THE B.A.S. SPEAKER

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In This Issue

Most audiophiles own an FM tuner, but few think of it as a source of really good sound. Local members of the BAS are fortunate in having several opportunities each week to hear either live broadcasts or noise-reduced high speed master tapes played back over good transmitting equipment, from public radio stations WBUR and WGBH. This makes it worthwhile to put up a roof antenna with a rotor and proper cable. John Allen is a local designer and installer of large master antenna systems, and his feature article gives complete instructions on how to put up a home antenna system that really works. The other feature is Al Foster's comprehensive review, including both long term subjective evaluation and bench tests, of the AGI, Apt, DB Systems, and Hafler preamps.

If you are confused about the new pure metal tape coatings, you're not alone. But be of good cheer -- a comprehensive and clear explanation of what's really going on, by Peter Mitchell, awaits within. Peter also gives us the results of a massive tape test commissioned by the Swedish magazine, Radio & Television, and reveals some of the pitfalls that lurk in such comparisons.

There are replies to a member's query on antiskating controls, user's reports of the Stanton 881s cartridge and the Sequerra tuner, an opportunity to subscribe to the Shop Talk Bicycle (what?), the first review of the Carver Sonic Hologram (no, that's not a misprint), and the meeting notes on the men from Empire.

Next month -- at long last -- the results of the BAS turntable/arm/cartridge clinic. Also notes on quadraphonic sound and the ADS time delay, and more.

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*Supex 900E+ Super moving coil cartridge, brand new, with warranty card. Cost $225, asking $125. (608) 262-4903.
*Harman-Kardon Citation 11a preamp, $190; Citation 12 amp, $190; Braun PS-600 changer; Sherwood mono FM tuner, $115; Soundcraftsmen 20-12 equalizer, $175; Audiopulse Model One, $395; original Berning preamp, $300; Sony NR 115 Dolby adapter, $70; DeCoursey electronic crossover, 50 Hz, $70; Disctraker, new, $10; Stylift, $8; McIntosh MR-71 tuner, $375; FRI MkIIIF new, never used, $150; Supex SDX-1000, brand new, in box, $325, or best offers for everything. Don Konicoff, 120 West Palmetto Park Road, Boca Raton, FL 33432, (305) 392-6716 (after 7 PM).
*Vestigal tone arm, $30; Supex SD900 E+ Super, like new, $100. Prices include first class or air mail postage. Edward J. Ellis, 562-78-2279, Eusa Band, APO San Francisco, 96301.
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*Pair Luxman 3045 tube power amps, excellent condition, $495. (617) 749-2219.
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*Rappaport AMP-1 power amplifier, $900; cartridges, all in excellent condition: Ortofon SL 15E Mk II, $60; Dynavector 20A, $60; AKG P8E, $40. (617) 369-1949 or (617) 667-2464.
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*Magneplanar Tympani 1U loudspeakers, modified by Magnepan, with rewired tweeters, crossover changed to 1600 Hz, front-facing m/r diaphragms, steel bars installed, $595; Janis W1 subwoofers, $700/pair; DeCoursey 500 Series crossover, Type C, 100 Hz, 18 dB/octave, $50; all mint. (612) 544-6276.
*Fulton Premiere speakers; Audio magazine, 1974 to present; Stereophile magazine, Vol. 1 No. 1 to present; BAS Speaker newsletters, 1974 to present; Absolute Sound, Vol. 1 No. 1 (1973) to present. Everything is in absolutely mint condition, best offer. (617) 593-5937.
*Custom 6-module speaker system, 2-15" CTS woofers, 8-8" CTS woofers, 8-5" Pyle midranges,

8 Philips dome tweeters, 8 piezoelectric supertweeters, 7 ft. high, 400 lbs., must be heard, parts cost $950 wholesale, will sell for $500. Don Wheaton, 209 Chelsea Street, East Boston, MA 02128, (617) 762-4087 (leave message).

*Magnepan MG-2 speakers, white, late model with jacks, mint, $425; ARC D-75A, silver, with new tubes throughout, as new, $525; ARC D-100B, $850; Polk Model 10A, with stands, rosewood vinyl finish, $320. (919) 449-4132 (days), (919) 449-6912 (evenings).

Wanted

*McIntosh MX-110 tuner-preamp; MR-71 tuner; C-22 preamp; MC-275 or MC-75 power amp; MC-2100 or MC-100 power amp; MX-113, MPI-3, or MPI-4 scope; walnut cabinets for C-22, MX-110, MPI-3. John Johnson, 435 E. 70th Street, New York, NY 10021, (212) 628-2461.

*Grundig "Transistor-Satellit" FM receiver, Model 6000-6002, 4000-210, 3005, or 1005, in good condition. Bill Kalish, 565 Walnut Avenue, Redlands, CA 92373, (714) 792-0220.

*Sennheiser HDI 434 wireless headphones, SI 434 infrared transmitter; Niles Audio CPM-31 component patching matrix; Brazilian rosewood cabinet for Sequerra tuner. L. Barry Tinkoff, P.O. Box 590, Fall River, MA 02722, (617) 673-6622 (evenings).

*Mobile Advent 300/12 12-Volt DC stereo receiver, working or not, must be reasonable; extra arm mount for Micro-Seiki DDX-1000 turntable; Zenith Transoceanic radio, late model. Dwight L. Hedge, 135 Woodside Drive, Dyersburg, TN 38024, (901) 285-0615 (home), (901) 286-1512 (office).

The Bicycle Rolls On

The BAS was formed in 1972 as a spinoff from "Shop Talk," a weekly 90-minute talk show about audio which has been broadcast on WBUR-FM every Saturday morning for the past 10 1/2 years. The program's content includes product news, reviews, explanations of how things work, humor, informal conversation and opinions, phone calls from listeners, and interviews with hi-fi design engineers, manufacturers, acoustical scientists, recording engineers, and an occasional conductor. A couple of years ago Dean Slindee suggested that a tape subscription network be set up so that BAS members outside of the Boston area might hear the show (particularly the interviews with some of the leading luminaries in the field), and he did the basic organizing preparatory to establishing the subscription network. Tapes of about 50 "Shop Talk" programs have been distributed to subscribers to date.

The distribution program is called the Shop Talk Bicycle because the subscription list is divided into regional groups of 8 or 10 members, and in each group the tapes circulate from member to member until each subscriber has heard them all -- the same way that syndicated TV shows like "Star Trek" are "bicycled" from station to station. When you receive a tape from the preceding member in your region you have a week in which to listen to it, copy it for friends, and then mail it to the next member using pre-addressed labels.

The subscription runs for 52 tapes, but typically it lasts well over a year since the tapes are generally mailed out at a rate of about two a month rather than weekly. The original group of subscriptions is running out and is up for renewal, and additional BAS members are invited to subscribe at this time. The cost for the series of 52 tapes is $35, which covers the cost of the blank tapes, mailers, postage from Boston, and purchase of several cassette decks used to make multiple tapes of each program. Send checks to Peter Mitchell, 36 Circuit Street, West Medford, MA 02155.

The tapes mailed during the past year have included interviews with Tom Holman (Apt), Gordon Gow (McIntosh), Andy Rappaport, Mark Davis, Andy Petite (Boston Acoustics), Roy Allison, Keith Monks, Joel Cohen (Sound Concepts), Mitchell Cotter, Erik Edvardsen (NAD), David Hadaway (DB Systems), Ed Schummer (Dolby Labs), and Ted Schultz (BB&N) among others. One of the first tapes in the new series will include an interview with Telarc digital producer Jack Renner.

-- Peter Mitchell (Massachusetts)

Cartridge Brushes and Skating Force

Stanton Magnetics Replies to a Reader

In the last issue of the BAS Speaker, I came across a letter from Mr. Venkatanarayanan from the Philippines who needed help with his turntable and Shure Type IV cartridge. Mr. Venkatanarayanan did not know exactly how to set up the antiskating. I would like to help him.

The skating force is the result of the friction between the stylus or the brush and the record surface. While the stylus touches the sides of the groove, the brush rides over the land between the grooves and sometimes in the groove. The geometry of the conventional tone arm is such that the offset angle determines the magnitude of the skating force vector (a tangential tone arm with no offset angle has zero sideways force, at least theoretically). The brush is located in front of the stylus or to be more precise, behind it with respect to the motion of the record. Consequently the imaginary offset angle of the brush is larger than the one of the stylus, and so is the overhang. (This is true for the Stanton brush, but not for the Shure. -- Ed.)

Now comes the tricky part. In order to set the antiskating dial correctly with the brush, adjust the tone arm counterweight or tracking force so that only the brush rides the surface of the record. Normally this force downward with the Shure V15 Type IV should be about . 5 gm. Make sure that the stylus does not touch the record. Do this while the record is turning. The tone arm will skate happily toward the spindle. Return the tone arm to the outside of the record and adjust the antiskating until the tone arm stops skating. Now you can increase your tracking force by 1 gm to normal force required by the stylus and add another gram of antiskating on top of the existing setting. Now you are all set. If you mistrack on the outside channel you should not blame your tone arm setting but the stylus or the record. What you do using this method is set the antiskating for the brush first, then add the tracking force and antiskating for your stylus.

-- George Alexandrovich, Vice President, Field Engineering, Stanton Magnetics Incorporated

The Manufacturer's Version

Concerning the proper antiskating force when using the Shure V15 Type IV cartridge: with the stabilizer in operation, the tracking force at the stylus tip is .5 gram less than the tracking force setting on the tone arm. For example, if the desired tracking force at the tip is 1.0 gram, the arm tracking force adjustment must be set to 1.5 grams.

The factors that cause skating forces on the record are the same for both the diamond tip and the stabilizer bristles. Just as the tracking force must be set to include both the diamond tip and the bristle forces, the antiskating force should be set to accommodate the total skating effect for both tip and bristles. Thus the correct antiskating force is that which corresponds to the tracking force setting on the tone arm. Referring to the example above, if the total tone arm tracking force setting is 1.5 grams, the antiskating force should be set to compensate for 1.5 grams. In this example, both the tracking force and the antiskating force are properly set for playing at a tracking force of 1.0 gram at the stylus tip.

The maximum tracking force that should be applied to the tip is 1.25 grams, which means that with the stabilizer in operation, the maximum tracking force setting on the tone arm should be 1.75 grams. Any additional tracking force exceeds the recommended tracking force range of the cartridge. I hope my explanation has clarified the questions concerning proper tracking force and antiskating force settings with the V15 Type IV cartridge.

-- Scott Mastricola, Product Manager, High Fidelity Products, Shure Brothers, Inc.

And the Editor's Last Word

The two previous explanations of the skating force generated by brushes are similar in concept, and for a brush located close to the stylus should yield the same setting of the antiskating control. But there is a way to determine in actual use whether the control is set correctly, and it should be used as a final check of any system, whether or not it is equipped with a brush.

The essential idea of any antiskating device is to balance the horizontal forces on the stylus assembly so that the stylus shank is centered in its support structure, thus having equal compliance in both directions. Most good cartridges are sufficiently compliant that they will exhibit a visible deviation from the center position if the horizontal forces are imbalanced. To find out whether this is the case on your system, place one eye directly in front of the cartridge body with the arm lifted just off the record and sight down past the center line, or some other convenient feature of the cartridge body, to the stylus. Then, using the cue lever if you have one, lower the arm onto the record while watching the stylus tip. If the skating force is correctly adjusted the stylus will move up toward your eye but will not shift sideways with respect to your reference mark. From this position it will be easy to vary the antiskating knob and watch the stylus deflect to either side of the center point.

One thing this technique will quickly reveal is that some antiskating systems are misdesigned. The one on the Philips 877 turntable, for instance, shares with the earlier Philips units a simple design error: the force is applied by a spring, and it increases as the arm moves toward the center of the disc. Instead of being a gentle spring which is deflected a long way at normal settings, the spring has a high constant and small deflection, and the force varies so much over the course of the side that the antiskating force goes all the way from zero at the outer edge (stylus deflected to the right as viewed from the front) through just right at the middle of the side, to too much at the inner grooves (stylus deflected to the left). With the most compliant cartridges it is even possible to see the skating force change with the modulation level on the disc. This is the reason, incidentally, why adjusting the antiskate for equal distortion on a test record like the Shure Era discs will result in too much antiskating force: the level at which the test signal is recorded is scarcely ever reached on actual commercial records, so that the needle drag, and therefore the inward bias for which the antiskate system is correcting, is unrealistically high.

There is, it is true, a rationale for doing things this way despite the problem I have just outlined. That is that it is most important to have the horizontal forces on the stylus assembly balance when the music is the loudest, because this is when the system's tracking ability is most severely taxed. Maybe so, but then the other 99.9% of the time the stylus will be pushing too heavily against the outer groove wall and will wear unevenly. You can, obviously, take your choice. Personally I prefer to put on a popular record with sustained levels that are high, but not extreme, such as Fleetwood Mac or Joe Walsh or Frank Zappa or whatever, and adjust the system for zero horizontal deflection of the stylus at that level.

-- Brad Meyer (Massachusetts)

A User's View of the Stanton 881s

This Christmas my Supex SD-901-e Super was replaced with a Stanton 881s. I made this decision grudgingly, because I had been almost totally content with the Supex. But it encountered two records it could not track in certain spots (London Phase Four "Firebird," and "Scheherezade," Stokowski conducting both).

A Shure Type IV on loan for a week proved that some of those spots were indeed playable, so I began an intensive search for the best tracking cartridge. Scrutiny of many test reports, and reading between the lines, seemed to indicate that the Stanton was the better tracker. It also had the best overall separation curve.

