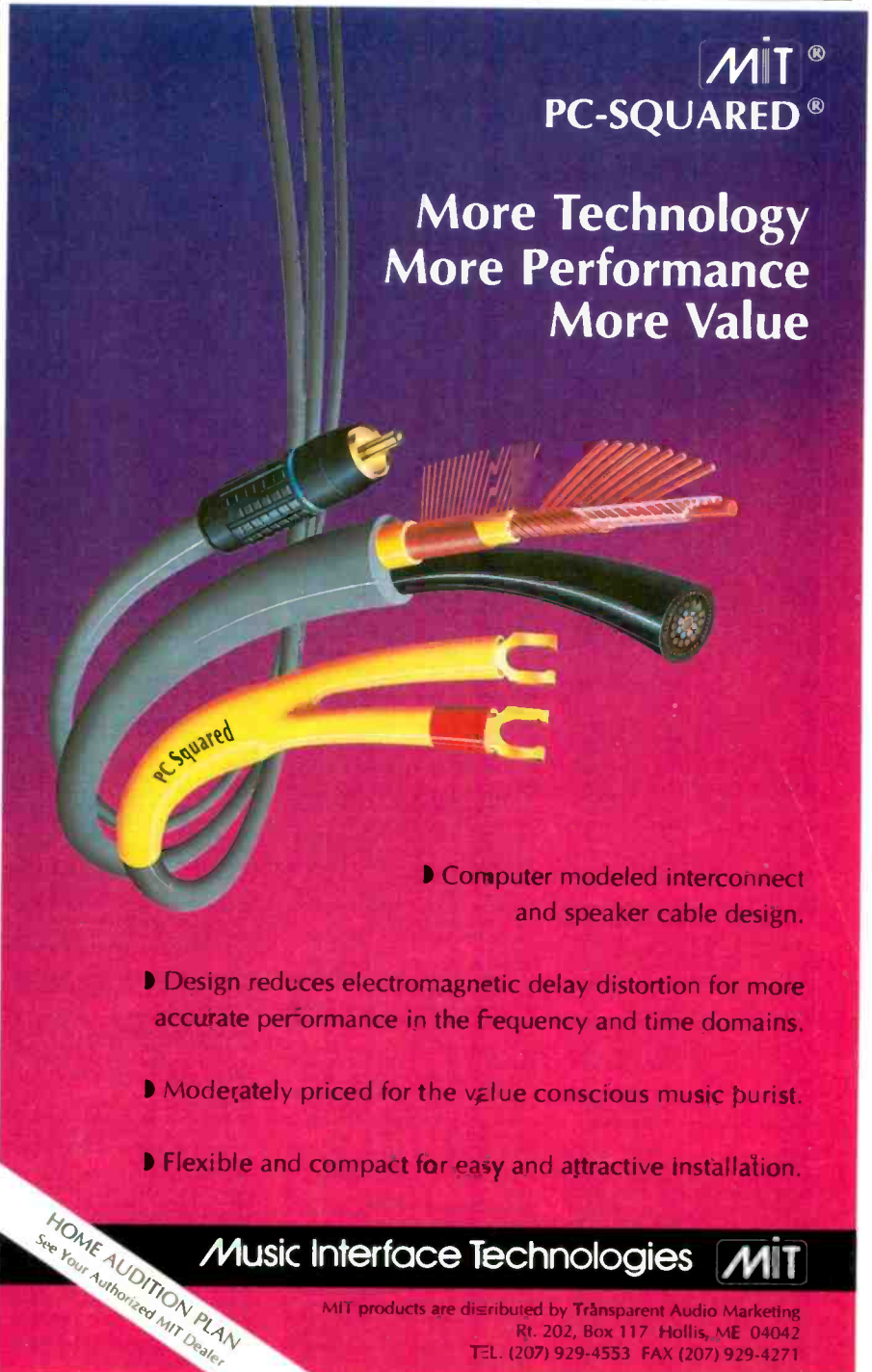
Boyk's tests confirm most of what has been written on the subject of stereo microphone techniques, and it is quite valuable to have these comparisons all in one place and with an invariant "program" source. I have only two minor complaints. It would have been good to duplicate the tests in a larger, more reverberant space so that we could compare the various stereo arrays in terms of direct-reverberant pickup and spatial texture. Certainly there is room for this on the disc. Also, the original recordings were analog, and there is noticeable print-through on the master tape of the rim shots in the test sections. This does not get in the way of the primary objective of the disc, which is to demonstrate stereo imaging, but it does make it difficult to assess how the various arrays respond to reflected sound.

The Chesky brothers are known to audiophiles for their leasing of old RCA masters and reissuing them on quality LPs and CDs. In recent years, they have ventured into the studio to produce jazz recordings of their own, emphasizing acoustical instruments, natural pickup (read, minimal miking), and up-to-date A/D conversion technology.

On *Jazz Sampler & Audiophile Test Compact Disc, Vol. 1* (Chesky JD37), nearly 40 minutes of the hour-long CD is taken up with tasty music examples from the Chesky jazz catalog, most of it of a Brazilian sort. Then comes the technical portion, which is designed to help you optimize your playback system. The first band presents basic as-

pects of stereo localization using the Blumlein technique. This is followed by an interesting localization test called LEDR (Listening Environment Diagnostic Recording), consisting of transient-rich, broad-band signals that move between, over, and around your speakers. You have to be directly on the axis

of symmetry of your loudspeakers to hear all of this, and your listening room must be substantially free of pronounced early reflections from floor, walls, and ceiling. As best as I can determine, these signals have been processed via external ear (pinna) transforms to simulate the frequency



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In the Chesky LEDR test, you'll hear a very striking effect: The test signal moving over and above the normal stereo stage.

response changes that elevated sources exhibit relative to straight-ahead sources. Thus, the listener of the stereo program will hear the test signal move over and above the normal stereo stage. Interesting.

Then follows a set of announcements, with tambourine punctuation,

recorded 1 to 12 feet from the mike. This may sound like a small range, but acoustically the difference in sound level between 1 and 12 feet is a little greater than 20 dB! What this means is that the direct-to-reverberant ratio changes by this amount during the announcements. This test underscores

the significant changes in recorded sound texture that relatively small changes in mike placement can cause.

Absolute polarity is given a good workout, but the results are, to me, inconclusive. If absolute polarity has been maintained in the signal path, then a positive-going pressure at the microphone will result in a positive-going pressure from your loudspeakers. Ideally, this should be the case, but it is quite hard when listening to music to determine if this relation has been maintained. (The loudspeakers must be of like polarity, whether the absolute polarity is out or in.) Most sure-fire tests of the audibility of absolute polarity have used high-level test signals, with the listener wearing headphones.

Can digital really overcome the cumulative degradation of multiple generations of tape copying? I'd say yes, based on the evidence presented in the disc's "Multiple-Generation and Low-Level Linearity Test." A first-generation digital recording is compared with a 100th generation, made through the "cloning" nature of digital copying, and I would be lying if I said I heard a difference.

Finally, we come to the "Bonger" test. The test signal is a sine-wave tone with its attack and decay modulated to sound somewhat like "bongs" or slow successive strikes with a fluffy mallet on a marimba on the note G below middle C. Such tones have been used over the years to detect modulation distortion and other problems in signal transmission. The signal has a rapid rise-time and can thus trigger transient-related problems; the decay of the pure tone provides little masking of any aberrations or artifacts which may result. Chesky's 128-times oversampling A/D converter is compared with a standard successive-approximation converter. The bonger signal is presented at a number of levels with each converter. With the Chesky converter, there is an audible "click" on the first two samples (at -3 and -13 dB); by comparison, the standard A/D converter has no such problem but, rather, produces a fuzzy second harmonic (an octave higher) tone as the fundamental 270 Hz decays. Each converter seems to have its problems.

Both discs reviewed here are highly recommended. 

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were tight and well-detailed"

Dick Olsher
Stereophile Vol. 13, No. 3.

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ensemble playing in your car.

Introducing the Premier

KEX-M900 from Pioneer Electronics.

An incredible 3-source unit that is,

to put it quite simply, the most advanced car audio system ever created. And it's due to the way we've utilized a revolution-

ary new technology known as Digital Signal Processing (or just DSP). A remarkable



development that provides

complete digital audio control, totally altering the way you listen to music in a car.

Basically, it means we put a computer inside a car stereo head unit. A

high-speed, special-purpose microprocessor, to be exact.

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modes of equalization we give you to choose from. The 3-band parametric EQ gives you the freedom and versatility to recreate sounds with incomparable accuracy.

While the built-in 7-band graphic EQ features the convenience of six user presets.



graphical EQ features the

NOW YOU'VE HEARD EVERYTHING.

Which is where things really begin to get interesting.



The digital sound field control enables you to

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Even the tuner we designed for this system is something out of the ordinary.

Our SUPERTUNER® IV™ is the very first to come along with single-digit

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entire system without ever taking your eyes off the road. And with the learn fea-

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Detachable Face Security.™ An industry first, this feature allows you to remove the faceplate and place it in an accompanying carrying case that fits easily in your pocket.

About the only thing more exclusive than this extraordinary system is



them longer than any other tuner on the market today.

And what about all your cassette tapes, you're asking?

Afraid you'll have to sacrifice them

to get CD sound in your car?

Not true. A simple touch of a button and the faceplate flips down to reveal a cassette deck with full-logic control, auto-reverse and all the features you'd expect from Premier.



any one additional function appearing on the unit's face.

Now, at this point, you're probably wondering where you're going to find a security system sophisticated enough to protect your investment.

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our network of Premier Installation Specialists.

These expert craftsmen will design and install your system with the

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utmost care and attention to detail. For more information and the name of the Premier dealer nearest you, give us a call at 1-800-421-1601.

We could go on, of course. But we think you've probably heard enough.

PIONEER
The Art of Entertainment

IVAN BERGER

LAND OF THUMP AND GLORY



It didn't surprise me that I could feel, as well as hear, the throbbing woofers even as I drove into the parking lot of the International Auto Sound Challenge Association's Invitational Finals and Electronics Expo—"the Nationals," for short—in Tempe, Ariz. last November. After all, you'd expect some noise from a contest that's the culmination of IASCA's nationwide series of local and regional car stereo competitions. But what did surprise me was that the noise wasn't coming from the contestants who were vying for the \$70,000 in prizes.

Building and judging fine car stereo systems is serious business—and, like most serious business, not that much fun to watch. The 245 contestants' cars sat in long rows under the sun, waiting for their turns to pass through the judging tents, which were placed as far as possible from the crowd of nearly 23,000. The judging was a quiet process, done with the car's doors closed to keep the sound in and noise from other cars and the crowd out.

Yet the reason the industry sponsors contests like this is to drum up excitement about car stereo. That means not only encouraging people to sweat and spend on competition-worthy super-systems but also encouraging the less committed to lust after better car stereo than they already have.

So along with the serious judging comes the carnival: Games! Balloons!

Radio-controlled car races! Bikini contests! And more than 100 manufacturers' demo cars, rockin' and roarin' simultaneously from the tents that covered the audience side of the field. Every car was playing its heart out, bass turned up and windows open (an admitted necessity in the 80° weather, with the cars' engines and air-conditioners off). Stillwater's Kicker van, with 10,675 watts' worth of Linear Power amplifiers, was throbbing so hard you could see its sides shake, and feel the breeze from it a few inches away. I began to wonder what would happen if all those woofers played the same music in sync—and in phase—and therefore happily accepted a pair of ear plugs from IASCA.

The manufacturers emphasized bass and volume in other ways: Lanza's candy-apple red Cadillac hearse was named Assassinator, and Hafler's dark purple one was the Terminator. Rockford-Fosgate offered tee shirts that read: "If Your Mirrors Ain't Shakin', You Got Taken," while Pioneer's posters said "Don't Go Quietly." And though IASCA has stopped giving points for maximum volume levels beyond 130 dB SPL (down from 140 dB last year), they did post a tally of the loudest cars recorded in each judging category. The levels ranged from 128.5 dB SPL for the amateur, 0 to 50-watt class, up to 149 dB SPL for the unlimited-power pro class.

Woofers happy as the manufacturers were, most of their demo vehicles sounded fine—as soon as you turned down the bass and played some gentler music, and always assuming you could hear that vehicle above the sound of the subwoofers in the cars surrounding you. By the second day, I began to feel that the demo cars only had tweeters and midrange drivers to provide sync cues so you'd know whose woofers you were hearing.

The good stuff was in the contestants' area, but the crowd, predominantly young men toting dates, stayed where the excitement was, not hopping the low wire which fenced them off from the contestants. Their area was a different world, a quiet place of people polishing their cars and trophies one last time, occasionally tweaking equalizers, and listening largely to "acoustical" music—jazz, classical, and even some folk—much cooler than the heavy metal hammering away across the wire.

"The manufacturers are trying to sell something; we're trying to show off," said Matt Murphy of Chula Vista, Cal., whose Nissan Pathfinder eventually took fourth place in the amateur, 51 to 100-watt class. "It's the really challenging music that shows what your system can do. Classical is more challenging, and that is what you want."

"I'm not just in this for thump and glory. I love to show a system that can reproduce something almost as good as, if not better than, the actual performance. I like to thump sometimes, but what we're all about is sound quality. This is not just a bunch of woofers and tweeters with a lot of boom-boom,

Lanza's "Assassinator" Cadillac hearse



Photographs: Ivan Berger

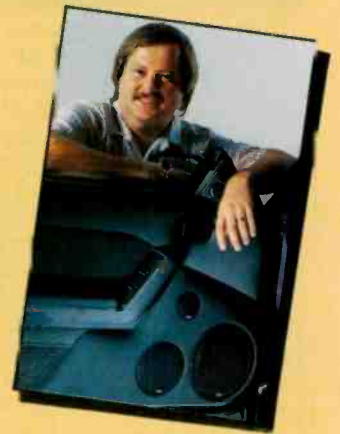
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*Eric Holdaway, Speaker Works, Orange CA.
First Place Winner in 1988 CAN Pro, 1989 IASCA Finals.*



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*Drew Williams, PJs Auto Sound, Erie PA.
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"Just when I thought I couldn't be impressed anymore, along comes Quart."
*Holly Mungal, Canadian Audio Radio, Toronto Canada.
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Anyone who knows car stereo knows these guys. Collectively, they've probably won more autosound competitions than any other installers in the field.

And while they may have differences of opinion on other system components, there's no argument about loudspeakers.



Rich, Eric, Drew, Holly and Lucio simply refuse to work with anything less than Quart. Because when they do an install, more than just equipment is involved. Their reputations are on the line. And in speakers, that line is Quart.

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Most of the demo vehicles sounded fine, as soon as you turned down the bass and played gentler music.

wicki-wicki. It's *sound*. We went in and sound-deadened the whole car; it's like a studio inside. No engine noise, either—I took care of that."

Amateurs make real sacrifices to get competition-worthy systems. I doubt, for example, that David Quesenberry's system was as casual a purchase as a pack of gum. Quesenberry, a computer programmer in Columbus, Ohio, bought a \$17,000 Dodge Daytona V6, added about \$3,000 worth of such improvements as rustproofing, a phone, and mag wheels, and then put \$14,700 worth of equipment and materials, plus hundreds of hours of his own labor, into his sound system. Quesenberry's attention to detail is outstanding. Even the radio antenna has been bent into a lightning-bolt "Z" and painted to match the car, which won the \$3,000 first prize in the amateur class for systems with 1 to 50 watts.

Mike Peerson, a pharmacist from Tyler, Tex., didn't exactly buy his system with spare change either. What caught



Mike Peerson's rear center channel

my eye about his '87 Thunderbird Turbo Coupe was that it had center-channel speakers not only in the front (a feature shared by many top systems nowadays) but in the rear as well.

"The system used to have a stereo rear field," said Peerson, "But different people would hear different things at different times, and not hear the same thing at all. So we said, 'Let's try to make this more consistent!' We took an idea promulgated by Joseph D'Appolito [a speaker designer and a Contributing Editor of *Speaker Builder* magazine]. He found that if he put a tweeter between two midranges, he'd get an even dispersion of sound frequencies, even 45° off the tweeter's axis. We took his idea and turned it horizontally, so we could get the same dispersion

throughout the car." Added Mike Brown of Custom Car Stereo in Stillwater, Okla., where the system was installed, "We made it bipolar, to use the reflections off the glass to make it sound a little bigger and smoother in the back, give it a little ambient effect." The center channel makes the sound "maybe more clear," said Peerson's wife Jeannette. "You get it about equal on both sides."

"Overall," Mike Peerson told me, "there's in excess of 10 grand in the car. Hours, I couldn't begin to tell you. I put in a lot of time, but most of the work was done by Custom Car Stereo. The shop is eight hours away, but I'm willing to drive that far and fly back, just to let them deal with the car."

The car won fifth place in its power class. Had there been time and money to install a second battery, however, the car would have earned five more points. That would have lifted it to third place, just a fraction of a point behind the second-place winner.

The system includes Coustic amplifiers and crossover and an Alpine parametric equalizer, all hidden in the trunk, and a speaker complement that includes an 18-inch Stillwater Kicker subwoofer mounted behind the rear seat, where it fires into the trunk. The Kicker, which is crossed over at 50 Hz, fires backward, "mainly because that was the only way it would fit into this car." The subwoofer's baffle board is 3 inches thick and is tied to the car's rear deck and floor by 3/8-inch-thick Allen-head bolts. Quipped Peerson, "It's not going anywhere." A control panel built into the trunk lid shows the status of all fuses at a glance and allows him to monitor the d.c. input voltage to each component of the system on a small digital meter.

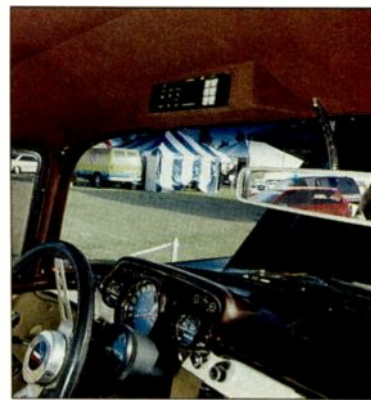
"I love it," said Jeannette Peerson. "We have two kids, and we need trunk space to put groceries and so on. A lot of cars, they've got what-have-you back there, and you've got no space; they're just something you show. This car is driven all the time, it's our family car. They kept that in mind when they were doing this installation, just as I told them to."

Helmut Steiglitz of HiFonics agreed that the Peersons' approach is far more practical than the manufacturers' approach of stuffing demo vans with

amps and speakers until there's no more cargo space or rearward vision. "From a practical point of view," he said of his own company's 8,400-watt van, "there's no room for a toothbrush anymore, let alone luggage. But that's the nature of competition vehicles."

There seemed to be a few such sound-stuffed vans among the professional-class contestants too (and the pros were more likely than the amateurs to play loud rock in their leisure moments), but most of the professional entrants had vehicles that are as well adapted to everyday use as to compe-

"Headroom" has a double meaning in Kevin Kelly's '57 Chevy



tion. Kevin Kelly of Santa Barbara Auto Stereo, for example, has carefully preserved both the looks and the utility of his '57 Chevy 210 wagon. "The car has to be useful," he explained. "Otherwise, it's stupid! This is my only car, and I have to drive it every day."

Kelly's current system is an upgraded version of the one he's been using for the past nine years. He's still running his original Spectron amplifiers, and his old Marantz head unit is still in his dash. His current signal source is an Alpine 5952S CD changer; the Chevy's generous headroom let Kelly mount the Alpine's controller up above the windshield. The changer itself is under the front seat, facing forward. With one magazine in the changer and four extras in the glove compartment, Kelly has 30 discs immediately available, enough for even long trips.

Other upgrades to the system include a center channel, an 85-ampere alternator, and an Alpine 3401 parametric equalizer. Like many competi-



tors, Kelly has a thermostatically controlled fan-cooling system for his amps, which are under the back seat. That seat still folds: "This makes it totally functional, with zero loss of vehicle use," remarked Kelly.

Aside from some speaker grilles and the replacement of painted trim with chrome plating ("It lasts longer than paint and looks prettier"), the car looks stock. The speakers behind the grilles are a mix of models from Audax, SEAS, and Dynaudio. Back where the spare tire used to go are a pair of 12-inch woofers. Since Kelly switched to larger tires, the spare would no longer fit, in any case; he throws in a neatly covered spare for long trips.

Probably the most impressive and unique system I heard was in Richard Clark's '86 Buick Grand National, which garnered more points than any other car, regardless of class. Other contestants lined up eight deep to hear it. Said Clark, who hails from Burlington, N.C., "It's like this at every show. The line never ends."

Sitting in the car, I got a vivid sense of ambience, as if the sound had wrapped in a 270° arc around me. The source of the sound seemed a bit above me, and the instruments spread before me in a semicircle, as if I had belied up to a stage full of musicians. Some instruments even seemed to wrap behind me a bit.

So it was almost a shock to learn that the system has no surround processors or surround speakers. It is straight stereo, though its speakers are divided a bit between front and rear. Sounds below 400 Hz come from the rear of the car, while sounds above that frequency come from a pair of flat-panel tweeters at knee level below the dash. Clark wouldn't discuss the tweeters, other than to say that they're his own modification of someone else's design and that each tweeter now projects a good deal of its energy toward the opposite side of the car.

The enclosures for the woofers and subwoofers behind the back seat, and for the electronics, are shallow enough to make it seem as if the Buick still has

its full trunk capacity. Besides 2,500 watts' worth of Alpine amps, the car holds a third-octave equalizer and a time-corrected crossover by USD.

Although he competes in the unlimited-power professional class, Clark is not professionally involved with car stereo, nor does he do his own installations (they're done by Speaker Works in Orange, Cal.) But he *is* involved with audio, as head of engineering for a company that designs and builds professional audio equipment and duplicates tapes for major record labels. The Buick, which he trailers to events, is his second show car; his other one is a Cadillac Fleetwood that he drives every day and which placed second in the Nationals last year. (He once entered both cars in a contest; for the first two days, they tied, but the Buick finally won.)

Clark tries to keep his work and his car stereo hobby far apart. Competitors think his profession gives him an unfair advantage, and co-workers find his interest in car stereo embarrassing: "I hate to tell my colleagues what I do. They have such a distorted opinion of car stereo. But if I can ever get them to hear it, they change their minds."

Car stereo's reputation, Clark feels, may suffer from the kind of showmanship going on across the fence that divides the contestants from the manufacturers' exhibit tents: "I believe thump is the crowd-pleasing part only because that's the only part the crowd can see. The competitors don't put the cars on display. There's generally no thought given to staging the cars so people can see them, and people have no chance to hear the good stuff, only the embarrassing efforts of the manufacturers to see how much equipment they can cram in. The manufacturers' cars are exercises in consumption; if a given number of speakers and amps is good, they believe, then twice that many must be better. In terms of specs, a lot of this equipment is incredible, remarkably similar to some of the better home equipment. What makes or breaks it is the installations. It's an installer's art." A



"Henry Kloss brought Dolby sound, CrO cassette tape, and large-screen projection television into living rooms, and made the dominant speaker systems of three decades. Now he's at it again at Cambridge SoundWorks, selling direct to the public." *Inc. Magazine*

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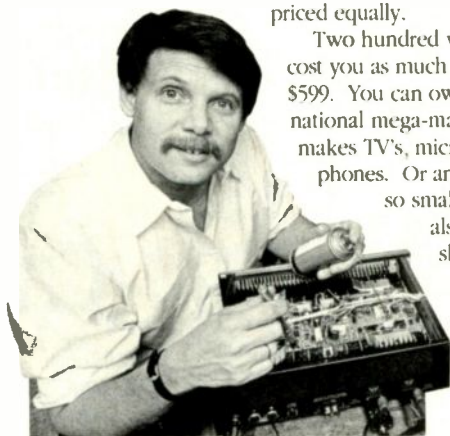
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HOW MUCH SHOULD A GOOD AMPLIFIER COST?

Reflections on the esoteric myths and economic realities of power amplifier design, by Bob Carver.

Thumb through *Audio's* Annual Equipment Directory and you'll see vivid proof that all power amplifiers are neither created equal nor priced equally.



Two hundred watts per channel can cost you as much as \$8,400 or as little as \$599. You can own an amp from a multinational mega-manufacturer who also makes TV's, microwaves and cellular phones. Or an amp from a company so small that the designer is also the assembler and shipping clerk.

Can it be that amplifiers are sonically equal? Some seem to have muscular power reserves far beyond their FTC-rated output. Others sound great until they're challenged by a dynamic passage and then sound like a Buick hitting a row of garbage cans. Some are (to indulge in audiophile jargon) so "fluid" that you practically need a drop cloth under them. Others seem to sound harsh, "metallic" and brittle at any output level.

A casual comparison of perceived sound quality versus price tags may lead to an erroneous conclusion: that an amplifier must be expensive to sound good.

The truth is a bit more complicated: Cosmetic glitz aside, an amplifier's cost is primarily determined by its power supply.¹ In other words, within reason, you generally do get what you pay for when you buy a conventional amp design. But the key word here is "conventional."

My decidedly *un*-conventional Magnetic Field Power Supply is capable of outperforming conventional power supplies of the same size. Result: A significantly better power amplifier value for you.

Let me explain.

NO MAGIC. JUST FOUR CRITICAL QUANTITATIVE FACTORS.

When I fervently state that "*the sound of an amplifier need not be related to its price,*" you might think we're veering off into the land of

Snake Oil and Gimmicks. Quite the contrary.

I and other members of the scientific audio community know that just four factors determine the sonic characteristics of an amplifier:

1. *Current output*
2. *Voltage output*
3. *Power output*
4. *Transfer function* as evidenced by the interrelationship of frequency response and output impedance.

These factors transcend the usual trivial debates over tubes vs. solid state, MOS-FETs vs. bi-polar, Class A vs. AB, silver Leitz wiring vs. copper, gold-plated front panels, WonderCaps and my favorite: hand-ground-open transistors filled with a proprietary crystalline substance that stops ringing (honest, I'm not kidding!). An amp can have any combination of these entertaining variables (plus special bricks stacked on top) and yes, sound wonderful...provided it ALSO has high current, voltage and power output and the correct output impedance.

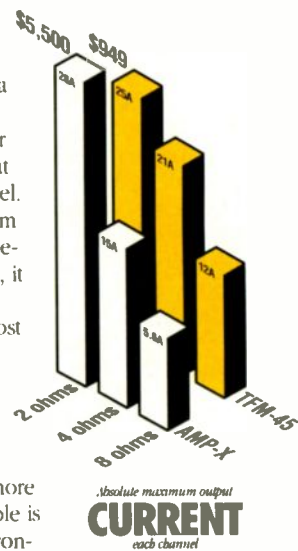
Thus the Four Factors explain why expensive amplifiers generally sound better than cheap amplifiers. But also why that doesn't necessarily have to be the case.

FACTORS 1-3: THE POWER SUPPLY BEHIND THE SOUND

An amplifier's power supply produces current and voltage. A preponderance of one without the other is meaningless.² To maximize SIMULTANEOUS current and voltage output using traditional design approaches costs serious

money. For example, we recently tested a competitor's \$2,000 amplifier that was rated at 20 watts/channel. Believe me, from a parts and materials standpoint, it was worth \$2,000, with most of that money being spent on an amazingly rugged power supply. Another more extreme example is my own ultra-conventional Silver Seven Tube amplifier design. Its "money-is-no-object" power supply helps set the price of a pair of S-7's at around \$20,000.00.

Now, since it is universally agreed among amplifier designers that current/voltage/power output directly affects the sound of an amplifier,



absolute maximum output
CURRENT
each channel

and since good traditional power supplies are costly, price and sonic quality ARE often closely related.

But what if there was a way around the economic constraints of conventional, inefficient power supplies? What if there was a power supply that could deliver awesome simultaneous current and voltage into real-world speaker impedances without shocking your pocketbook?

That's just what my patented Magnetic Field Power Supply does. Without gimmicks, mysticism or loss of bass response. Simply put, a Magnetic Field Power Supply uses progressively more of each line voltage swing as amplifier power demand increases. It's just plain more efficient. How and why this works is explained in our new White Paper called "The Magnetic Field Story Parts I, II & III" which you can get free by calling 1-800-443-CAVR.

Right now, let's consider the tangible benefits. The series of comparison charts in this ad shows how my Magnetic Field Power Supply successfully challenges the previously hard-and-fast rule that high-performance power supplies must be expensive.

Amp X is a highly-respected solid state design rated at 200 watts into 8 ohms. It cost \$5,500. My TFM-45 is rated at 375 watts per channel both channels driven into 8 ohms 20-20KHz with less than 0.1% THD. It has a suggested retail of \$949.

Even more impressive is this same sort of comparison chart with the TFM-45 vs. other amplifiers in its own price range. In deference to how utterly

we trounce similarly-priced, conventional competition, we've confined those charts to our new White Paper.