Stanton does not specify compliance, but a letter to them elicited a figure of 30×10^{-6} cm/dyne, so I chose the smallest paddle for the damping attachment to my SME III. The arm is adjusted for the lowest effective mass possible by setting both rider weights fully forward, and adding lead inserts, so that the main assembly would ride as far forward as possible. Tracking force is set for 1.25 grams, with an external gauge.

The Stanton tracks the Phase Four records as well as the Shure IV, but I could not say that it is any better. The sound, however, is better than that of the Supex. It seems that the line-contact stylus makes a significant difference, since the Stanton delivers fine details which the Supex smooths out. The Supex can be characterized as utterly smooth, whereas the Stanton is very finely detailed, without hype. The Stanton delivers very deep, solid, and controlled bass on the

SME-III. The rest of the range is completely smooth, and gives the subjective impression of limitless treble.

The stereo stage on symphonic music and opera is very wide and deep. Massed violins are a particular pleasure to hear since they stay in their place, instead of diffusing through a larger area. They come through with overtones which the Supex did not deliver. Since there is no hype on the treble, the effect is of a sweeter top with newly discovered overtones.

There is, however, one problem which is shared by all light-tracking cartridges. The slightest bit of debris on the stylus damages the sound of the treble to a pronounced degree. This is aggravated because the Stereohedron stylus seems to ride deeper in the groove, plowing up gunk which had been untouched by other styli. Old records need a couple of playings before the problem is eliminated. But I would not trade the Stanton and its detail for a heavier-tracking cartridge. Very clean records are a rare treat through the Stanton.

One interesting side effect is that my Dynaquad system has to be used at a lower volume setting, since the rear images come through at a higher volume.

So, my search for a high-trackability cartridge brought with it a cartridge with truly superior sound. It seems the Stanton 881s likes pouncing on unsuspecting moving-coils.

-- Carlos E. Bauza (Puerto Rico)

Another Look at the Carver Sonic Hologram Preamp

I had a Carver C-4000 preamp, Serial No. 0721, for several days early in January. This report is of necessity made up mostly of first impressions, but may be of some value nonetheless. It represents a total of about eight hours of experimentation and listening.

The system with which the C-4000 was used consists of a Sonus Blue Label cartridge (the old series, not the Gold) mounted in a JH Formula IV arm on an AR turntable, a pair of Audionics CC-2 amplifiers operating in bridged configuration, and a pair of the old series Snell type A speakers. The listening room is 27' x 16 1/2' x 8', with a volume of slightly under 3600 ft^3, and is at present somewhat too live for ideal listening even to normal stereo, having a decay time (T60) of 1.1 seconds in the 1 kHz octave band. (This corresponds to an absorption coefficient of 0.1, meaning that the room behaves as if 10% of its surface is absolutely absorptive and 90% absolutely reflective. According to Beranek's Acoustics, an average absorption coefficient of 0.05 means the room is "live," 0.1 is "medium live," 0.15 is "average," 0.25 is "medium dead," and 0.4 is "dead.") The speakers are placed on the two long walls about 5 ft from one end of the room, and my usual listening position is slightly beyond the center of the room.

Compared to my reference preamp, an Apt, the large package of the Carver has some advantages. The Apt is slightly too small for my taste, one result being that the power cords going into the auxiliary sockets on the back are crowded together. The CC-2's power cord has a plug with little rubber projections on one side of it, and until I figured out that I would never use them for anything and cut them off it was hard to get both of them into the Apt. If your power amp has a grounded three-prong plug that requires an adapter, it won't fit back there, which is too bad, because with its heavy-duty power cord, switch, and sockets the Apt is otherwise well designed for switching large amps. The reason the Carver is as large as it is, is not because it's filled with electronics, which it isn't, but because it has so many features that there are scads of little switches, which take up lots of front panel space.

At first the C-4000 went into the system in place of the Apt. It didn't stay there long, however. The noise in the stages following the volume control is so great as to be annoying anywhere in the listening room. The problem is aggravated by the fact that the bridged power amps are 6 dB more sensitive than normal, but the Snells are not very efficient, and that should help. I have had the Apt modified so that the second set of outputs is about 12 dB lower than the main ones so as to give greater resolution to the stepped volume control, but even at the normal outputs the

Apt's noise is inaudible more than 1 1/2 feet from the speaker. The noise figures expressed in dB re 1 Volt, are:

Carver Hologram Off	Carver Hologram On	Apt Normal	Apt Low Level
-77.4 dBC	-80.5 dBC	-99.8 dBC	-111.6 dBC
-87.9 dBA	-85.8 dBA	-100.7 dBA	<-112.5 dBA

The differences between the two units are not as great with A weighting as with C, indicating that the worst problem is hum, which is less audible than hiss at that level, but the hiss, as indicated by the A-weighted figures, is still 13 to 15 dB higher in the Carver, depending on whether the hologram generator is on or not. Note also that the hologram circuit makes the hum go down (-2 dB at 60 Hz, -6 dB at 180 Hz) while it makes the hiss go up (2 to 6 dB above 2 kHz, increasing with frequency).

Because of the noise problem, and also because the Carver's volume control has the annoying trait of not going all the way down to infinite attenuation, I replaced the Apt in the system and put the C-4000 in the external processor loop, adjusting its volume control (and the balance, which had to be set at 11 o'clock) for unity gain in both channels. In a brief listening test, using records as source material, I couldn't hear any difference when the Carver, sans hologram, was switched in and out.

I put the C-4000 out in the center of the room next to my listening position so that I could switch the hologram in and out without moving my head from the center line between the speakers, and played some records. I began with the Telarc Firebird, having been told that it worked well with the hologram generator. The most striking thing about the sound with the hologram in was a gross change in frequency response. The entire mid-bass and bass region was elevated, except for the low bass, which was rolled off. The region from about 1 to 6 kHz sounded attenuated, while the very top, from about 8 kHz up, was elevated. There is a button on the Carver that reduces everything below 800 Hz by 2 dB, and this improved the overall balance quite a bit, although the bass region still sounded thick and slightly muddy, and the upper part of the frequency range was as already described. The Firebird sounds very smooth and natural on the Sonus/Snell combination, with slightly glamorous but basically realistic instrumental timbres. With the hologram generator in, it sounded like what we used in the '50s to call "hi-fi," sort of like many of the half-track stereo tapes that were released commercially then, for those who remember. In contrast, the Sheffield/Leinsdorf Romeo and Juliet, which sounds hard and overbright on the Sonus, was improved by the hologram circuit. (A Denon 103D, in a more massive arm, has been installed since, and has improved the sound of everything.) The hologram, however, is not supposed to be about frequency balance, but about stereo imaging. So what else did it do ?

The image changed distinctly, becoming more diffuse, with central sounds seeming to recede and extreme left and right moving slightly forward. Having heard that early reflections can destroy the holographic effect, I then moved the speakers about 4 feet out from the wall, aimed them toward the listening position, and tried again. This time the change in the image was more pronounced, although basically similar to what had happened before. Instead of being confined to an almost flat plane between the speakers, the instruments occupied a curved plane stretched from about two feet outside each speaker, and slightly in front of it, through the speakers and back to about 4 or 5 feet behind them in the center. There were also one or two woodwinds midway between the speakers at the same distance from the listener as the cabinets. Thinking that I should be hearing something more dramatic than this, I draped the sides and top of the Snells with absorptive material to make them more directional. This made a very small improvement, scarcely worth mentioning. I also found that the apparent solidity of the instruments outside the speakers was strengthened by placing a reflective surface immediately behind the listener's head.

My overall opinion of the sonic hologram in its present form is that it is an interesting novelty which I might keep around to play with occasionally, but I certainly wouldn't pay good money for it. (Whether the money is any good nowadays is not up for discussion in this report.) This is somewhat puzzling, in light of the unbridled raves to which we have been subjected of late. I have thought about it a good deal, and offer the following observations:

1. Whenever I hear a rave review of anything, whether it is a concert performance, a movie, or whatever, I then demand much more from it than I would if I stumbled on it unprepared.

2. I care more about naturalness of timbre in reproduced sound than I do about imaging. I have made master tapes of large-scale classical works using both coincident and spaced-omni miking, and while the image is more precise with the coincident or ORTF cardioid set-ups, I find that the best omni microphones as a class have a warmth, a naturalness of frequency balance, and an overall aliveness that, for me, more than make up for the imprecision of instrumental placement. Similarly, the hologram changes the frequency balance of the sound in such an unattractive way that I am more turned off by that than I am turned on by the changes in the image.

3. My listening room is probably too live for the hologram to work optimally, even with the speakers well away from the walls. And since it is also a living room, not just a listening space, I refuse to live with any outlandish looking speaker placement. The Snells are big, they are designed to go against the wall, and that's where they are going to stay. This may well change when I get a better, and deader, room which can be devoted exclusively to hi-fi, but not for now. I am unwilling to endure the disruption of a major rearrangement, without which the device doesn't work.

4. All of my listening to the hologram was done during the day. This is not, in my opinion, a trivial point, or even merely incidental. The purpose of the hologram is to separate the music physically from the speakers, and the combination of a darkened room and the change in mindset that occurs late at night may be vital to the effectiveness of the illusion.

Finally, it is important to note that this review, sketchy as it is, is the first one ever printed of the Carver sonic hologram. All previous reports have been written not about the device, but about the device plus hours of rearrangement and tinkering plus an equal number of hours of Bob Carver himself, tuning and persuading and selling and generally weaving his spell around the reviewers. Carver is not a detail man, as can be seen from his products. (In addition to the oversights that I mentioned earlier, the entire basic preamp is remarkably similar to the Apt in the configuration of its features.) Carver is, however, a genuine genius at synthesizing different basic concepts into interesting new products (as will be demonstrated to a startling degree in the description of the operation of his new power amplifier, coming up in the February Speaker) and he is a brilliant and engaging salesman. It just so happens that my interest in spells and spellweavers is, as far as audio is concerned, nonexistent. I use my system as a tool with which to evaluate recordings specifically and to find out about the universe in general. I enjoy listening to recorded music, but I would never mistake it for the real thing, so a device that makes the system less concrete and more dream-like just doesn't do as much for me as it might for a genuine audiophile.

As a final note, I have not at this writing heard the C-4000 as set up at Al Foster's house, which has been blessed by the archbishop himself. If my opinion changes, readers of the Speaker will be so informed. Foster's hologram circuit, however, is different from the one I heard, the latter being an actual production model, and there may yet be further refinements in the design, so that even the hardware itself seems a little hard to pin down for examination. Meanwhile, other image-enhancing devices, from other manufacturers, are slated for introduction soon. At least one of these, from Sound Concepts, claims to be adjustable to fit your present speaker placement rather than the other way around. So stay tuned for further developments.

-- Brad Meyer (Massachusetts)

A Trip Along the FM Dial

All of the FM stations in the United States are spaced 200 kHz apart (a channel width is 200 kHz on the FM dial), and all stations' frequencies end in tenths of an MHz (103.9, 104.1, etc.). Because of this and the fact that the length of the FM band occupies only a small portion of the electromagnetic spectrum, from 88.1 MHz to 107.9 MHz, there is a theoretical maximum number of stations which can be received from one location. If all of the FM channels were to be utilized, assuming one station transmitting per channel, it would be possible to receive 100 different stations. These are all theoretical speculations, but what are the facts? How many stations can be received by an average FM listener living in the suburbs?

To find out, I equipped myself with a good tuner with a built-in spectrum analyzer and a home made FM dipole antenna made of 300-Ohm ribbon cable. I did not use a better antenna, on the assumption that the average FM listener does not have access to an outdoor FM antenna. Of course, an outdoor antenna is needed for optimum performance of any FM tuner or receiver. This applies even to the best FM tuners. (See the back of this issue for instructions on how to buy and properly install an outdoor antenna. -- Ed.) Of course there are on the market all kinds of indoor FM antennas (adjustable rabbit ear antennas, the B. I. C. "Beam Box," etc.) but I decided to experiment with the simplest and cheapest one, even though this type of antenna is sometimes inadequate for best reception of weak stations.

I decided to try three different locations, about 10 miles north, south and west of Boston. I found the reception to vary significantly, especially for stations whose signals were weak. The signal strength of the strong local transmitters varied also, a little, from location to location even though reception quality was not affected. The most significant changes occurred on the noncommercial FM band (from 88. 1 MHz to 91.9 MHz) where some stations transmit with a power of only 10 Watts. Moving a few miles away from these transmitters can decrease the quality of reception, or even eliminate it altogether. Because many FM stations on this noncommercial band transmit on the same frequency, changes of receiving location frequently brought totally new stations on the same frequency. For example, on the frequency of 88.3 MHz I was able to receive four different stations from only two different locations by changing the orientation of the antenna.

Even though I checked the reception at three different places, I decided to describe reception in only one. The location which offered the most interesting reception conditions was in Waltham, about 10 miles west of Boston, on the second floor of an apartment house, a few hundred yards from the main street. From time to time the reception was interfered with by cars passing nearby, but this was noticeable only on very weak stations. The measurements and comparisons described here were made over several months in the spring and summer of 1979.

Overall, I found some interesting results. By rotating the antenna for best possible reception, I was able to receive over one hundred different stations. Thirty-five of these had a signal strength at the output of the antenna of 50 or more microvolts, and eleven were between 10,000 and 80,000μV. All of the thirty-five stations were received with a very good quieting in stereo. More than one dozen additional stations had signal strengths of more than 7 but less than 50 microvolts. Most of these stations achieved good quieting in mono, but a few of them in the 30 to 50 μV range gave good quieting in stereo too. Even with the best tuners or receivers, it is impossible to get good quieting (by which I mean a noise suppression in stereo of over 60 dB) when the signal strength at the antenna terminals is less than 20μV. On the other hand, for mono, 60 dB of quieting is easily obtained with a good modern FM tuner or receiver at a signal input of approximately 15 μV or more, and today's top products can reach this quieting in mono with half of this signal. The weakest FM transmitters I was able to receive gave signal strengths of approximately 1.5 to 7μV. I received over 50 of these extremely weak stations. Some were in stereo, although without enough quieting for good hi-fi listening, but many stations with signals of only a few microvolts were received in mono with good quieting.

In my trip along the FM dial, I found 10 stations which were over 100 miles away. I was able to receive six of these ten DX stations in stereo, but quiet reception was achieved only in mono. Four of these DX stations were from Portland, Maine, 104 miles away, at frequencies of 90.1 MHz, 93.1 MHz, 97.9 MHz and 102.9 MHz. The fifth one, WHOM (94.9 MHz), was on top of Mt. Washington, about 131 miles away. Reception of this station was good in mono (signal strength of about 6 to 8 μV), but was noisy in stereo. Reception of this station occasionally faded, and the antenna had to be carefully oriented, because WSOX also transmits on the same frequency of 94.9 MHz from West Yarmouth on Cape Cod, Massachusetts, and its signal is stronger than WHOM's. My tuner has a good capture ratio (0.75 dB) and I did not have any problem in achieving good reception (in mono, of course) from either of these stations. Another DX station, WAMC, a college FM station from Albany, New York, was audible only at the time when the local transmitter at WZBC (Boston College) did not transmit. Both stations transmit at 90.3 MHz and it is impossible to listen to the distant one when the nearer is operating. WAMC is 101 miles away (its transmitter is located in northwest Massachusetts) and was received in stereo, with a signal strength of only a few microvolts. WZBC is received with a signal of over 3000μV. Other DX stations I was able to receive from a distance of over 100 miles were WRKI (Brookfield, Connecticut), WKCI (Hamden, Connecticut), WKXA (Brunswick, Maine), and a station from Poughkeepsie, New York.

On a half dozen frequencies on which two stations were transmitting at the same time, I was able to achieve good reception of either station by turning the dipole, for example, WOTW (Nashua, New Hampshire) and WWON (Woonsocket, Rhode Island), both transmitting on 106.3 MHz. All of these double stations on the same frequency were distant and their signal strengths were never above 15 microvolts.

Another reception problem which was present most of the time on the weaker stations was multipath distortion, which results from reflected, and thus delayed, FM signals being received by the tuner. Even with the antenna carefully oriented, I was sometimes unable to get rid of the multipath distortion, which made stations sound unpleasantly unclear. The solution for this problem, of course, is a large outdoor FM antenna, with a narrow horizontal reception angle.

In my search for FM stations I also found that a surprisingly large number of 10-Watt stations in the range between 88.1 and 91.1 MHz occasionally overmodulate and cause reception problems for a weaker adjacent station. Good orientation of the antenna will solve this problem most of the time. I even found one station at the lower part of the dial which transmitted on an <u>even</u> multiple of 100 kHz, a frequency which is not assigned by FCC! I called the station, and they told me that they have a problem with their transmitter, and that its frequency is in fact not right. They assured me that the problem will be solved soon.

As many of you will have already guessed, my tuner is the Sequerra Model 1, currently the best available FM tuner on the market. It has a built-in RF spectrum analyzer. This tuner is used by many FM radio stations all over the world to monitor their broadcasts, as it is the only tuner which can, with its built-in oscilloscope, pinpoint transmitting or receiving difficulties. By monitoring the oscilloscope, I was able to see the weakest FM signals before they were audible. Having determined the existence of a signal with the oscilloscope, I was then able to get the best possible reception by rotating the antenna. (Without the spectrum analyzer, most weak stations would probably be overlooked.) The best comparison to this oscilloscope is with a TV screen. Sometimes it is much easier to get a TV station when you know that it exists, because of slight shadows on the screen, even though there is no sound to be heard. By turning the antenna for the best reception, which can be monitored by looking at the picutre, the sound can be made to appear. With the built-in spectrum analyzer, an exclusive feature of the Sequerra, and the extremely high sensitivity and selectivity of the tuner itself, I was able to receive the weakest FM signals which appeared at the output of the simple antenna.

I have compared the Sequerra 1 tuner with four of the best FM tuners available on the market. I found that without the spectrum analyzer, in spite of the very impressive technical specifications claimed by the manufacturers, I was unable to repeat the receiving performance of the Sequerra 1 with any of the four. With the best of the four other tuners I was able to receive only 88% of the FM stations which were received on the Sequerra.

All of the tests I did were largely subjective and not everyone will necessarily agree with my choice of location or antenna. The main point of the experiment was to see how many stations on the FM dial could be received in suburban Boston, with the simplest (and cheapest) FM antenna. I found that more than 60% of the stations I received had good reception in mono, and about three-quarters of those, or 45% of the total, had good reception in stereo too.

Of course you must bear in mind that reception of an FM signal varies significantly from location to location, and sometimes reception conditions for particular stations (especially for the distant ones) will drastically change over only a few dozen feet.

Despite being a digital tuner, the Sequerra can be mistuned. This characteristic actually helped me receive more stations than with the other tuners. Conventional digital tuners will tune only to synthesized, discrete frequencies. With the aid of its own oscilloscope tuning display, special circuits and a quartz crystal oscillator, the Sequerra 1 tuner can be tuned to a station with the precision of the best digital synthesized tuners. The mistuning capability helps in receiving weak stations which are only 200 kHz away from the strong, local stations. In spite of the great adjacent selectivity (about 20 dB), a slight mistuning of the weaker station, away from the strong one, improves the reception in very difficult situations.

In my opinion, the Sequerra Model 1 is the state-of-the-art tuner, made not only for the present, but for the future. Since its introduction, in 1974, this unique hi-fi instrument has been one of the best products of its kind in the world. Its ability to be mistuned anywhere between the FM frequencies currently assigned by FCC prepares this product for the possible future reassignment of FM frequencies, a circumstance with which no currently available digital synthesized FM tuner can cope. (This reassignment is not very likely ever to take place at all, and is in any event at least five years away. -- Ed.)

In the country where the most of the best hi-fi equipment in the world is sold, it is not surprising that the Sequerra Model 1 FM Tuner was recently named by a leading Japanese hi-fi magazine as the best tuner in the world. I must agree, as this is the hi-fi product I have been the most satisfied with in every respect. The unit has not only met its manufacturer's claims, but has exceeded my highest expectations.

Some specifications of the Sequerra Model 1 FM Tuner:

Tuning Range: 87.0 MHz to 110.5 MHz
Quieting, Mono (30 dB): 6.02 dbf (1.1 μV)
Quieting, Stereo (30 dB): 12.80 dbf (2.4 μV)
Volume Sensitivity (2 dB): < 5.19 dbf (<1. 0 μV)
Capture Ratio: 0.75 dB
Alternate Channel Selectivity (400 kHz): >120 dB
Adjacent Channel Selectivity (200 kHz): — 20 dB
Minimum Discernible Signal (Panoramic Display): Less than 5 dbf (less than 1.0 μV)

These are the most important technical data for reception of a large number of FM stations where the quality of the reception is not important. For this reason I did not include other important data such as distortion, stereo separation, frequency response, sensitivity at 50 dB quieting, etc.

To identify the FM stations, I used the Broadcasting Yearbook (1979) which lists all the FM transmitters in the U.S.A. This publication, which cost $37.50 and is nearly the size of the Yellow Pages, also includes listings of AM and TV transmitters in the U.S.A. (and some foreign ones) as well as valuable information on broadcasting. For those who want to order the 1980 edition, here is the address: Broadcasting Publications, Inc., Broadcasting-Telecasting Building, 1735 DeSales Street, N.W., Washington, D. C. 20036. The new edition might cost more than the 1979 one, so write for the price before ordering the book.

Those who would like a copy of the list of stations received in this experiment may get one by sending a SASE to LIST, c/o The BAS Speaker, Trapelo Road, Lincoln, MA 01773.

-- Vladi Vudler (Massachusetts)

Cassette Tape Tests

The Truth about Metal Tape

Metal-particle cassette tape was first announced nearly two years ago, by 3M. It has been available at the retail level since last summer, though in a restricted array of brands and tape lengths, and machines claimed to be metal-ready have also been sold at retail since last summer. But so far (with the notable exception of one incisive report in Audio) the English-language hi-fi publications have not provided very thorough documentation of the real (as opposed to the claimed) performance of metal tapes and metal-hyped machines. Beginning in September I have conducted a variety of tests of metal tapes and machines, and it may be useful to sum up the essential results here. My test procedures are described in detail in the "High End" supplement to the

October 2, 1979 issue of the Boston Phoenix; they are fairly conventional except for the most important one, the test for high-frequency headroom.

Many testers simply use a measure of saturation as an index of headroom -- varying the level of a 15 kHz tone to find the maximum output level which can be achieved as the tape saturates, or running frequency response curves at progressively higher levels until the top end rolls off due to saturation. There are two problems with this approach. One is that the high-frequency saturation level is very sensitive to the adjustment of bias; you can make the 15 kHz saturation level look significantly better or worse by making tiny changes in bias, changes which are too small to have any effect on the overall performance of the recorder. So small differences in reported 15 kHz saturation level are essentially meaningless. The other problem is that this approach only tells you that the tape produces an output; it doesn't tell you how good that output is -- like the cheap speaker with "response from 30 Hz to 20 kHz" even though its response at 30 Hz is just a distorted rattle. Harmonic distortion tests at high frequencies are meaningless, of course, since the harmonics fall beyond the recorder's bandwidth. (And the listener's. -- Ed.) So the only meaningful test of a tape's high-frequency performance is an intermodulation test of the twin-tone variety: two high-frequency tones of equal level, spaced in frequency so that their intermodulation product falls in the middle of the audible spectrum. This test has several advantages. (1) It's easy to perform, and does not require very elaborate or costly equipment. (2) As the tape or the recorder's heads approach saturation the IM distortion shoots up sharply, so the signal level which produces 3% IM is easy to determine with precision and repeatability. (3) Bias is not critical; small changes in bias have little effect on the signal level at which 3% IM occurs. (4) It corresponds with what the ear hears in music -- when brass or percussion sounds are recorded at levels close to saturation, they do splatter plainly audible IM products into the midrange. For the test I use signals at 10 and 11 kHz, measuring the IM product at 1 kHz. I use 10 and 11 kHz (rather than 14 and 15 kHz for example) because in musical material high energy levels do sometimes occur around 10 kHz in cymbals and other instruments. High energy levels at 15 kHz, on the other hand, are very rare in music even after the pre-emphasis provided by the record equalization.

Briefly, here is a summary of what I have found about metal particle tape. Despite an announced international standardization of the coercivity of metal tape, brands differ substantially and are not interchangeable, so a recorder with adjustable bias is recommended. Once you have followed this recommendation, however, you will find that the major differences among brands of metal can successfully be ironed out simply by adjusting the bias. Scotch Metafine takes the lowest bias; it is quite dull on a machine set up for any of the Japanese tapes. Conversely, if a machine is set up for Metafine, the Japanese metal tapes will have a screeching high-frequency peak. Recognizing this problem, JVC provided an odd solution in its KD-A5: at its $360 retail price they did not want to build in a conventional front-panel bias-trim control, so instead they added a back-panel three-position switch which adjusts the bias for metal tapes only; it is factory set for TDK MA at the center position and for Metafine at the "-10%" position.

Metal tape is not just hype. It provides a real benefit: 7 to 10 dB increased headroom at high frequencies, both in terms of saturation and in terms of the signal level at which 3% IM distortion occurs, in comparisons of metal tapes versus the best oxide tapes such as TDK SA. Although Metafine is a little lower in coercivity than competing metal tapes, it is not demonstrably inferior to them in actual performance; for example, here are the high-frequency headroom figures as measured on the JVC KD-A5: TDK SA, -21 VU; Metafine, -13 VU; Nakamichi ZX metal, -14 VU. (ZX is identical to TDK MAR tape.) It is worth noting that Metafine is substantially less expensive than any of the Japanese metal tapes.

However, the benefit of metal tape is confined solely to high frequencies. At low and middle frequencies metal provides about the same usable headroom as the better oxide formulations, give or take a dB or two depending on the individual recorder. In the best metal-ready decks tested (JVC and Nakamichi), metal tapes produced not more than 2 dB improvement over TDK SA in the measured 333 Hz MOL (at 3% THD). In other metal-ready decks metal tapes have provided either about the same or one to two dB worse headroom at 333 Hz than TDK SA. Theoretically metal could provide a 6 dB advantage, since its remanence is twice that of chromium dioxide. But reportedly the metal tapes are being made with reduced coating thickness because if they were any thicker they would be impossible to erase with present head designs. Also, the tapes have a lower particle packing density than conventional tapes, because each particle is surrounded by an extra-thick layer of resinous binder, presumably to minimize the possibility of spontaneous oxidation when iron particles are exposed to air. So even though the particles are made of pure iron rather than iron oxide and so are magnetically more potent, the net amount of magnetizable iron per square millimeter of tape is hardly any greater than with conventional tapes. Metal tape is not, therefore, a panacea for the limitations of cassette recording. The only problem it cures is high-frequency tape saturation.

Erasure is a problem. The best metal-ready machines that I have looked at (the JVCs) wipe metal tapes clean. But in some metal-ready decks erasure is complete only at middle and high frequencies, with increasingly poorer erasure at low frequencies. This is not revealed by most specification sheets, since erasure is typically only specified at 1 kHz. A good test for this problem is to record drumbeats (whose peak energy is at 100 to 200 Hz) at a 0 VU level and then erase by re-recording and see whether an audible residue of the drumbeats remains. Most bulk erasers, even good ones, are also surprisingly inept at erasing metal cassettes; mine draws 10 amps, overheats if left on for more than a minute or two, and normally wipes cassettes and open-reel tapes completely clean, but it can't cope with metal tape.