To summarize: Magnetic Field Power Supply technology allows reasonably-priced power amplifier designs to deliver simultaneous



TFM-45; 375 watts RMS/ch. into 8Ω 20-20kHz with no more than 0.5% THD (\$949 sugg. retail.) and TFM-15; 100 watts RMS/ch. into 8Ω 20-20kHz with no more than 0.1% THD (\$399 suggested retail).

FACTOR 4: TRANSFER FUNCTION

Consider two hypothetical amplifiers with identical power supplies. Same power rating; same gain, etc. Yet they still sound different when powering identical speakers through identical cables.

Why? A fourth quantifiable factor is at work. One that, unlike power supply output, is totally independent of economic constraints.

I've left Factor 4 (transfer function/frequency response damping) until last intentionally. Because until an amplifier can deliver sufficient power with simultaneous current and voltage (Factors 1-3), transfer function is immaterial.

Frankly, I'm guilty of not making this fully clear in the past. Some readers may have gotten the impression that by magically adjusting some arcane parameter called transfer function, one could somehow cause a cheap amp to sound like an expensive one. Nothing could be further from the truth. If there's no guts (power supply), there's no glory (optimized transfer function).

By transfer function, I mean the effect an amplifier's output impedance has on real world frequency response. I don't mean the flat, "DC to light" Rated Full Power Bandwidth found in column 11 of *Audio's* Equipment Directory, which is measured using a resistor as a load. Rather, I'm referring to the frequency response curve that occurs when an amplifier and speaker cables interact with a specific speaker.

As distinctive as a fingerprint, this curve determines the "sound" of each amplifier design. Its warmth or harshness. The quality of the bass. The definition of its upper registers. Even the configuration of the stereo "sound stage" it can create.

My engineering department and I are capable of making one amplifier design sound like

current and voltage levels previously only found in extremely expensive "esoteric" designs. Or to look at it another way, in a given price range (say \$900-\$1,000), Carver simply gives you far more for your money.

another amplifier design to within 99 parts out of 100 (a null of 40dB). For example, we've used Transfer Function Calibration to closely emulate the sonic characteristics of my reference Silver Seven in our TFM-45 and TFM-42 solid state designs. In other cases we've used the process to simply adjust the sound of an amplifier to have pleasant but unique sonic characteristics: in general, a warm "tube" sound with rich, rolling bass and soft yet detailed treble (such as our TFM-22/25, S-7t and TFM-15). Either way, we use painstaking measurement and adjustment processes to finetune output impedance/frequency response. Not magic.

And, needless to say, we start with highly capable power amplifier designs before the Transfer Function Modification process.

ARE YOU INTRIGUED...OR THREATENED?

My Transfer Function Calibrated power amplifiers have suggested retail prices of from \$399 to \$1,000. That I even dare to suggest they can sound as good as designs in the \$2,000 to \$6,000 price range has not endeared me with some audiophiles or underground magazine writers.

That's a real shame, because I have absolutely nothing but respect for well-made, high-ticket conventional amplifiers. Like Rolexes and Lamborghinis, they are a joy to own if you can afford them. But just as a Rolex doesn't tell time any better than the inexpensive watch I'm wearing right now, good sound does not necessarily have to be costly.

If this concept intrigues you, please visit a Carver dealer soon. Bring demo material you're familiar with and be willing to do some critical listening. Compare my designs to competition costing about the same amount as well as to more expensive models.

Your ears alone should be the final arbiter. I feel confident that you will join the tens of thousands of audiophiles who have gotten the best possible value by owning Carver.

Bob Carver

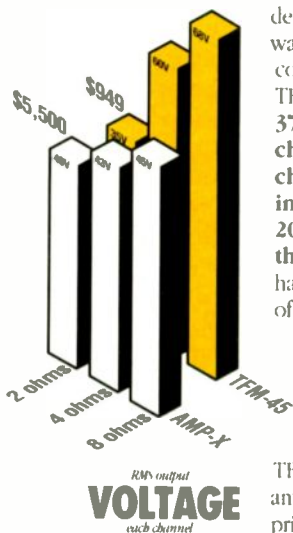
Bob Carver, President



CARVER CORP., LYNNWOOD, WA, U.S.A. 1-800-443-CAVR
Distributed in Canada by Evolution Audio Inc. 1-(416) 847-8888

¹ My definition of "cosmetic glitz" is any part of an amplifier whose sole audio contribution is to cause one's friends to go, "Ooooo!" when they see one's new purchase. My own Silver Seven amplifier's hand-rubbed piano lacquer and solid granite surfaces meet this definition.

² Since power (watts) equals voltage times current, the same wattage can represent significantly different combinations of voltage and current -- and thus very different performance into the same load.



Robert Parker

Jazz Classics in a Mellow Tone



It's been a surprise to many in the record business that reissues on CD of not only mono master tapes but even old 78s have been a big success. The jazz world has seen a massive program of reissues that aspires to surpass the mountain of albums brought out during the LP era.

One of the most interesting series of CD reissues of jazz has been the Jazz Classics in Digital Stereo collection on the BBC Records label. The producer responsible for this marriage of modern (but non-computerized) technology with a sensitive musical appreciation for the priceless original discs is Robert Parker. He is also an Australian broadcaster based in Sydney, a collector of old jazz records (his collection of 78-rpm records totals over 17,000), and a sound engineer.

Parker began airing some of his fabulous collection of 78s on the Australian Broadcasting Corp. He later moved to Britain to produce a series called "Jazz Classics" on BBC Radio. Listeners felt they had entered a time warp, hearing nostalgic old 78s with not only an almost total freedom from hiss, clicks, and pops but

even hearing them in an often quite convincing pseudo-stereo depth and spread. London's *The Sunday Telegraph* commented that Parker's approach has "finally pried out of the antique wax groove everything which was cut into it in the first place." Britain's *The Listener* compared it to "viewing a series of newly restored Renaissance frescos in their original colours."

Parker augments his own mint 78s with those from similar vast collections of some fellow Australians. His love and knowledge of classic jazz is much in evidence in the selection of titles on each CD. They are a deft mixture of the well known with the rare and unusual. The presentation is not overly scholarly, as with some jazz reissues, even though matrix numbers, session dates, and performers are listed. The idea is to appeal to modern record buyers, many of whom may be hearing the original recordings by these jazz greats and almost-greats for the very first time.

Lately Parker has extended his special techniques into other areas of early popular music with a new series, *The Classic Years*, which includes recordings of Bing Crosby and Fred Astaire. The crisp sonics and clarity retain the hallmarks of his restoration efforts.

J.S.

John Sunier





Fats Waller,
1934



Bix Beiderbecke,
1923



Joe Venuti, Harry Goldfield,
and Eddie Lang,
1930

How did you get started in the restoration of classic 78s?

Through record collecting. I am an incurable collector of old shellac records. I started when I was a teenager and survived the onslaught of the LP, deciding that my 78s really sounded better as 78s than listening to them as LP transfers; I kept on collecting and never stopped.

I've done that myself with some of the LP transfers of 78s and the originals that friends had; the LPs always ended up sounding much poorer than the originals and I wondered why.

Well, when I started collecting records it was before the LP era, about 1948, and I became interested in things that had been recorded in 1928 and listening to them on the equipment of that day, just before the high-fidelity era arrived. There was no technological difference between listening to a Bix Beiderbecke recording made in 1927 and a modern pop record by Bing Crosby or The Andrews Sisters made in 1947. Style was different, music content was different, but the technology was basically the same.

When the LP arrived and they started to transfer 78s, a terrible dilemma was introduced because they had sold this wonderful new thing. It was the greatest thing that could have happened to recording—particularly for classical music—to have a longer playing time and a quieter surface. So what did they do with these scratchy 78s? Well, by the 1950s, transfer equipment, amplifiers, and loudspeakers were able to reproduce the full audio range. When you reproduce the full frequency range of a 78, you're reproducing mostly surface noise because

all of the upper high frequencies have nothing but noise in them. So paradoxically, as the equipment got better, the 78s started sounding worse compared to modern recordings. But they also started to sound better because we could hear, for the first time, the extent of the high-frequency information that had been recorded in the '20s by engineers who'd never heard it: The speakers and the disc players could not reproduce the full range that had been inscribed into the wax. To transfer the recordings to LP, they did the obvious thing and filtered out the scratch using high-frequency filters. In doing so they also locked out a lot of the good high-frequency information. That was why if you made [mental] allowance for the scratch (which we did as dedicated collectors), the record sounded better played through 78-rpm equipment (with a certain amount of the top rolled off to minimize the noise) than they did coming off LPs.

The LPs also seemed to lack bass end compared to the originals.

Well, when you lop off the top, you feel duty-bound to lop off the bottom too, so that you get a balanced midrange. Some of it is so extreme that the transfers you hear today may sound as if they are coming through a telephone. They have no highs and no lows at all. Of course, the bottom end of 78s is difficult to do justice to, because there's often a tremendous amount of rumble recorded into the discs. The turntables were not nearly as good as we have today. So if you want to get bass, you've got to devise methods of recovering the bass and minimizing the rumble. You need quite sophisticated equalizing techniques to do that.

The same thing is true for the high end, where you've got to find ways of minimizing the noise content without destroying the high-frequency end.

What do you start with? Do you go to the metal parts (i.e., the plated masters, mothers, and stampers) from which new discs are pressed?

I start from pressings almost invariably. I don't have any access to metal parts, and in any event metal parts are a mixed blessing these days because they have begun to corrode very badly. You very often find even a master made in the '50s is not as good-sounding as a pressing originated in 1936. If you can find an unworn pressing, it will generally be likely to sound brighter and less distorted, with less breakup in the sound content, than a later new pressing made from a source that's been going through the separation of the metals for several generations because the metals start to deteriorate and the sound quality goes down.

One of the most time-consuming things that I have been doing is trying to find first-class source material, pressings which were made in good-quality shellac or, if it's at all possible, in vinyl—pressings which were made obviously in the postwar era, and then tracking them down so that I can be certain of what I want to work with. My objective is to present in my albums a selection of the great jazz artists playing at their peak or at least representative of the major part of their career and also sounding as good as it is possible to get them to sound, which means that I won't reproduce something from a really worn and damaged record. I try to find records in good condition to work from, and then at

Frank Driggs Collection

A pressing from 1936 often sounds better than a '50s master because the source's metals may have separated after several generations.

least I've got a fighting chance of being able to retain all the high frequencies that were recorded in the disc and to get the bottom end as well.

This breakup problem that you mentioned is something that I've noticed in a lot of transfers. Do you prevent that by having the proper stylus radius when you play the disc?

Well, very often you'll find that there's damage in one part of the groove and not in another, so if you'll experiment with different stylus sizes, you are liable to come upon one which sounds dramatically better. Finding the right stylus is most important. In my briefcase, I have 15 different-sized styli for playing back 78-rpm records.

What do you do after you have the source you want? What's next? Equalization? Noise reduction?

Yes. I use an electronic switching device which I reproduce in stereo. The electronics can sense which groove wall has the quieter, less noise-filled sound, and it switches to the side which produces the cleaner sound. So you get a lot of noise reduction, without having to do any filtering at all, as a first step, and then just apply very careful equalization, using every known means. I use basically all analog equalizing but I do also have the ability to do some digital equalizing, which can be very handy if you want to remove a hum. Sometimes there's a 60-cycle hum recorded on the disc by some fault in the amplification system, and that sort of sound responds very well to digital filtering rather than analog filtering.

And do you also use parametric equalizers in the analog mode?

Yes, parametric and graphic.

I know a lot of other people doing restorations use these same pieces of equipment, like the Packburn noise suppressor, but they don't seem to get the impact and clarity that you do. What's your secret?

Well, the secret is in the way in which you *listen* to the music, I think. There's no secret that I can tell you in terms of "You do X." There's no black box! Every record is done while listening to it, and every record is different. I have in my equalizing about 50 variables to play with and may play with all of them during the course of experimenting with one record. It may take me from hours to days just to get the sort of result that I want, or I may *never* get it.

Some records have such peculiarities as to defeat you, so it is really a subjective thing that I am doing. Everybody who works in this field comes up

with a different result because it relies on two things: How you hear music yourself—how you react to it—and what your expectation is of what you can get from the original material. A lot of the problem in the past can be traced to the fact that the engineers who were doing the transfers had very low expectations of what quality of sound could have existed in the early recordings. And so they treated the sound accordingly and said, "Whack the highs with a low-pass filter and then take all the bass out down at the bottom to compensate." That really is a reflection of the recording engineer's attitude to the original.

I took a different attitude. I took the positive attitude that, theoretically, if you make a recording even on the worst equipment, you have captured the full-range frequency response; it should be possible to recover the good



Red Nichols and His Five Pennies,
1929



Fred Astaire,
1936

Stereo lets you hear more of the musical structure that was part of the genius of people like Morton, Oliver, and Ellington.



Johnny Dodds, 1938

sound image from that recording if you can just find the means of equalizing it and the ways of treating the distortion and so on. So if you make the positive assumption that the sound quality is good and that lurking somewhere in those grooves is a representation of a real performance of live music produced by great live musicians at the time, then it becomes an archaeological dig to try and dig out what you know *should* be there—a more realistic sound picture of that band at work.

I've done quite a lot of original recording and like to listen to live performances of acoustic instruments as much as I possibly can. I love the sound of live instruments playing, and I love the sound of them playing in a nice live acoustic space which gives me all the information that I need about the instruments and so on. And I like to

hear them with two ears so that I've got directional information which helps me to separate out the instruments.

So having that preference, I decided that I would try to find a means of translating mono recordings into wider range, more realistic-sounding recordings in a stereo sound field with a more recognizable ambience than was allowed to be recorded by the original recording engineers. They didn't like reverberation [in those days]. For whatever reason—aesthetic or purely practical—they hung drapes all around everything when they started making electrical recordings, and they made them sound as flat as a pancake. This was a terrible thing to do to good live music, in my view.

Well, they were already sound-treating studios like that for the early radio broadcasts too.

Yes, for whatever reason they did it, they did it, and in my listening experience it diminishes the impact and the emotional power of the performance. If you've got Louis Armstrong at his prime in 1927 really belting out, very loud, he's got tremendous volume as a player and it's coming back to you flattened by drapes hanging on the walls and in mono, so that the whole band is coming out of a single point. To my way of experiencing music, that diminishes my ability to enjoy the performance. I have to work on it. It becomes hard work, particularly if I've got a lot of surface noise to listen to.

There's a whole generation of people now who haven't listened to 78s, maybe never even seen one. They're really being denied access to these early recordings because of this technological barrier that has grown up which wasn't there when I started listening. As I said earlier, everything in the era just before the LP sounded the same technologically. Now suddenly these 78s sound like antique collectors' items, and in a way that's what they've become. They've become almost the province of specialist collectors who enjoy the music and are prepared to put up with the noise. But there's a whole lot of other people who are interested in music and in jazz who perhaps wouldn't take the trouble to listen through the antique sound. I'd like them to be able to listen to this jazz in a way which is pleasurable on modern equipment.

And those purists who think it's sacrilegious to manipulate the originals by adding stereo rechannelling can just simply flip the switch to mono if they want, right?



Duke Ellington, 1933



William Russ

Frank Driggs Collection



Louis Armstrong,
1931



Jelly Roll Morton,
1929



Bing Crosby,
1932



Absolutely, it's compatible. I did take care to use a system which is mono-compatible so that it does combine back into mono. They can't remove the reverberation that I put in, but if someone doesn't want to listen to it that way, then they won't. That's fine. I'm not trying to dictate that all old records should be heard in this way. What I'm saying is that we should have the opportunity to hear them in this way, as well as hearing them in anthologies which have every take of a given artist on any session in consecutive order, with all the outtakes as well. But I'm not doing that.

I want to make an album of Louis Armstrong or Jelly Roll Morton or Duke Ellington for the listener who may not be a specialist in early jazz but is just interested in good music. You don't have to be interested in jazz to need to have in your collection a recording of Jelly Roll Morton's Red Hot Peppers because of their tremendous importance to the development of modern music. And I'd like for people, if they want to get an album of Jelly Roll Morton, to be able to have representative works and to be able to listen to them in really good-sounding Compact Disc versions.

The acoustic recordings seem to be restored just about as well as the electrical ones. With other transfers, it seemed like the acoustic ones really sounded terribly dated compared to the ones after 1925.

They're much more difficult. I haven't done nearly as many acoustical recordings because they are really difficult. There are so many other variables that are frequently being placed in the way of getting a realistic sound picture:

The roll-off, resonances, the horns and diaphragms, and the rather strange balances.

At least when electrical recording came in, the balance between the instruments started to be something quite realistic [and can be] spread out into a stereo sound field without sounding lopsided. Now the object is to get a lot of depth information, as well as width, to give the ears and the brain a chance to think we're listening to stereo. We can separate out the instruments, although I'm not able to pinpoint placement of instruments in a sound field. I think that's important because you really don't get that experience in live performance anyway, unless you are in an absolutely perfect acoustic space, which very rarely happens. You generally have so much information coming from all sides that it tends to blur the picture.

Really, it's only stereo recordings that produce this absolutely pinpoint imaging. I know people whose passion in life is to listen to recordings in which everything is absolutely perfectly in its place. Well, I'm not trying to do that and I don't think it's important. What I'm trying to do is to give an impression so that the brain can then start to concentrate. And you actually begin to hear all sorts of little details in the music. Listen to them again in mono and, of course, they're there.

With stereo, there's definitely the advantage of being able to hear much more of what is going on in the structure of the music. And that adds to the enjoyment, because you begin to appreciate all sorts of little subtleties in combinations of instruments which hadn't been readily apparent before

and were a part of the genius of people like Morton, Oliver, and Ellington. They really did care about the fine detail, and even though they probably didn't think it would ever be heard on the recordings, it's there.

In the '60s, a lot of the record companies were reissuing some rechanneled mono material, but it didn't go over very well with the public because collectors felt it had distortion and sounded unnatural. What's different about this and the way you rechannel for stereo?

I don't know. I really don't know what they did that made it so terrible! Because it was. I hated it like everybody else. It wasn't the idea; I think they had the right idea. I think most of the problem was actually in the transfers. It is so easy to make 78s sound distorted, and it is so difficult to make them sound clean when you are trying to do something more than just playing them back straight through from a pickup through a sound system.

When you're actually trying to remove the surface noise and doing all these complicated electronic things to the music, it is difficult to maintain the clarity. You have to be very careful of the mechanical side of it; you have to be very careful that you've got the right stylus, the right tracking weight and so on, to get the maximum quality out of the grooves before you start trying to do things with it. I think that's where a lot of the problem has been.

There are reissues still being produced today where I just do not understand how they produce so much distortion from what are reasonably clean sources. There is a lot of distortion in the top end of 78s. Anybody who says

Many people interested in music and jazz won't make the effort of listening through the antique sound.

Bessie Smith,
1923



they're well recorded is really kidding himself because the 78 was a very primitive, early attempt to do something very complicated and it worked extraordinarily well. There's a lot of very good clean information, but there's also a lot of distortion. If you are not aware of that, you can wind up accentuating the distortion to the detriment of the clarity of the music.

On some of the early ones, it seemed like they were just putting all the treble on one channel and the bass on the other, and adding a lot of distortion in the bargain.

That was probably putting demands on the stereo cutting system which were unacceptable. It's not a very good system to put the top on one side and the bass on the other, because you wind up with a very unnatural-sounding stereo. Sometimes it works quite well with the symphony orchestra—but that's about all.

The Orban stereo synthesizer unit you're using breaks the signal up into five different spectra, is that right?

That's right. And like everything else, it's the way in which you use it. It's hours and hours of experimenting. Saying, "should we do it this way or that? Does this record sound better with the settings in another way?" All of these things are considered. You've got so many variables.

Have you turned your attention to cylinder records or Edison discs as yet?

Not very many well-known artists were recorded on these, were they?

No, but there are some quite good jazz records in the Edison Diamond Disc catalog. The cylinders I haven't really worried very much about, because again there's very little material in the jazz field and a lot of it is dubbed. The things that I'm interested in, generally the diamond discs, were the originals, and the cylinders were dubbed from the diamond discs. That doesn't help their sound. Besides, cylinders are very difficult because they get rippled with age; they shrink, which gives a flutter that is terribly difficult, if not impossible, to do anything with. If anybody can come up with a solution to that, I'll be delighted to hear of it.

At what point do you go to the final digital copy? After you add the stereo rechannelling?

I do the whole thing in real time, straight to digital.

Just one pass while you do all the equalization, stereo and everything?

Yes, everything all in one hit because I don't want to be doing generations; once it goes onto digital, then other things can be done at a later date if need be. For instance, I might do some digital editing to clean up any cuts between different copies of a record, in case there is damage on one so that I can make a clean composite. I prefer to work in real time because I want to hear what I am doing and I want to be able to listen, to refer back all the time to the original record to hear untreated against treated sound, to try and avoid these things where, as we were talking about earlier, a lot of distortion suddenly creeps in and it starts to sound like an ugly mess when the original doesn't.

Do you edit in the analog domain? Do you take one part that has one type of EQ and join it to another part that has a different EQ, or do you just go all the way through one whole selection?

If I edit, I do digital editing. Sometimes, I make sections. I might need to do an opening section and then use a smaller stylus diameter in the middle, for instance. I prefer to do editing in digital. Going to analog, I only use sections if I'm working with really terribly damaged material so that I can start scraping away tape to minimize noise (which, of course, you can't do on digital in the same way).

But I only do it if I am dealing with really damaged material, which I try to avoid. It's important that we preserve the damaged material, and that is being done by many other people in the

Highlights from Robert Parker's Collections

The following series of recordings issued by BBC Records are distributed in North America by Allegro Imports and should be available through finer record stores.

Jazz Classics in Digital Stereo

- 588 New Orleans, 1927-34
- 589 Chicago, 1926-34
- 590 New York, Vol. 3
- 597 Louis Armstrong, 1925-31
- 598 Fats Waller, 1927-34
- 601 Bix Beiderbecke, 1924-30
- 602 Bessie Smith
- 603 Johnny Dodds, 1923-29
- 604 Jelly Roll Morton, 1926-34
- 643 Duke Ellington, 1927-34
- 644 Eddie Lang & Joe Venuti, 1926-33
- 647 Hot Town (lesser-known jazz pioneers of the '20s and '30s)
- 664 Red Nichols & Miff Mole
- 682 Fletcher Henderson, 1929-37
- 721 Clarence Williams, 1927-34



Classic Years in Digital Stereo

- 648 Bing Crosby, 1927-34
- 651 Love Songs, Vol. 4
- 652 Silly Songs, Vol. 5
- 654 Movie Musicals, 1927-36
- 655 Swing! Big Bands, 1929-36
- 665 Fred Astaire, 1926-37
- 666 Swing! Small Groups, 1931-36
- 680 Hot Violins, Vol. II
- 704 The Roaring Twenties



field. That's not really the purpose of what I'm doing. If I've got something which is not damaged to the point where it begins to sound dreadful or substandard when it goes into the album, then I will put it onto quarter-inch tape. But that's a very small percentage of tracks.

Since you made reference to misguided noise reduction and do yours entirely in the analog domain, I gather that computerized noise reduction fails to pass muster with you.

Right. In my view, nothing available at the moment works. The best declipping for 78s seems to be the British CEDAR system, which I am now using. But the computer noise-reduction systems

currently in use are all, in my view, sonic disasters! I have never received any tests that I would want to use on a CD. The *noise* goes, all right, but so does the inner detail, the dynamics, and what I can only describe as sonic sweetness. Once the sound has been through the computer mill, no amount of equalization can put it back together again.

There seem to be as many philosophies of audio restoration as there are different approaches to tweaking the best sonics from, say, an analog turntable or a CD player. How do you classify the different approaches?

There are really only two categories: Archival and enhanced. The moment

you decrease the noise or alter the equalization of the original, you're into enhancement. From there on, it's only a matter of degree and objective. If the objective is to be purist, then the moment a filter is applied, your goal is lost. The only real archival purists are those who play the discs with flat EQ, on state-of-the-art reproducers—the way, in fact, I check all my work in progress with an A/B comparison switch on the mixing desk. If the objective is to make it sound the way it was heard in the 1920s, then that's not purist. I call them the impurists—the guys who want to get in the way of what actually happened in the recording studio and you and me!

▲

D · I · G · I · T · A

If you had sampled and tested as many CD players as I have since CDs were introduced in 1983, you would surely share my conclusion that recent home players measure and sound a whole lot better than their predecessors. When *Audio* suggested that I closely check a few portable players, the idea appealed to me. I was anxious to learn whether manufacturers skimped on digital processing in CD players that they knew would be used more for casual listening on the go than for critical listening in a home environment.

Two of the portables I tested are positioned by their designers as being beyond even the home-unit norm in their features and in the quality of their sound reproduction. The Sony D-555 Discman augments ordinary CD playing with a host of features, including digital signal processing



LEONARD FELDMAN

• L • D • U • E • L •

Three Portable CD Players

functions that have never appeared in a CD player—portable or otherwise. For the DCP-100, on the other hand, Denon emphasizes ease of use and dual D/A converters with 20-bit filtering and eight-times oversampling. As for NEC's HES-CDR-01 TurboGrafx CD player, it is in a class by itself; its primary function is as an adjunct to the company's TurboGrafx-16 video game and video-graphics display system. However, because of some of its nearly unique digital features, such as the ability to play CD-graphics discs, the NEC will appeal to some readers very strongly (see sidebar).



D · I · G · I · T · A · L

The Sony D-555 has digital equalization, compression, surround, and bass boost, while Denon's DCP-100 has advanced D/A processing and simplicity of use.

Sony D-555 Features

In terms of its straight CD playing functions, the D-555 has many of the features found in Sony's home units. You can locate a particular selection by audible scanning, by direct track access, or even by index access. Repeat play can be used for a single track, an entire disc, a previously selected musical segment, or a series of programmed tracks. There's also random play (or, as Sony calls it, shuffle play) and the capability to program up to 22 selections in any given order. It can be powered from its built-in, rechargeable battery, from a supplied a.c. adaptor, or from an optional car-battery cord.

In addition, Sony has incorporated four digital functions for adjusting sound quality to meet the demands of the different environments in which a portable might be used (e.g., outdoors, while driving a car, etc.). There's a digitally based five-band

graphic equalizer, a surround-sound circuit, a bass-boost circuit, and a dynamic controller or compressor. The degree to which any of these digital enhancements is used is shown in a secondary display window on the player's top surface.

Denon DCP-100 Features

One important feature stressed by Denon is the length of time that the DCP-100 will play on battery power. Because the DCP-100 can house two rechargeable batteries, it can play for more than four hours without recharging. It can be programmed to play up to 32 selections and has all the usual repeat-play modes. Like the Sony unit,

it provides for automatic random play of the entire disc or a program.

In terms of ease of use, the DCP-100 is unsurpassed, largely because its controls have been grouped on the top as well as on the front of the unit. Controls are therefore accessible in the player's most used positions: Standing up in its soft case and lying on a car seat, a table, or a desk. Charging the battery (or batteries, if two are used) occurs when the unit is connected to the a.c. adaptor.

Sony D-555 Controls

On the front of the D-555 is a "Hold" switch that locks all other operating buttons, preventing them from being accidentally pressed while carrying or transporting the player. The display window on the front surface normally shows track number and elapsed time. Three other buttons are on the front panel. "Key Mode" sequentially changes the two search buttons' functions from track-to-track advance, to fast audible search, to index advance. "Play Mode" sequentially selects intro scan, the five repeat modes (single track, full disc, A-B section, shuffle play, and program), and then normal play again. "Enter/Remain" changes the display from remaining time of current track to remaining time of the entire disc and, during programming, is used for storing selected tracks in memory. It's pretty obvious that Sony, by assigning multiple functions to these keys, has managed to provide a great number of functions without overly complicating the control layout.

A headphone jack is on the right side panel of the D-555, while a remote jack and an optical digital output jack are positioned on the left side panel. Since all of this player's signal processing takes place in the digital domain, equalization, surround, bass boost, and compression affect the sig-



D·U·E·L

nal at the digital output port, not just at the analog jacks. A stereo mini-jack for line output and an input jack for 9-V d.c. power are on the rear panel.

Pushbuttons along the top surface of the unit include the two fast-search buttons, a stop button, and a play/pause button. An "Open" button pops the lid for access to the disc compartment. Additional controls on the lid itself include buttons for volume up and down, an "Effect Mode" button (that sequentially chooses equalization, surround sound, bass boost, and digital dynamic compression), a band-select button for the graphic equalizer, and "+" and "-" buttons that adjust the degree of the particular effect chosen. A display window in the hinged lid nor-



MANUFACTURER'S SPECIFICATIONS

Sony D-555 Discman

Frequency Response: 20 Hz to 20 kHz, ± 1.0 dB.

S/N: Greater than 90 dB.

Output Level: Line, 0.7 V; optical, -21 to -15 dBm; headphone, 9 mW at 32 ohms.