As recently as the January 1980 CES, sales representatives for Tandberg were still being quoted as claiming that only a three-head cassette deck can possibly cope with the special requirements of metal tape. It's not true. In fact, of the decks I have personally tested, the best results happen to have been achieved on a two-head JVC deck (the KD-A5), and another simple two-head deck (the NAD 6100M) has also delivered a full 8 dB of increased undistorted high-frequency headroom with TDK MAR. Still, is a three-head deck better than a two-head deck? Not necessarily; in tests of two samples, the top-of-the-line Pioneer CTF 1250 yielded only 2 dB of improved headroom in one case and 4 dB in the second case. This machine uses a ferrite head; the decks which have performed best with metal tape have all used Sendust heads. I plan to test one of the lower-cost metal-ready Pioneers, which employ Sendust, to see if they might outperform the 1250. Incidentally, these figures for the improvement rendered by metal are referenced to a common standard; all the decks tested have performed normally (i. e., well) with reference oxide tapes such as TDK SA. Evidently manufacturers are not degrading their oxide-tape performance in order to enhance their metal performance; if anything the upgrading needed to cope with metal has ensured full exploitation of the dynamic range of oxide tapes without head saturation.

Metal tapes are not quieter than oxide tapes; their bias noise is comparable to ferricobalts such as SA and is a couple of dB worse than the best true chromes. So any gain in usable dynamic range with metal can come only through increased headroom.

Is the high cost of metal tape worth it? Only for those recording situations where the usable dynamic range is limited by high-frequency tape saturation, such as when dubbing brilliantly orchestrated D-to-D jazz performances, or for live on-location recording of percussion or brass. But when it comes to recording the heavy beat of disco, the bass drum of a Telarc digital, or the massive orchestration of a Mahler symphony, high-frequency headroom isn't the problem and metal isn't the solution.

Personally, I'm not buying a metal-ready deck. I'm waiting for Dolby HX, which may be a more cost-effective solution to the high-frequency headroom problem. Still, I'm glad that metal tape exists. It has stimulated machine manufacturers to improve their designs, particularly in the area of head saturation, and it has stimulated tape makers to work harder on new oxide formulations which will approach metal's performance without its high cost. Meanwhile I'm putting my money into video tape for use in digital recording.

Cassette Tests from Sweden

Radio & Television is the leading Swedish audio magazine. While its coverage spans the entire field of consumer electronics, it often includes detailed test reports on audio components. The December 1979 issue contained a comprehensive report on tests of 62 cassette tapes -- 7 metal, 12 CrO_2 or equivalent, 5 ferrichrome, 20 premium ferric, and 18 normal (DIN bias) ferric oxides. We don't propose to reprint the report in its entirety; it's long, and it's in Swedish. But its highlights are noteworthy, especially since no comparative tests of the various metal formulations have appeared in U.S. prints yet.

The cassette tests were performed on a Nakamichi 582 and included relative sensitivity at 300 Hz and 15 kHz, maximum output level (MOL) at 300 Hz (3% THD) and at 15 kHz (saturation), THD at 0 VU, amplitude stability (variation in level of a 10 kHz tone), bias noise, and print-through. Here, for example, are the relative sensitivity figures at 15 kHz for the metal-particle tapes:

BASF Metal	-1. 5 dB	Scotch Metafine	2.5
Fuji Metal	+2. 9	Sony Metallic	+0. 2
Maxell Metal	+1. 4	TDK MA-R	+0.4
Philips Metal	-1. 0		

Thus the various metal tapes are not exactly compatible with each other; Fuji is 5.4 dB hotter than Metafine at the high end. (But if these two are eliminated, the remaining metal tapes should be reasonably interchangeable on decks lacking bias-trim controls.) Doubtless 3M will eventually issue a hotter Metafine formulation in order to keep up with the Japanese competition -- which they can easily do, since the coercivity of metal tapes is arbitrary and completely under the control of the maker.

Of the parameters tested by Radio & Television, the cassettes varied most in dynamic range -- specifically in midrange MOL, high-frequency MOL, and bias noise. These results, rounded off to the nearest whole dB, are summarized in the following table for all the metal tapes and for the better tapes in each of the other categories. In each group the tapes are listed in order of a "figure-of-merit" score which we have derived from the data. Score = MOL $_{300}$ plus MOL $_{15K}$ minus bias noise. The figures are expressed in dB relative to DIN 0 VU level (250 nW/m), which is 2 dB above Dolby level and 4 dB above the 0 VU level of most Japanese decks (160 pW/mm).

Tape	MOL 300	MOL 15K	Bias Noise	Score
Metal				
Fuji Metal	+6	-12	-53	47
Maxell Metal	6	13	54	47
Sony Metallic	6	15	54	45
TDK MA-R	5	15	54	44
Scotch Metafine	6	19	56	43
Philips Metal	4	17	54	41
BASF Metal	4	17	53	40
Ferrichrome				
Scotch Master 3	6	-18	-57	45
Sony FeCr	5	18	57	44
BASF Ferrochrom	4	19	58	43
DIN (Normal) Ferric				
Ampex Plus	4	-17	55	42
Ampex 20/20	4	16	54	42
BASF Super LH Red	4	16	54	42
EMI Hi-Fidelity HF	2	14	53	41
Philips Super Ferro	3	17	54	40

Tape	MOL 300	MOL 15K	Bias Noise	Score
Premium Ferric				
TDK AD	+3	-14	-55	44
Maxell UDXL 1	7	18	53	42
Scotch Master 1	6	18	54	42
Maxell UD	5	17	53	41
Sony AHF	5	17	53	41
Agfa Superferro	7	20	53	40
Memorex MRX3	5	19.	53	39
BASF Super LH1 Green	3	16	52	39
Philips Super Ferro 1	6	20	53	39
Ampex GrandMaster 1	5	20	52	37
TDK OD	4	21	52	35
CrO_2 and Ferricobalt				
BASF Super Chrom.	5	17	58	46
Agfa Superchrom	5	20	59	44
Memorex High Bias	4	20	58	42
TDK SA	5	22	55	38
Maxell UDXL 2	6	25	56	37
Scotch Master 2	6	27	56	35
Sony CD-a	4	24	55	35
Ampex GrandMaster 2	3	25	56	34

In terms of midrange MOL and bias noise, these tests yield results consistent with what other tests have shown: metal particle tapes do not provide any improvement in midrange headroom over the best ferric oxide formulations, and their bias noise tends to be not as low as the best chrome tapes. However, the high-frequency headroom data shown here are, to say the least, unexpected, indicating that the better DIN-bias cassettes are as good at the top end as the premium ferrics, that the best ferrics are within 2 dB of the best metal tape, and that the worst high-frequency headroom is provided by the CrO_2-equivalent ferricobalt formulations such as Maxell

UDXL/2 and Scotch Master 2. The only plausible explanation is that the recorder is over-biased for the ferricobalt tapes at its "CrO_2" setting and slightly under-biased for the standard ferrics at its "normal" bias switch setting; this speculation is supported by the 315 Hz and 15 kHz relative sensitivity figures which were included among the test results. With a slight reduction of bias in the CrO_2 setting the 15 kHz headroom figures for the ferricobalts would have been substantially improved, yielding scores closer to the metal formulations. This is a classic difficulty with published tape tests; in the final analysis they apply only to the machine on which the tests were made. Recording is a synergistic process whose results depend on the record head gap width, play head gap, bias, and record EQ as well as on the characteristics of the tape itself. The strongest of these factors is bias, which must be individually optimized for each tape in turn if the results are to have any general validity.

The same problem arose in a "technical brochure" and press release recently issued by DuPont in which it is alleged that the second-generation chromium dioxide formulation, Crolyn II, is competitive with metal tapes. The brochure reported tests of five metal tapes and compared the data with Crolyn II. One of the metals, Scotch Metafine, was found to have even <u>less</u> headroom at 15 kHz than Crolyn II! But the brochure frankly stated that this was because the recorder used for the tests (another Nakamichi 582) was overbiased for Metafine, having been factory-set for Nakamichi's own ZX metal tape (which is actually TDK MA). DuPont reported that "all the metal-alloy tapes were tested at the recorder's factory settings for bias and equalization, since most users cannot be expected to have machines with variable bias and the facilities for adjusting it." Interestingly, DuPont's own data show a 4.8 dB variation in 15 kHz sensitivity among the five metal tapes tested, so if a consumer hopes to have the freedom to use more than one brand of metal tape he will have to buy a machine equipped with a variable bias control.

-- Peter Mitchell (Massachusetts)

In the Literature

Audio, December 1979

*Behind the Scenes (p. 3): On concert hall recording acoustics.
*Audio ETC (p. 20): Canby raves about dbx encoded discs.
*Ins and Outs of Toroidal Transformers (p. 39): Good reading for amplifier design engineers.
*Picking at the Congress (p. 44): Peter Mitchell discusses some of the notable products shown at the summer CES.
*Audiophile Records (p. 53): A label-by-label survey.
*Digital Recording (p. 70): Survey of proposed digital disc systems.
*Equipment Profiles (p. 78): Teac C-1 cassette deck (expensive and good). TDK Calibrated Test Tapes (accurate and well made). ADC 1700DD turntable (good). KEF 104aB loudspeaker (a mixed review -- in some respects excellent but has no deep bass, its complex reactive impedance presents a difficult load, and its woofer flops wildly when fed subsonic signals).
*European Records (p. 99): On some of the best recent discs.
*Top of the Pile (p. 120): Reviews of audiophile recordings.

Audio Engineering Society Journal, October 1979

*Auditory Backward Inhibition in Concert Halls (p. 780): Revealing that reflected sounds delayed 60 milliseconds may inhibit perception of primary sounds.

Audio Engineering Society Journal, November 1979

*A Unified SQ Compatible System (p. 866): Ben Bauer's final paper, a thorough analysis of refined SQ matrices for quad encoding.

Audio Times, November 15, 1979

News items: Dupont is working on an improved CrO_2 formulation to compete with metal; it may be marketed in 1980. FCC postponed any decision on AM stereo until proposals to reduce AM channel spacing to 9 kHz are settled. The IHF has merged with, and become a subdivision of, the EIA.

Audio Times, December 1, 1979

Garrard has been bought by Gradiente Electronics of Brazil, after losing $10 million last year. The announced merger of GAS with Craig has been cancelled. Dynavector and Denon have split off from ESS and Discwasher respectively and set up their own marketing.

DB, December 1979

*Stereo Microphone Technique (p. 34): On the lateral imaging of various miking setups, concluding that ORTF miking gives the most accurate image (mikes angled at 90 to 110 degrees with noses spaced 7 to 8 inches apart).
*The FRAP (p. 47): Using the FRAP triaxial contact mike on acoustic and orchestral instruments.

Gramophone (England), November 1979

*Quarterly Retrospect (p. 775): The best recent releases.
*Equipment Reviews (p. 933): JR EX1 Super Woofer powered subwoofer (works as advertised). ADC Sound Shaper Mk II equalizer (good). AR 90 loudspeaker (good imaging, excellent deep bass, but upper-midrange is a bit brash). Dominus 3 outboard phono preamp (excellent, with flexible resistance/capacitance selection). Record weights and clamps (six tested, all more or less useful).

Hi-Fi News & Record Review (England), November 1979

*Harrogate (p. 93): Notes from a hi-fi show.

*Subjective Sounds (p. 97): Enthusiasm for Enigma's new series of recordings -- true stereo miking, digital mastering, German pressing.
*Mikes and Miking (p. 106): About microphone polar patterns and the virtue of coincident miking.
*Positive Feedback (p. 115): On TPD (Transient Phase Distortion) and the desirability of flat response to 5 Hz including the speaker.
*Eugene Ormandy (p. 117): A biographical sketch of the 80-year-old conductor.
*Three Cassette Decks (p. 165): Thorough reviews of the JVC KD-A8, Hitachi D5500, and Thorens PC 650 (JVC clearly the best of the group and excellent by any standard).
*Fifteen Moving-coil Stepup Devices (p. 177): Detailed tests of transformers and head amps. Among transformers the best-liked were Ortofon T-30 and Denon AU320, followed by Anzai A75, Signet Mk-10T, and Ortofon STM72. (Cotter/Verion not tested.) In head amps the Denon HA-500 and Hafler DH-102 lead, Ortofon MCA-10 and Signet/U. K. PA-1 follow, Marcof PPA-1 and Lentek next; models by UAD, Nippro, and Isleworth trail.

HiFi Stereophonie (Germany), December 1979

*The New Music - An Outsider (p. 1710): An analysis of the complex problems of modern music from the viewpoint of its composers.
*The Public: How It Can Intimidate and Lure (p. 1718).
*Out of the Ghetto - But at What Price? (p. 1722): The new music pays for its break-through by eclecticism.
*Atonality and Jazz (p. 1732).
*Irish Traditional Music (p. 1740).
*The 12th Prix Mondial du Disque de Montreux (p. 1743).
*Test Reports (p. 1788): The Aiwa, BASF and Grundig mini components (good, but not to be used with inefficient mini loudspeakers). The AKG K-340 and the Sennheiser Unipolar 2002 headphones (two-way designs, dynamic-electret and all electret respectively, both very good). The Dual CL 730, CL 720 and CL '710 loudspeakers (good in the bass range, remarkably uncolored). The Coral X-30 Monitor loudspeaker (capable of very high volume). The BIC Beam Box FM Antenna (disappointing).

High Fidelity, December 1979

*Equipment Reports (p. 33): Sansui TU-919 tuner (fine FM, exceptional AM). Yamaha MC-1 moving-coil pickup (superb, with correct VTA). JVC KD-A8 cassette deck (fine performance, splendid bias/EQ tuning system, inadequate metering). E-V Interface A Series 3 speaker (clear, spacious, little warmth). RG Pro-20W dynamic processor ("possibly the best expander on the market"). Rotel RX-504 receiver (some bass rolloff, tuner can't switch to mono, otherwise okay).
*A Personal Approach to Choosing Components (p. 56): Sample systems selected by six stereophiles, including the BAS' Mike Riggs.
*Cracking the Vaults at Columbia and RCA (p. 63): The disheartening story of classical rarities rotting in the storage rooms.
*Gifts for the Audiophile (p. 71): Cheap goodies.

Modern Recording, December 1979

*Reviews (p. 62): Pioneer RT-909 open-reel deck (silky-smooth transport, first-rate sound, aimed at audiophile rather than studio use). Phase Linear 7000 cassette deck (made by Pioneer, automatic bias/EQ tuning system works well, superb transport). Hafler DH-200 power amp (ideal performance, a great bargain).

Popular Electronics, December 1979

*Stereo Scene (p. 16): Ambiguities in specifications.
*Test Reports (p. 22): Kenwood KR 6050 receiver (tuner very good in Wide mode, mediocre in Narrow; preamp good except for phono input interaction; amplifier good but for 5-ampere current limit). Technics M33 cassette deck (good at its price).
*Super Discs (p. 71): Including some brief reviews.

Radio Electronics, January 1980

*Backyard Satellite TV Receivers (p. 55): Part of a continuing series, this installment on the system electronics.
*Reviews (p. 60): Realistic STA2200 receiver (pretty good).
*Pickup Arm Performance (p. 63): On the infrasonic arm/cartridge resonance and the design of low-mass arms, especially Thorens Isotrack.

Recording Engineer/Producer, October 1979

*Disco Sound System Design (p. 61): On making it clean and loud.
*Microphone Placement (p. 78): How to close-mike and still achieve natural instrumental timbres.
*Apocalypse Now (p. 118): On the modified John Meyer powered woofer system used in Coppola's theater -- producing 130 dB at 50 Hz at 1 meter distance.
*Hazardous to Your Health (p. 126): On the hearing damage risk associated with high volume levels: includes a detailed discussion of the anatomy of the ear and probable modes of damage, plus hormonal and chemical side effects.
*Stylus-to-Preamp Interface (p. 140): By using a flux loop in place of the stylus assembly to inject test signals into the cartridge, cartridge/preamp interface problems are revealed. High-inductance cartridges are condemned, and preamp design criteria are discussed.
*The Great Amplifier Shootout (p. 183): In a search for the best monitor amp to drive UREI 813 time-aligned studio monitors, assorted golden-eared recording pros did a 10-way amplifier comparison with matched levels. Conclusion: preferences were random.

SMPTE Journal, Vol. 88 No. 12, December 1979

*Telecine Reproduction of Motion Picture Audio (p. 835): A thorough survey of film audio formats, reference and test standards, and causes of flutter and treble loss.

Stereophile, Vol. 4 No. 5

*Preservation of Sound Recordings (p. 4): Archival practices.
*Reviews (p. 9): Denon 2550 turntable (a state-of-the-art platter spinner on a chintzy base; needs Duxseal or a Cotter base to realize its true potential). Berning TF-10 preamp (the one against which all others must be judged; simply the best despite its modest phono S/N). Sumo phono cartridge (pretty good, needs arm damping). AKG K340 headphones (pretty good with very strong bass and smooth, detailed top). Infinity HCA power amp (expensive but easily the best ever heard). Shure V15/IV cartridge (very accurate, especially the V15G spherical version; moving-coil superiority alleged to be mythical). Infinity 4. 5 speaker (terrific bottom and top, but not accurate in the midrange; early samples even worse). Tandberg 340A cassette recorder (one of the best). Grado G-1+, Pickering XSV3000, Sumiko LMS, and Grado F-3+ cartridges (G-1+ the best of the group).
*Recordings (p. 50): Assorted reviews.
*Visit to Vienna (p. 58): Notes on an AKG junket.
*Miscellany: A demonstration of acoustic feedback in turntables, absolute phasing, etc.

Stereo Review, December 1979

*The FM Squeeze (p. 30): Don't worry about digital tuners becoming obsolete due to a reduction in channel spacing; it won't happen for at least five years, if ever.
*Tape Talk (p. 37): Record EQ vs. playback EQ.
*Technical Talk (p. 39): Some measurement difficulties.
*Test Reports (p. 40): Tandberg 20A open reel recorder (splendid at both 7 1/2 and 3 3/4 ips; response at 7 1/2 flat from 12 Hz to 30 kHz). MXR Dynamic Expander (works effectively). E-V Interface C/II speaker (efficient, exceptionally uniform dispersion, measures and sounds fine). Dual 506 turntable with ULM 55E cartridge by Ortofon (good arm geometry and human-engineering, excellent tracking of warped discs, smooth cartridge response). Audio Pro TA150 microprocessor-controlled one-knob receiver (mediocre tuner, good amplifier, unique control convenience).
*Audio Accessories (p. 75): Assorted handy goodies.

Studio Sound (England), November 1979

*Cassette Copying (p. 54): Commercial high-speed cassette duplicators and their problems.
*Reviews (p. 78): Ivie IE-30A one-third octave spectrum analyzer (a remarkably compact, efficient, wide-range system, accurate except for a deep-bass rolloff in the spectrum display). Ivie IE-17A microprocessor/analyzer for IE-30A (as advertised, it makes the IE-30A a sophisticated, powerful audio analysis system).

Transactions of the I. E. E. E. On Consumer Electronics CE25-4, August 1979

*High-Performance Combination Head (p. 515): A Hitachi combo record/play head for cassette decks using metal tape. The head surface is coated with titanium dioxide to give it the low wear of ferrite. Spacing of record and play gaps is 1.4 mm, yet mutual coupling is down 50 dB at 20 Hz.

-- Peter Mitchell and Jiri Burdych

November BAS Meeting

The November meeting of the BAS was held at GTE Labs in Waltham. Peter Mitchell opened the meeting with a report of the results of a recent meeting of the executive committee. First, a committee to update the BAS constitution has been formed and those members who are interested are invited to join the group and/or submit their thoughts on relevant issues to other committee members.

Second, the committee wants to thank those who have written meeting summaries over the past year and is happy to announce that henceforth a small stipend will be paid to those who perform this task in the future. (It will vary from year to year, but not drastically downward. This year it was $40/meeting. -- Ed.) Third, Peter pointed out that the conclusions of the executive committee are by no means sacred and can be overridden by the membership.

Frank Farlow added that the Constitutional Update Committee is still very small and he encouraged anyone interested to join in.

Peter also mentioned the possibility of forming a new committee to explore alternative meeting formats -- something in addition to our regular new product-manufacturer's presentations -- and Al Foster noted that we could set up recording sessions for the membership, or perhaps have group listening sessions. Al also announced that he had tried to get Peter Aczel and Harry Pearson for guest-speakers and both have answered "no."

Dave Ranada added that he thought Larry Klein would be willing to speak to a meeting and Al asked Dave to arrange it for late spring or early summer of next year.

John Schlafer, the new chairman of the Test Equipment Committee, announced that they had run into a temporary roadblock on the issue of insurance. Brad Meyer explained that insurance companies were not willing to write a theft and accident policy for a sum as small as would be needed to cover an Ivie 10A and two pink noise generators. Brad announced that they will continue to pursue this, because with all the hazards involved in sending out test equipment, it would be foolish not to have it insured.

Peter announced that BAS members have been invited to attend the next local meeting of the AES (topic -- delta modulation) and the next SMPTE meeting (topic -- present and future video technology).

Finally, Peter closed the open forum with a solicitation to members to offer their opinion on other forms of meeting in general and specifically on whether we ought to expand our topics to include computer and video subjects as well as audio.

Meeting Feature - Mitchell Ravitz, Empire Scientific

Mitchell Ravitz, the Technical Director of Empire Scientific Corporation, was the featured speaker. Mr. Ravitz began his presentation with a brief history of Empire and then went into detail on the research and development that took place at Empire in preparation for their new phono cartridge, the EDR.9.

The EDR.9 represents, according to Ravitz, an attempt to produce a moving magnet cartridge compatible with typical preamplifier circuitry which could capture the "sound" of a moving coil cartridge. The result, he believes, is the best sounding cartridge Empire produces, even though it does not have the best specifications.

Ravitz pointed out that typical moving magnet cartridges (e. g. , the Shure M91 or Empire 2000E3) have a fundamental resonance around 18 kHz and their open-circuit response shows a hump whose center is near this frequency. This rise can be electronically damped with a capacitative load. Empire's 2000Z, with a moving system only 70% the size of that in the 2000E3, has its resonance at 27 kHz and thus can be very flat (± 1 dB) in the 20 to 20 kHz region with only a 300 pF load, while the more massive, and therefore lower-resonance, M91s and 2000E3s need a 450 to 500 pF load to remain flat in the audible region. Ravitz admitted that these cartridges do not often see this size load in typical cable-preamp combinations and are therefore audibly not flat in real-life situations.

The EDR.9, however, was designed to have mechanically flat response and low inductance, therefore not needing and, in fact, being quite independent of, capacitive loading. In this it is like the Grado designs.

Mechanically flat response is achieved in the EDR.9 by using a small iron magnet placed inside of a hollow cantilever and supported at the stylus pivot by an elastomer. This system is tuned such that it resonates out of phase with the stylus, thus flattening the mechanical response which, in turn, flattens the electrical response without the need for capacitive damping. This is similar to the system Shure uses in the V15 W; Shure uses a rubber piece as a mechanical resonance damper, but Ravitz feels that Empire's system has the advantage in that it is easier for the manufacturer to properly tune the system with a metal, rather than a rubber, phase-cancelling assembly.

Under questioning, Ravitz agreed that this damping system was not purely mechanical, since the out-of-phase iron piece, being magnetic, would also be inducing out-of-phase electrical signals in the coils, thus giving electrical damping as well.

The overall response of the cartridge is not as flat as some of Empire's other designs, Ravits acknowledged. The EDR.9 is specified at ± 1.75 dB, 20 to 30 kHz. There are slight rises in the curve at 10 kHz and 20 kHz (typically 1.5 dB) and the response is not rolled off above 20 kHz as is typical with moving magnet cartridges. As a result, the rise time of the EDR.9 is 16 μsec rather than the 25 μsec typical of other designs. Unlike capacitive loading, the mechanical damper decouples at ultrasonic frequencies, thereby permitting this ultrafast response.

This, of course, makes the cartridge prone to ringing. Ravitz argued that many very fine sounding cartridges have had essentially uncontrolled ringing; this includes most moving coil units as well as other designs, such as the ADC XLM. Many people have noted, Ravitz pointed out, that listeners often like a small amount of IM distortion, and this may be the reason why these cartridges find so much favor.

EDR.9 has what Empire calls an LAC (Large Area of Contact) stylus. In this design, which Empire produces in-house, material is cut away from both the leading and trailing edges of the stylus in order to produce a very narrow, very predictable line-contact which is perpendicular to the groove. Even though this design necessitates a higher tracking force than an elliptical stylus, the larger footprint of the LAC unit means there is no corresponding increase in record wear. According to Ravitz, the EDR. 9 affects a record groove so little that, after 5000 plays, there will be no change in the record's response in the audible range and only a one dB rolloff at 40 kHz. Another kind of wear, which produces a 2 to 3 dB rise in the response at 24 kHz due to the tip resonance denting the groove, is more serious but also inaudible, he claimed.

In response to a question about temperature sensitivity, Ravitz replied that the EDR. 9 is essentially unaffected by temperature change between 60° and 77° F., but that the 10 kHz and 20 kHz response peaks would be affected by temperatures outside this range; higher temperatures raise the peak at 20 kHz, lower temperatures raise the peak at 10 kHz.

Disco Film

After the break, Ravitz demonstrated DiscoFilm. He showed that, although it is tricky to use, it can indeed remove particles from deep inside a record groove, thereby (he claimed) restoring an old record to playability. In answer to complaints about problems in application, he said that Empire is about to market an applicator which will be more consistent and easier to use. As to DiscoFilm's contents, Ravitz said that it contains polyvinyl acetate, another polyvinyl, alcohol, and triethylene glycol. According to Empire's tests, it does no harm to records. Although expensive, it is meant to be an infrequent treatment, and therefore should not be an undue expense to the audiophile.

In addition, Ravitz noted, their studies have shown that DiscoFilm leaves no residue, although he cautioned that it will remove Sound Guard, especially if the Sound Guard layer is not fresh, so the Sound Guard should be reapplied after a DiscoFilm treatment.

Epilogue - Bias Reduction, Distortion, and Dolby HX

The new Dolby HX circuit, which should be available on cassette decks sometime next year, increases high frequency headroom by reducing the bias signal, simultaneously decreasing the record pre-emphasis to keep the response flat, when high-level high frequency information comes along. The problem with this approach would seem to be that when the bias is decreased, the midrange distortion goes up. Dolby Labs claims that this doesn't matter because the increased distortion will be masked by the loud high frequencies. However, as Angus MacKenzie discovered and reported in the October '79 Hi- Fi News and Record Review, the alleged increase in distortion never occurs.