Dimensions: 5 in. W \times 1⁵/₁₆ in. H \times 5¹¹/₁₆ in. D.

Weight: Approximately 1 $\frac{1}{2}$ lbs.

Price: \$450.

Company Address: Sony Dr., Park Ridge, N.J. 07656.

For literature, circle No. 97

Denon DCP-100

Frequency Response: 20 Hz to 20 kHz.

S/N: 91 dB.

Dynamic Range: 90 dB.

THD: 0.006%.

Dimensions: 5.4 in. W \times 1.5 in. H \times 6.6 in. D.

Weight: 1 $\frac{1}{2}$ lbs., including battery.

Prices: \$400, including a.c. power supply and charger; AP-10 stand-alone charger, \$30; AP-11 extra battery, \$15.

Company Address: 222 New Rd., Parsippany, N.J. 07054.

For literature, circle No. 98

NEC TurboGrafx-16

Prices: HES-CDR-01 CD player, \$399.99; TurboGrafx-16 video game, \$159.99; TurboStick controller, \$44.99; TurboPad controller, \$19.99; TurboTap multi-player adaptor, \$19.99; TurboBooster accessory, \$34.99; game cards, \$20.99 to \$81.99; CD games, \$61.99 to \$81.99 (see sidebar).

Company Address: 1255 Michael Dr., Wood Dale, Ill. 60191.

For literature, circle No. 99

mally shows the level of the left and right channels but can be switched to indicate settings of the digital effects. This little player even has a demonstration mode (initiated by pressing the "EQ," "+," and "-" buttons simultaneously). This feature samples the four effects functions, one after the other for approximately 10 S each (20 S for the equalizer), to give you an idea of how these functions will affect the sound of a disc as it is played.

Denon DCP-100 Controls

The DCP-100 has far fewer controls than the D-555, so Denon has also configured some of them to do double duty. As on the Sony unit, the Denon player has a hold control located near the display window on the front panel. Also found on this surface are a display-mode selector button ("Set"), a "Mode" button (for selecting the type of repeat play and for programming), and a thumb-wheel volume control. The headphone mini-jack is on the right side of the player, while the line-output mini-jack is located on the left side. A jack for connecting an external, 9-V d.c. power supply is on the rear panel.

An "Open" button is on the top surface of the unit, as are buttons for play/pause, stop, and forward and reverse search. If the search controls are

PLAYING CD GAMES

NEC's expandable video game system uses an advanced, 16-bit graphics processor that allows game programmers to use more heroes, villains, and other characters in games and to create more realistic images. Video games for the TurboGrafx-16 system normally come programmed on game cards no bigger than credit cards, but the system's optional CD player produces high-quality stereo sound for game play and allows for new and advanced types of games. The CD player uses standard Compact Discs as well as CDs with graphics. It is the only video game peripheral of its kind. Since CDs can hold up to 550 megabytes of information (the equivalent of approximately 275,000 typewritten pages or approximately 2,000 standard game cards), adding this player to the NEC TurboGrafx-16 system will provide a dramatic new level of experience in video games. The characters on screen have real voices, not cartoon speech balloons. Explosions sound real, and so does the music associated with the games.

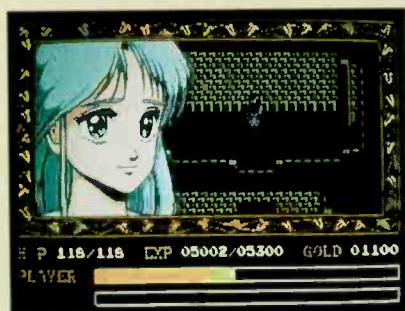
The HES-CDR-01 CD player is normally interfaced with the rest of the TurboGrafx-16 system. Once that is done, it can be used for games, standard CDs, and CDs with encoded graphics. Some record companies, such as Warner

Bros., have added graphics to Compact Discs so that you can watch visual images, such as photos of the vocalist featured on the disc, lyrics in multiple languages, or whatever images the record company wants to include. These

Linking the NEC CD player to a TV via the TurboGrafx-16 game adaptor gives it a full-featured control panel and display, though the controls are actually operated from the small controller shown.



Game graphics from Ys: Book I & II (NEC TurboGrafx.TGXCD1002).



"CD+G" discs currently sell for about the same price as standard music-only CDs.

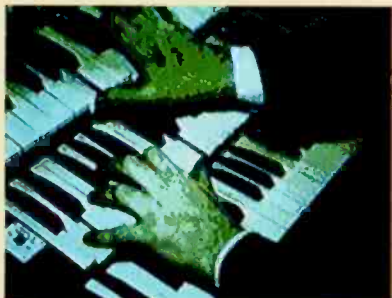
When the NEC TurboGrafx CD portable is attached to the interface unit, inserting a special card in the game-card slot turns the system into a full-featured CD player. In this configuration, the CD controls and displays are shown on whatever video monitor or TV set is hooked up to the system and are operated by the TurboPad or TurboStick game controllers. The screen

shows a track calendar (like those found on many CD player displays), track and index numbers, time (elapsed or remaining, for the entire disc or current track), audio level, operating mode, and a full set of simulated "pushbuttons" for programming and operation. Using either type of game controller, you move a disembodied hand with outstretched finger to the function "button" you wish to activate, then press a real button on the controller. The functions available include all the usual CD transport controls, a 10-key pad for direct track selection and programming, a fade-out feature that slowly lowers volume and pauses at the beginning of the next track, intro scan of the first minute of each track, and repeat (of the disc, program, or any user-defined section). Automatic random play can be selected from the on-screen menu, as can a feature called "Space" that inserts a 4-S pause between tracks.

As I mentioned earlier, the HES-CDR-01 CD player is really meant to be used with the rest of the TurboGrafx-16 system, and from the description of how flexible the player becomes when it is in this system, you can appreciate why the player and game components were "made for each other."

L.F.

CD + G graphic from John Rose, Organ: The French Romantics (Towerhill CD-900101).



touched briefly (for less than 0.5 S), they serve as track advance or reverse buttons. If you hold either of these controls down longer, their function changes to audible, manual search.

The display window shows the player's operating mode in addition to showing track number and the usual types of time indication (time into the current track, remaining time of the current track, and remaining time of the entire disc). An indicator starts flashing when the battery power gets too low.

NEC HES-CDR-01 TurboGrafx Controls

Since this player is intended primarily for use with NEC's TurboGrafx-16 audio/video entertainment system, it has the fewest controls. As explained in the sidebar, that doesn't mean you would have any less control flexibility with this player than you would with the Sony or the Denon—provided you hook the player up to the rest of the TurboGrafx-16 system. On its own, however, the HES-CDR-01 TurboGrafx CD player is equipped only with a headphone volume control and jack, buttons for forward and reverse trackskip, play/pause, stop, and repeat, plus connections for line-level output, d.c. input, and the interface with the rest of the video game system. The tiny

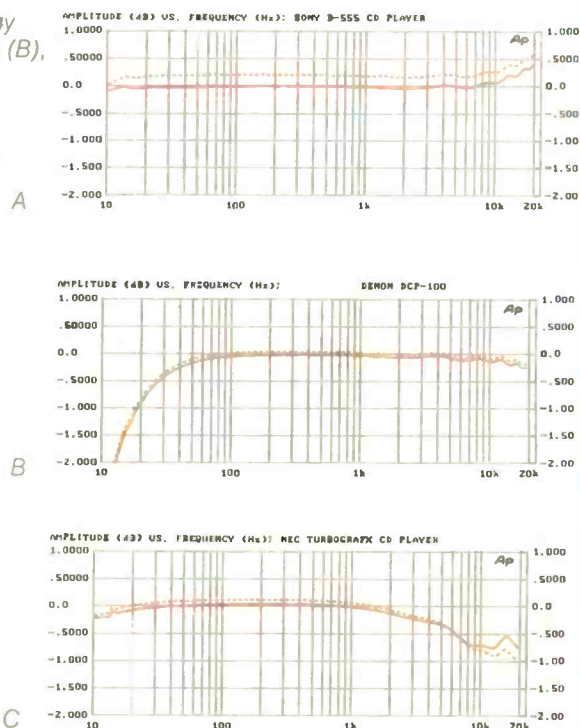
circular display on the CD player's top surface shows only the current track number, though other information can be displayed on a video screen when the TurboGrafx-16 system is connected to the player.

Measurements

Figures 1A, 1B, and 1C show the frequency response of the Sony, Denon, and NEC players, respectively. The Sony exhibited a slight rise in response at the treble end, amounting to no more than around 0.5 dB. While the Denon unit had somewhat flatter response at the high frequencies, there was obviously a slight roll-off at the extreme bass end. At 20 Hz, response was down 1.0 dB for this sample and was about -0.5 dB at 40 Hz. The NEC unit had no such bass roll-off but was down by between 0.5 and 1.0 dB for frequencies from 6 kHz up.

All three units produced inaudibly low distortion at maximum recorded level. In the graphs showing THD + N versus frequency (Fig. 2), the Denon unit had the lowest figure at 1 kHz (0.02%, as shown in Fig. 2B), followed closely by the Sony unit (slightly more than 0.03%, as shown in Fig. 2A), with the NEC unit coming in third (0.06% to 0.07%, as shown in Fig. 2C). The graphs in Fig. 3, which illustrate how THD + N for a 1-kHz test signal varied with recorded level, pretty well con-

Fig. 1—
Frequency response of Sony D-555 (A), Denon DCP-100 (B), and NEC HES-CDR-01 TurboGrafx (C) portable CD players. Here and through Fig. 4, solid curves are for left channel, dashed curves are for right channel.



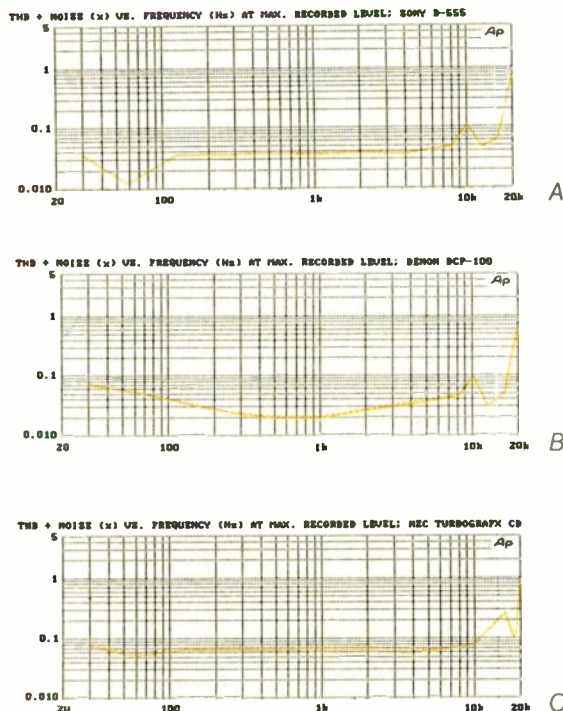


Fig. 2—
THD + N vs. frequency for
CD players from Sony (A),
Denon (B), and NEC (C).

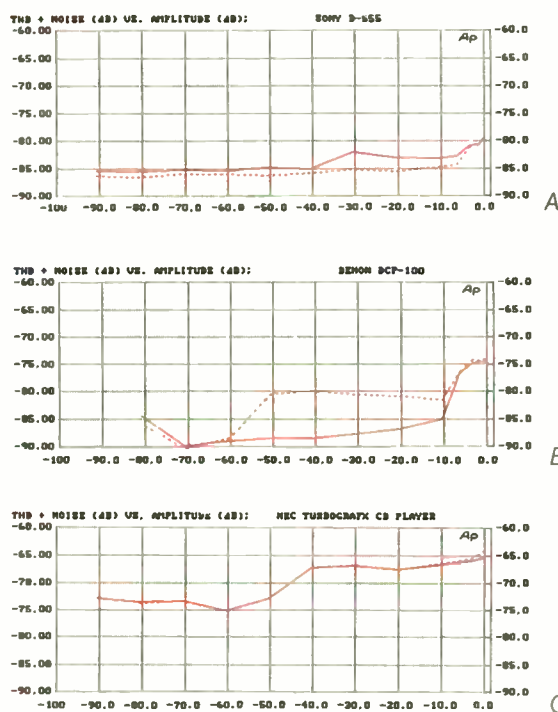


Fig. 3—
THD + N, referred to
maximum recorded level,
vs. signal amplitude for
CD players from Sony (A),
Denon (B), and NEC (C).

firming the results in Fig. 2. A somewhat puzzling result can be seen in Fig. 3B, for the Denon player. Although THD + N at maximum recorded level (0 dB) was around -74 dB for both channels, corresponding almost exactly to the 0.02% reading obtained earlier, at lower recorded levels the right channel's performance was considera-

bly worse than that of the left channel's from -10 to around -60 dB. The NEC player, measured as a stand-alone unit, exhibited higher levels of distortion plus noise during these tests, as shown in Fig. 3C.

The A-weighted signal-to-noise ratios (referred to maximum recorded level) were nearly 94 dB for the Sony,

96 dB for the Denon, and 85 dB for the NEC. Spectral analyses of residual noise for the players are shown in Fig. 4. The chief reason for the NEC's higher noise level seems to be rather substantial noise peaks at the power-line frequency of 60 Hz.

Figure 5 shows how separation varied with frequency for the players tested. Separation for the Sony ranged from 76.5 to 80 dB at 1 kHz and decreased to 55 dB at 16 kHz. The Denon had somewhat lower separation, 74 dB at 1 kHz and 50.5 dB at 16 kHz. Just about the same results were exhibited by the NEC player, 72 to 74 dB at 1 kHz and 50 dB at 16 kHz.

The Denon DCP-100 had excellent linearity, with virtually no deviation at -80 dB, while the Sony and NEC players showed deviations of about +2 and -2 dB, respectively, at -80 dB. The EIAJ dynamic range measured close to 88 dB for the Sony, just over 89 dB for the Denon, and about 83 dB for the NEC. The EIA dynamic range was 107 dB for the Sony, 111 dB for the Denon, but only about 95 dB for the NEC player.

Use and Listening Tests

Since the Sony unit had extra digital signal processing, I wanted to take at least one measurement of these features. In the owner's manual, Sony illustrates suggested settings of the graphic equalizer for various types of music (rock, vocals, background music, '50s sound) and for obtaining a "natural sound" (Sony's terminology, not mine) in a car. I set the graphic equalizer so that the display on the top of the D-555 appeared as illustrated for optimal sound in a car. I then plotted a new curve for frequency response and obtained the results shown in Fig. 6. Using one of those cassette-like adaptors that couple signals from a CD player to the tape heads of a car cassette player, I listened to the D-555 while driving my car and found that overall tonal quality was better with this EQ setting. However, I was able to improve upon the recommended settings by pulling the amplitude around the equalizer's 250-Hz band down a bit

D · I · G · I · T · A · L · D · U · E · L

The Denon provided the best sound quality, the Sony had the best audio features, but the NEC was the only one with graphics.

further than shown. The optimum setting will probably vary from one automobile interior to another. Of particular interest to me was the D-555's digital compressor, which allowed me to enjoy CDs in my car without having to constantly readjust the volume control in my audio system as the music's dynamics changed. This feature will be especially useful if, like me, you like to listen to classical music while driving. If your taste runs more to rock and pop music, you'll probably find that it is less effective and in some cases may hardly be audible.

I listened extensively to all three players in a home environment, both through headphones and by connecting their line outputs to my reference audio system. If I had to give overall rankings to the players in terms of the quality of their sound reproduction, I would place the Denon first, the Sony unit a close second, and the NEC a distant third.

Of course, the Sony offers the most features, quite apart from its regular playback capabilities. The digital surround effect is quite remarkable when listening through a good pair of headphones. You would think that surround sound effects cannot possibly be effective unless you listen through front and rear speakers, but you'll be pleasantly surprised when you slip a pair of headphones on and listen to good stereo source material played back on the Sony D-555.

If what you want is just a good portable player that is easy to use and that boasts performance specifications almost (but not quite) as good as those found on home units, you may want to select the less elaborate Denon DCP-100 as your portable of choice. Finally, if video games and video graphics from a CD intrigue you, check out the NEC TurboGrafx-16 player, but make certain you buy the whole TurboGrafx-16 system. If you go for this system in its entirety, the fact that you can also play regular audio CDs may well become a secondary consideration. You'll be so busy playing games and watching CD graphics on your TV monitor that you may not care very much about the audio quality of the system's CD player portion. **A**

Fig. 4—
Spectrum analysis of residual noise when playing "no-signal" test track for CD portables from Sony (A), Denon (B), and NEC (C).

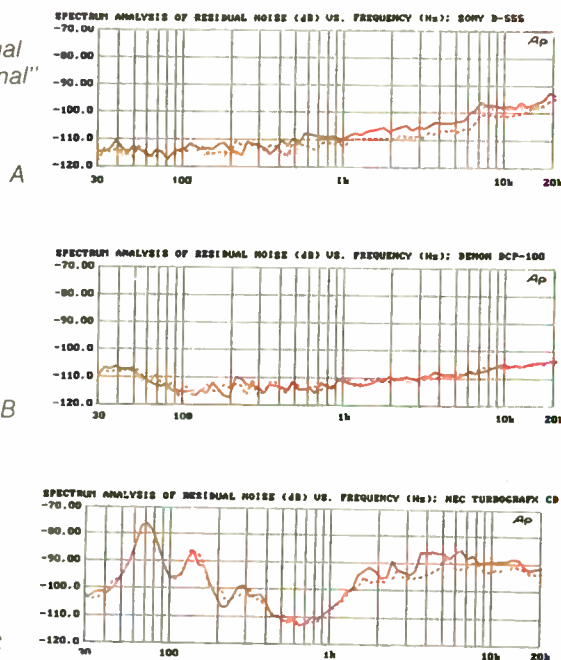


Fig. 5—
Separation vs. frequency for crosstalk from right-to-left and from left-to-right channels. Note how similar the curves are in both directions for all three players.

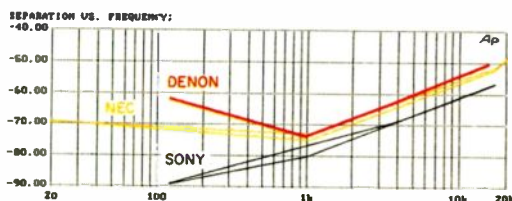
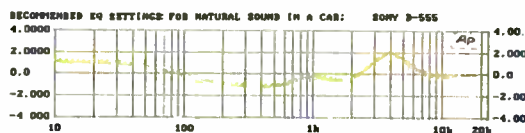


Fig. 6—
One of the many response curves possible with the Sony D-555's digital equalizer. Curve shown is for settings Sony recommends for natural sound in a moving car; see text.



Listening in the 90's

Today people have become more and more space conscious. Many apartment dwellers don't want to give up valuable floor space for large speaker systems. Others who are planning a surround sound or home theatre system simply don't have the room for more speakers in their listening rooms or hesitate to commit the floor or wall space to a good sounding pair of speakers.

Until now, serious music lovers have had little, if anything, to choose from that would produce a large, bigger-than-life sound in a small, compact size. Systems that fit one's space requirements have been woefully disappointing in sound quality.

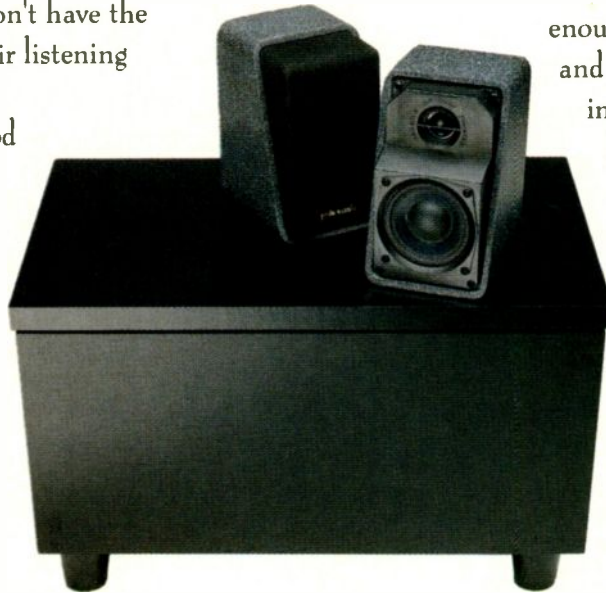
The RM 3000 Three Piece System

Polk's engineers had determined long ago that there were indeed certain technical advantages in

sonic performance.

The small satellites can be located on shelves, mounted on a wall or placed on their own floor stands. They are very attractive and yet small enough to be hidden from view if desired.

The RM 3000 subwoofer is also small enough to sit behind your furniture and can be used on its side to fit into tight spaces. And since it is beautifully finished, it can be used as a piece of furniture.



The RM 3000's satellites measure 7"H x 4 1/4"W x 5 3/8"D and are available in black matrix, gloss black piano or paintable white. The subwoofer is 12 1/2"H x 20"W x 12 1/2"D and is available with black wood grain sides and a black, mar-resistant top.

The Legendary Sound of Polk

In the tradition of Polk Audio, Matthew Polk and his team of engineers were determined to make the RM 3000 sound better than any other speaker of its type.

Initial reactions have been filled with superlatives including Julian Hirsch of *Stereo Review* magazine who says, "...they sound excellent...spectral balance was excellent—smooth and seamless."

Sound as big as life from speakers

small speaker systems. Both high and mid frequencies could be faithfully reproduced with superior transient response and dispersion characteristics, and the convenient, more flexible placement of small enclosures within the listening area could create an ideal sound stage. Unfortunately, reproducing the life-like, full body of the lower frequencies could not be achieved in a truly compact enclosure.

Polk's RM 3000 replaces the traditional pair of speakers with three elements, two compact midrange/tweeter satellites and one low frequency subwoofer system. This configuration makes it easy to properly and inconspicuously place the system within your listening room while offering superior

Behind these accolades is an impressive technical story.

The Technical Side

The big sound of the RM 3000 is due, in part, to the unique arrangement of the tweeter and midrange elements. This "time aligned system" delivers the high and mid frequencies at precisely the same instant. The result is a clear, lifelike and expansive presentation.

The cabinet materials selected for the satellites are over four times as dense as typical enclosures. The black matrix finish is a non-resonant polymer aggregate (FOUNTAINHEAD®). The gloss black piano and paintable white finishes are rigid ABS

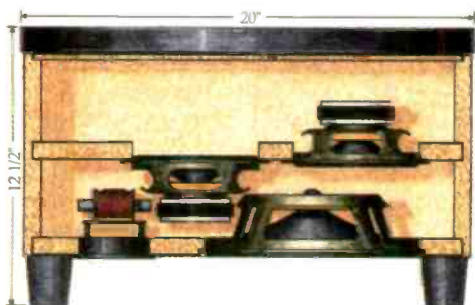


Polk's RM 3000 Three Piece Speaker System easily fits into today's home decor.

small enough to live with.

surrounding a mineral filled polypropylene inner cabinet. Polk engineers have all but eliminated any "singing" or resonating of the satellite enclosure. You hear the effortless, free sound of a much larger system.

Most subwoofer systems look alike on the outside, but the Polk is worlds apart on the inside. Utilizing twin 6 1/2" drivers coupled to a 10 inch sub-bass



For deep, well defined bass, Polk uses twin drivers coupled to a sub-bass radiator. Normally, one subwoofer system is used for both channels. For those desiring even greater low frequency performance, a second subwoofer can be added, one fed by the left channel, the other by the right channel.

radiator, the bass is tight and well defined. There is no tuned port to create "whistling" or "boominess" of the bass frequencies.

You Have To Hear It To Believe It

You really won't believe how good the RM 3000 sounds until you hear it. We invite you to your nearest authorized Polk dealer for a demonstration. You'll hear sound as big as life...from a speaker you can live with.

You'll hear the next generation of loudspeakers.

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1

CARVER SILVER SEVEN MONO AMP

Manufacturer's Specifications

Rated Power Output: 375 watts into 8 ohms, 20 Hz to 20 kHz, at 0.5% THD or less.

Power Output at Clipping: 475 watts rms into 4 or 8 ohms, 510 watts into 1 ohm.

Power Bandwidth: 18 Hz to 40 kHz, referred to maximum output of 475 watts.

Frequency Response: Flat from 1.5 Hz to 100 kHz.

Noise: 110 dBA below rated power.

Energy Storage: 390 joules.

Output Tubes: Fourteen KT88/6550A tubes per channel.

Dimensions, Including Feet and Bases: Main chassis, 13 in. W × 9½ in. H × 18 in. D (33 cm × 24.1 cm × 45.7 cm); power supply, 10 in. W × 9½ in. H × 18 in. D (25.4 cm × 24.1 cm × 45.7 cm).

Weight: 145 lbs. (65.8 kg), including granite bases.

Price: \$17,500 per pair.

Company Address: P.O. Box 1237, Lynnwood, Wash. 98046.

For literature, circle No. 90

Here we have some serious amplifiers, folks! These beauties, the Silver Sevens, are the biggest tube power amps that I have ever had my hands on. They are Bob Carver's crack at making the world's best power amplifier.

Bob Carver has claimed that he can clone the sound of any amplifier by making another amplifier (usually solid state) match the first amp's transfer function. In at least two instances, he has claimed in other audio publications to have duplicated the sound of other very good, highly regarded amplifiers. In subsequent advertising, he claimed that various solid-state amplifiers from Carver Corp. sounded like these two audiophile reference amplifiers and, of course, were available at a much lower price. In what I consider a brilliant bit of advertising genius, Bob Carver

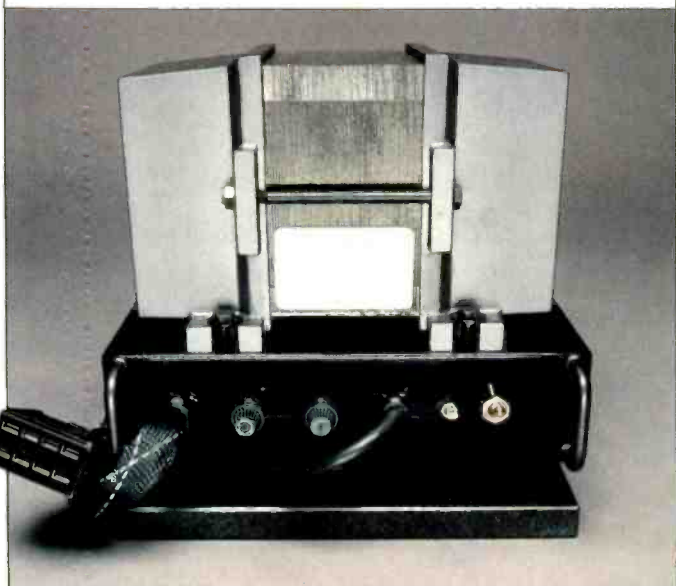


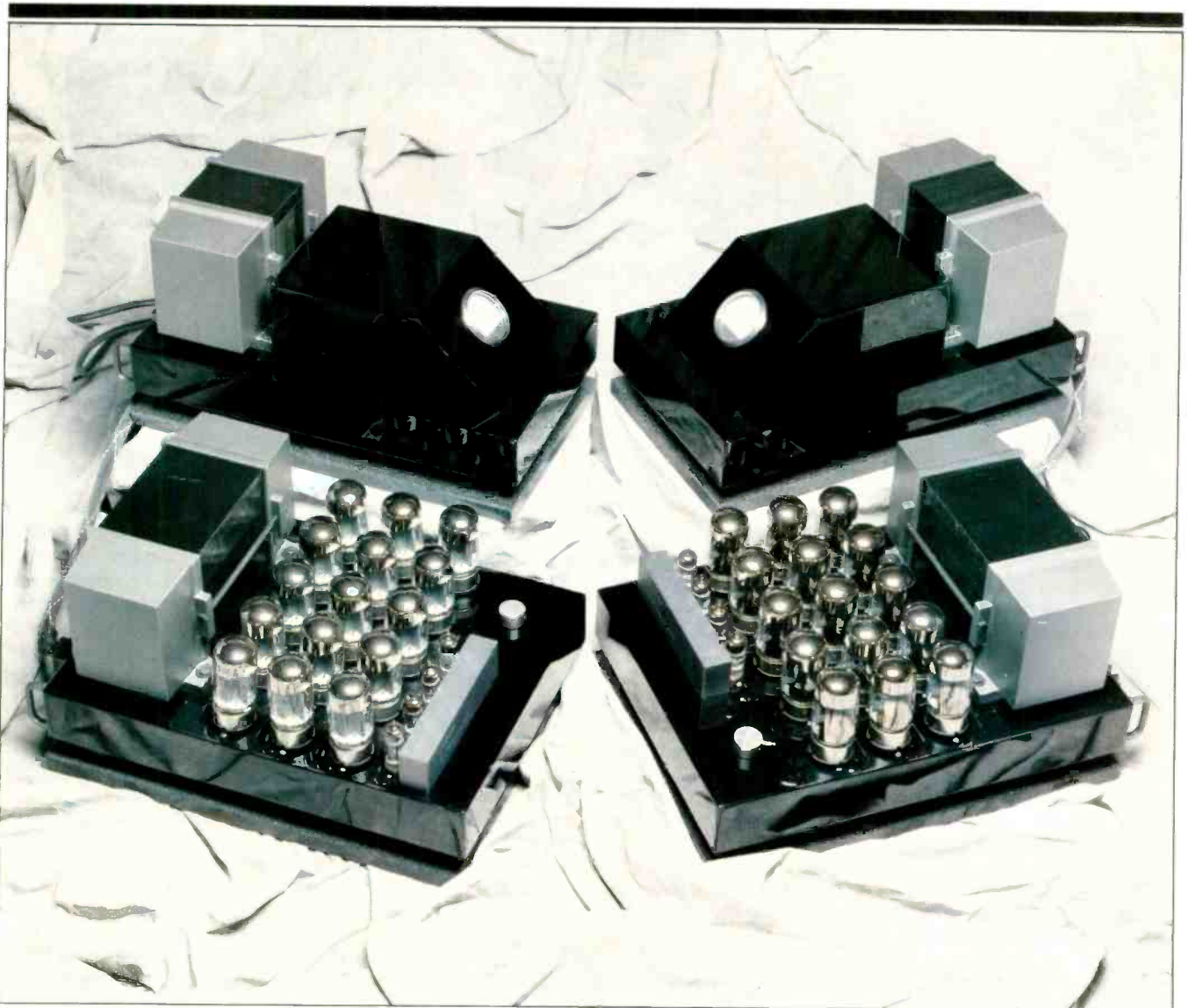
even followed up some rave reviews of his own Silver Seven tube amp by advertising a Silver Seven-t solid-state amp, cloned from the sound of his tube original.