The reason for this is that the loud high frequency information actually acts as a bias signal for the lower frequencies. At the close of the meeting, Peter Mitchell demonstrated this effect using a Pioneer CT-F900 cassette deck, two BAS oscillators, and a one-third-octave spectrum analyzer. A tone of about 300 Hz was fed to the recorder, and the bias was decreased from the optimum value. It was then possible to observe the third harmonic of the test tone increasing in level. Then a 10 kHz tone was mixed with the lower frequency tone, and as the level of the 10 kHz reached -10 VU the third harmonic of the low frequency tone decreased to approximately its original value. This effect takes place for values of the high frequency tone between -10 and 0 VU, but not for values either above or below that range.

-- Dick Glidewell

(The past three meeting summaries were inadvertently unattributed. We offer our apologies, and the names of the authors: the August, September, and October meetings were written up by Mark Fishman, Brad Meyer, and John Schlafer. -- Ed.)

A Publication of the BAS

A Complete Guide to TV/FM Antenna Installations

John Allen

It's safe to say that just about everyone with an FM receiver, a TV set, or both, could benefit from a better antenna. Proper antennas not only receive more distant stations but allow the local stations to be seen and heard more clearly, particularly in color (for TV) and in stereo (for FM). It's also safe to say that anyone trying to get expert antenna advice or high-quality products is in for a good deal of frustration.

This article intends to provide you with useful information about purchasing a properly installed antenna system or, should you wish, installing your own.

Unfortunately, consumers generally have chosen price over quality when making antenna purchases, and therefore share with the manufacturers and salespeople responsibility for all the junk that's on the market. Salesmen have played down the benefits of a good antenna and its associated cost in order not to scare off sales.

First, we will look at the reception of both television and FM radio signals. The spectrum involved is divided up as follows: channels 2 through 6 occupy the space between 54 and 88 MHz; channels 7 through 13 run from 174 to 216 MHz; UHF (channels 14 to 83) goes from 470 to 890 MHz. As the frequency increases, the wavelength decreases. If you are carrying a signal from an antenna to a receiver through a cable, the loss of signal in the cable will increase with frequency.

Antenna systems for television and FM are identical except for the antenna itself and the receiver connection. FM systems should be built to deliver signal levels in the 500-to-2000-microvolt range to the receiver. Television systems should be built to provide 2000 to 10, 000 microvolts. These are the levels required by color TVs and FM receivers to provide the maximum performance of which they are capable. Insufficient signal levels will give noisy reception, perceptible in pictures as snow and on FM as hiss. Too much signal overloads the TV or FM tuner, creating cross-modulation, which causes you to see or hear another station in the background of the one to which you are tuned.

There are many FM transmitters in the Boston area, located in virtually all directions for any reception point. FM receivers don't require as much signal as television sets to operate properly, so manufacturers usually provide a "T"-type antenna with their receivers. These are made with 300-ohm flat or ribbon wire. Figuring that there will be enough signal getting into your home for your tuner, they instruct you to place the T behind the receiver. For TV, you are given a set of rabbit ears to install on top of your set. The problem is that while the signal in your home may indeed be strong enough, it can be badly distorted passing through your walls, your furniture, and you.

For FM reception, a better solution is to place the antenna in the attic. For most locations in the Boston suburbs this will be sufficient; an omnidirectional antenna can be used. These are small and cost from $4 to $10. Their physical strength is not too important, for the antenna is mounted indoors. The most important step here is to use shielded coaxial cable between the

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antenna and the receiver. Coaxial cables are listed in the industry by type number. For FM only, an RG-59 cable with a foil shield will do fine. For FM with UHF- and VHF-TV as well, RG-6 or CAC-6 cable with a foil shield is required, because RG-59 has too high a loss in the UHF band (9 dB per 100 feet at channel 56). The coaxial connectors must be carefully installed; instructions will be given later for doing this. Precut lengths of 50 and 100 feet with the connectors installed are available. No other type of coaxial or unshielded cable should be used. They can act as antennas themselves, picking up unwanted and distorted signals, affecting your reception. Seventy-five-to-300-ohm transformers are required at each end of the cable, at a cost of about $1.50 each. Also, a 75-ohm attenuator (signal reducer) will be required for most of those within about 10 miles of Boston, to alleviate signal overload. A unit providing about 18 to 20 dB of attenuation (about $9) is usually enough.

Should the omni antenna fail to provide clear reception of the stations you listen to, or if you live either within the city or more than 15 to 20 miles from the transmitters, you will need a larger, directional antenna with a rotor. A system of this type, using good-quality materials (coaxial cable with a foil shield and proper grounding), should cost from $325 to $375 installed.

The following is a list of the items needed should you wish to install your own system. It also represents the level of quality you should insist on if you hire an installer. Some companies will not have materials of this grade in stock. For television-antenna installations, use a UHF-VHF- FM antenna, although high-quality FM tuners are happiest when fed by a separate, FM-only antenna.

My list comprises specific product preferences. As with all my installations, I am recommending Jerrold equipment, because I have found over the years that it performs better and lasts longer than other brands. Additionally, Jerrold antennas generally provide more gain per dollar than the competition.

<u>1 Jerrold antenna</u>. For FM only, use Model QFM-9. This is not a deep-fringe antenna. For installation on tall buildings, near the ocean, or anywhere with extra strong winds, use a Jerrold J-55-FM commercial-grade antenna. (These add about $50 to the cost of the system.)

For television reception within a 15-mile radius of the intersection of Routes 9 and 128, use a Model VU-932S. From 15 to 25 miles, use a VU-935S antenna. Both these antennas will accept a UHF extension to increase UHF sensitivity (Model VU-8PZ). For installations in locations with strong winds, use the commercial-grade Jerrold J-283X. (This model adds about $250, but is necessary for high-wind conditions.) If the J-283X does not give enough UHF signal, use a J-275D commercial-grade UHF antenna with an FCO-375 UHF-VHF combiner.

<u>1 Jerrold T6789DP weatherproof transformer</u>. Discard the supplied connector. No transformer is needed for the J series antennas.

<u>1 Jerrold T6000 transformer</u>. Indoor type (for FM systems), or FSX-1314 FM splitter (for television systems).

<u>1 Jerrold LGB grounding block</u>.

<u>2 Jerrold WB-56 weather boots</u>. For the LGB.

<u>4 Jerrold F56A one-piece coaxial connectors</u>. Do not accept two-piece connectors. If the FCO-375 combiner is used, a total of seven connectors will be required.

<u>Jerrold CAC-6 coaxial cable with a foil shield</u>. Also acceptable and more readily available are Times 2060 and Belden 8228. The Belden is electrically equal to the others but not as strong. Use it carefully. Do not put sharp bends in coaxial cable.

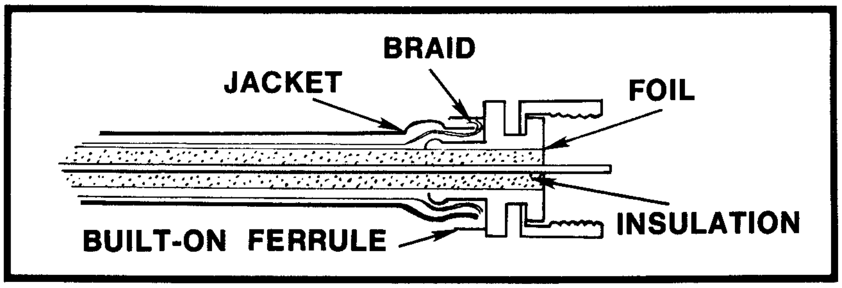

Figure 1

Jerrold PDA-20 or PDA-10 75-ohm attenuator. Use these as required to reduce signal overload. For FM systems in Boston or Cambridge you may need both, for a total of 30 dB of attenuation. They should be installed just before the tuner. You may remove them to receive distant stations at full power. If you can tune in any station at more than one location on the FM dial, or if you can see another TV picture in the background of the one you are tuned to, you need an attenuator. Be sure to get F56A connectors for the PDAs.

1 Jerrold PL-659 crimping tool for the coaxial connectors. Make very sure you bring the foil shield up inside the F56A connectors when you install them. The braid (or drain wires, in the case of the Belden 8228) and jacket are slipped under the built-on ferrule. Refer to the connector installation diagram, Figure 1.

1 Alliance U-100 antenna rotor. Old reliable. In high-wind areas, use the U-100 with an Alliance TBB bracket, part number 4589R.

1 Rohn, or other, 10-foot 16-gauge steel mast. Never use aluminum masts outdoors. Don't let anyone sell you an aluminum mast. Cut off the top two feet and use for the rotating section of the mast. The antenna should be no more than eight to 10 inches above the rotor.

Four-conductor rotor wire, 20 gauge. For runs of over 100 feet, use 18 gauge; over 175 feet, use 16 gauge.

No. 6 copper wire, type THHN or THW. This is the grounding cable. Never use or accept the aluminum ground wire commonly sold for antennas; it's not enough.

2 Raco, or other, one-inch bare ground clamps. Use brass only. One is for the mast (use it also to clamp the LGB to the mast), and the other should be placed on a cold-water pipe such as that on the street side of your water meter. Newer water mains take a two-inch clamp. Or, get one ground clamp for the mast and a half-inch-diameter, six- or eight-foot ground rod (not a four-foot rod) with a cable clamp. Drive the rod into the ground near where the antenna wires enter the house, or another convenient location. The no. 6 wire is connected between the clamp on the mast and the rod (or the other clamp on a pipe). The wire should be run without splices or sharp bends. Some new water mains use plastic pipe. These are not suitable for grounding. If you have one of these systems, use a ground rod.

1 South River antenna mount. Suitable for your installation. For chimneys, use the rugged ratchet-type mounts with six corner guards. The corner guards are purchased separately, as South River type CGB.

Rohn, or other, three-inch standoffs. Use these to anchor the cables to the house. Do not pinch the coaxial cable and do not bend either the coax or the ground wire sharply. Remove the insulators from the standoffs and fasten the cables with tape where they run through the standoffs.

*   *   *

As mentioned, an FM-only antenna will provide superior sound for those with elaborate high-quality equipment. For the majority, however, a television antenna can be the ideal solution for FM reception.

The first thing to do is to make sure your TV-antenna system is up to the grade described above, and that RG-6 (not RG-59) coaxial cable is used between your antenna and TV set. If 300-ohm flat lead was installed, replace it with RG-6 coaxial cable. In addition to the items listed, you'll need a Jerrold FSX 1314 FM splitter installed between the coaxial cable and the antenna terminals of your TV. This "band splitter" will separate the incoming UHF and VHF signals and send them to the appropriate terminals on your set.

Once your television system is in order, there are two routes to go. You can run a short length of 300-ohm flat lead from the FM terminals on the FSX-1314 splitter to the FM tuner, assuming that your tuner is near your TV set. The preferred way is to use a coaxial splitter and run coaxial cable right to the tuner or receiver as well as to the TV. In the city or near the suburbs, I use a Jerrold DC-16B directional coupler and feed the tuner from the "tap" outlet. Directional couplers are uneven splitters -- one leg loses 16 dB while the other leg loses 1 dB. They have the advantage of reducing the FM load while leaving TV signals at essentially full strength. This is most important for receiving UHF stations, especially (locally) Channel 56.

If you use a directional coupler you may not require any further signal reduction for the FM. City dwellers, however, may still need a 10 or 20 dB attenuator.

Those beyond the suburbs generally should use a standard coaxial splitter. Some television antennas are made so additional UHF elements can be added. If you have such an antenna and install a standard splitter, you should add the UHF extension if any UHF stations become snowy.

A word of caution: some antennas sold for TV use are hardly useful at all for FM. Others have FM-blocking elements that can be broken off. If your antenna has these blocking elements in place and you want to use it for FM, they should be removed.

The details of a typical installation, done according to these instructions, are shown in Figure 2.

Deep-fringe reception

If you live a long distance from the stations you enjoy and are bothered by all the snow or hiss you see or hear, you are among those who require a deep-fringe antenna system. Unfortunately, these are never inexpensive.

The basic system needed has already been described; the only difference is the antenna. There may be additional structures required, even towers, since the strength of the signals you are trying to receive increases with increasing distance from the ground. The farther away the station you wish to receive, the more sensitive your antenna must be. Most directional antennas have a gain of 8 to 9 dB. Larger antennas with a gain of 12 to 13 dB are available for those in fringe areas. They can cost hundreds of dollars and are over 15 feet long. If you still need more signal strength than one of these monsters can provide, you have three choices: doubling the height of the antenna, stacking two or four antennas, or using an amplifier. The amplifier is by far the cheapest solution, but it has limitations. Stacking antennas and/or doubling their height from the ground will increase your signal level without increasing noise. Nothing else can do that. Amplifiers will add noise; even the best add 4 dB or so. Doubling the height or stacking the antennas will increase the signal-to-noise ratio (reduce the snow or hiss) by about 3 dB. Four antennas would yield an increase of about 6 dB.

Obviously, stacking is the route to go if noise caused by low signal levels is a problem. The trouble is that these arrays can be structural nightmares, for they are huge. Most people can build a stack of two antennas, however, without too much trouble. Some rules must be followed.

Use the largest and strongest antennas you can buy. The vertical spacing of the antennas is determined by the lowest frequency you wish to receive: 140 inches for channel 2, 127 inches for channel 3, 116 inches for channel 4, and 80 inches for FM only. If you "stack" (position) the antennas horizontally (side by side), these spacings should be multiplied by 1.5. Wiring these antennas together is critical. First you'll need a coaxial "hybrid"-type (not resistive) splitter, such as the Jerrold 1596B, and a weather-proof housing to put it in. The splitter is placed midway between the antennas, and when used in this way works as a combiner. Connect coaxial cables of equal length from each antenna to the splitter. From the splitter, run extra-low-loss coaxial cable, such as Jerrold CAC-11 or Times 2062, to the receiver. You will probably need a 20 dB attenuator for receiving strong local stations. But your sensitivity and signal-to-noise ratio on those really distant stations is increased around 2.5 dB. This is a small gain for a lot of effort and expense, but in some cases it can make an important difference.