My personal engineering belief is that even though the logic of it looks undeniable, it isn't really possible to make one amplifier duplicate another's sound by keeping the differences between their outputs (for the same input signals) below a certain measured threshold. I give you this as background on the thinking of the person behind the Silver Sevens.

As can be seen in the photograph, four pieces make up the Silver Seven system, two mono amplifiers and two power supplies. The size of each amp's output transformer certainly looks appropriate for a power level of some 300 to 400 watts. The power transformer, on the other hand, does not look equally up to the task of supplying power for a circuit that puts out nearly 400 watts continuous, but it won't ever have to in music service. I see a parallel with Bob's original Phase Linear 700 solid-state amplifier in the sense that its power transformer had poor regulation but did allow for some enormous power bursts (and pretty good steady-state power too!).

Taking a closer look, each amplifier chassis has an input level control on the top surface, next to the input tubes. In front of these tubes is a solid piece of aluminum that serves as a nice-looking nameplate and provides a radiating sur-





face for transferring some of the input tubes' heat to the air. At center stage are 15 power tubes, 14 of which are used in the output stage and the odd one serving as a series-pass element in a screen-grid regulator for the output stage. And then, of course, there is that impressive hunk of output transformer!

On the rear surface of the amplifier chassis are a four-terminal output barrier strip (with provision for matching 1-, 2-, 4-, and 8-ohm loads), two signal input jacks à la Tiffany (one direct, the other capacitor-coupled), a connector for the cable from the power supply, fuses for the total cathode currents of each bank of output tubes, and a control for adjusting the quiescent current of the output stage.

Each power supply has a meter that monitors the total B+ current drawn by the amplifier's output stage. This meter is mounted on the slanted front surface of the filter-capacitor housing. On the rear surface of each power supply is a connector for the a.c. line cord, two fuse-holders, a standby/

operate switch, a main power switch, and an interconnect power cord, captive to the power supply, that terminates at the amplifier chassis. One of the fuses is for total B+ current drawn from the high-voltage supply, and the other is an a.c. line fuse.

The finish on these amplifiers is a beautiful, hand-rubbed black lacquer and really looks good. Granite mounting slabs and rubber dampers go under each of the amplifier and power-supply chassis.

Internal construction of the amplifier unit is all point-to-point wiring via the pins on the tube sockets and via terminal strips mounted to the chassis where needed. No p.c. boards are used in the amplifier chassis. All bus interconnecting wires are made of sterling silver! (Hence the "silver" in Silver Seven.) Numerous Wonder Cap polypropylene capacitors are used in the signal circuitry in bypass and coupling applications. The general level of parts quality used is of high order, although I was puzzled by the use of

There are no p.c. boards in the amplifier sections, just point-to-point wiring including sterling silver bus interconnects!

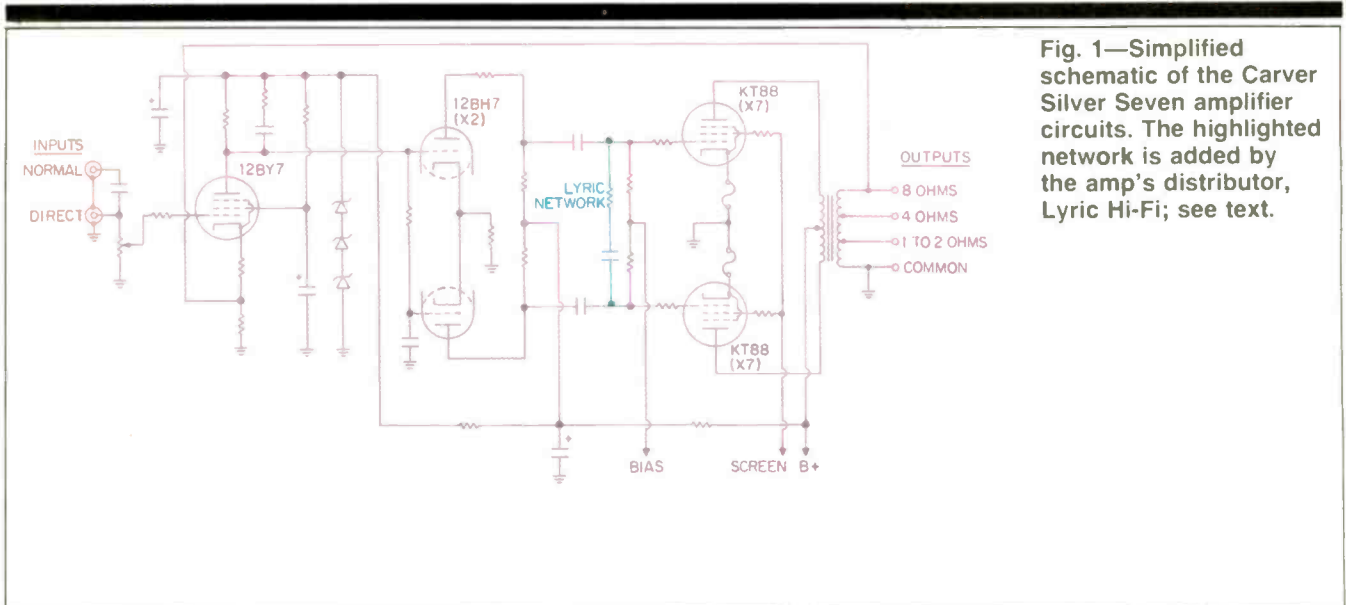


Fig. 1—Simplified schematic of the Carver Silver Seven amplifier circuits. The highlighted network is added by the amp's distributor, Lyric Hi-Fi; see text.

some ceramic capacitors in the signal circuitry. The power supply does utilize p.c. boards in two areas—one for the high-voltage rectifier diode assembly and the other for the turn-on/turn-off delay circuit. Workmanship and wiring quality are first-rate in the Silver Sevens, as well they should be for such an expensive product.

Circuit Description

The circuit topology of the Silver Seven is much like that of other tube amps that I have reviewed recently. (See Fig. 1 for a simplified diagram of this topology.) In the Carver circuit, the input stage is a 12BY7 video-amplifier tube connected as a pentode. Its screen grid is fed through a dropping resistor and is bypassed to ground by an electrolytic capacitor bypassed with a 0.01- μ F polypropylene capacitor. The B+ supply for this first stage is regulated with a shunt zener-diode string bypassed by electrolytic and film

capacitors. The plate output of the first stage is direct-coupled to one grid of a 12BH7 twin-triode tube operated as a long-tailed-pair phase inverter. Another such tube is paralleled for increased drive capability. No provision is made for push-pull balance, as is done in many such phase-inverter circuits. The Carver design uses plate resistors of fixed but unequal value, which is necessary in this type of phase-inverter circuit due to the use of low-gain triodes to obtain equal outputs. Push-pull output from the plates of the phase-inverter stage is capacitor-coupled to the control grids of the two banks of output tubes. Each grid is fed through a 6.8-kilohm "grid-stopper" resistor from the common-phase drive line.

The output tubes are operated as pentodes with fixed bias. (Fixed bias is used in most tube power amplifiers.) In this mode of operation, the output tube cathodes are grounded, or nearly grounded, through small current-sampling resistors; a negative voltage of appropriate value (usually -35 to -45 V) is applied to the grid-leak resistors for the two push-pull output tubes (or to the two banks of output tubes in the case of push-pull, parallel-connected stages like this one). Earlier versions of the Silver Seven had a two-position bias switch labelled "Low" and "High." These positions allowed total output stage currents of about 200 to 250 mA and 500 mA, respectively. The reviewed samples have a screwdriver-adjustable pot on each amplifier chassis so that you can vary total output stage current from about 200 to 500 mA. Incidentally, the incoming bias from the power supply is zener-regulated to about -48 V. As received, the amplifiers were adjusted for about 250 mA, and that is how they were set for all my measurements (except where otherwise noted).

The odd 15th output tube is connected as a triode (screen grid connected to plate) and functions as a series-pass element in a circuit that supplies regulated voltage to all of the screen grids of the output tubes. A third 12BH7 is used as the error amplifier for this screen regulator. (In earlier versions of the Silver Seven, it was paralleled with the





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Serious about sound

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With hybrid electrostatic speakers, the Silver Sevens produced an incredible sense of space, tonal honesty, and resolution.

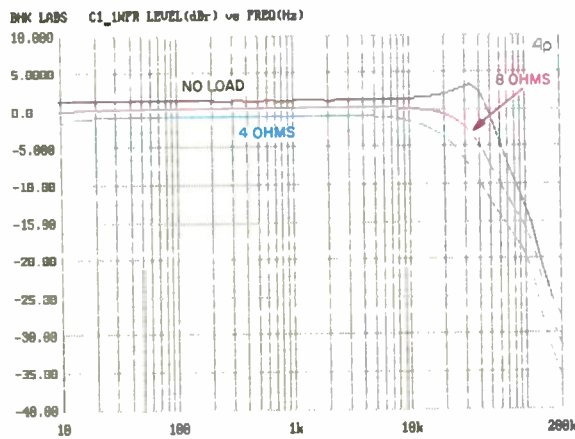


Fig. 2—Frequency response at the 8-ohm tap with various loads; see text.

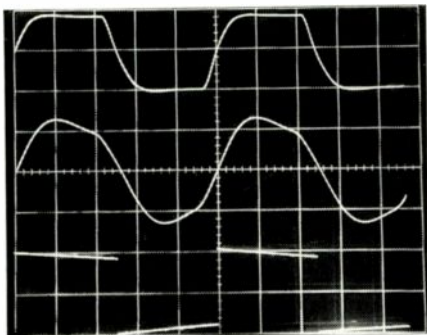


Fig. 3—Square-wave response at 8-ohm tap for 10 kHz into 8-ohm resistive load (top), 10 kHz into 8 ohms paralleled by 2 μ F (middle), and 40 Hz into 8 ohms (bottom). Scales: Vertical, 5 V/div.; horizontal, 20 μ S/div. for 10-kHz traces, 5 mS/div. for 40-Hz trace.

phase-inverter section of the amplifier circuit.) The regulated voltage to the screen grids is about +330 V; B+ to the center tap of the output transformer is a hefty +660 V.

Overall negative feedback is taken back to the first stage's cathode from the 8-ohm tap of the output transformer's secondary winding. The Silver Seven's output-stabilizing RC network is more complex than the usual resistor and capacitor in series across an amplifier's output. Here, there are two such networks, one connected from the output transformer's 8-ohm tap to ground and one from the 4-ohm tap to ground. Several hundred ohms of resistance are also connected from the 8- to the 4-ohm output.

In the power supply, the high-voltage secondary of the transformer is rectified by a full-wave bridge and fed into a capacitor input filter that consists of two 2,000- μ F, 450-V capacitors in series, for an effective capacitance of 1,000 μ F at 900 V. Each diode arm of the bridge is physically two diodes in series, and each of the two diodes is bypassed with a 470-kilohm resistor and a 0.01- μ F, 1-kV ceramic capacitor. Next in the B+ line is a filter choke of some 32 mH (a relatively small value for tube amplifiers' high-voltage supplies). This filter choke terminates in another series-connected capacitor pair of 2,000- μ F, 450-V capacitors. In a long-term sense, the net capacitance of this supply is 2,000 μ F; in the short term, for high-frequency transients, its effective capacitance is 1,000 μ F because of the isolating properties of the series filter choke. Another secondary winding is rectified by a full-wave bridge and is RC-filtered to form a regulated bias supply for the output stage. A heater winding, putting out about 18 V a.c., powers the filaments of the output tubes in a series-parallel arrangement consisting of three tubes in series in each of five parallel strings. For openers, this is some 150 watts of filament dissipation before we even begin to talk about plate dissipation!

Part of the 18-V winding's output is half-wave rectified to supply d.c. power to the turn-on/turn-off time-delay circuit. This circuit delays the application of B+ to the output stage for several minutes after power on, by switching the B+ with a series relay. The filaments and B+ to the front-end circuitry come on at power turn-on. At power turn-off, this relay drops out immediately to prevent any surges or "blaps" from reaching the speakers as the front-end supply decays. The standby switch is in series with the relay coil and serves to reduce power consumption by removing plate power from the output stage. This is useful if the amplifiers haven't been used for a short while, because you don't have to go through the whole warm-up cycle. One nice touch which contributes to component longevity is the use of a few surge resistors in the primary circuit of the power transformer. These devices exhibit relatively high resistance when cold and, accordingly, reduce inrush current considerably at turn-on. As the current through these devices warms them up, their resistance drops down to a few ohms, allowing essentially full power into the transformer.

Measurements

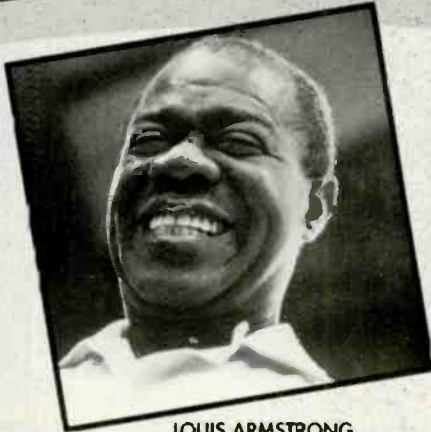
Boy, what a grunt it was, moving these amplifiers from my house to my lab for measuring! This was especially so, as I left the Silver Sevens on their granite bases and rubber isolators. In testing, I measured the S/N of both units, Serial Nos. 00113R and 00113L (hereafter referred to as R and L, respectively) to check for any significant difference in behavior. The data plotted is for amp R, which, as it turned out, performed slightly better.

As is my custom, I measure gain and sensitivity early on, as they're the easiest to do. (I like to work into these things.) The gain of these amps was higher than the usual 26 dB or so; it came out to about 35.2 dB on the 8-ohm tap with an 8-ohm load. Corresponding IHF sensitivity was 49.3 mV. Gain with the 4-ohm tap loaded by 4 ohms was 31.6 dB, closer to the norm.

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JZ-01

When I cranked up the plate current, the spacious and detailed but slightly edgy sound became more open, lush, and musically true.

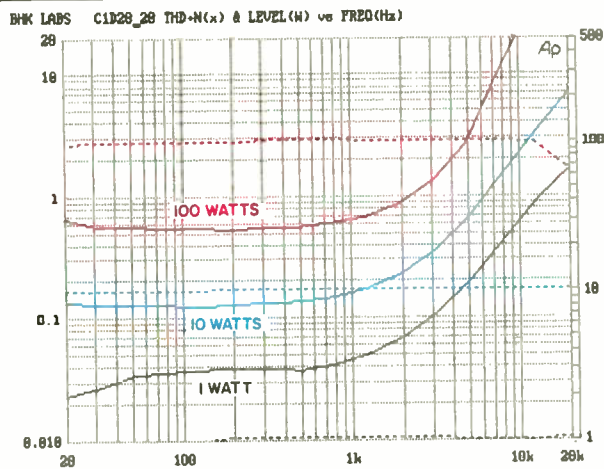


Fig. 4—THD + N vs. power and frequency for 8-ohm load on 8-ohm tap. Dashed curves are actual power output vs. frequency at the indicated

levels; read power from right-hand scale. The slope of the 100-watt dashed curve was caused by an uncorrected drop-off of the test signal.

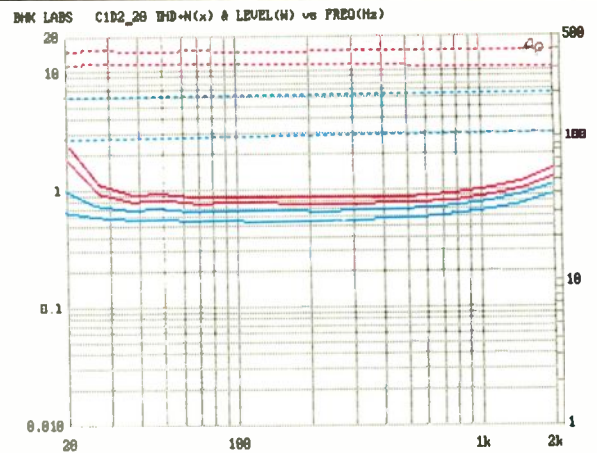


Fig. 5—Same as Fig. 4 but for higher power levels (375, 300, 200, and 100 watts, from top to bottom) and

for frequencies only up to 2 kHz.

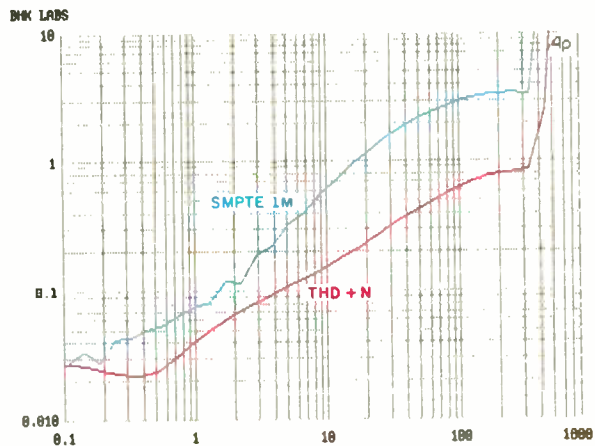


Fig. 6—SMPT E IM and THD + N vs. power

output for 8-ohm load on 8-ohm tap.

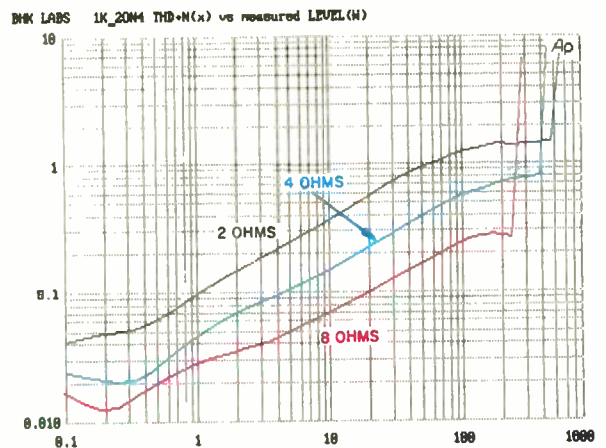


Fig. 7—THD + N vs. power for various loads on 4-ohm tap; see text.

Next, frequency response was checked at the customary 1-watt output level. Figure 2 shows responses at the 8-ohm tap with no load, the normal 8-ohm load, and a load of 4 ohms. Plotting the curves this way gives you an insight as to how low the output impedance was (the lower the output impedance, the less the change in level as a function of load) and how the high-frequency response (damping) varied with load. With 8-ohm loading, the high-frequency response is nicely damped but is 3 dB down at about 30 kHz, a bit low for "good" high-frequency bandwidth. Low-frequency response for open-circuit and 8-ohm loading looks excellent. With 4-ohm loading on the 8-ohm tap, you can see the beginnings of a low-frequency roll-off. This is because the reduction in open-loop gain caused by the higher

loading reduces the feedback, which then no longer compensates as well for the transformer's low-frequency roll-off.

The high-frequency response of Amp L was down more than that of Amp R, reaching its cutoff point (3 dB down) at about 22 kHz for an 8-ohm load. With an open-circuit load, Amp L's response was up about 1 dB at 10 Hz.

Square-wave response is shown in Fig. 3. In the top trace, at a frequency of 10 kHz, the damping is excellent; just a trace of overshoot is present. Rise- and fall-times are on the order of 12 μ S. Paralleling the 8-ohm load with a 2- μ F capacitor yields the 10-kHz response in the middle trace. Again, ringing is reasonably low. In the bottom trace, response to a 40-Hz square wave, low-frequency tilt is not as low as I have seen in some other tube amplifiers.

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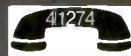
"... For once we wholeheartedly agree... the Paradigm is most definitely a no-compromise two-way design capable of outperforming systems costing several times as much."

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The incredible solidity, as well as tonal rightness and warmth in the lower midrange, continue to captivate my attention.

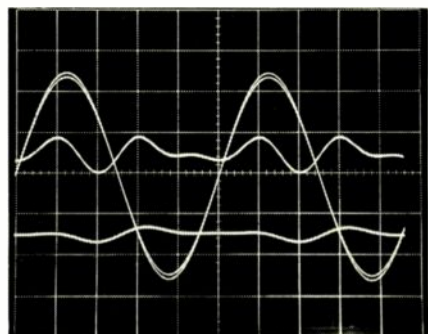


Fig. 8— Output and distortion residue at 10 watts out into 8 ohms, for output stage current of 250 mA (smaller output trace and upper residue trace) and 500 mA (larger output trace and bottom residue trace).

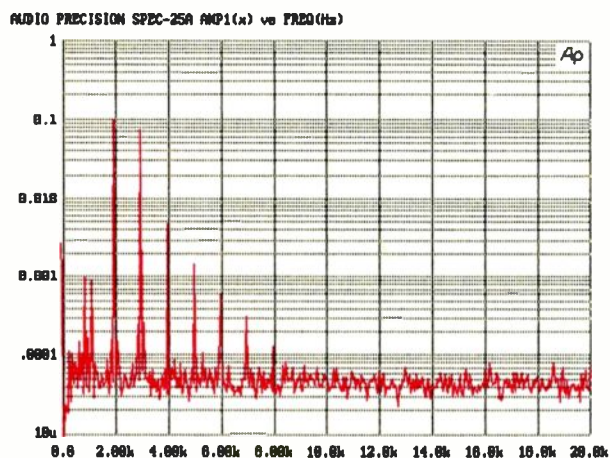


Fig. 9— Spectrum of residual distortion for 1-kHz signal at 10 watts into 8-ohm load on 8-ohm tap, with output stage current of 250 mA; see text.

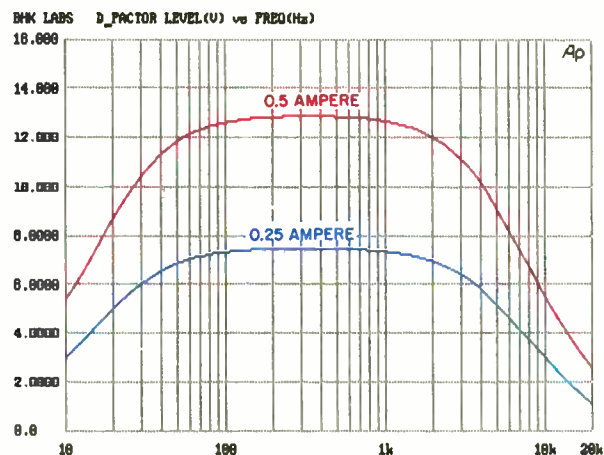


Fig. 10— Damping factor vs. frequency for two levels of output stage current.

Lyric Hi-Fi, exclusive distributor for the Silver Seven, adds a network to help the amplifier achieve the sound quality they desire. This network, however, causes the output to slew at higher frequencies and power levels. I therefore separated the data for THD + N as a function of frequency and power into two plots. Figure 4 shows THD + N over the full range from 20 Hz to 20 kHz for power levels up to 100 watts. For distortion at higher power levels, I restructured the measurement to cover only the range from 20 Hz to 2 kHz, as shown in Fig. 5. I did so because it is not really useful to show these results beyond the point where slewing raises the distortion. In Fig. 5, it can be seen that THD + N remains low at low frequencies at full rated power (375 watts), a testament to the appropriateness of the output transformer's size. (Amp L had a bit more distortion at the frequency extremes than shown here.)

Total harmonic distortion plus noise at 1 kHz, and SMPTE IM distortion, are shown in Fig. 6. Results are typical for tube amplifiers in that distortion generally increases with power. To see how distortion and power output might vary with loading, THD + N at 1 kHz was plotted versus power for 2-, 4-, and 8-ohm loads on the 4-ohm tap (Fig. 7). As expected, distortion is lower for loads of higher impedance, and maximum power is higher for loads of lower impedance.

Figure 8 shows the waveform and residue of harmonic distortion at an output of 10 watts for output stage idling currents of 0.25 and 0.5 ampere. The top residue trace and the smaller of the superimposed output traces is for a current of 0.25 ampere, at which distortion measures 0.12%. The slightly larger output trace is for the higher current, 0.5 ampere (output stage gain is decidedly a function of idling current); the distortion residue for this current, 0.037%, is shown in the lower residue trace. The dominant harmonics appear to be second and third. A spectrum of the distortion residue for an idling current of 0.25 ampere is shown in Fig. 9. There are some higher order harmonics, but their amplitudes are low and decrease rapidly as distortion order increases. At the higher output stage current, the higher order harmonics disappear more quickly into the noise floor.

Table I— Output noise. The IHF S/N ratios were 88.0 dB for Amp R and 86.5 dB for Amp L.

Bandwidth	Output Noise, nV	
	Amp R	Amp L
Wideband	255	395
22 Hz to 22 kHz	229	380
400 Hz to 20 kHz	138	158
A-Weighted	111	135

Output noise levels are listed in Table I. Notable in these amplifiers is their relatively low wideband noise for a design with such high signal gain.

Damping factor versus frequency is shown in Fig. 10 for output stage currents of 0.25 and 0.5 ampere. As can be seen, distortion level and gain are not the only things that change with output stage idling current. What is of note in these curves is that the damping factor decreases in the low



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Probably the most realistic and best amps I have heard, the Silver Sevens surely are a contender for the title of world's best amplifier.



end, below about 100 Hz, in addition to the quite common fall-off in the high end of the spectrum. This reduction in damping factor at low frequencies is most likely due to the relatively short interstage time constant in the coupling between the phase-inverter stage and the output tube's grid-drive lines. This time constant is usually kept short to raise its roll-off point so that it will not coincide with that of the output transformer and output stage. The net result is that the amount of feedback is reduced at low frequencies, with a consequent increase in output impedance.

Dynamic power output of the Carver Silver Sevens was a very impressive 540 watts with 8-ohm loading on the 8-ohm tap; this works out to a dynamic headroom of about 1.6 dB. Power at visual onset of clipping was 460 watts, for a clipping headroom of about 0.9 dB. With a 1-ohm load on the tap for 1 to 2 ohms, and using the tone-burst signal for dynamic headroom, I measured a peak current of ± 30 amperes, which is equivalent to a burst power of 450 watts.

Current draw off the a.c. line was 3.6 amperes at an output stage current of 0.25 ampere and about 5 amperes when the output stage current was up to 0.5 ampere. That's 10 amperes for the pair of Silver Sevens just idling! Believe me, this heats up a room quite noticeably after the amplifiers have been on awhile.

Use and Listening Tests

Signal sources used to evaluate the Silver Sevens included an Oracle turntable fitted with a Well Tempered Arm and a Spectral Audio MCR-1 Select moving-coil cartridge, a Magnavox CDB-560 CD player feeding a Wadia 2000 decoding computer, a Nakamichi 250 cassette recorder, a Nakamichi ST-7 tuner, and a Technics open-reel recorder. A Vendetta Research SPC-2B MC phono preamp was used for playing records. The outputs of the Vendetta and the other high-level sources were selected and volume-controlled with my reference selector switch and switched attenuator unit. Other power amplifiers on hand during the review period were a Berning EA-2101, a pair of Cary Audio monoblock CAD-50SLs, EAR 519s, an Infinity HCA, and a

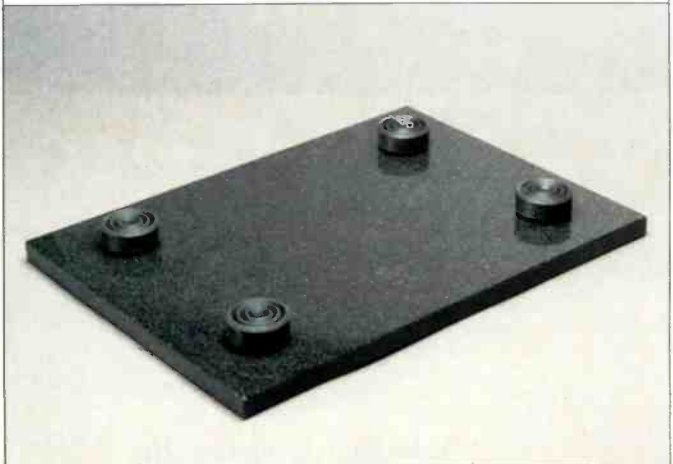
pair of EAR 549 mono tube amps. Speakers used were pairs of the Siefert Research Magnum III, Martin-Logan Monolith III, and Spica Angelus plus experimental two-way systems loaned to me by Arnold Nudell.

I first listened to the Silver Sevens on the Siefert Research speakers. The first music I heard was Mahler *Teider* with piano and male voice. I was stunned at how big, full, and real the sound was; the speakers never sounded so good. Using the Martin-Logan hybrid electrostatics, I got a sense of incredible space, tonal honesty, and resolution but some hint of edginess and irritation on certain program material. As I mentioned earlier, the amplifiers were preset at an idling current of about 250 mA, and all of the listening thus far had been at this bias setting. Fortunately, I decided to increase idling current in the output stage. (The bias pots permit a total current of about 500 mA, and I cranked them up to this level.) The sound of the amplifiers changed quite a bit with the increased plate currents. What had been a spacious, very detailed, but slightly irritating sound became more open and lush and far more musically believable.

The experimental two-way speakers are astonishingly good. These little systems provide outstanding spaciousness, inner detail, and a refreshing upper midrange and high end that are not harsh or fatiguing. I had been enjoying these systems very much with the EAR 549s, but when I switched over to the Silver Sevens, I really appreciated how good both the speakers and the Silver Sevens are. These amplifiers are probably the best and most realistic that I have ever heard. I'm tempted to say that all other amplifiers are pretenders, but that is going a bit too far. There is an incredible solidity to the sound and a lower midrange warmth and tonal rightness that continue to captivate my attention. Needless to say, for me this requires that the plate current be set up to the 500-ampere level. Tube life and reliability may be compromised a bit (even though the approximate plate dissipation per tube, at 25 watts, is still well within rating), but I don't think this will deter anyone with the wherewithal to afford these amplifiers.

Although I haven't heard all the contenders for the title of world's best amplifier, I know the Silver Sevens would be a serious contender and possibly the winner in such a contest. Kudos, Bob Carver.

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THIEL CS5 SPEAKER

Manufacturer's Specifications

System Type: Tower-style, five way, acoustic suspension.

Drivers: Three 8-in. (203-mm) cone woofers, 5-in. (127-mm) cone midrange, 2-in. (50.8-mm) metal-dome upper midrange, and 1-in. (25.4-mm) metal-dome tweeter.

Frequency Response: 25 Hz to 20 kHz, ± 1 dB.

Phase Response: Minimum, $\pm 7^\circ$.

Sensitivity: 87 dB SPL at 1 meter for 2.83 V rms.

Crossover Frequencies: 50 Hz, 400 Hz, 1 kHz, and 3 kHz.

Impedance: 3 ohms nominal, 2 ohms minimum.

Recommended Amplifier Power: 100 to 400 watts per channel.

Dimensions: 64 in. H x 13 in. W x 17 in. D (162.6 cm x 33 cm x 43.2 cm).

Weight: 180 lbs. (82 kg).

Price: \$9,200 per pair in standard fin-



ishes, \$800 extra for rosewood; custom finishes are available on special order.

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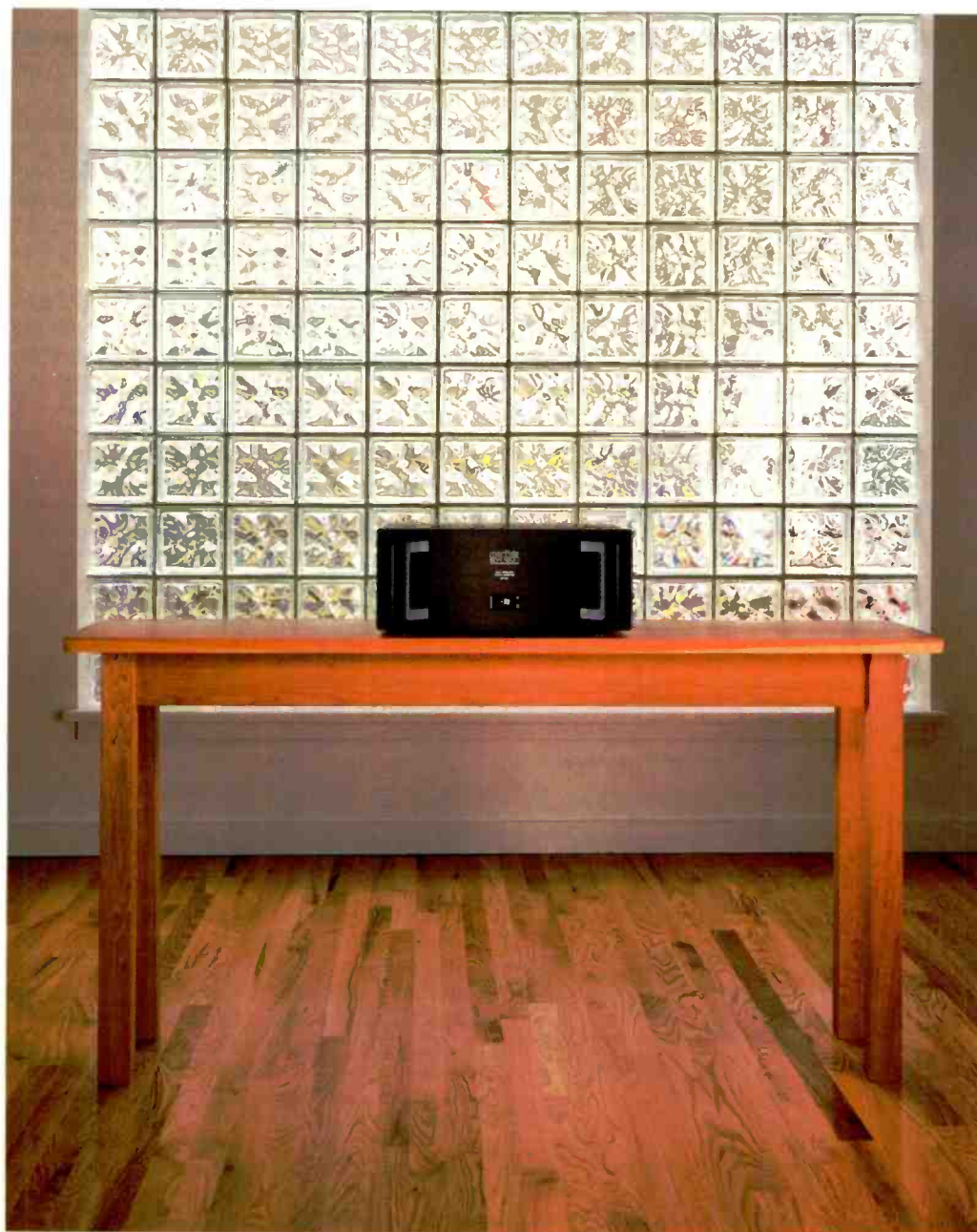
I first realized the Thiel CS5 loudspeakers had arrived when a truck and semi-trailer pulled up in front of my house and the driver unloaded two large, coffin-shaped, 250-pound wooden boxes in my driveway! It was a major chore just moving them temporarily into the garage with the help of my teenage son. I first saw and heard the CS5s at the last Summer Consumer Electronics Show in Thiel's hospitality suite. I was quite taken with their sound, and listened to Jim Thiel, the company's president and chief designer (also founder, owner, and chief honcho), enthusiastically explain some of the design and technical aspects of his system.

This included showing me a very impressive, large CS5 crossover network containing 114 separate components!

Each system is large, tall, and heavy and contains six direct-radiator drivers. The massive, sloping front panel is made of a cast marble/polymer composite that provides a very rigid mounting surface for the drivers and is shaped to minimize unwanted cabinet edge diffraction. In addition to a very attractive gloss-black laminate finish, rosewood, walnut, white oak, and teak are available. Thiel's exacting manufacturing methods for the CS5 cabinets were written up in an article that appeared in *Furniture Design & Manu-*

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Table courtesy of Fairhaven Woodworks

The system's coherent phase response is due to careful driver placement and use of an elaborate, low-order crossover design.

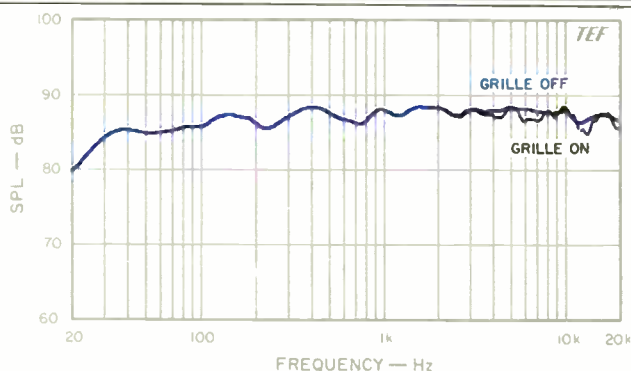


Fig. 1—Frequency response on axis. Note the minimal difference with the grille on.

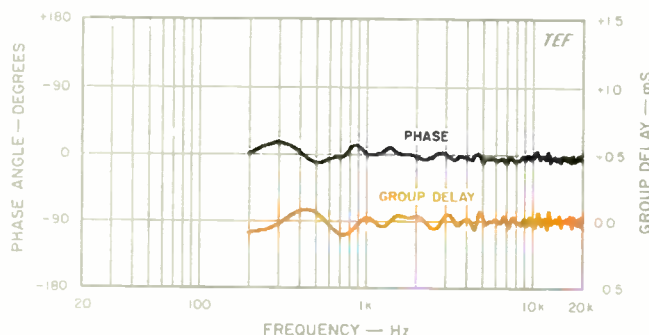


Fig. 2—On-axis phase response and group delay, corrected for tweeter arrival time. The phase curve is notably flat, within an envelope of approximately $\pm 10^\circ$.

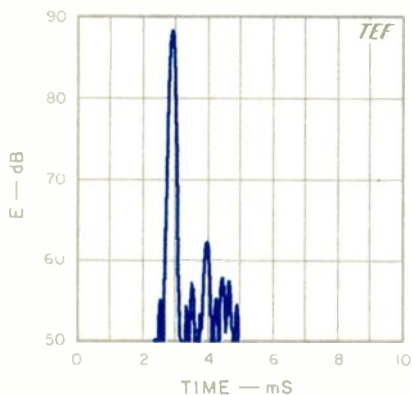


Fig. 3—Equivalent 1-meter, on-axis energy/time curve, measured at 3 meters with grille on.

facturing magazine in July 1988. (Ask Thiel for a reprint; it makes fascinating reading.)

Jim Thiel has been in the speaker business since 1977, when he entered the home hi-fi market with his Model 01 bookshelf system that used active electronic equalization. His company now manufactures four models of loudspeakers—the CS1.2, CS2, and CS3.5 as well as the CS5—and has grown to 27 employees and 27,000 square feet of production space.

Jim Thiel's design goals for the CS5 include very uniform and extended frequency response, time response accuracy, phase response accuracy, very low energy storage, and very low distortion. These are world-class goals that are very seldom met all at once, in any system, at any price. Read on in this review to see how well they have been met.

Thiel produced a very well done technical white paper on the CS5 that describes its technical and design features in great detail. I drew extensively on the information in this paper to generate some of the descriptive passages in this review. The white paper even has a section on measuring the CS5, which was very helpful to me.

The systems are designed to be both phase- and time-coherent using Thiel's Coherent Source design method, which carefully matches the effective acoustic distances from each driver to the listener's ears. This matching is done through physical driver placement and orientation, and through the use of special electrical all-pass delay circuits in the crossover. Phase coherence is achieved by the use of first-order (6-dB/octave) acoustic roll-off slopes for each driver. The 6-dB/octave crossover type is the only one that can simultaneously maintain correct amplitude, phase, and time information for the acoustic arrivals at a specific listening point. The crossover contains components that accurately tailor each driver's response to match its specific required acoustic target response. This type of crossover places high demands on the drivers, because their response must extend at least two octaves above and below the chosen crossover frequencies.

All of the CS5's drivers incorporate several special features that decrease distortion and increase dynamic range. All of the system's cone drivers (the three woofers and lower midrange) have very long, overhung coils with very large magnets to yield high excursion capability. Even the tweeter has been designed to have a large linear excursion capability, in excess of ± 1.5 mm, due to the use of a short-coil, long-gap magnetic system and an unusually wide roll surround. The cone drivers all incorporate heavy copper "flux-stabilizer" rings that decrease distortion; in addition, their symmetrical-geometry pole configurations further reduce even harmonic distortion.

Thiel employs special means in the bass system to achieve 20-Hz bass extension and high output capability from a relatively small enclosure. This capability is achieved by using three long-excursion 8-inch woofers in a configuration that places two of them in a common main enclosure and the third in a separate sub-enclosure. All three woofers are used in parallel below 50 Hz, while the center, separately enclosed, woofer is used alone at higher bass frequencies. Operating only one woofer at higher frequencies can minimize line-source directivity effects. The impedance is

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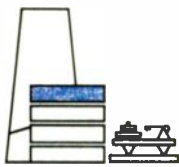


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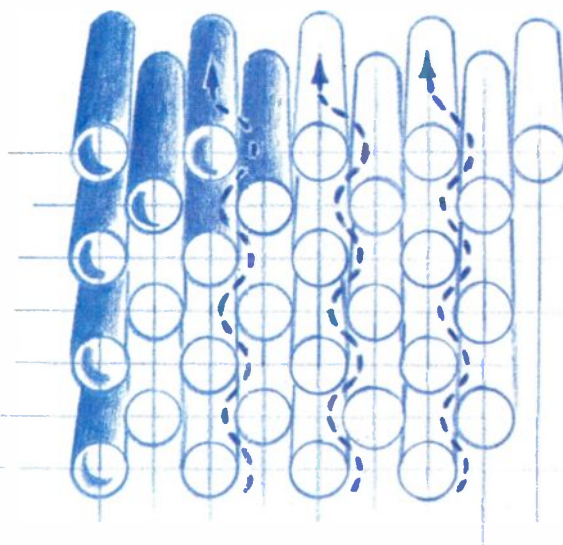
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A-2

Frequency response is quite flat and extended, fitting within an envelope of ± 2 dB

The CS5's energy/time curve, the best I've measured yet, shows how closely Thiel aligned the outputs of this system's drivers.

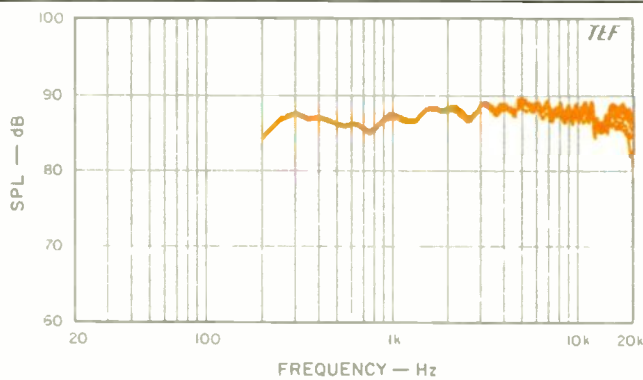


Fig. 7—Composite of horizontal frequency responses, taken every 5°, over a range of $\pm 15^\circ$ off axis. The average of these curves is the mean horizontal -15° to $+15^\circ$ on-axis curve of Fig. 6.

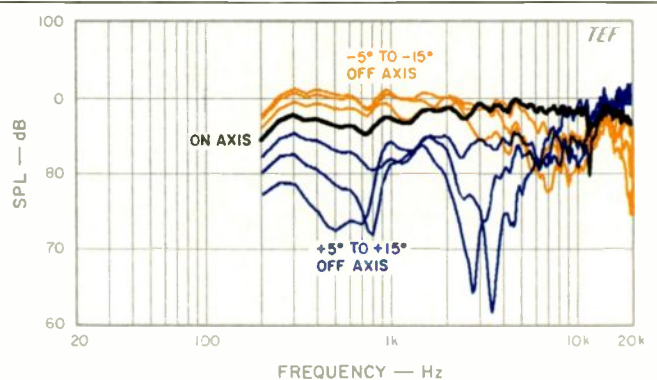


Fig. 9—Composite of vertical frequency responses, taken every 5°, over a range of $\pm 15^\circ$ off axis. The average of these curves is the mean vertical -15° to $+15^\circ$ on-axis curve of Fig. 8.

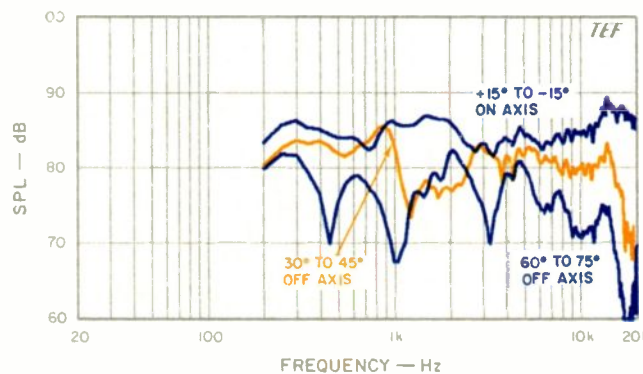


Fig. 8—Mean vertical responses derived from data of Fig. 5.

sponse is quite flat and extended and fits within a ± 2 dB envelope from 31 Hz to 20 kHz. Above 100 Hz, it fits within a notably tighter window of ± 1.5 dB. Below 100 Hz, the response is quite extended, being down only 3 dB at 26 Hz and 6 dB at 19 Hz. Averaging the response from 250 Hz to 4 kHz yields a sensitivity of 87.5 dB SPL, essentially equal to the manufacturer's rating. The grille has minimal effect on the response, and those effects primarily occur in the top two octaves, where the response is reduced only by about 1.5 dB between 6 to 7 kHz and 12 to 15 kHz.

A test comparing the axial response of both right and left speakers in the range from 200 Hz to 20 kHz (not shown) yielded an excellent match of ± 0.5 dB. The differences in level were distributed approximately randomly over the measured range.

Figure 2 shows the on-axis phase and group-delay responses of the system, corrected for the time arrival of its tweeter. As can be seen, these curves are exceptionally flat and are not typical of most speakers whose phase response undergoes large changes as frequency increases. Above 400 Hz, the phase curve fits within an envelope of $\pm 10^\circ$! The careful design attention given by Jim Thiel to achieving linear phase response is clearly evident. The minor fluctuations in the phase and group-delay responses are primarily coupled to the corresponding undulations in the magnitude curve through minimum-phase relationships. These fluctuations would be absent if the magnitude curve were equalized flat with a minimum-phase equalizer (99% of all equalizers are minimum phase). Because these curves are based on 2-meter data, I presume the phase response would be even flatter if I had been able to get better curves at a distance of 3 meters or more.

The on-axis, 1 meter, 2.83-V rms energy/time curve (ETC) is shown in Fig. 3. The data was measured at 2 meters and then referenced back to 1 meter. The test signal was linearly swept over the range from 200 Hz to 10 kHz, and it primarily emphasizes the response of the tweeter and upper mid-range. The first-arrival response is exceptionally compact, which indicates the drivers' acoustic outputs are very closely aligned. All subsequent system output is greater than 25 dB down from the first arrival. This response represents the best ETC I have measured to date.

A high-level, low-frequency sine-wave sweep revealed that the woofers' maximum linear excursion capability was about ± 0.2 inch (0.4 inch, peak to peak). The woofers had an effective radiating diameter of about $6\frac{3}{4}$ inches, which means that the three together can move nearly the same amount of air as a single 15-inch woofer. The drivers were

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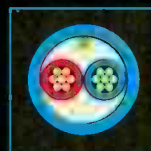
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The woofers' maximum linear excursion capability proved to be about ± 0.2 inch—or 0.4 inch, peak to peak!

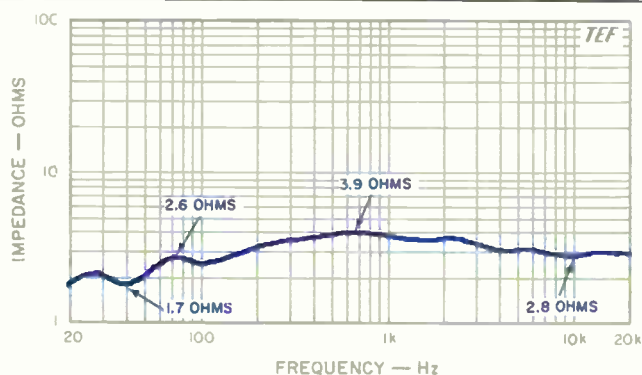


Fig. 10—Magnitude of impedance; note the logarithmic impedance scale. See text.

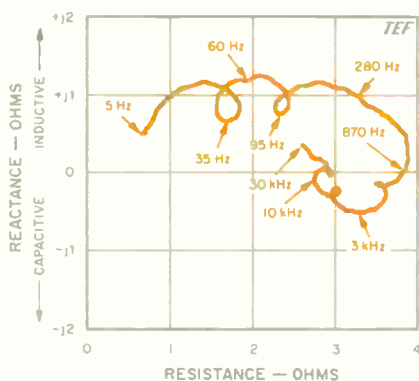


Fig. 11—Complex impedance, showing reactance and resistance vs. frequency. Note that the horizontal and vertical scales cover only a 4-ohm range.

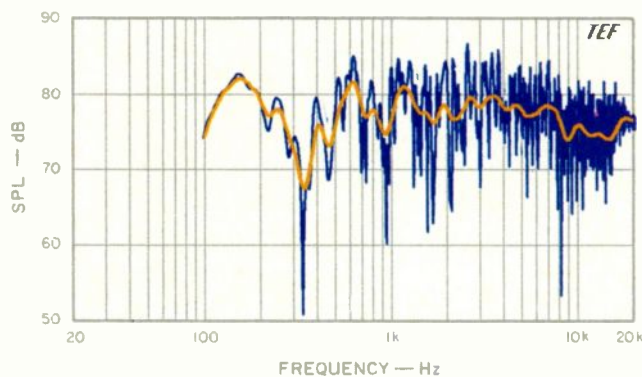


Fig. 12—Three-meter room response, showing both raw and smoothed data.

quite capable of being driven to much higher excursion amplitudes, up to about 0.7 inch, peak to peak, but with correspondingly higher distortion. Some dynamic offset was noted between 30 and 40 Hz at levels of 8 V rms and higher for the upper and lower woofers; the center woofer had no offset displacement in this frequency range. Curiously, the upper woofer displaced outward, and the lower woofer displaced inward! The whole enclosure was well sealed, and the side walls were very rigid and exhibited absolutely no wall vibration.

Figures 4 and 5 show, respectively, the CS5's horizontal and vertical off-axis frequency response in a "3-D" format. The curves were derived from measurements made approximately at 5° increments along the major horizontal and vertical planes of the system. The vertical off-axis curves were measured using the ground-plane technique at a distance of 3 meters. No additional smoothing was done except for the constant-bandwidth smoothing that results from the TDS measurement process. These graphs are normalized and have a logarithmic frequency scale. The normalization clearly reveals the differences between the on- and off-axis curves, because the on-axis curve is a straight line and the off-axis curves only show the deviation between them and the on-axis curve.

The normalized, horizontal off-axis responses, shown in Fig. 4, disclose a very well-behaved system. Each individual response curve is quite flat and approximately parallel to the on-axis curve for angles out to about 40°. This indicates that the CS5's curved front surface is indeed minimizing cabinet edge diffraction.

In contrast, the vertical off-axis responses, presented in Fig. 5, disclose a considerable amount of off-axis aberration, primarily due to the use of 6-dB/octave, first-order transitions in the crossover. In addition, the curves reveal a substantial amount of lobing, which means that the unavoidable directional lobes in the crossover regions are not aimed in the on-axis direction. Observe the left end of the graph at 200 Hz, where the lobe is aimed 30° downward and where a null in the response exists at 30° upward. This amount of lobing means that the response changes quite dramatically with small changes in vertical angle. The responses also show that the system's downward responses are substantially better than its upward ones. The responses just above the axis are extremely rough and depressed in level, in some cases by as much as 10 to 15 dB.

The mean horizontal and vertical on- and off-axis responses are shown in Figs. 6 and 8, respectively. These responses were derived from the previous "3-D" data by calculating response averages of several adjacent curves in specific angular regions; this approach is similar to that taken at the Canadian NRC's test facilities. Figures 7 and 9 are composites showing the individual response curves which made up the $\pm 15^\circ$ mean on-axis curves.

In the mean horizontal response curves, Fig. 6, the $\pm 15^\circ$ and 30° to 45° curves are quite flat and fairly smooth except for progressively more high-frequency roll-off as the angle increases. The 60° to 75° curve is somewhat rougher but still shows significant extension up to 15 kHz. The smooth, extended horizontal responses indicate that the systems should reproduce excellent stereo images over a wide hori-

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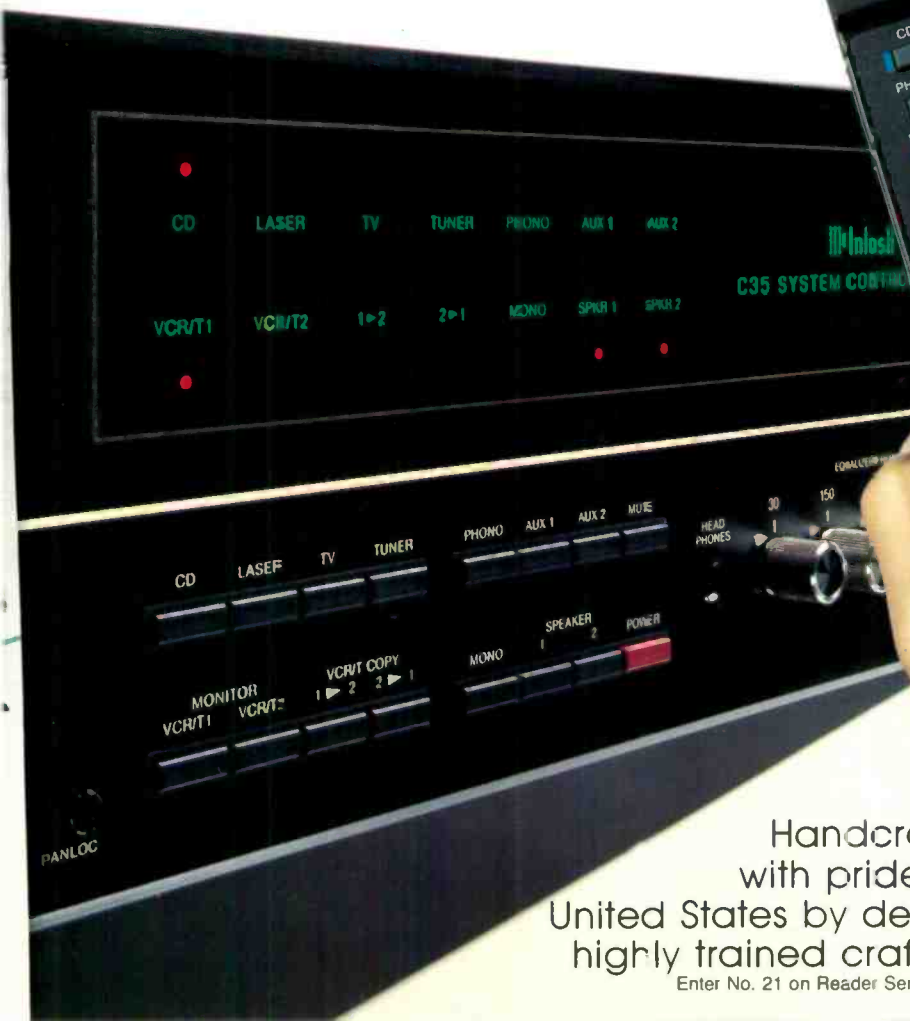
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Even when reproducing E_1 (41.2 Hz) at the highest levels, the Thiel CS5s overloaded gracefully.