And where do signal amplifiers fit into this picture? The answer to this one lies not in the signal-to-noise ratio of the signal you are receiving but in the signal-to-noise ratio of receivers and the cable connecting them to their antenna. The basic rule is that an amplifier will help if the loss between the antenna and the receiver is greater than the noise figure of the amplifier. The important thing here is that signal-strength surveys and calculations are required when amplifiers are involved. These are beyond the scope of this article, and are mentioned only to alert you to the possibility that some installers may not be qualified to design a good fringe system.

Frankly, those in need of this kind of equipment ought to consider hiring a professional designer and installer -- one who owns and uses a field-strength meter. Much money can easily be wasted by building an array that either doesn't work or was unnecessary to start with. You must begin with a complete signal-strength survey to measure the levels of the various stations, strong and weak, and your particular location.

<u>For apartment-dwellers only</u>

At last we address those who live in apartments and wish to get good reception. The trouble is that it is nearly impossible to do so unless you can erect your own outdoor antenna, and few landlords will allow this.

But let's start at the beginning. If your building has no central or master-antenna system, your landlord may be more inclined to let you go ahead with your own system. This is the best thing that could happen.

If your building has a master system, you may really be up the creek. Unfortunately, the master-antenna system business is full of incompetent, sloppy, even crooked people. For years they have offered MATV systems at very low prices (lowest bidder usually wins), used poor-quality components, and, to top it all off, completely bungled the installation. MATV systems must be flawless or they won't work. We have seen installations where not one single thing has been done properly. Needless to say, the pictures were terrible and the complaints many. The owners of your building may have been at the mercy of one of these installers. If so, your system doesn't work, and never will. Since it always seems to cost more to rebuild these faulty systems than it would have cost to do the job correctly in the first place, few systems get fixed, and tenants are stuck. The solution is replacement.

In large systems, one way of cutting costs is to reduce the number of channels carried. FM is rarely included, and so it may not appear at your wall outlet. One consequence of this is that many frustrated tenants have tampered with their outlets, perhaps finding some improvement (but usually not) and ruining reception for many others. At this point, simply adding FM to the system won't do much good; if you can't get decent television pictures from your master system you probably won't get decent FM either.

But if you are one of the few lucky ones with a good system (including FM) in your building, connecting it to your FM tuner and/or TV is quite simple. If your outlet gives you a round coaxial-cable fitting to connect to, a length of coaxial cable with a foil shield and a 75-to-300-ohm transformer are all you will need. Just connect the transformer to your receiver. If you are feeding your TV and FM tuner from the same outlet, you'll need a coaxial splitter, such as the Jerrold 1596B. Some outlets provide two screws for you to use with 300-ohm flat lead. We suggest that you connect a 75-to-300-ohm transformer, such as the Jerrold T6000 to this type of outlet and run coaxial cable to your receivers. You will need an FSX-1314 FM UHF/VHF/FM splitter for the TV, except in the case of certain MATV systems that convert the UHF channels to unused VHF frequencies before distributing them through the system. If this is the case with your antenna system, you need buy only a regular 75-to-300-ohm transformer for the TV. Be sure to use only the one-piece coaxial connectors with the built-on ferrules, not the common two-piece connectors.

For those who are stuck with worthless MATV systems, the only way the situation will improve is for tenants to complain and complain, over and over, until someone can be found, and the money allocated to fix the system. We wish you the best of luck.

Thanks are due to John Tata for the illustrations and to Brad Meyer for his editorial assistance.

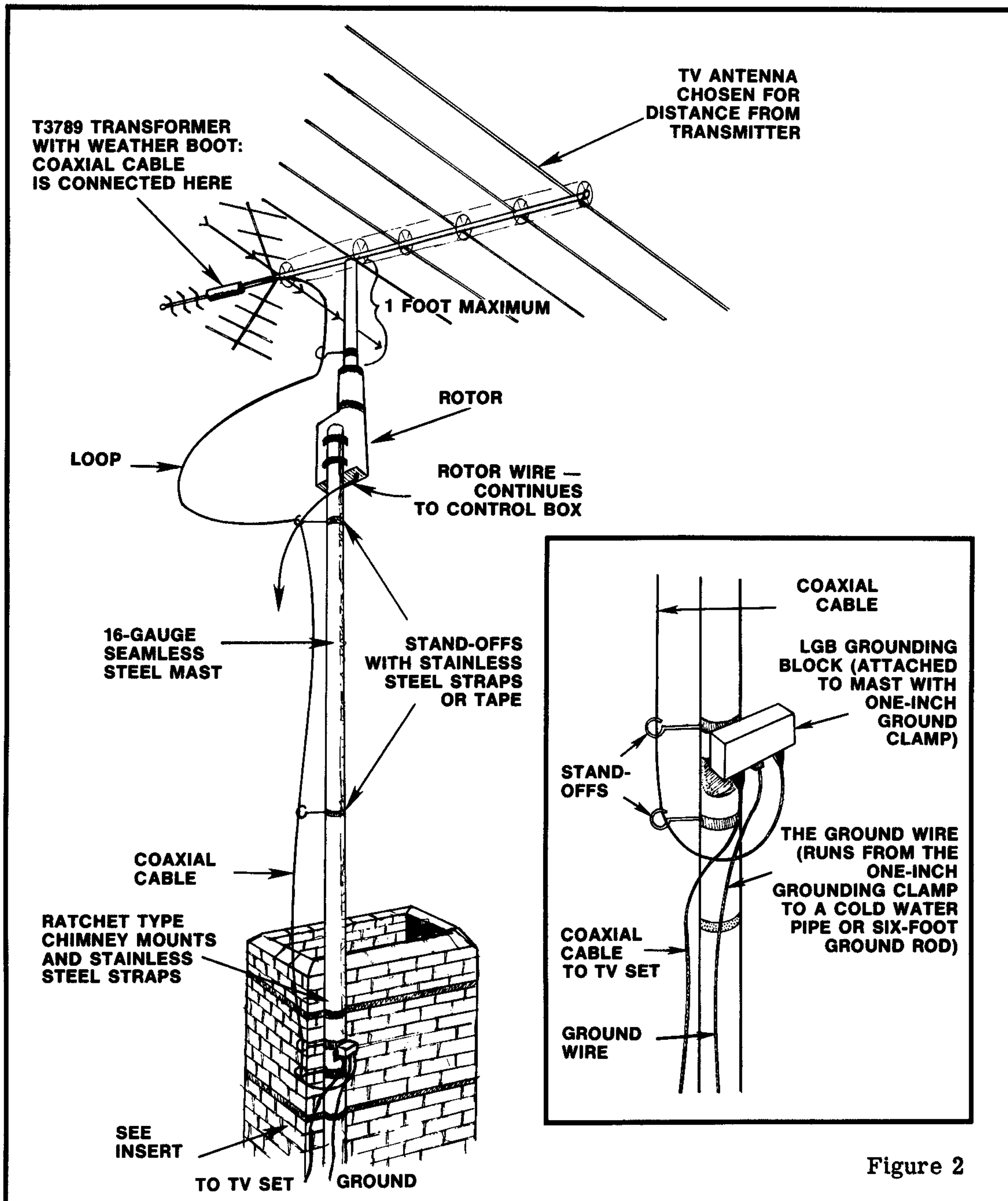

Figure 2

A Publication of the BAS

Four State-of-the-Art Preamplifiers

Alvin Foster

Of the 130 preamps listed in Audio's 1978 equipment directory, I selected four that have received top billing in the audio press for careful review: the AGI 511A, the Apt/Holman, the DB Systems IA, and the Hafler DH-101. My investigations, which are reported here, included a two-part listening test and a series of bench tests. For the listening test, each unit was loaned to an audiophile for extended use in his home. At the end of the audition period, I followed up with a blind A/B comparison between the review unit and the subject's own preamplifier. My ten objective tests comprised measurements of noise, distortion, output impedance, maximum output level, separation, input isolation (crosstalk), phono input impedance, RIAA equalization accuracy, filter response, and tone control response.

Noise

I measured the RMS signal-to-noise (S/N) ratio by feeding a 10-mV, 1-kHz sine wave into the phono input and reading off the noise level in dB below the signal at the tape output. Information from this test appears in several rows on the table. The "Gain" entry shows the amount of amplification (in dB) from phono in to tape out. The "Shorted" entry gives the S/N ratio with the preamp's phono inputs terminated with shorting plugs, using no filtering or weighting.

The trouble with the shorted-input measurement is that it indicates only the noise voltage, ignoring the preamp's current noise and the noise of the phono cartridge. Also, the absence of a weighting filter causes noise at all frequencies to be evaluated equally, even though the ear is more sensitive to noise at some frequencies than at others (e. g., it is more sensitive to hiss than to hum).

The "Cartridge" entries attempt to overcome these limitations and, after weighting is applied, more accurately reflect what we hear. For these measurements, I terminated the phono inputs with an Audio-Technica AT-11 cartridge mounted in an aluminum box positioned so as to minimize hum and used passive A- and C-weighting filters. The C-weighting filter is down about 3 dB at 30 Hz and about 11 dB at 20 kHz, with generally flat, but rolling response in between. A-weighted response is about -30 dB at 50 Hz and -10 dB at 20 kHz. A weighting most nearly approximates the ear's response, but the C-filter is useful for detecting hum.

The table shows that with A weighting, all four preamps have S/N ratios approaching the theoretical minimum (variations of as much as 3 dB between units may result from measurement error, caused by random fluctuations in the noise output). You cannot buy a preamplifier that measures or sounds quieter than these.

Distortion

I used a wave analyzer to measure 20-kHz harmonic distortion from phono in to main out with the volume control set for 2.5 Volts output. If the THD is below 0.25%, the output will not be audibly distorted on musical material (in fact, the threshold of audibility is probably above 1.0%). All of the preamps meet this criterion with plenty of room to spare.

Like most two-tone IM, TIM, and SID tests, this technique makes unrealistically severe demands on a preamp's slewing capability. The only possible benefit of having a system slew rate much higher than will be demanded by program sources is improved RFI rejection. No power amplifier requires more than 2.5 Volts to be driven to full output, and no available software will drive a preamp to 2.5 Volts at 20 kHz, so any preamp that can cope with such a demand with low distortion has a more than adequate slew rate.

All four preamps had unmeasurably low distortion (less than 0.008% THD) for 2.5 Volts out at 1 kHz.

Output Impedance

I measured each preamp's output impedance by paralleling its output with a variable resistor. With the output of the preamp connected to an AC VTVM, I drove the unit to 1.0 Volt out with a 1-kHz sine wave, then turned up the resistor until the output dropped 6 dB. At that point, the impedance of the variable resistor matches the preamp's output impedance within 20%.

A component's output impedance should be much lower than the input impedance of the unit it is driving, especially where long or high-capacitance connecting cables are used, to prevent signal degradation. For this reason, modern preamps are designed with output impedances of less than 2K Ohms. All of the preamps tested out well below that figure.

Maximum Output Level (1-kHz Overload)

I measured each preamp's maximum output level (just below clipping) into a 10K-Ohm load by driving both phono inputs with a 1-kHz sine wave. The table shows the results in Volts for both the tape and main outputs. A preamp should be capable of at least 2.5 Volts out - a value all of the units tested exceeded by a wide margin.

Separation

I measured 1-kHz and 20-kHz channel separation for the phono and high-level sections simultaneously, referencing the main outputs to 2.5 Volts and terminating the unused phono input with a shorting plug. Separation at 20 kHz is usually lower than at 1 kHz because the signal coupling between closely spaced wires increases with frequency. Large preamplifiers may tend to have better separation, because they offer more opportunity to keep signal leads for the two channels apart (note, for example, that the smallest of the preamplifiers, the DB, produced the lowest separation figures). In any case, all of the preamps had adequate separation (more than 23 dB at 1 kHz).

Input Isolation (Crosstalk)

The isolation tests measure a preamp's ability to prevent signals entering unselected inputs from bleeding through into the program from the chosen input. This phenomenon is known as "crosstalk." If you have heard your tuner playing faintly in the background on your tape monitor loop, for example, you have a crosstalk problem.

For the less stringent of the two tests, I inserted shorting plugs in the unused input jacks and drove the tuner input with a 20-kHz sine wave until the preamp produced 2.5 Volts at its main output with its volume control wide open. I then switched to each of the shorted inputs, using a narrow-band wave analyzer to measure the amount of 20-kHz crosstalk appearing at the output.

The second, more difficult test left the unused inputs open. This condition produces worse feedthrough, because crosstalk voltages are not shunted to ground. But since most components have output impedances below 1000 Ohms, they approximate a short circuit much more closely than an open circuit so long as they are turned on. Consequently, if your preamp does well on the shorted-input test, you probably will never be bothered by crosstalk unless, for example, you have a tape machine that turns itself completely off when the tape runs out. And if your preamp has low open-input crosstalk, you won't be bothered even then.

All of the preamps did well on the shorted-input test, and the AGI was consistently excellent on the open-input test, as well.

Phono Input Impedance

I measured each preamp's phono input impedance with a Mark Davis impedance bridge (April 1977 Speaker). The impedance should consist entirely of a 47K-Ohm resistance in parallel with some reasonably low capacitance. Some cartridges, such as the Micro/Acoustics models, have low internal impedances, which make them relatively insensitive to loading, but most show frequency-response anomalies if they are not properly terminated. Too much resistance usually elevates high-frequency response, while too much capacitance has the opposite effect. A load that cannot be modeled by a simple resistance and capacitance may cause unpredictable errors not readily amenable to correction.