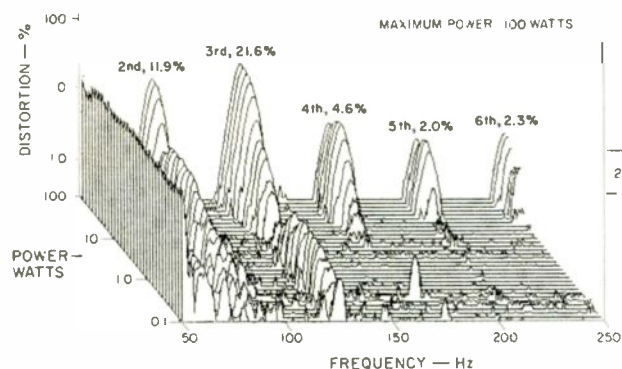


Fig. 13—Harmonic distortion products for the musical tone E_1 (41.2 Hz). The maximum-power figure of 100 watts is based on the CS5's rated impedance of 3 ohms; the actual maximum power is 176 watts, because the impedance drops to a minimum of 1.7 ohms at 41 Hz.

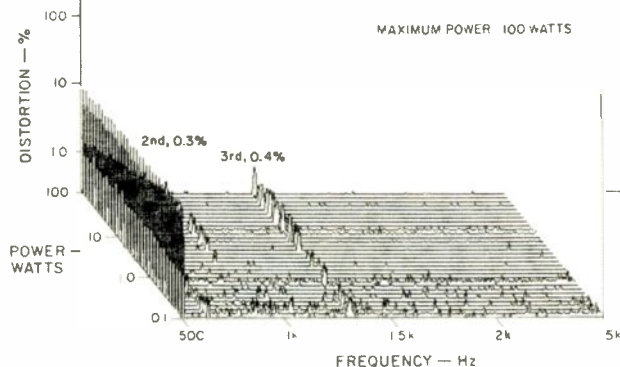


Fig. 15—Harmonic distortion products for the musical tone A_4 (440 Hz).

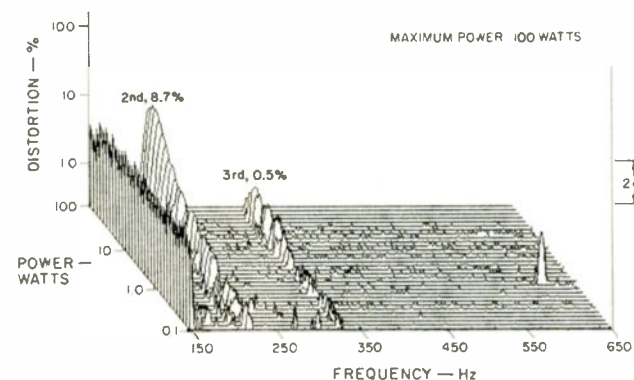


Fig. 14—Harmonic distortion products for the musical tone A_2 (110 Hz).

zonal listening area. Figure 7 shows a composite of all seven response curves that contributed to the $\pm 15^\circ$ mean on-axis curve of Fig. 6. The curves are all extremely close together, fitting in an envelope of ± 1 dB up to 10 kHz and ± 1.5 dB to 15 kHz.

The mean vertical responses are shown in Fig. 8. These curves are considerably rougher than the mean horizontal curves in Fig. 6 due to the strong effects of driver interference at off-axis angles. In this situation, the mean vertical responses are not as significant in predicting general trends

in the response, as they normally would do, because the individual curves that made up the mean curves are very dissimilar. As an example, Fig. 9 shows all seven individual response curves that contributed to the $\pm 15^\circ$ mean on-axis curve of Fig. 8. Considerable variations of greater than ± 10 dB are evident here. The extreme roughness of the upward curves ($+5^\circ$ to $+15^\circ$) is very evident as compared to the downward (-5° to -15°) curves.

Figure 10 shows the CS5's magnitude of impedance plotted over the range from 20 Hz to 20 kHz. A very low minimum impedance of 1.7 ohms occurs at the power-hungry bass frequency of 40 Hz, and a maximum of only 3.9 ohms is reached at 700 Hz. This minimum/maximum range represents a ratio of 2.3 to 1. The very low impedance of the CS5 makes the system very sensitive to cable resistance. To keep cable-drop effects from causing peaks and dips in response greater than 0.1 dB, cable series resistance must be limited to a (very low) maximum of 35 milliohms!

Figure 11, a complex magnitude-phase (Nyquist) polar plot of impedance, covers the range from 5 Hz to 30 kHz—but note that the horizontal and vertical scales only cover a range of 4 ohms. The low impedance of the CS5 is clearly evident from this graph. At the lowest measured frequency of 5 Hz, the impedance is only 0.75 ohm! The positive reactance values between 5 and 870 Hz indicate that the system is inductive over this range. The phase angle of the impedance (not shown) reached a maximum of $+43^\circ$ at 17 Hz; above 20 Hz, the largest angle was $+32^\circ$, at 55 Hz.

The extremely low impedance of the CS5 will make it a very demanding load on any amplifier. Only amps that can supply high current into low impedances should be used with the CS5. Additionally, only use short lengths of low-resistance cable to connect these systems to power amps.

Figure 12 shows the 3-meter room curve with both raw and sixth-octave smoothed data. The CS5 was in the right stereo position, and the test microphone was placed at ear height, at the listener's position on the sofa. The system was swept from 100 Hz to 20 kHz with a 2.83-V rms sine-wave signal (corresponding to 2.7 watts into the rated 3-ohm



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"In its price category, the Adcom GFA-535 is not only an excellent choice; it's the only choice."

Sam Tellig, The Audio Cheapskate

stereophile

Vol. 10 No. November 1987



Adcom GFA-535 power amplifier.

The complete report:

Sometimes products are too cheap for their own good, and people don't take them seriously: the Superphon Revelation Basic Dual Mono preamp, Rega RB300 arm, AR ES-1 turntable, Shure V15-V MR cartridge, and the B&K ST-140 power amp. They can't be any good because they cost so little, right?

Wrong, of course.

Adcom appears to be having the same problem with their \$299.95 GFA-535 amp. Credibility.

Now if this amplifier were imported from England and sold for \$599.95, then maybe it would be taken seriously. And highly praised, no doubt.

For the baby Adcom is one of the finest solid-state amps I have heard. No, not the best; I'm not sure what *is* the best. But it's an amplifier that is so good for so little money as to be practically a gift.

Actually, when Rob Ain from Adcom called, I was about as enthusiastic about the GFA-535 as you were before you finish reading this piece. But Rob insisted, "You've gotta hear this amp."

He brought it over the next day, along with the GFP-555 preamp (\$499.95), and we put both pieces into the rest of the system: a Shure Ultra 500 in a Rega RB300 arm on an AR ES-1 table, with Quad ESL-63 speakers on Arcici stands. Then we chatted for a half hour or so while the electronics warmed up.

And then, simultaneously, the two of us decided to shut up and listen.

"I've never heard the Quad ESL-63 sound better," Rob said. Of course, he was hardly an impartial observer, but the sound was extraordinarily clean, detailed, and musical. If it wasn't the best sound I have ever heard from Quads, it was pretty close.

This humble \$300 amplifier was driving a pair of very revealing \$3000 speakers and giving a very good account of itself. (We listened first to some Goran Sollscher classical guitar.)

"So how come this product isn't flying off the dealers' shelves?" I asked Rob.

"I don't know. Everyone wants the GFA-555 with 200 watts per channel. Including people who don't need it."

"Does the GFA-555 sound any better?" I asked.

"It's our aim to have all our amps sound pretty much the same. You pay more money, you get more power."

Rob pointed out that while the GFA-535 is rated at 60Wpc, it puts out more like 80. And while I did not do any measurements, my experience with other amps tells me Rob's right. I suppose Adcom doesn't want to steal sales from its GFA-545, rated at 100Wpc and selling for \$200 more.

After a couple of hours, Rob left, grinning from ear to ear, and I later sat down to listen alone. True, when I tried certain Telarcs and pushed hard I could get the amplifier to clip—two LEDs quickly light up (very useful). But the Quads were running out of the ability to use the power anyway. My first impressions

were confirmed: the GFA-535 is one of the best amplifiers around for driving Quads. Spondor SP-1s, too.

Suddenly, it hit me what this meant. Conventional wisdom had been dealt a severe blow. You know, the old saw that you should never power a good pair of speakers with a

“The GFA-535 reminds me of... amplifiers that sell... for about three and five times the price.”

cheap amplifier. Here was a cheap amp—one of the cheapest on the market—that sounded good with Quads, Spondors, later Vandersteens. Probably Thiels, too—at least the CS1. What it means is you can stretch your speaker budget a bit and get the speakers you really want, then economize by buying an Adcom GFA-535 for \$299.95. True, you may be a little power shy, but probably not much. And to say the least, the GFA-535 would make a decent interim amp.

What does the GFA-535 sound like? (You thought I'd forget that part, right?) Well, this is one of the most neutral amps I've heard.

“...the baby Adcom is one of the finest solid-state amps I have heard... so good for so little money as to be practically a gift.”

While it doesn't sound particularly tubelike, it avoids the typical transistor nasties through the midrange and into the treble. I wouldn't call it sweet—there's no euphonic coloring—but it isn't cold or sterile. What it is, is smooth. And detailed. Far more detailed than I would ever imagine a \$300 amplifier could be. The GFA-535 reminds me of the Eagle 2A and PS Audio 200C, amplifiers that sell, respectively, for about three and five times the price. Of course, they have more power. And they *are* more detailed. The point is, the Adcom comes close. Very close.

The bass, like everything else, is neutral, certainly not fat and overdone. But it's here where

you notice that this amp is not a powerhouse. You just don't get the solidity and extension you get with a very powerful (and expensive) solid-state amp. Nor do you get the breadth and depth of soundstage that you often find with a very powerful amp. The Adcom GFA-535 sounds a wee bit small, which it is.

My only criticism, and it's more of a quibble, is that the speaker connectors are non-standard and unique (so far as I know). You insert bared speaker wire into a hole and twist the connector tight a quarter turn. Most speaker cables will fit, but some will not. Certainly MIT won't. Neither will the best Kimber, the kind with eight clumps of strands. The less costly four-clump Kimber will, and proved an excellent choice. My sample amp was quiet—

“This amplifier is so good and so cheap that I think any CD owner who buys an integrated amp is nuts.”

no hum—and ran cool. There are selectors for two sets of speakers. And the 535 looks nice.

And talk about economy: If you're not into LPs anymore, you could buy a Mod Squad, dbx, or Old Colony line-level switching box—or possibly a B&K Pro 5 preamp, with its switchable line amp section (only \$350), or the Adcom SLC-505 passive preamp (\$150)—and run it with a CD player. In fact, if you are into CD only (no tape, no tuner, no phono), you could buy a CD player with a variable volume output and run it directly into the Adcom. This amplifier is so good and so cheap that I think any CD owner who buys an integrated amp is nuts.

In its price category, the Adcom GFA-535 is not only an excellent choice; it's the only choice. The real question is whether you should buy one even if \$299.95 is much *less* than you planned to spend for an amp—*ie*, whether you should put the money into a better CD player or pair of speakers instead.

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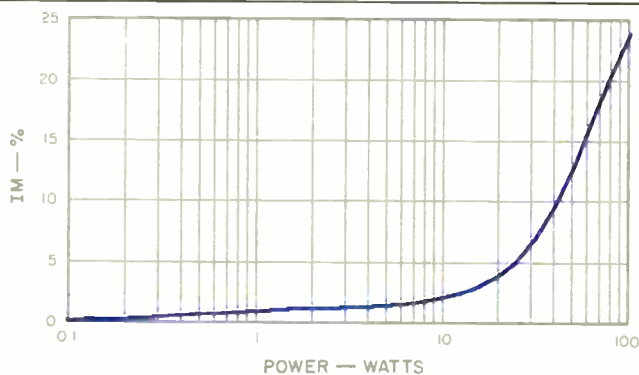


Fig. 16—IM distortion on 440 Hz (A_4) produced by 41.2 Hz (E_1) when mixed in one-to-one proportion.

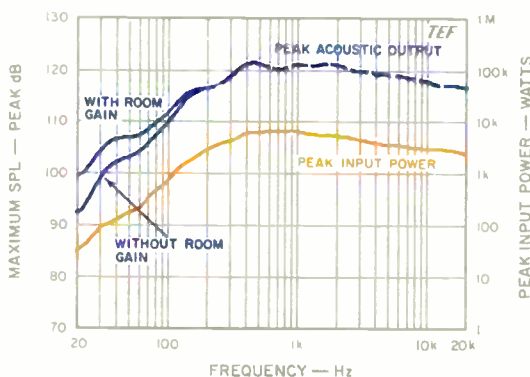


Fig. 17—Maximum peak sound output, measured at 1 meter on axis, and corresponding maximum peak input power levels. The effect of gain for a typical room is shown below 200 Hz on the output curve. Acoustic output above 600 Hz (dashed curve section) was limited by amplifier clipping.

load); the resultant sound levels can be read directly off the graph. The parameters of the TDS sweep were chosen so that the direct sound plus 13 mS of the room's reverberation were included. Except for a dip in the floor bounce region at 350 Hz, and some midrange roughness between 500 and 1,300 Hz, the curve is quite flat and extended.

Figures 13, 14, and 15, respectively, show the spectra of single-frequency harmonic distortion versus power level at the musical notes of E_1 (41.2 Hz), A_2 (110 Hz), and A_4 (440 Hz). These measurements indicate the level of harmonic distortion that is generated by the system with the application of a single-frequency sine wave at power levels from 0.1

to 100 watts (-10 to +20 dBW, a 30-dB dynamic range). The power levels were computed using the rated impedance of 3 ohms. The curves were run by successively increasing the sine-wave input level in 1-dB increments. At each power level, a swept spectrum analysis was done over a frequency range covering up to the fifth or sixth harmonic.

Figure 13 shows the E_1 (41.2-Hz) harmonic distortion data. The 100-watt maximum power is based on the rated impedance of 3 ohms; actual power is a much higher 176 watts, because the system's impedance reaches a minimum of 1.7 ohms at this test frequency. The nonharmonically related spikes, at lower power levels, are due to background noise in the measurement setup and were not generated by the speaker. At lower power levels, the second and third harmonics prevail at about the same level, while at higher power levels, the fourth, fifth, and sixth harmonics join the lower ones. At higher levels, the second and third harmonics predominate and reach 11.9% and 21.6%, respectively, at 100 watts. Even though this distortion is somewhat high, realize that 100 watts at 41 Hz generates a loud 100 dB SPL at 1 meter. At the highest levels, the system did not generate any extraneous noises; it overloaded quite gracefully.

The A_2 (110-Hz) harmonic data is shown in Fig. 14. The plot reveals that the second was the only significant harmonic over most of the power range. The second harmonic increases gradually with power, reaching a modest 8.7% at 100 watts. The third harmonic actually reached an intermediate high of about 0.5% at 40 Hz and then decreased to the measurement floor of the test at 100 watts. As in the previous graph, the random, nonharmonic information is due to background noise and other uncontrolled effects in the test setup.

The A_4 (440-Hz) harmonic measurements are shown in Fig. 15. Only the second and third harmonics were significant at 440 Hz, reaching levels of only 0.3% and 0.4%, respectively, at 100 watts. Even though the second harmonic distortion is mostly obscured by the fundamental bleed-through on the left in the graph, the second did not exceed 0.3% at any power level. These distortion levels are very low considering that at 440 Hz, the system generates in excess of 103 dB SPL at 1 meter with 100 watts input.

The IM distortion on a 440-Hz (A_4) tone created by a 41.2-Hz (E_1) tone of equal level is shown in Fig. 16. ("Equal level" refers here to input power, not output acoustic level.) The IM distortion gradually rises with power, reaching a high of about 24% at 100 watts. The first-order ($f_2 \pm f_1$) and second-order ($f_2 \pm 2f_1$) side frequencies predominated in this power range. The distortion is fairly high because the lower midrange, which handles the 440-Hz tone, also receives a significant amount of the 41-Hz tone due to the system's use of 6-dB/octave crossover slopes. Steeper crossover slopes would have reduced the IM distortion but at the expense of degrading the system's time-phase behavior.

Figure 17 shows the CS5's short-term peak-power input and output capabilities as a function of frequency. The tests were run by exercising the system with a high-level, shaped, 6½-cycle sine-wave tone burst from a Crown MA-2400 power amplifier configured in the bridged mode. The signal used for this test covers a third-octave bandwidth with a

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The CS5s have delightfully clear and dynamic midrange coupled with a detailed, smooth treble few systems can compete with.

time duration that increases as the frequency decreases. The duty cycle of the test signal is low enough so that the long-term thermal characteristics of the speaker under test are not exercised.

The test consists of determining the maximum peak input power-handling capacity and maximum output peak sound pressure levels, in the range from 10 Hz to 20 kHz, at all the third-octave center frequencies, using waveform and audible judgments. For the CS5, the peak input power was calculated by assuming that the measured voltage was applied across the rated 3-ohm impedance.

The maximum peak electrical input power-handling capacity of the CS5 is shown in the lower curve of Fig. 17. Below 20 Hz (not shown), the peak input power was about 15 watts. In this subsonic region, the input power was limited primarily by the excursion capability and linearity of the woofer's suspension. Above 20 Hz, the input power rises smoothly up to about 600 Hz, where the test power amplifier ran out of gas at about 6 kW (135 V, peak). At all higher frequencies, the power amplifier's clip limit was reached before the speaker reached its limit! The high-frequency droop, noted in the curves of peak input power and peak acoustic output SPL, is also due to limitations of amplifier power bandwidth. These limitations occurred because the impedance of the CS5 drops below 3 ohms above 8 kHz. The CS5s handled these tests in a very straightforward manner without any anomalies or unexpected behavior.

The upper curve in Fig. 17 shows the maximum peak sound pressure levels the system can generate at a distance of 1 meter on axis for the input power levels shown in the lower curve. Also shown is the "room gain" of a typical listening room at low frequencies. This adds about 3 dB to the response at 80 Hz and 9 dB at 20 Hz. The peak acoustic output rises smoothly with frequency up to the midband region, where the power amplifier limits the output. As noted, the high-frequency decrease in output is also due to power amplifier limitations. With room gain, a single CS5 can generate peaks in excess of 110 dB SPL above 80 Hz and greater than 120 dB SPL above 350 Hz. Note that with room gain, the low-frequency output of a single system rolls off quite gradually with frequency, still providing a healthy 100 dB SPL at 20 Hz! Of course, a pair of these systems operating with mono bass will be able to generate even higher levels by some 3 to 6 dB. With this amount of bass output, subwoofers will definitely not be required with these speakers!

Use and Listening Tests

The listening portion of this review was performed in my auditioning room, which has dimensions of approximately 15½ × 27 × 8 feet. The room has normal living-room furnishings and a carpeted floor. Evaluation equipment included Onkyo Grand Integra DX-G10 and Meridian 206 CD players, a Krell KSP-7B preamp, a Krell KSA-200B solid-state power amplifier, and Straight Wire Maestro interconnects and speaker cables. As usual, I did the majority of my listening before I made the measurements.

All of the listening was done with the CS5s placed in my normal evaluation position, about 6 feet away from the short rear wall and separated by 8 feet. The side-wall spacing

was about 4 feet. The speakers were toed in so that I was on the system axis laterally. Listening took place on the sofa, about 10 feet away, with my ears approximately 36 inches from the floor.

The systems were hooked up in a normal single-cable configuration (not bi-wired). Not only does Thiel not provide bi-wiring capability on the CS5s, they also philosophically discourage its use, believing that the speaker will sound better with one very good amplifier than with two lesser amplifiers. The company states that the speaker should always be used with the best amplifier that can be afforded rather than splitting the available money between two amps. It is Thiel's opinion that the amount of sonic improvement that can be attained by using two of the best power amplifiers represents a very poor cost/performance value. They believe that the extra money would be *much* better spent on purchasing a second pair of CS5s (good for Thiel, bad for amplifier manufacturers!). The second pair would be placed directly behind the first, pointing backwards, which would provide greater bass output, reduced distortion, and a greater sense of ease. Due to the CS5s' low impedance, the extra speakers would have to be wired in series with the original pair. Because the system's impedance doesn't vary much with frequency, this should be no problem.

The CS5s have been a delight to listen to. They have a high degree of midrange dynamics and clarity, coupled with a very smooth, detailed treble, that few systems can compete with. However, you had better be sitting down when I tell you this: You *have to be* sitting down when you listen to these systems! They have been optimized for a listening height of 36 inches at a distance of 10 feet, and you had better not raise your head! These speakers definitely have a sweet spot (or line) that extends laterally about 36 inches above the floor.

When I listened in a partially standing or standing position, I noticed that the excellent qualities of the system were greatly diminished. With higher positions, the upper midrange was depressed, rough, and sounded quite constricted. At heights above about 40 inches, the lateral image position of instruments would shift greatly, depending on height. Furthermore, I also noticed a "phasiness" or "swishiness" when I was in the process of standing up or sitting down. When sitting, however, the systems sounded excellent, with rock-stable imaging and a very open sound coupled with impressive depth and focus.

Unless otherwise stated, the following comments apply to listening done while I was sitting down. On Ana Caram's new Chesky CD, *Amazonia* (JD45), the CS5s did a very credible job of reproducing the ambience and soundstaging of the Brazilian jungle on the title track. The CS5s' height and driver placement contributed to an awareness of increased source height, and of an elevated sound source, that was not at all unpleasant. (When sitting, the tweeter is at an up angle of about 6°, whereas a typical system is usually at about 0°.)

On *Tommy Newsom and His TV Jazz Stars* (LaserLight 15 331), the sound was very clean and open, and the horns seemed to float in space in front of me. The bass lines were very even, and the room reverb on track 4 was reproduced very well. *Spies: By Way of the World* (Telarc CD-83305),

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The Thiels are transparent and accurate, with linear response, near-subwoofer bass, excellent imaging, and extended dynamics.

encoded in Shure HTS surround, has turned out to be great demo material, even played in normal stereo. The CS5s did a super job on the kick drum and sound effects on track 6. Track 7's spatial effects were reproduced with lots of beyond-the-speaker images (the HTS processing, I presume), and the moving sounds on track 12 were very believable. Even though this is a highly processed multi-track CD, it's clean, well recorded, and fun!

The complex orchestration—with soloists, choir, and lots of percussion—on Gilbert Amy's *Missa Cum Jubilo* (Musifrance Erato 2292-45020-2) was rendered effortlessly, without any hint of harshness. (If you like Orff's *Carmina Burana*, you'll like this disc.) The Sony Classical CD which includes Mozart's Sonata in B-Flat Major for Bassoon and Cello (from the Marlboro Music Festival—40th Anniversary series, SMK 46248), exhibited the CS5's very smooth midrange and upper midrange along with the balanced upper bass of the cello. On the very demanding organ version of *Pictures at an Exhibition* (Dorian DOR-90117), I did notice some IM distortion and muddiness on track 5 when the pedal notes were played at high volume; my reference systems were a bit cleaner on this track. The difficult passages on track 15 that made my reference systems stumble at 3:41 and 3:44, as noted in the B & W 801 Matrix Series 2 review in the November 1990 issue, were passed by the CS5s without any noticeable problems in dynamic offset.

Amanda McBroom's voice on the Sheffield Lab *West of Oz* (CD-15) was reproduced with more openness than my reference systems. The harmonica on tracks 1 and 2 seemed to float in space right above her head. (Who knows where the harmonica was supposed to be?) McBroom's solo on track 6 was effortless and clean. The CS5s also did a very convincing job on live rock music with the title track of my daughter's *Lick It Up* by Kiss (Mercury 814 297-2). I turned up the volume until the Krell was clipping at ± 80 V (2.1 kW into 3 ohms!), where the sound level meter was indicating 98 dBA and 105 dBC at the listening position. The result was loud and fairly clean, a lot cleaner than a typical heavy-metal concert!

The Thiel CS5s have some exceptionally strong attributes in their favor: Accuracy, transparency, linear magnitude/phase response, low distortion, midrange dynamics and clarity, excellent soundstaging and imaging, extended dynamic range, a smooth and extended low end with near-subwoofer performance, and a smooth and detailed treble. Their downside includes a high price, heavy weight, large size, very low impedance, rough upper midrange response at elevated angles, and a potential for sensitivity to room acoustics because of an uneven off-axis vertical response. The CS5s, however, are a serious high-end contender and demand auditioning by anyone who's in the market for this caliber of loudspeaker.

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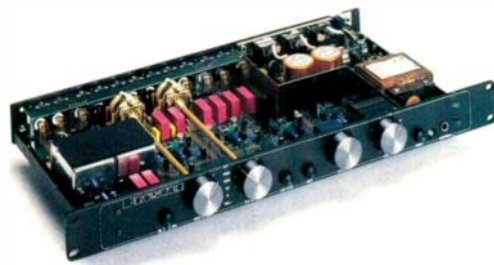
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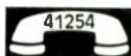
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3

HARMAN KARDON TD4800 CASSETTE DECK

Manufacturer's Specifications

Frequency Response: 20 Hz to 22 kHz, ± 3 dB, at -20 dB for all formulations; 20 Hz to 20 kHz, ± 3 dB, at 0 dB with Dolby C NR and metal tape.

Harmonic Distortion: 0.9% at 1 kHz at Dolby level with Type IV tape.

Signal/Noise Ratio: 66 dBA with Dolby B NR, 74 dBA with Dolby C NR, 75 dBA with Dolby S NR, all with Type II tape.

Separation: 45 dB.

Crosstalk: 70 dB.

Erasure: 65 dB.

Bias Frequency: 210 kHz.

Input Sensitivity: Line, 45 mV.

Input Impedance: 22 kilohms.

Output Level: 1.15 V at 0 dB.

Headphone Impedance: 8 ohms minimum.

Flutter: 0.04% wtd. rms, $\pm 0.07\%$ wtd. peak.

Fast-Wind Time: 90 S for C-60 cassette.

Power Requirements: 120 V a.c., 60 Hz.

Dimensions: 17 $\frac{1}{8}$ in. W x 5 in. H x 12 $\frac{5}{8}$ in. D (44.3 cm x 12.6 cm x 32 cm).

Weight: 15.2 lbs. (6.9 kg).

Price: \$1,199.

Company Address: 240 Crossways Park West, Woodbury, N.Y. 11797 and 8400 Balboa Blvd., Northridge, Cal. 91239.

For literature, circle No. 91

The Harman Kardon TD4800 appears to be the first cassette deck with Dolby S noise reduction to reach actual production. This new noise-reduction system, described in the June 1990 issue, offers advantages over other designs, including Dolby C NR. Getting the maximum benefits from Dolby S NR requires high-quality recorder design, construction, and alignment. The TD4800 has three heads to ensure maximum magnetic performance and to permit monitoring the playback while recording. Its recording and playback circuitry uses discrete components for maximum design flexibility and highest possible performance. The Harman Kardon deck includes tape calibration with adjustable bias and record sensitivity. Front-panel metering of the adjustments aids in getting superior frequency response, low distortion, and optimum Dolby NR tracking. The TD4800

also has Dolby HX Pro to provide better high-frequency response at higher levels with all NR modes.

The deck's large fluorescent meter display simplifies setting record levels accurately. The elapsed-time counter keeps up with the tape in fast-winding modes and guides the user on efficient use of tape recording time. The monitor selector switches automatically so that the source signal is heard and metered when the deck is stopped, and the playback signal is heard and metered during recording and playback. However, the monitor's setting can be overridden manually. Intro scan and forward/reverse skip greatly speed up finding, identifying, and playing wanted selections. In "Replay" mode, the deck repeatedly rewinds and plays the current cassette side. A remote control is provided with the Harman Kardon TD4800.





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In recording and playback, frequency response was excellent, with extended low and high limits.

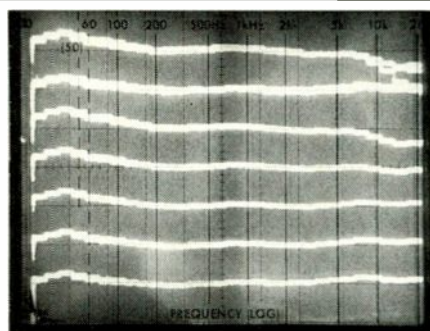


Fig. 1—Record/playback responses for band-limited pink noise, using Maxell XL-I tape. Top two traces show responses for all NR modes, superimposed; top trace is at Dolby level (meter zero), and second trace is at -20 dB. Bottom five traces are with Dolby S NR at (from third trace to bottom) 0, -5 , -10 , -15 , and -20 dB. See text. (Vertical scale: 5 dB/div.)

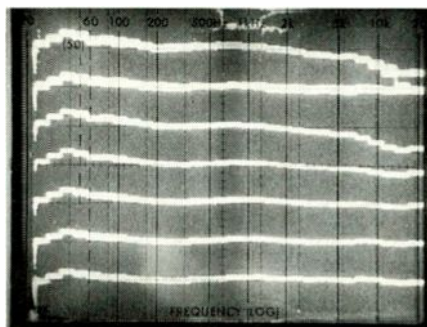


Fig. 2—Same as Fig. 1 but with TDK SA tape.

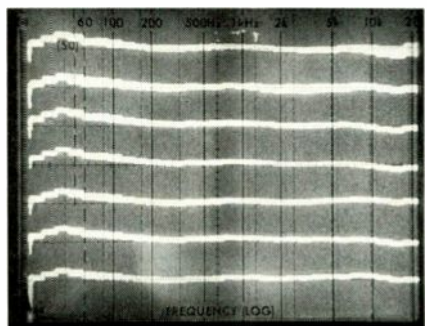


Fig. 3—Same as Fig. 1 but with TDK MA tape.

Control Layout

The TD4800 is somewhat larger than the typical deck, and a convex section near the top of the front panel reinforces this impression. At the left end is the large "Power" on/off button. Immediately to the right is the window of the cassette compartment door, which, along with the "Eject" button to its right, has the same curvature as the "Power" switch. The door opens smoothly after a gentle push of the button, providing easy access for loading and unloading tapes. The opening for cleaning and demagnetizing is good, and the front door cover can be removed for additional clearance. The dual-capstan drive and the tape guides appeared to be solidly built. The erase head and the sandwich-type, record and playback head structure are well supported.

To the right of "Eject" is the display panel, whose clear cover is curved to match the buttons flanking it. At the left is the sensor for the remote control, followed by the fluorescent elapsed-time display in "00:00" form. Next to the right are the fluorescent meters, with "L" above and "R" below. Each meter has 12 segments, blue-white from " -35 " to " -1 " and red from zero (double-D Dolby symbol) to " $+8$." The "dB" scale between the meters has the same color scheme, which aids in reading levels. Below these displays are a series of annunciators, all blue-white except for "Rec," which is red. From just below the left end of the counter, they are: "Memo," "Intro," "Replay," "Rec," "Play," double arrows for rewind (which flash during reverse skip) and fast forward (which flash during forward skip and intro scan), "Tape" and "Source," and "Type" (with indicators for "I," "II," and "IV") followed by the double-D Dolby symbol and "B," "C," and "S" to show which Dolby NR mode may be in use.

Below the left end of the display panel are horizontal-bar, spring-loaded buttons for "Bias Tone" and "Rec Cal." Some distance to the right are six similar buttons for "Dolby NR" ("Off," "B," "C," and "S"), "Meter Weighting," and "MPX Filter." Below these buttons are six good-sized transport control bars. From the left are record/pause, play, stop, rewind, fast forward, and record mute. When the deck is in record/pause or record mute, "Rec" flashes in the display panel, faster when muted than when paused. Below the record/pause bar is the "Bias Fine Trim" potentiometer, with "Hi Cut $-$ " at the left end of its scale and " $+ Hi Boost$ " at the right end. The left and right "Rec Cal" pots are centered under the transport buttons. The "Output" pot, which controls both line and headphone levels, is under "Rec Mute." All of the pots for "Rec Cal" and "Output" have "Min" at the left end and "Max" at the right. The bias and record calibration pots have helpful center detents, and these detents are soft enough for easy adjustment close to the center. When "Bias Tone" is held in, the left-channel meter shows playback level of a 400-Hz test tone and the right-channel meter displays playback level of a 12-kHz test tone. Bias level is adjusted to make the meter readings the same. When "Rec Cal" is pushed, a 400-Hz test tone is fed to both channels. Then, the pots for each channel are adjusted to make the two channel levels read meter zero.

At the top right of the front panel are seven large buttons, three above and four below, with the same convex shape as the display-panel window to their left. At the top left is "Intro



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The MOL tests demonstrated the worth of Dolby S NR's distortion reduction and bass spectral skewing.

Fig. 4—Responses when using Dolby B and C NR to playback tapes recorded with Dolby S NR at (top to bottom) 0, -10, and -20 dB. Note the broad peak around 1 kHz, the rising high-frequency response for playback with Dolby C NR, and the falling high-frequency response for playback with Dolby B NR. (Vertical scale: 5 dB/div.)

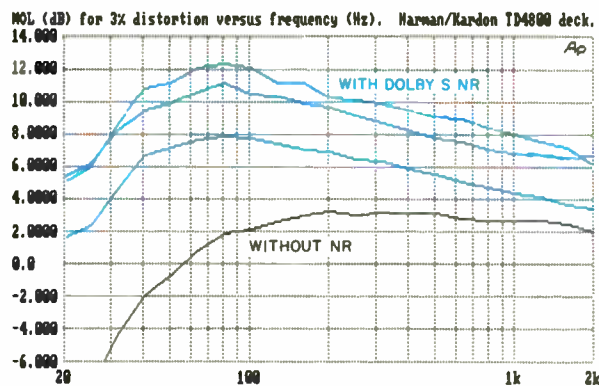
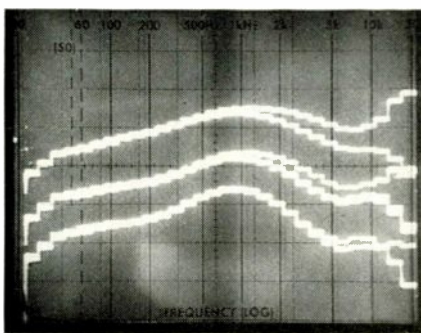


Fig. 5—MOL (for 3% distortion) vs. frequency from 20 Hz to 2 kHz. Top three curves were made with Dolby S NR with

(from top down) TDK MA, Maxell XL-I, and TDK SA tapes. Bottom curve is for TDK SA without noise reduction.

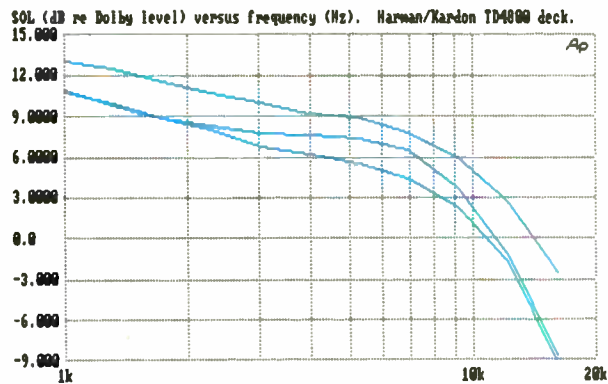


Fig. 6—SOL vs. frequency from 1 to 16 kHz, using Dolby S NR for (top to bottom) TDK MA, Maxell

XL-I, and TDK SA tapes, all referenced to Dolby level.

Scan," the largest of the buttons, for scanning the first 15 S of each selection on a tape. To the right are buttons for skip reverse and skip forward. When skip forward is used, "P 01" first appears in place of the normal counter display. If skip reverse is used, "P 00" appears (rewinding to the beginning of the current piece); a second push changes the display to "P-01." The maximum settings are "P 15" and "P-15," providing a fast wind up to 15 tunes from the current selection. Below those three buttons are "Monitor," "Reset" for the counter, "Memory" (which makes the tape stop at counter zero during rewind but not during fast forward), and "Replay." In "Replay" mode, the deck continuously rewinds the tape at its end and plays it back from its beginning, continuing until "Replay" is turned off (by pushing it again) or the stop button is pushed. Below these buttons are concentric "Input Level" pots. The knobs are large in diameter, making interchannel adjustments easy to make against their coupling friction. The "Headphones" jack is to the right. All panel labels are easy to read over a wide range of lighting because of their good size and the contrasting color.

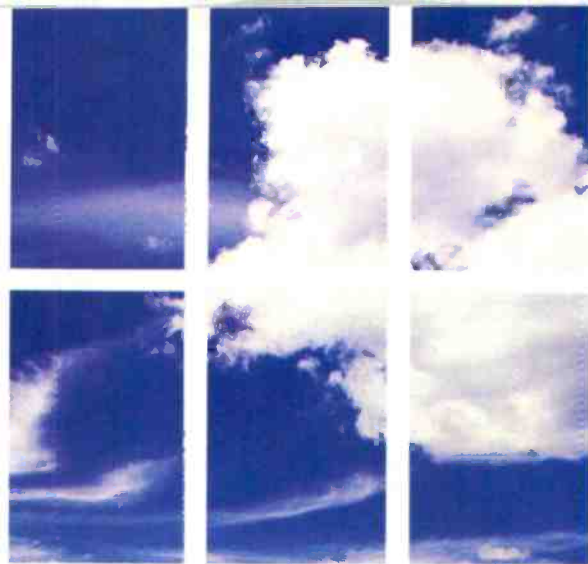
At the left end of the rear panel are the stereo "Input" and "Output" phono jacks. Some distance to the right are the "Remote" jacks ("In" and "Out") that permit using an external infrared sensor and/or controlling other components through a connecting cable.

Examining the interior, I was immediately struck by the five large p.c. boards. The quality of the boards and the components was high, the layout was neat, and all parts were numbered. All visible solder joints were excellent. Connections between boards were made with ribbon cables or bundled single wires, all via multi-pin plugs and sockets. Support for the boards was good, and front-to-back rails and supports made the assembly rigid. I judged the transport design to be quite rigid, and the flywheels were fairly large in diameter. Operation was very quiet in record/play but was somewhat noisy while fast winding. The transformer was just warm to the touch after hours of use.

The remote control is light in weight and easily held in one hand. The first row of buttons from the transmitting end are "Display" at the left and counter "Reset" and "Memory" next to each other at the right. "Display" is an uncommon choice on a remote, but a good one it is: When the panel display is not needed, it can be turned off—reducing possible distractions and potential electrical noise. Some distance below are "Monitor" at the left and "Replay" and "Intro" scan at the right. Below are rows of buttons for rewind and fast forward, forward and reverse skip, record mute and record/pause, play, and stop. The light gold letters are very legible against the black background. The top of the control's back end is convex, repeating the motif of the deck's front panel.

Measurements

The TD4800's playback responses, using BASF alignment tapes, were very good with both 120- and 70- μ S equalization. All the points were within ± 0.5 dB from 31.5 Hz to beyond 10 kHz. The 15-kHz points were down about 2 dB. The indicated playback level of my Dolby-level test tape was 1 dB high, "+ 1" on the left meter and just at the "+ 1" threshold (flickering) on the right meter. Tape play speed was close, just 0.3% slow. The Maxell XL-I, TDK SA, and



Nº 27

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Dolby S NR worked well with all but the very poorest and peakiest of the 90 tape formulations I used.

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

Tape	With Dolby S NR				Without NR			
	Dolby Lvl		–20 dB		Dolby Lvl		–20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell XL-I	8.1	13.3	7.5	21.4	9.4	10.7	7.7	22.2
TDK SA	9.2	12.8	9.3	21.8	10.7	9.6	9.0	23.2
TDK MA	8.9	18.8	8.7	23.9	9.9	12.4	8.7	23.7

Tape	With Dolby C NR				Without NR			
	Dolby Lvl		–20 dB		Dolby Lvl		–20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell XL-I	9.4	12.9	7.0	21.5	9.4	10.7	7.7	22.2
TDK SA	10.9	12.2	8.8	21.7	10.7	9.6	9.0	23.2
TDK MA	9.7	20.9	8.6	23.7	9.9	12.4	8.7	23.7

Table II—Miscellaneous record/playback characteristics.

Erasure At 100 Hz	Separation At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase		MPX Filter At 19.00 kHz
			Error	Jitter	
71 dB	57 dB	<–90 dB	–7°	±2°	–38.1 dB

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

Tape	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby S NR		Without NR		W/Dolby S NR		Without NR	
	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Maxell XL-I	70.7	79.0	52.5	58.3	71.7	80.0	49.3	55.1
TDK SA	73.7	79.6	55.3	58.3	74.5	80.4	52.5	55.5
TDK MA	74.1	83.5	55.8	62.4	75.0	84.4	53.0	59.6

Table IV—Input and output characteristics at 1 kHz.

Input	Level		Imp., Kilohms	Output	Level		Imp., Ohms	Clip (Re: Meter 0)
	Sens.	Overload			Open Ckt.	Loaded		
Line	37 mV	29.1 V	18.4	Line Hdphn.	950 mV	930 mV	351	+16.7 dB
					980 mV	330 mV	102	

TDK MA tapes provided by Harman Kardon for evaluating the deck were used for the majority of the tests.

With the "Rec Cal" control at its center detent, the TDK SA cassette reproduced the calibration signal right at meter zero, but the record sensitivity adjustment could be varied from –3.2 to +4.1 dB to accommodate other tapes. The "Bias Fine Trim" oscillator frequency was 12.8 kHz, and the level change for SA tape during bias trimming was from –2.8 to +2.9 dB relative to the pot's center detent. There was very little bias in the playback output during recording, and the 200-kHz bias frequency was hard to pick out in a highly amplified oscilloscope display.

Figure 1 shows the record/playback responses with Maxell XL-I (Type I) tape, using a pink-noise source band-limited from 16 Hz to 25 kHz. The top trace, at Dolby level, includes the responses with Dolby B, C, and S NR and response without NR. All the responses are almost exactly the same up to 10 kHz. Above that frequency, the responses using Dolby C and S NR are further extended, but with Dolby B

and without NR, the roll-off becomes sharper. The second trace has the overlaid responses at –20 dB for the same four conditions; notice how closely the responses match at this level. The remaining five traces display the Dolby S NR responses from Dolby level to –20 dB, in 5-dB steps. Although all the curves have a moderate but unwanted response rise around 40 Hz, their consistent shapes prove the TD4800's excellent Dolby NR tracking.

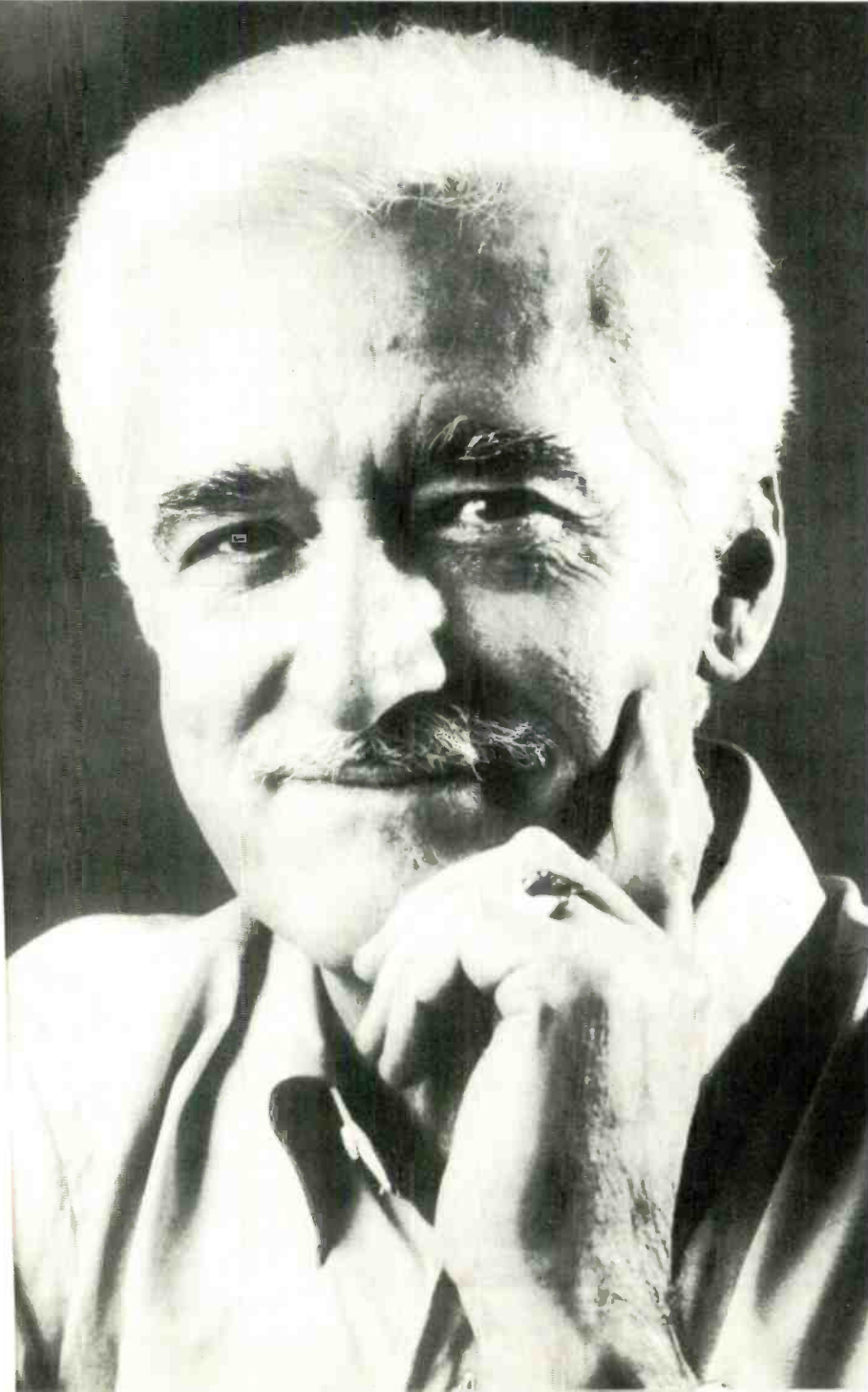
Figure 2 provides the results for TDK SA tape under the same conditions as in Fig. 1. Compared to the results with XL-I, the 40-Hz rise is smaller but the high-frequency roll-off is greater (the latter expected with a Type II tape). Figure 3 shows the results using TDK MA (Type IV) tape for the same tests. The flatness of the responses at high frequencies at all levels is certainly impressive, although the moderate rise around 40 Hz remains a bit disappointing.

For all the response tests discussed above, I used pink noise as a source because sweeping or stepping sine waves can cause the true response deviations to be multiplied by Dolby noise-reduction systems. However, sine waves were used to obtain the results in Table I, which lists the –3 dB response limits for the three tapes when used with Dolby C NR, with Dolby S NR, and without noise reduction. The results are excellent, showing extended limits at both low and high frequencies. Table II lists several record/playback properties, all of which are excellent. The 71-dB erasure at 100 Hz with metal tape is one of the better results I have obtained to date, and the 10-kHz A/B phase results were the best to date.

Next, I recorded pink noise, using Dolby S NR, at meter zero and at –10 and –20 dB. I played the tape back using Dolby B and C NR and stored the responses on the oscilloscope. Figure 4 shows what happened: Both the Dolby B and Dolby C NR responses peaked around 1 kHz, and the responses with Dolby B NR roll off more than with Dolby C NR above this point. Above 10 kHz, the Dolby B responses roll off sharply while Dolby C NR responses are flat or rise noticeably. My scope was calibrated to show signals at meter zero three divisions down from the top of the screen. Thus, at 0 dB the Dolby B and C NR playback levels at 1 kHz are about 2 dB high. At –10 dB for Dolby S NR, the playback 1-kHz levels are about 7 dB high; at –20 dB for Dolby S NR, they are about 12 dB high. The playback response shapes with Dolby B and C NR are fairly consistent as level is changed, but compression is apparent in the figure. When I listened with headphones, the concentration of energy around 1 kHz was very obvious, and the rise above 10 kHz with Dolby C NR also stood out. As expected, a switch back to Dolby S NR in the –20 dB section of the tape caused an ear-catching level drop. My assessment of the sonic results when using other Dolby NR settings for tapes made with Dolby S NR awaited the in-use tests.

Figure 5 shows the TD4800's maximum output levels (MOLs) from 20 Hz to 2 kHz for the three tapes. The top three curves were made with Dolby S NR, and the rise in MOLs below 2 kHz is very obvious. The deck's MOLs for SA tape were plotted again, without Dolby NR, and the reductions in the 3% distortion limits were 6 dB at 90 Hz, 8 dB at 50 Hz, and 10 dB at 20 Hz. (The 20-Hz MOL without NR was –8.4 dB.) These results emphasize the distortion-reduction

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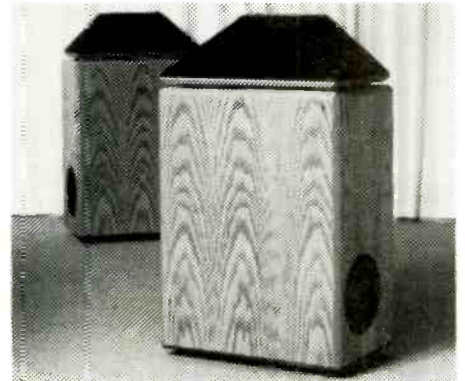


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Even using randomly chosen tapes, the excellent level matching and flatness with Dolby S NR impressed me.

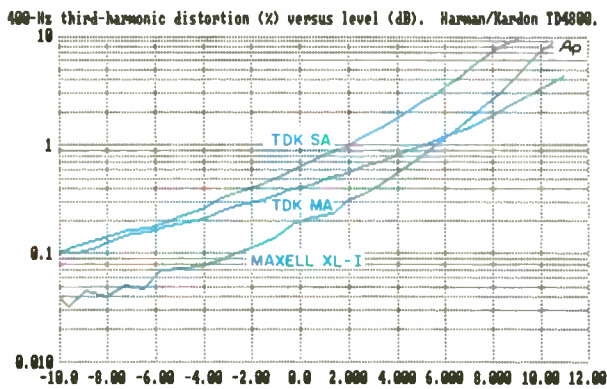


Fig. 7—Third-harmonic distortion vs. level for a 400-Hz signal, using Dolby S NR for the three tapes.

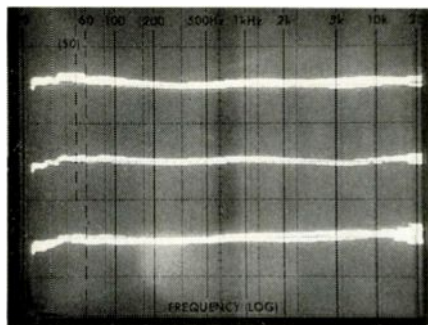


Fig. 8—Record/playback responses at -20 dB, using Dolby S NR, for five different formulations of each tape type. Top trace is superimposed response of Type I tapes, second trace is Type II tapes, and bottom trace is Type IV tapes. See text. (Vertical scale: 5 dB/div.)

capability of Dolby S NR and the advantage of its low-frequency spectral skewing.

The Harman Kardon's saturation output limits (SOLs) for the three tapes from 1 to 16 kHz when using Dolby S NR are seen in Fig. 6. The SOLs are highest using the Type IV tape, TDK MA, as expected. For XL-I and SA tapes, the SOLs are nearly as close at the frequency extremes, but XL-I is noticeably better between 2.5 and 10 kHz. With Dolby C NR, the SOLs would have been similar, but with Dolby B or no NR, they would have been noticeably less.

The 400-Hz third-harmonic distortion versus level for the three tapes is shown in Fig. 7. Dolby S NR helps to keep both noise and distortion low, although the distortion readings at the lowest levels include some noise. At -10 dB, the distortion for SA and MA tapes is the same (0.1%) but is much lower for XL-I tape (less than 0.04%). With increasing levels, distortion increases relatively slowly with MA tape and with XL-I it is higher than with MA above $+6$ dB.

I measured signal-to-noise ratios at Dolby level for the three tapes with Dolby S NR and without NR for both IEC A and CCIR/ARM weightings. Table III lists all these ratios plus those relative to the 400-Hz MOLs (3% third harmonic). The smaller difference in the ratios without noise reduction demonstrates the distortion-reduction characteristic of Dolby S NR. For example, without NR, the Maxell XL-I ratios are 52.5 dBA at Dolby level and 58.3 dBA at "HD = 3%," a difference of 5.8 dBA. With Dolby S NR, the results are 70.7 dBA at Dolby level and 79.0 dBA at "HD = 3%," a difference of 8.3 dBA.

At this point, I decided to try a wide range of tapes on the TD4800 using Dolby S NR. Although Harman Kardon had supplied selected tapes, I believed many formulations would be fine matches, especially with the TD4800's good record/tape calibration system. Using Dolby S NR, I tried most of the 90 tapes I have. The deck got at least very good responses from every tape except the poorest and those with peaked high-end responses. The following are but a few examples: Denon DX1 was not a good choice, but DX4 was an excellent one; Denon HD6 and HD7 were fine, HD8 was not; TDK AR and SA were excellent, AR-X and SA-X were not. Maxell's Metal Vertex and That's Type IV Suono both produced excellent responses on this deck. The impressive responses of BASF Metal IV pleasantly surprised me; I have had some trouble setting bias and record sensitivity for this formulation in the past—but not this time.

Figure 8 presents a series of -20 dB record/playback responses with Dolby S NR. Each trace is the result of overlaid responses stored one after another, five tapes for each tape type. I did not take the time to select the best five; I quickly picked out one tape after another, adjusted bias and record calibration, and then stored the response. The spread in the traces includes any response deviations and any level errors in the calibration. As I write this, I look at the oscilloscope photograph, and the excellent flatness and level matching impress me again.

Various input and output attributes at 1 kHz are shown in Table IV. The input sensitivity, 37 mV, is better (lower voltage) than that for most decks, and the output impedance is admirably low. The input impedance is slightly low, in my view, with the input pot wide open (test condition), but it increased with the control lowered to typical settings. The maximum output level was very high for all headphones I tried, but I easily controlled it with the output pot. The two sections of the input pot tracked within 1 dB from wide open down to 65 dB of attenuation, which is excellent performance. The sections of the output pot tracked within 1 dB from wide open down to 50 dB of attenuation, fairly good performance. The meter calibrations were very good over the entire range "from -35 " to " $+8$," and most actual thresholds were within 0.4 dB of the scale markings. Meter-segment and scale illumination was excellent. The meter response was 3 dB down at 17 Hz and at an unnecessarily high 236 kHz.

When using a 5-kHz tone burst with a continuous level 1 dB above meter zero and a 20-mS duration, I obtained a zero-level response. Any levels to zero or above caused a 2-S hold of the highest levels reached, which is good. Offset bursts yielded higher readings, as they should have. How-



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The TD4800 is priced higher than some DAT decks, but it gets very high performance with low-cost, but not so lowly, analog cassettes.

ever, this effect was less pronounced with positive offsets than it was for negative offsets. With "Meter Weighting" pushed in, the higher frequencies (above 1 kHz) produced higher readings but not as much as record equalization would cause. With "Meter Weighting" actuated, I got a zero-level response from a 6-mS burst; this shows a faster meter response, which is good. The output polarity while recording was the same as the source with the monitor in "Source" but was reversed in "Tape."

Playback of a recorded 3-kHz tone showed no variation in tape speed when line voltage was reduced from 120 to 110 V. With the voltage increased to 130 V, the speed increased very slightly, by 0.01%. Over a few minutes, tape speed varied a maximum of $\pm 0.02\%$. Typical figures for flutter were 0.06% weighted rms and $\pm 0.08\%$ weighted peak, only very slightly higher than specification; after a couple of trials, I found cassettes that met the manufacturer's figures. Fast winding of one side of a C-60 cassette took 70 S; a C-90 took 103 S. From fast wind or play, the deck took 3 S to switch to stop mode when the tape ran out, and it took 1 S or less to reverse fast-wind directions or switch from fast-wind to play. When "Intro Scan" was actuated, the first 13 S of each tune on the cassette was played, which I found much more helpful than the 8 S many decks provide. The elapsed time shown by the counter for one side of a tape was 19 S high for a C-60, 80 S high for a C-75, and 50 S low for a C-90. Errors were of the same order of magnitude for C-100s and C-120s. Smaller errors are desirable, but the deck's tape-time calibration remains very closely the same whether in record (or play) or in fast wind—and that is very helpful. The remote control was effective out to at least 25 feet on the sensor's axis and could be pointed off 30° at that distance. At more normal distances, the control could be up to 60° off axis if it was pointed at the sensor and could be pointed off up to 45° if it was located on the sensor's axis.

Use and Listening Tests

The owner's manual is generally well written. Its illustrations are good, particularly the front-panel one that is almost full size. Several sections would benefit from more detail. The description of skip forward/reverse, for example, does not state that the maximum setting is "P 15" or "P-15." I also wished it said more on setting record levels, the effects of tape choices, and the reasons for selecting particular Dolby NR modes. In two places, the manual incorrectly states that record calibration adjustments are made "to match the playback sensitivity" of the tape. Such adjustments are made to match the tape's *record* sensitivity to the playback calibration of the Dolby decoder.

I checked for noises recorded when switching to record, pause, or stop, using Dolby C NR and amplifying the playback greatly for aural and meter monitoring. Record and pause sounds were soft, double clunks which were slightly above the level of tape noise on the deck's meter. Stopping produced a triple clunk which was a bit louder, reaching about 2 dB above the tape noise. Pushing "Rec Mute" produces a 5-S muting and then a switch to record/pause. A shorter mute was easily secured by pushing the record/pause control. A longer mute was obtained by holding in "Rec Mute"; the deck went into record/pause as soon as the

button was released. During muting, the red "Rec" annunciator flashed more rapidly than during record/pause.