My "R" (resistance) values are accurate within 5%, and my "C" (capacitance) figures within 20%. The impedance bridge is a nulling device, and the quality of the null provides some insight into how nearly the load can be characterized as a pure R and C. I have devised three categories of null quality: perfect, good, and bad. A perfect null indicates a pure resistance and capacitance. A "good" rating suggests that the load is more complex and that the impedance varies less predictably with frequency, but that the effects are probably inaudible. Input RFI filtering often has the effect of pulling the null quality rating down to "good." A bad null is symptomatic of a very complex load, which probably will cause audible response errors. None of the four preamps tested received a "bad" rating, but the Hafler fell into the "good" category.

RIAA Equalization

I used an AC VTVM to measure phono equalization accuracy into a 10K-Ohm load. The signal source was a sine-wave generator with a 600-Ohm output impedance, which I connected directly to the phono input. The table lists deviations from the RIAA standard in decibels (dB). Although errors of less than ± 0.25 dB are sometimes audible, they are of little consequence and are not shown on the table. The DB and the AGI were, within my ability to measure, dead flat from 20 Hz to 20 kHz.

Filter Response

Rolling a preamplifier's response off sharply below 20 Hz is a very effective way of preventing large infrasonic signals from record warps and badly placed arm/cartridge resonances from getting to the amplifier and loudspeakers. Less power is wasted, and less distortion is generated. In the table, a large negative response deviation at 5 Hz indicates the presence of an infrasonic filter. Ideally, response should be flat to 20 Hz, with a sharp drop below. The Apt has the most effective filter. The AGI is the only preamp in this survey that does not include any high-pass filter, although a 12 dB/octave rolloff below a user-specified frequency is available as a built-in $50 option. And DB, which includes a switchable 6 dB/octave filter after its phono preamp (one position conforming to the IEC's RIAA recommendations), also sells a separate bandpass filter and switchable polarity inverter that includes an 18 dB/octave infrasonic filter and runs off the same power supply as the preamp. The Hafler has a non-defeatable 6 dB/octave filter in its phono stage with a response that is a compromise between the standard RIAA curve and the IEC-recommended curve.

Tone Control Response

The ideal tone-control contour varies according to the listening environment, source material, and the user's preferences. But two tone-control features are certainly desirable: infra and ultrasonic filters to keep out-of-band garbage from being amplified to potentially dangerous levels. For example, a treble control that boosts excessively above 20 kHz could amplify tweeter-killing ultrasonics from leaky tape recorder bias amplifiers or high-frequency carrier signals from some FM tuners. Whether such filters are included, and how effective they are, can be determined from the 5 Hz and 100 kHz gain entries in the tone-control section of the table. The table also shows the maximum gains at 30 Hz and 20 kHz and the +3 dB frequencies with the controls turned to maximum boost.

Listening Tests

For the first part of the listening tests, I loaned each preamp to an audiophile for at least two months. All four subjects had systems worth more than $4000, were avid readers of hi-fi literature, and exchanged stereo gear constantly -- true addicts. One of them had built his own electrostatic speakers and companion amplifier. Their charge was to compare the test units with their own preamps. I did not dictate the comparison method. Most preferred long-term listening trials, alternating between the two preamps by unplugging one and plugging in the other, and vice versa.

The results of these trials are reported in the sections on each preamp, below. Briefly, however, each audiophile preferred his own preamp. They often described their test units as "hard," "bright," and "less transparent" than their old reliables.

For the second part of the listening exercise, I visited each audiophile's home with A/B switching apparatus: an AC voltmeter, a passive preamp switch box, a CBS STR-100 test record, and patch cords. After matching playback levels between the two preamps, I asked the subject to name the unit playing. Failing that, they were asked just to indicate any audible difference, i.e., whether A was playing or B.

The results indicate that becoming a good listener takes training. For example, in one instance none of the four experienced listeners on hand could distinguish between the two preamps. After training, their accuracy went up to 100%. In every case, however, the audible differences were traced to RIAA deviations.

Features

All four preamps have phono, tape, tuner, and auxiliary inputs. The Apt and the Hafler have two phono inputs, and the Apt and the DB have two auxiliary inputs. With the exception of the DB, all of the units have a mono switch, two tape monitor loops, dubbing facilities, an external processor loop, and multiple AC line outputs. The DB and AGI are always on electrically. All of the units except the AGI have low-frequency filters. The Apt/Holman is the only one with a switchable ultrasonic filter, a switchable low filter that is truly infrasonic, or switchable bass control characteristics. The Apt and the Hafler include defeat switches for their tone controls, while the AGI and the DB eschew tone controls altogether.

The DB is the smallest and lightest of the four preamps and the only one that houses its power supply in a separate box, which can be used to power all DB Systems electronics (except the power amp). It is also the only one that will not readily accept the European-size phono plug (standard on the SME arm), which has a slightly longer-than-normal nose. Only the Apt has a headphone jack, phono-input resistance and capacitance switches, and center detents for its balance and tone controls. The Hafler uses non-standard phono equalization -- an adaptation of the IEC recommendations. DB, on the other hand, guarantees adherence to the RIAA standard within ± 0.05 dB and provides a low-filter position that follows the IEC curve. All of the preamps tested employ active or passive buffers ahead of their tape and external processor outputs.

AGI 511A

AGI takes the "straight-line" approach to preamp design. The 511A has no tone controls, filters, or the like. It does, however, have an external processor loop and provisions for easy internal mounting of cartridge loading capacitors. The unit fairly reeks of quality; everything is well built and works smoothly. Its RCA input and output jacks are firmly mounted and unusually designed, so that the center portion of the jack extends slightly and tightly wraps the nose of the inserted plug.

The audiophile who used this preamp thought it sounded virtually identical to an All-Test Devices phono preamp and a Levinson JC-2, but that it occasionally had a tendency to edginess. In blind A/B testing, he could not distinguish the AGI from the All-Test Devices unit and concluded that they were, in fact, identical. Before he reviewed the AGI, he had read that it sounds edgy. He auditioned it expecting to hear the alleged deficiency and with the added handicap of always knowing which unit was playing.

Apt/Holman

This well put-together preamp has features galore (more than any of the others tested), from its phono input impedance switches to its excellent tone controls. It resembles the Hafler in that it has a low profile, but unlike the Hafler, it is attractive, in an austere, New England way.

I found only a couple of things to fault about the Apt. One is its mute switch, which kills the output altogether, rather than just attenuating it. This does a good job of protecting speakers, but it does not let you know when the stylus sets down on the record -- the source of the most distressing thumps. I could find little use for it. The other problem is very minor: when phono plugs are inserted or extracted, the internal printed circuit board moves. I do not think this will cause the board to loosen.

The audiophile who got the Apt preamp criticized it heavily and refused to listen to it after about a month. But during the initial A/B testing, he was unable to distinguish which unit was playing. After training, he could clearly identify the preamp under test.

This individual was once a professional drummer. He chose his own preamp after considerable thought and a long-term listening trial. He probably came to prefer the particular model because of its inaccurate RIAA equalization at high frequencies. The CBS test record revealed that his unit's response began rising above 5 kHz to a peak of +2 dB at 20 kHz.

DB-1A

Like the AGI, the DB is a low-frills design. It is the only preamp in this review to come in two packages. This feature is something of a bother, made worse by the fact that the power supply cord fits neatly into either the Power Output or Tape Process socket. (The manufacturer says that the unit will operate correctly even if this mistake is made.) The DB is also unique in that the manufacturer guarantees its RIAA accuracy to within ± 0.05 dB -- the tightest spec in the industry.

Phono plugs mount directly onto the PC board, which is located at the back of the unit. The board is solidly mounted and should withstand years of use. The filter and mute switches are the long toggle type, which feel flimsy. The manufacturer assures me, however, that they are high-quality devices.

The audiophile who auditioned this preamp said it sounded harsh and bright, but was unable to distinguish it in A/B tests. After several false calls, I was able to hear a difference, which I traced to a 0.1-dB bump in his preamp's RIAA response between 100 and 400 Hz.

Hafler DH- 101

Hailer designed its preamp to sell for considerably less than its competition, especially in kit form (the Hafler is the only kit preamp in this survey), and it cuts corners with grace. However, it is the least eye-catching of the four preamps, and its case has sharp corners. The input and output jacks are all on bakelite strips, which bend when plugs are inserted. With time, unless the user is careful, these strips may break.

The Hafler's phono input null was good, but not perfect. This probably is caused by RFI-rejection circuitry. In any case, I do not think it would interfere with the playback response of a high-inductance cartridge. Hafler also makes a moving-coil pre-preamplifier, which mounts inside the DH-101.

Overall output declines 0.4 dB, and the 20-kHz output by an additional 0.2 dB, when the tone controls are engaged. The flat positions for the tone controls were not coincident with the straight-up markings on the front panel. Hafler supplies an Allen wrench for making fine equalization adjustments.

The Hafler's main flaw, in my view, is its nonstandard phono equalization. At the low end, they use a variant of the IEC-recommended response, which is 3 dB down at 20 Hz with a 6 dB/octave rolloff below (-12 dB at 5 Hz). To mitigate the effect of this filtering in the audible range, Hafler chose to split the difference between the IEC and RIAA curves, which gives a response that is down only 1.5 dB at 20 Hz. The difference is still audible, however, making the unit sound thinner and less "veiled" than it would with correct equalization.

Hafler also tinkers with the high end of the phono curve, putting in a 0.5 dB rise at 20 kHz. I also disagree with this modification, but Hafler feels it is justified because it partially compensates for the high-frequency rolloff in disc cutting equipment.

I loaned the Hafler to an audiophile who normally uses a Dyna PAT-5 that he has extensively modified. Before the A/B test, he ticked off a number of complaints about the Hafler unit, claiming that it had an inadequate power supply and that it sounded hard and was impossible to live with. I had to restrain him from modifying the preamp. The irony is that in the blind A/B test, he preferred the Hafler. The two preamps have significantly different RIAA curves and so were easily distinguishable on comparison.

Choosing Sides

Each of these preamps has its own appeal. The AGI combines high performance on the essential functions with top-notch construction. The Apt brings together performance, features, and handsome styling in a single box. DB guarantees extraordinarily low distortion and exceptionally precise RIAA equalization for its entry. And Hafler offers a full-function preamp at a bargain price. The DB Systems and the AGI sound identical; the Apt is different but only trivially so. Only the Hafler is significantly off the mark.

The listening tests turned out to be interesting and instructive. They indicate that people tend to prefer what they are used to, especially when making long-term comparisons. They also suggest that sonic differences between quality preamps are traceable to frequency-response deviations and that people tend to describe a preamp's sound in the same terms they associated with it before auditioning.

	AGI 511A #8430051 $495	Apt/Holman #A001209 $493 (east) $502 (west)	Hafler DH-101 #1851814 $200 kit $300 assembled	DB Systems IA #2081231 $400 less power supply
Input Quality/Impedance				
R (kOhms)	47	47/100	47	47
C (pF)	90	50/100/200/300/400	200	105
Null Quality	Perfect	Perfect	Good	Perfect
1-kHz Overload				
Tape Out (V)	6.8	8. 6	9	9. 8
Main Out (V)	10	8.4	10.5	7.5
Input (mV)	160	150	175	148
RMS S/N (dB)				
Gain	32. 5	36	35. 2	36.5
Shorted	79	74	77	80
Cartridge, C-Weighted	75	78	79	79
Cartridge, A-Weighted	84	84	83	83
RIAA Deviations (dB)				
20 Hz	0	-.27	-1.7	0
30 Hz	0	0	-. 6	0
400 Hz	0	0	-. 3	0
1 kHz	0	0	0	0
5 kHz	0	0	0	0
10 kHz	0	0	0	0
15 kHz	0	0	+. 3	0
20 kHz	0	0	+. 6	0

	AGI 511A	Apt/Holman	Hailer DH-101	DB Systems 1A
Infrasonic Filter (dB)				
5 Hz	0	-33	-8.6	0
20 Hz	0	-.57	-1.7	0
Tone Controls, Bass				
5 Hz (dB)	N.A.	-19.4	+19.2	N.A.
30 Hz (dB)	N.A.	+15. 2	+17	N.A.
+3 dB (Hz)	N.A.	221/421	247	N.A.
Tone Controls, Treble				
20 kHz (dB)	N.A.	+10	+12.4	N.A.
100 kHz (dB)	N.A.	-5.4	+11	N.A.
+3 dB (kHz)	N.A.	3, 500	2, 201	N.A.
Max. (dB @ kHz)	N. A.	20 kHz, +10 dB	30, 543, +12.8	N.A.
20 kHz Distortion	<0.25%	<0. 25%	<0.25%	<0.25%
Output Impedance (R)				
Main	42 Ohms	320 Ohms	500 Ohms	1, 200 Ohms
Tape	220	U. M.	1, 100 Ohms	1, 000 Ohms
Ext. Adpt.	560	U.M.	2, 800 Ohms	N.A.
Separation (dB)				
1 kHz	73.8	66+	-70	61
20 kHz	69.4	52	-69	44.3
Isolation Tests (-dB)				
Input Shorted:				
Phono 1	84	105	106	85
Phono 2	N.A.	110	106	N.A.
Aux 1	95	100	76	109
Aux 2	N.A.	101	N.A.	109
Tape 1	85	91	62	108
Tape 2	112	88.5	62	N.A.
Input Open:				
Phono 1	100	103	92	72
Phono 2	N.A.	49.5	92	N.A.
Aux 1	102	75	94	42
Aux 2	LA.	75.5	N.A.	59.5
Tape 1	110	46.5	22	63.5
Tape 2	112	50	22	N.A.

LA. = Not Available
U. M. = Unmeasurable