All the controls and switches were completely reliable throughout the evaluation. I did find, however, that if I simultaneously pushed the play and record/pause buttons to begin recording, I might get just play instead. Therefore, I pushed the play button *after* pushing and releasing record/pause. Because of the buttons' small size, dark color, and lack of annunciators, I had to look carefully to tell if "Meter Weighting" and "MPX Filter" were on.

My first listening evaluation was from two sample Dolby S NR cassettes supplied by Dolby Laboratories—Eric Clapton's *Journeyman* (Reprise Records) and Joe Sample's *Spellbound* (Warner Bros.). Both sounded very good to me using Dolby S NR for the playback. Even listening at high volume through headphones, I still heard very little intertrack noise. When I switched back and forth from Dolby S to Dolby B or C NR, the emphasis in the middle frequencies was obvious and the level compression became apparent. The sonic character was generally consistent, and I judged that most listeners would accept, but not prefer, playback of Dolby S-encoded tapes with Dolby B or C NR.

I used a pink-noise source for my first record/playback tests with the three supplied cassettes. The TD4800's bias and level calibration system worked very well, and the sonic matches were excellent for the three tapes and for all NR choices. The first CD I tried was *Music of Waldteufel* (MMG MCD 10025; now available as Vox Unique VU 9009) performed by the Cincinnati Pops Orchestra with Erich Kunzel conducting. The advantage of Dolby S NR for low-frequency material was most apparent during bass drum beats, which were frequent on some of the pieces. Reproduction of cymbal crashes was best with Dolby C or S NR. On *Bach: The Organs at First Congregational Church, Los Angeles* with Michael Murray (Telarc CD-80088), I tried very high levels during low pedal notes with Dolby S NR. I was quite impressed with how Dolby S NR decreased distortion and reduced compression, keeping the distortion low at relatively high levels. Tchaikovsky's "1812" Overture (Telarc CD-80041), performed by Kunzel and the Cincinnati Symphony Orchestra, proved to me again how much low-frequency energy the cannon shots contain. Dolby S NR made normal recording levels possible; levels had to be reduced considerably with any other NR choices. I tried other CDs, and the TD4800 secured excellent reproduction from all of them; the tape/source match was outstanding in all cases.

The TD4800's metering was very good for setting levels quickly and accurately. Personally, I did not find an advantage to "Meter Weighting," but it might help some users avoid tape saturation. The flat responses, the bias and level calibration system, Dolby S NR, and the low distortion and noise were my major satisfactions. I also particularly liked the elapsed-time counter, the good displays, intro scan, and the skip function. It might be nice to have some other convenience features, but I didn't miss them. The price of the TD4800 is high—higher, in fact, than that of some DAT decks. However, this cassette deck is worthy of comparison to any other cassette deck at any price, and its very high performance can be obtained with low-cost software, the not-so-lowly cassette.

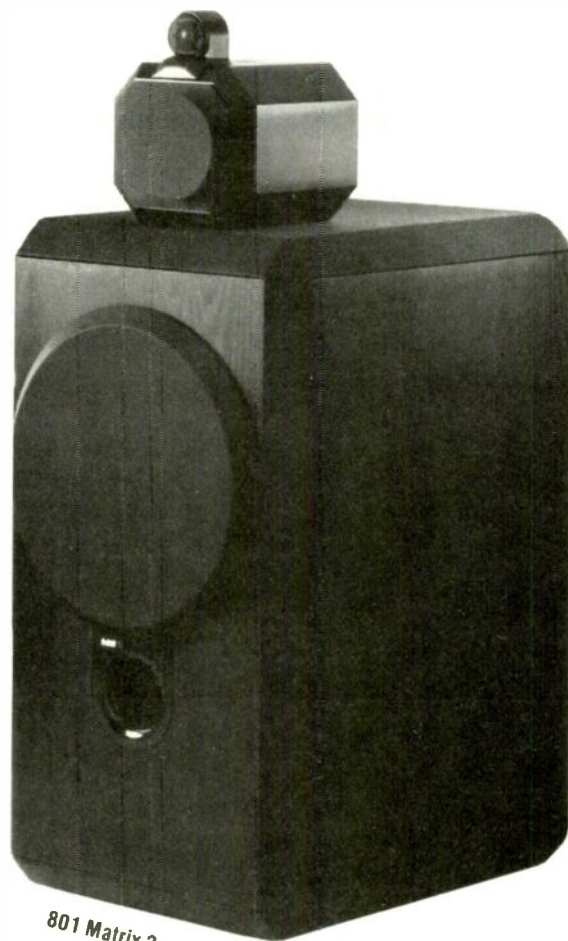
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Stereophile, Vol. 10, No. 9 Dec. 1987

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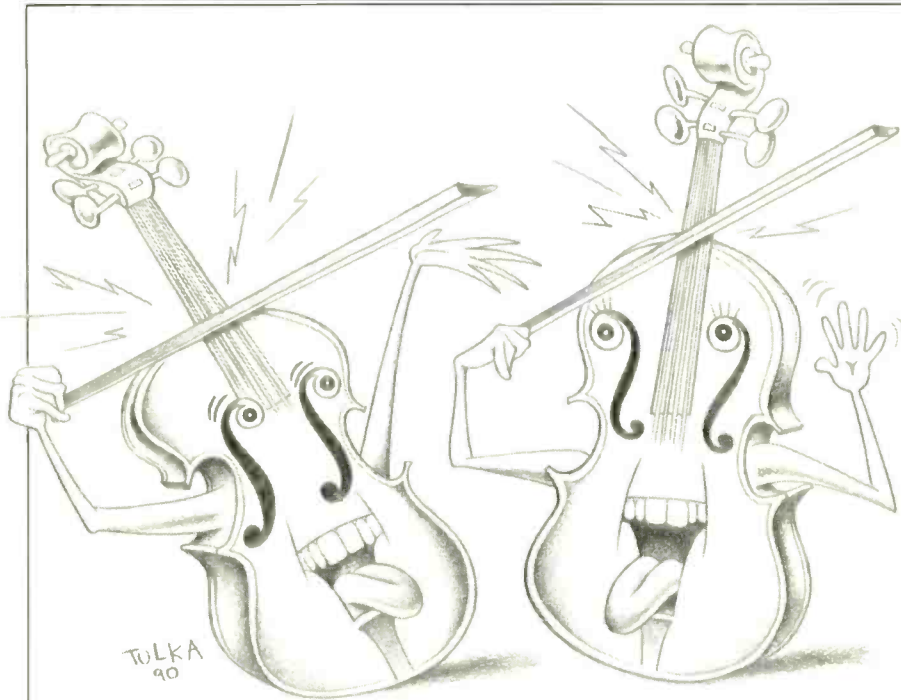
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The lead solo violin, Chiara Banchini, is a natural on her early-type violin, with an effortless and extraordinary ease in the florid ornament. Would Corelli himself do better, eyeballs rolling?
Edward Tatnall Canby

Archangelo Corelli: Sonate a Violino e Violone o Cimbalò, Op. V. Chiara Banchini, violin; Jesper Christensen, harpsichord; Luciano Contini, violin; Käthy Gohl, cello.
Harmonia Mundi HMC 901307, CD; DDD; 67:39

This French-label recording ("made in Germany") of Corelli sonatas played on original-type instruments centers musically just to the north of Corelli territory in Italian south Switzerland, with a touch of Danish—typically neo-European. The European community is coming much faster than most Americans realize, as I noted for myself on-the-spot in the summer of 1990. And music—as always—is even ahead of politics and the flag with a circle of white stars on a blue field that one now sees all over Europe.

In recent years, with the astonishing growth of interest in the "authentic" performance of older music, Corelli has suddenly emerged anew as a splendid and innovative composer. In his own day, his music was startling; people gasped not only at his own violin playing on "concert" tours but at the music itself, which simply put all else in its musical shade. Can we really evoke that amazement today?

Yes, to a vivid extent—if we play the music more as it was then played! The last dregs of Corelli fame still existed for us older listeners in what was so coyly called "music appreciation." We had to read about the Church Sonata and the Chamber Sonata, the latter a particularly unappetizing designation, I always thought. As to Corelli himself, we were treated to dull, plodding lumpy versions of his concerti, too fat, dun-colored, minus any trace of ornament, and we wondered what all the fuss was about.

Yet when he himself played, it was with awesome passion, as per a contemporary account cited here: "(His) eyes will sometimes turn as red as fire; his countenance will be distorted, his eyeballs roll as in agony." That in 1709.

Two things bring Corelli back to musical life, here and in other new performances. First, the old instruments—including those that, curiously, make him sound much more "antique"—such as the rich and varied combinations used for the accompanying continuo part (totally missing in older performances): An archlute, for instance, a plucked bass instrument; also the poignantly sweet sound of the old-type gut-stringed violins, so high colored and almost human in their sound, like a

Prokofiev: Piano Concertos Nos. 1, 4, and 5. Boris Berman, piano; Royal Concertgebouw Orchestra, Neeme Järvi.

Chandos CHAN 8791, CD; DDD; 63:44

Prokofiev: Piano Concerto No. 3; Rachmaninoff: Piano Concerto No. 3. Santiago Rodriguez, piano; Sofia Philharmonic, Emil Tabakov.

Elan CD 2220, CD; DDD; 68:46

Aside from Prokofiev's own recording of the Third, the benchmark among his recorded piano concertos is, I suppose, the London/Decca complete set of 1975, with Vladimir Ashkenazy backed by André Previn and the London Symphony. Actually, Ashkenazy's approach to the Third was very consistent with Prokofiev's own, and he and Previn made a convincing case for each of the five.

Overall, however, Berman and Järvi—especially the latter, who appears to be in control—make an even stronger case for their approach to the three recorded here. There are marked differences. The sound, for one thing: Close-up, as you might hear it if you were an assistant of Järvi's, as opposed to the old "ideal" of a 13th-row

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Remarkable emotional power is generated by pianist Boris Berman that brings Prokofiev's Fifth Piano Concerto to vivid life.



orchestra seat approximated in the London set. The Chandos miking, in fact, lends a quality suggesting chamber music to some interplays between piano and other solo instruments.

Järvi has an extremely fine Prokofiev orchestral cycle going on Chandos. This recording diverges from it not only in the added soloist but in substituting the Concertgebouw for the Scottish National Orchestra. The extra polish and refinement of the Dutch orchestra shows, though there are some passages that could have profited from the raw eagerness of the Scottish. By contrast, the Concertgebouw sounds slightly blasé, and even the deliberately rough edges—as in some outbursts from the brass—seem honed.

The First Piano Concerto was a student work of 1911, and one that Prokofiev played (to the consternation of Glazunov, as director of the St. Petersburg Conservatory) to win the Rubinstein Piano Prize. While Ashkenazy made it sound like a student work, combining iconoclasm with a certain winsomeness (even in rebellion, radicals like to be liked), Järvi squeezes it tighter into the mold of Prokofiev's mature style. To put it another way, Ashkenazy played what the Rubinstein judges wanted to hear; Järvi conducts what Glazunov was repelled by. Ashkenazy probably wins this confrontation by dint of the sheer cogency and charm of his conception, though both are valid ultimately.

The Fourth Concerto (1931) is the most problematic. Like Ravel's D major concerto, it was written for pianist Paul Wittgenstein, who had lost his right arm in World War I. Ravel was a competent pianist but not a touring virtuoso like Prokofiev. Perhaps for that reason, Ravel approached the five-finger piano as a unique instrument and wrote for its potential and limitations like any other. Prokofiev seems forever to be comparing it with his own, 10-finger playing and chases up and down the keyboard in arpeggiated skirmishes as though he's afraid of leaving either end "uncovered" for too long. Ashkenazy did nothing to overcome this quality, which makes one excessively aware of the writing's "left-handedness." Berman's grace in managing these passages is a significant step toward keeping attention focused on the music.

The Chandos Fifth leaves the London recording a pale second. The remarkable emotional power that Järvi and Berman generate brings it to vivid life. Though it was written only a year after the Fourth, it in a sense atones for the Fourth by unleashing a wealth of uninhibited pianism and melody—enough melody for two concertos, by Prokofiev's own reckoning.

The Elan recording, while not in the same league, is interesting because it takes a still different approach. The cover art places a rather Chopinesque photograph of Rodriguez against a romantic moonlit landscape (or seascape?) that gives the show away. The notes correctly point out how little separated in time and space were the careers of Rachmaninoff and Prokofiev, and the Prokofiev Third Concerto (1917 to 1921) has seldom been played with more specific references to its Rachmaninoff counterpart of 1909.

In a way, it seems almost presumptuous for a relatively young musician to choose two concertos which were recorded electrically by their composers, who also were brilliant pianists. With such unassailably definitive competition, what can the younger pianist add? A modern stereo recording, for one thing, though neither the orchestra nor the pickup is outstanding here. Fresh thinking about the music, for another. Unfortunately, though some passages in both concertos have a Romantic sweep that outdistances the originals, whatever is different here tends to be somewhat shallower. Rodriguez, in sum, comes on a little too much like a matinee idol to be altogether convincing, attractive as his sensibilities and technique are in themselves.

Robert Long

Ashkenazy "Live in Moscow." Royal Philharmonic Orchestra; Vladimir Ashkenazy, conductor and pianist.
MCA MCAD-6466, CD; DDD; 66:51.

This recording obviously is intended as a celebration of Ashkenazy's triumphant reentry into his native land after 26 years of exile—and nonrecognition there as a Tchaikovsky Competition laureate. The unified program makes no sense in any other context, and the gorgeousness of much of the sound cries out for a venue free of audience intrusions.

Ashkenazy opens by conducting Mussorgsky's *Khovanschina* Prelude, subtitled "Dawn over the Moscow River." He then conducts and plays the Beethoven Third Piano Concerto and finishes with Suite No. 2 from Ravel's *Daphnis et Chloë*. "Waltz of the Flowers" from Tchaikovsky's *Nutcracker* is thrown in as an encore. All profit from sense of occasion and the alertness that comes in a live performance, when retakes are out of the question. The most affecting (and the music in which Ashkenazy had most at stake) is the Beethoven.

Co-starring with Ashkenazy is the luscious acoustics of the Great Hall of the Moscow Conservatory, where the concert was taped. Arguably, the disc is worth the price of admission for that factor alone. It's hard to tell whom to congratulate for the pickup in the welter of credits and thanks on the packaging. I suspect the key is EMI London, which provided both the producer, John Fraser, and the balance engineer, Mark Vigars. Robert Long

A Venetian Coronation, 1595. Ceremonial music for the coronation of Doge Marino Grimani, by Giovanni and Andrea Gabrieli and others. Gabrieli Consort and Players, Paul McCreech.
Virgin Classics Veritas VC 791110-2, CD; DDD; 71:17.

Sound: A – Performance: A –

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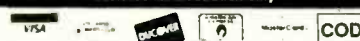
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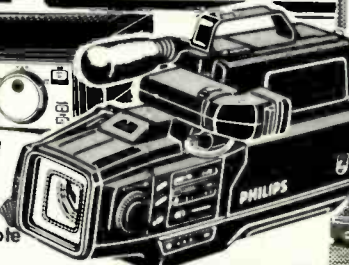
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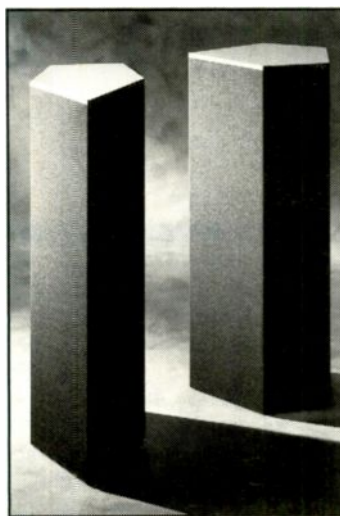
A Venetian Coronation, 1595 causes most of us in the surround sound camp to wish for more than two channels.

About 30 days a year were occasions for massive ceremonies, each with its own liturgy and elaborate music. This was the birthplace of spatial music/surround sound. There were at least seven niches around the altar of St. Marks from which musicians could perform, two main organs (sometimes even played together), plus additional chamber organs. Not just the instrumental groups but also the choral forces were divided up into as many as four different sections spaced around the cathedral. Up to 24 trumpeters and drummers performed.

McCreesh and his Gabrieli Consort and Players have attempted to re-create one of these Venetian blowouts which took place in 1595 for the coronation of a popular new doge. A number of sources provided the music for the various ceremonies in Venice. Some parts of the religious liturgy at the time were eliminated to emphasize the musical elaboration with toccatas, sonatas, canzonas, and motets.

One of the main organists of the time, Giovanni Gabrieli, provided much of the large-scale music, and his uncle Andrea provided most of the rest. The stirring sound of the younger Gabrieli's brass canzonas made them landmarks of instrumental music.

There are 29 separate selections on this CD, issued as part of Virgin's early music sub-label Veritas, including a capella vocal works, instrumental pieces, organ solos, and combinations of all three. A complete libretto is included. An exciting aspect of this album is the spatial activity, which includes musicians approaching from the distance as if in procession, and the tossing back and forth of music among various stationary groups of performers. It causes those of us in the surround sound camp to wish for more than two channels, but the CD does capture quite a bit of depth and feeling for the grandeur of the spaces involved. It was recorded entirely on DAT with the cooperation of Technics' British distributor. The venue was not St. Marks but Brinkburn Priory in Northumberland. The sonics are natural and fittingly spacious, though with an occasional wooliness to the brass tone. Altogether a most fascinating album to bend the ear of even recalcitrant early music listeners. *John Sunier*



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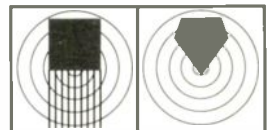
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—Peter W. Mitchell *Stereophile*, Vol. 13 No. 4, April 1990



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Audio

ADULT EDUCATION

Enlightenment: Van Morrison
Mercury 847-100-2, CD; AAD; 51:07.

Sound: B+ Performance: A-

In the '80s, Van Morrison's music, more often than not, was introspective and serene. Despite the title, *Enlight-*

ers. A lyric reference to "the viaducts of my dreams" completes a full circle back to "Cypress Avenue" on *Astral Weeks*. "Youth of 1,000 Summers" is an epiphany of a song—an upbeat Gospel-sounding celebration of joy.

"In the Days Before Rock 'N' Roll," featuring Paul Durcan on the spoken portions, is a mystical eight-minute trip through yesteryear that commemorates great rockers and bluesmen of the '50s. I haven't a clue as to what's really going on in Van's head here, but this is a fascinating trek nonetheless. Georgie Fame's bubbling organ is a special delight on this one. "Start All Over Again" feels like a slower "Jackie Wilson Said" with a bounce and a lilt. As a song of renewal, it is yet another hopeful statement. At the close of the album is "Memories," a rueful yet wistful musing that sports one of the most gorgeous melodies Van has ever devised. It is a most appropriate conclusion to this spellbinding album of hope and joy, as it celebrates good times and fellowship gone by.

Van's production is smooth and sure. The chief ingredients of the arrangements—keys, strings, horns, guitars—vary from song to song so that the album never becomes static. Van has also varied his tempos to heighten the dynamics of the project. It is an easy album to dive into and float along with.

I always enjoy hearing Van Morrison's music. However, most of his work in the last decade or so (with the notable exception of *Irish Heartbeat*, his collaboration with The Chieftains) doesn't stick with me very well. I don't think that will be true about *Enlightenment*. I think it will have some staying power in my active library.

Michael Tearson

Nomads • Indians • Saints: Indigo Girls

Epic EK 46820, CD; DDD; 47:23.

Sound: A- Performance: A-

In 1989, The Indigo Girls released their eponymous major-label debut. By the end of the year, *Indigo Girls* was certified gold, and the duo of Amy Ray and Emily Saliers collected a Grammy for Best Contemporary Folk Group. Faced with the pressure of their accomplishments and the dreaded Second Album, the lyric-intensive artists

did what any shrewd musicians would do—pick up where they left off. *Nomads • Indians • Saints* is a collection of passionate songs about relationships, darkness and light, life and how to live it. The Indigo Girls offer no surprises here (good or bad), but they do show signs of growth and refinement.

As before, Saliers' delicate vocals alternately contrast and blend brilliantly with Ray's powerful, soulful voice. Though many songs benefit from the duo's beautiful harmonies, the Girls are solitary songwriters with decidedly different styles, splitting the duties roughly 50-50 on this album. Of the two, Saliers seems to have matured more as a songwriter, her philosophical examinations more developed here than on the debut. Accompanied by a 12-piece string section in "The Girl with the Weight of the World in Her Hands," Saliers questions if we can truly know another's pain: "It makes us all angry though we feign to care/But who will be the scale to weigh the cross she has to bear?" Her "Southland in the Springtime" is an image-packed road song reminiscent of James Taylor's "Carolina in My Mind."

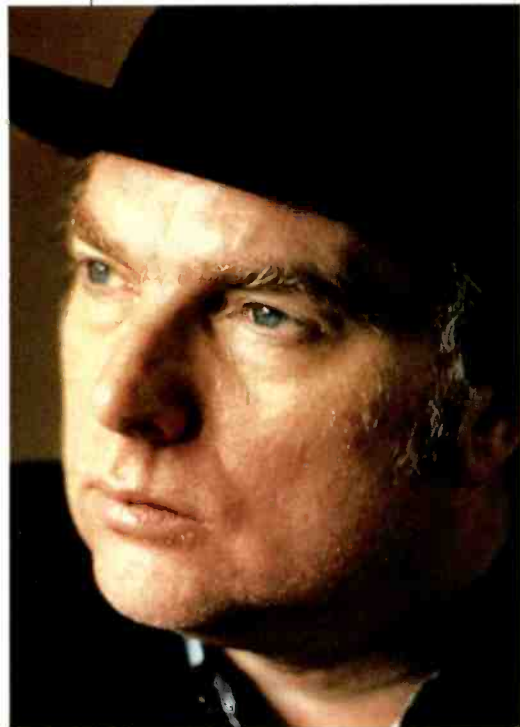
Listeners who enjoyed Ray's emotional exorcisms that dominated *Indigo Girls* may find some of her contributions to *Nomads* familiar and perhaps a little too grandiose. For example, the open arms and scars of "Keeper of My Heart" recall the restless arms, cuts, and burns of the previous album's "Blood and Fire." Still, standouts include Ray's "Pushing the Needle Too Far" and the upbeat "1 2 3," a song written and performed with fellow Georgia band, The Ellen James Society. The song is about artists who, like Ray, create by cultivating a darkness within them: "I understand your causes, sympathize the motivation/But all the details of this war are just self-infatuation."

In the romantic "You and Me of the 10,000 Wars," the women sing: "Everybody loves a melodrama"; surely with words such as "life," "death," "love," "emptiness," "pain," and "fear" recurring throughout, the album teeters on the brink of pretentiousness. But The Indigos pull it off through the strength and conviction of their performances. Integral to this are supporting musicians, including veteran drummers

enlightenment is his funkier in ages yet it is filled with introspection and serenity.

The album starts fast with "Real Real Gone," which has a groove reminiscent of "Domino." It celebrates the healing and energizing powers of love and rhythm & blues, invoking the names of such heroes as Sam Cooke, Wilson Pickett, Solomon Burke, James Brown, and Gene Chandler. It also establishes the main theme of the album. The title song is a wrestling match of the soul. Here Van sings, "Enlightenment, don't know what it is" and eventually reaches the conclusion that "It is up to you everyday." "So Quiet in Here" is about a really good time and place, a safe harbor. It is a song of sharing inner peace and joy with a loved one.

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Kenny Aronoff and Jim Keltner. R.E.M.'s Peter Buck makes a return appearance, playing dulcimer on "World Falls," and Benmont Tench of Tom Petty's Heartbreakers plays "fake accordion" on one track.

Nomads • Indians • Saints is a full-digital recording, ably produced by Scott Litt and superb sounding save for annoying pops at 23 and 70 seconds into the first track (Epic hopes to remedy the defect on future pressings). *Nomads* is further evidence that, where others have failed, The Indigo Girls have captured an effective middle ground between folk and pop. It is this style that makes the record so pleasantly unique. *Joe Wiesenfelder*

Family Style: The Vaughan Brothers
Epic/Associated ZK 46225, CD; DAD; 40:43.

Sound: A Performance: C+

The tragic loss of Stevie Ray Vaughan in a helicopter crash on August 27, 1990—another victim of life on the road—has inevitably added more interest and curiosity in *Family Style* by The Vaughan Brothers. The album, which unites Stevie with Jimmie Vaughan (best known for his years of work with The Fabulous Thunderbirds), was about to be released at the time of the accident.

While the emotional aura surrounding this record is high, the results aren't the ideal tribute to Stevie Ray's memory. Most of this set consists of laid-back, bluesy rockers ranging from the R&B-infected "Hard To Be" to '60s-flavored tunes like "White Boots." The album only really cooks in a couple of spots, notably the Lonnie Mack-styled rave-up, "D/FW." SRV's trademark sound cuts loose on "Telephone Song," a funky jam called "Baboom/Mama Said," and the blistering "Brothers," where the brothers actually throw each other the guitar to swap solos. Nile Rodgers' production is crisp, straightforward, and clean.

Fans of Stevie Ray Vaughan should check out *Family Style*. However, it isn't likely to displace *Texas Flood* or *Couldn't Stand the Weather* as essential SRV listening. *Michael Wright*

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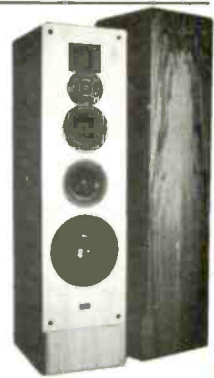
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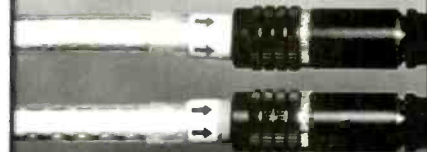
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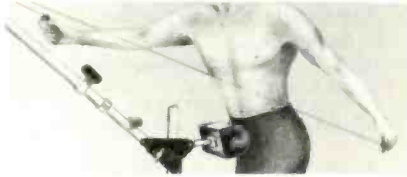
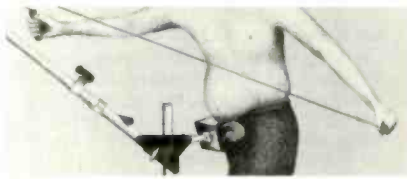
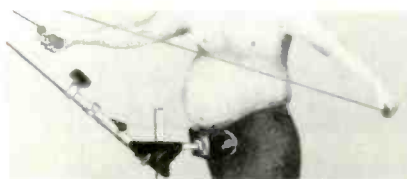
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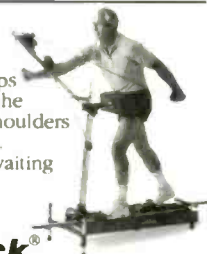


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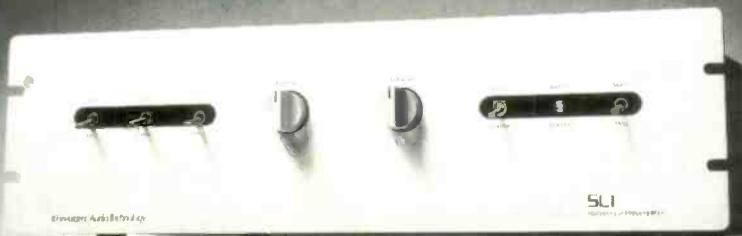
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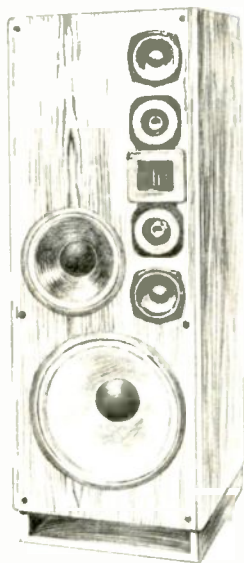
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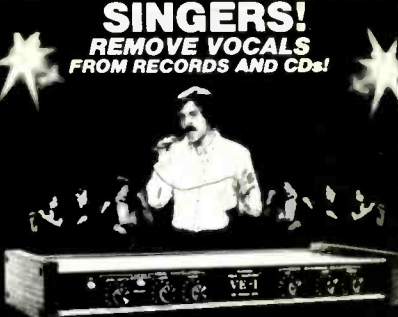
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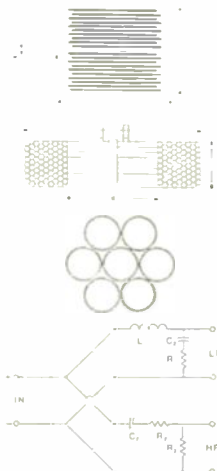


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